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Technical faculty "Mihajlo Pupin"
Zrenjanin, Serbia

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TNP 2011

TEXTILE SCIENCE & ECONOMY III

Zrenjanin, November 10-11, 2011
Serbia

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TECHNICAL FACULTY “MIHAJLO PUPIN”

ZRENJANIN, REPUBLIC OF SERBIA

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Proceedings

Zrenjanin, 10-11th November 2011

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INTRODUCTION

It is necessary and justified, nowadays, more than ever, to assemble the scientists and entrepreneurs in the field of textile and clothing industry. The Scientific-professional Conference "Textile Science and Economy III" (TNP2011) is organized with the goal to promote connection between Serbian entrepreneurs and scientists and experts to jointly contribute the development based on knowledge and innovations. We are aware that by establishing these development research institutions and institutions of academic education, very active participants in this process must be included.

It is necessary to keep connections and cooperation based on knowledge and experience because that leads us to sustainability and development of our textile and fashion industry. Therefore, this conference TNP2011 meets the Strategy of Scientific and Technological Development of Serbia for the period from 2010 to 2015. Through the papers of the Conference TNP2011 participants current situation in the textile and fashion industry is to be analyzed, as well as the vision of this industry in Europe up to 2020 from the standpoint of the European Technology Platform (ETP). The European Union has entered the new millennium, setting the strategic goal of achieving extremely competitive and dynamic economic development based on the innovations and technological development. Therefore, this Conference TNP2011 wants to contribute to the development strategy of the Serbian textile and fashion industry in the direction of the dynamic cooperation of science and economy.

The aim of this Conference TNP2011 is to foster the regional cooperation with the scientists, experts, businessmen from the neighboring countries as well as from the other countries, what gives this event international significance and its scientific and professional level. Therefore, it is a great pleasure that such a remarkable number of the scientists and businessmen, mainly from the region and the other countries, responded to our invitation. The submitted papers of our colleagues were published in The Conference Proceedings. Because of economic focus of this event, the business and professional papers and the papers of our graduates, now employed in many companies, have found their place in The Conference Proceedings.

At the plenary lecture we have tried to show you the European experiences related to technology transfer from the University to Economy.

In the part of inviting lectures, we have tried to assemble the leading scientists, experts and professionals from the industry whose working experiences can contribute to the Strategy of Scientific and Technological Development of the Republic of Serbia 2010-2015 (SSTDRS).

In the poster section we wanted to present scientific and professional work at our Faculty.

Technical Faculty "Mihajlo Pupin" is the only scientific institution in Vojvodina in the field of textiles and clothing. The intention of this Conference TNP2011 is to present to the entrepreneurs the Faculty's previous experiences and competences in the field of education and science. During the Conference TNP2011 and after, the Technical Faculty will promote its openness and acceptance of new ideas of improving cooperation with entrepreneurs and solving their everyday technological issues as well as those in the field of research - development projects.

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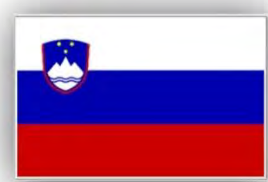

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TEKSTILNA NAUKA I PRIVREDA

CONTENTS

CONTENTS

ESTABLISHING AND SUSTAINING TECHNOLOGY TRANSFER ACTIVITIES AT UNIVERSITIES AND PUBLIC RESERCH ORGANISATIONS: RECENT LESSONS FROM OLD AND NEW EUROPE

Lisa COWEY

Abstract: *The exploitation of publicly funded research results is deemed to be an important driver for EU competitiveness. This increasing emphasis on technology transfer and knowledge exchange activities puts Higher Education Institutes (HEIs) and Public Research Organisations (PROs) under strong pressure to develop policy and practice to best manage their intellectual assets. To accelerate this process there is a tendency in the South and Central Eastern Europe (SEE and CEE) countries to look towards models that are operating successfully in countries where commercialisation from public sector research has reached maturity and to transfer Best Practice.*
This talk looks at recent initiatives in some SEE and CEE countries to improve Intellectual Property Rights for the R&D sector and to establish technology transfer and knowledge exchange activities at both national and organisational level; examples are drawn from Hungary, Bulgaria, Serbia and Croatia. The UK examples of Oxford University and Oxford Brookes University, (the former Oxford Polytechnic), are used to demonstrate how a model must fit to both organisational resources and long term aspirations and how this will impact on the best IP management strategy. Finally, we look at the role that local and national government can play in promoting improved commercialisation from the public research sector.

Key words: Technology Transfer, Universities, Best Practice.

Introduction

In recent years a strong emphasis has been placed on the need for Europe to meet the global competiveness challenge by moving towards a strong knowledge-based economy. The Lisbon Agenda and ‗Europe 2020' place innovation at the heart of the European economy. The role played by Universities, Higher Education Institutes (HEIs) and Public Research Organizations (PROs) as the knowledge engines of the Union is clearly acknowledged (EC COM (2007) 182). Universities and PROs have been encouraged and assisted to establish clear Intellectual Property Rights (IPRs) policies (Commission Recommendation 2008, WIPO a), frameworks for their delivery (WIPO b) and to understand and take advantage of the different IP regimes operating in different territories (Van Eecke P. et al., (2009). In addition, a shift has been acknowledged from pure Technology Transfer through licensing of IPR to industry or the initiation of a spinout company, to the more complex Knowledge Exchange activities that require long term and multiple vehicles for engagement with commercial partners, guidelines and frameworks to improve successful partnering have been proposed (EC (2005).

GENERIC PROCESSES IN TECHNOLOGY TRANSFER

Technology Transfer has been defined as ―the *process* whereby inventions or intellectual property from academic research is licensed or conveyed through use of rights to industry" (Association of University Technology Managers 1998). The technology transfer process for any organizations can be captured, rendered systematic and transparent and published to stakeholders. The final model should reflect the overall strategy of the organization and must be harmonized with any relevant national and

local legislation. Relevant legislation typically includes Rights-holding of Intellectual Property created by researchers as part of their normal, contractual work.
All generic models of Technology Transfer or Intellectual Property Management include General Processes, Decision Points (―Controls") and Documentation (―Tools"). Generic processes typically include Disclosure, Evaluation, Marketing, Legal, Post Licence/Spinout models. The objective in all cases is to optimize a process that will protect and then exploit Intellectual Property.

Many Universities and Research Institutes now publish their Intellectual Property Policy and also the associated process for commercialization of research results. A typical generic diagram of Technology Transfer involving formal intellectual property is shown in Figure 1. This clearly indicates general processes, decision points and associated documentation. The diagram further highlights the different stages of the process from Disclosure of an invention to post-commercialization Licensing activities. Timescales for decision making are fairly harmonized between European and American Universities but time to market an invention is still quickest in the USA. This difference reflects the tendency of European Universities to favour an ‗Inventory' based model where IPR may be protected whether or not a licensing partner can be quickly identified compared to the USA model where a Deal-Based or ‗Just in Time' model is preferred; here, investment in the IPR processes (patenting) is often not made unless strong interest is signalled by a potential licensing partner. The USA model enables a Technology Transfer Office to avoid a situation where substantial patenting costs are accruing on unlicensed IPR.

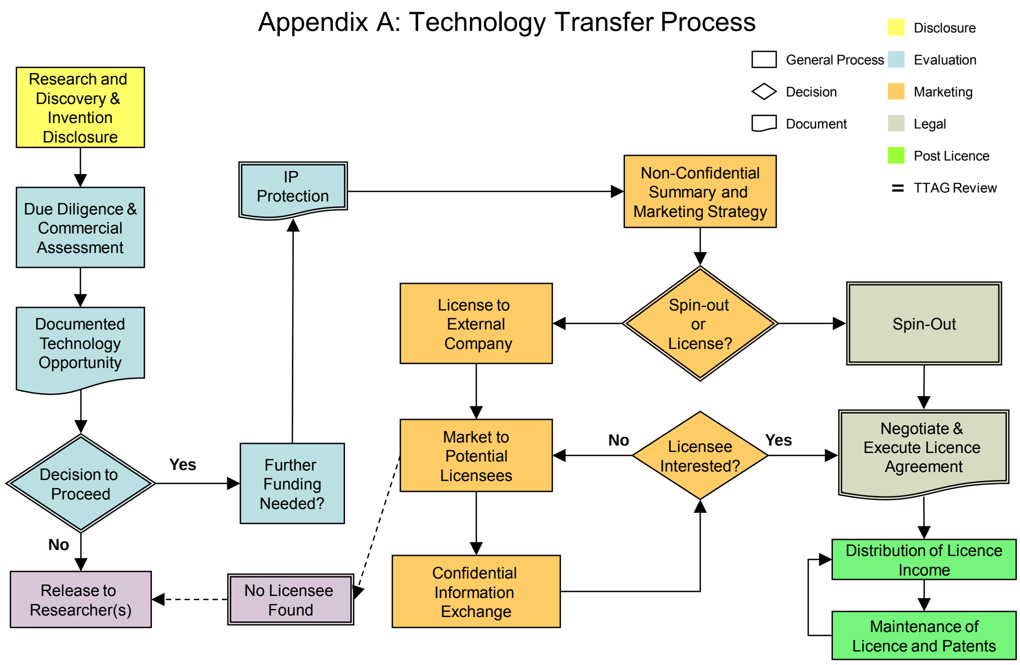


Figure 1: Generic processes of technology transfer from Public Research Organizations (PROs)

TECHNOLOGY TRANSFER: BEST PRACTICE MODELS

It is common for Universities, Faculties and Research Institutes who are starting to establish their Innovation activities to try and identify the ‗best' model for Technology Transfer. In doing this, it is important to avoid falling into the easy trap of examining outputs and not inputs into the process. To illustrate this point, examples are drawn below from two very different Universities of close geographic proximity

Oxford University UK

Oxford University in the UK provides an example of a traditional teaching University that also demonstrates strong research potential and high levels of innovation activity. Oxford University aims ―to remain at the forefront of centres of learning, teaching and research". The Technology Transfer Office (TTO), Isis Innovation, annually files over 70 patents (an average of more than one a week) and concludes over 70 licensing agreements each year. Isis Innovation is a limited liability company owned wholly by the University of Oxford. Isis Innovations has a staff of 54 employees of whom 30 have PhDs and 14 hold an MBA. The TTO helps to negotiate over 100 consulting deals each year between university researchers and industry and helps to manage Oxford University's 2.5 Million annual investment into technology transfer activities. The model of technology transfer operating at the University of Oxford is very similar to the one shown in Figure 1.

It would be tempting to conclude that this output is the result of the chosen model. However, it is not and we need to be clear about this. The results are highly dependent on the inputs. In the case of Oxford University the inputs are 4,200 researchers, 6,700 doctoral students, the Highest University Research Spend in UK (£389 million in 2007/2008), ranked 12 in the Research Spend by UK Companies, a list that includes GSK, AZ, BAE, BT, Unilever, Ford, Shell, Airbus, RR, RBS, Pfizer (DTI R&D Scoreboard). The ‗Most Powerful UK Research University' (Research Fortnight, December 2008 Research Assessment Exercise), the Most Innovative UK University (Cross Atlantic Capital Competition).

Oxford Brookes University UK

Eight kilometres from the University of Oxford is Oxford Brookes University (OBU), the former Oxford Polytechnic. This organization, which advertises itself as ‗an international university with a local focus' also engages successfully in Innovation activity but with some very notable differences. Oxford Brookes University focuses on being ‗Open for Business' and works in partnership with a strong regional focus. The University prides itself on providing ‗practical solutions to today's business problems using specialist knowledge, expertise and resources'. The unit responsible for coordinating Innovation activities is a department of the University, and not a limited liability company. It is known as the Research and Business Development Office (RBDO). The RBDO maintain the Research Experts Directory for the University, containing up-to-date information about academics and their research, enabling a commercial company, (frequently a local SME), to locate an expert for collaboration or consultancy. The RBDO manages the Knowledge Transfer Partnerships, a cost- effective way of providing a company with knowledge and expertise. The University also heads a consortium of eleven Higher Education Organizations (HEIs) from the region in an innovation partnership to serve local industry and it also offers help to academics, university staff, alumni, students, SME's and entrepreneurs.

Both Oxford University and Oxford Brookes University are considered to be extremely successful examples of universities engaging in technology transfer and knowledge-exchange activities. Their contribution to the economy at local, regional, national and international level is widely acknowledge and admired. They operate totally different models of ‗Technology Transfer'. Each model has been tailored to the resources, strengths and aspirations of the organization.

MODE OF OPERATION

Figure 2 illustrates the different modes of operation adopted by some Public Research Organisations (PROs) in different parts of Europe. The left arrow indicates the degree to which the organisation is centralised to ensure critical mass or to reflect funding. The right hand arrow indicates where the IP rights are held, e.g. at Government level or assigned to smaller legal entities.

In Croatia, the rights to intellectual property created within Universities are held at Faculty level. This situation is made clear by the Labour Law. As a result of this situation some Faculties have established their own TTOs; the Medical School of the University of Osijek is such an example. In contrast, the University of Zagreb (UoZ) has sought to create critical mass and to utilise World Bank

Funding for patenting activity by establishing a central TTO at Rectorate level. Before any of the resources of the UoZ TTO can be used to commercialise research the rights to the IP must be transferred from Faculty to University. In return, the University has formalised a revenue-sharing scheme between researcher and faculty that is laid down in the University of Zagreb Intellectual Property Policy. Faculties are free to decline to use the services of the TTO but most find the access to dedicated TTO staff and a patenting fund, combined with a fair revenue-sharing scheme a strong incentive to transfer their IPR. A similar initiative is now under way at the University of Belgrade involving the Serbian Intellectual Property Office.

The Universities of Zagreb and Rijeka TTOs are similar to the Oxford Brooks RBDO in being departments of the University. In contrast, the Croatian RuĊer Bošković Institute (RBI) set up RuĊer Innovations doo. This limited liability company is wholly owned by RBI. Its more commercial mode of operation is similar to that of Oxford University's Isis Innovation Ltd. This can offer advantages when engaging with the commercial world; a TTO unit that looks and sounds like a commercial entity offers reassurances to industry who want to know that the TTO speaks their own language and understands their economic drivers. However sometimes there is a stronger need to speak the language of the researchers in the early days and then an internal unit may offer the better model; The Central Laboratory Innovation and Knowledge Transfer (CLIK) is a Technology Transfer Office of the UK Science and Technology Facilities Council based at its Rutherford Appleton Laboratory in the UK. CLIK operates simply as a unit of the research institute.

Some countries reflect rights holdings and the need for critical mass by setting up Intellectual Property Units at Ministry level; the counter side of such an arrangement is that it may put too much distance between the researchers and the ongoing technology development needed for commercialisation. The move to relocate TTO activity closer to the research activity has also been driven by legislation that transfers IPR to the research organisation. The 1981 USA Bayh-Dole Act and the counterpart UK act of 1985 are examples of national legislation that acted to encourage the formation of technology transfer groups within PROs and HEIs.

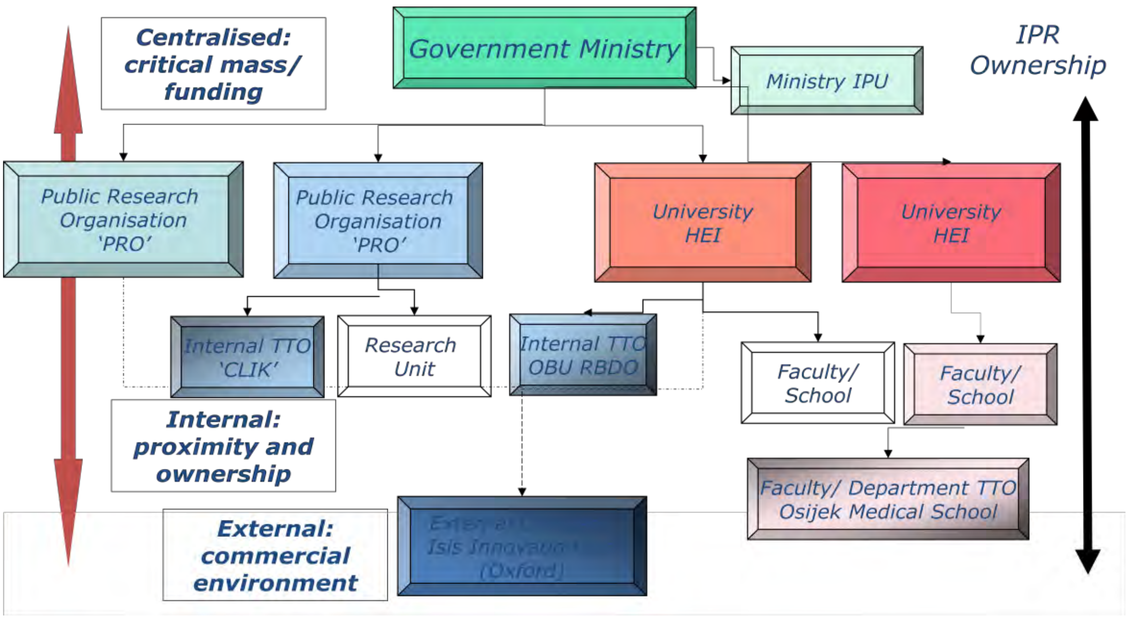


Figure 2: Operational modes adopted by different Public Research Organizations (PROs) in Europe.

From the above it should be clear that the ‗technology transfer' models adopted by research organisations can be very varied. In setting up such activities organisations should ask themselves if they wish to adopt a rather traditional approach or to embrace something more modern. Do they have the resources to operate alone or will they need to collaborate and pool resources to gain critical mass? Should the tech transfer unit be part of the main organisation or established as an external unit with its own culture? Will the focus be on generating profit for the research organisation or is the primary reason for engaging in technology transfer to ―create the greatest possible economic and social benefits, whether or not they accrue to the university" (Stanford USA). Is the focus to be licensing of patented technologies or facilitation of collaborations? Will it have local, regional or national reach? Should it focus on the research strengths of the university or will it aim to reflect the needs of local industry. Some of these issues are now explored in more detail below.

ALLIANCES AND COLLABORATIONS: GAINING CRITICAL MASS AND ACCESSING SPECIALIST SERVICES

Few Universities have the research strength to generate a pipeline of research results that can justify the employment of specialists rather than generalists in a TTO. This situation has been noted by the European Union who strongly encourages Member States to ‗actively promote and support the pooling of resources among research institutions including creating patent pools' (see "Improving knowledge transfer between research institutions and industry across Europe"). A number of illustrative examples exist of smaller or less experienced Universities who have sought to formalise relationships with other PROs, enabling them to drawn on external specialist patenting and licensing expertise when the need arises.

Strategic Alliances

Oxford Brookes University has set up just such an agreement with Isis Innovation Ltd; this enables OUB to make occasional use of legal experts for those occasions when the strength of a research result merits patent-drafting and prosecuting and negotiating a subsequent license agreement. In a similar way the Faculty of Medicine Osijek Croatia has formed a strategic alliance with Mount Sinai University USA, and Burgas University TTO Bulgaria has set up an agreement with INI-GraghicsNet Germany. The University of Zagreb Croatia has explored a similar arrangement with Politecnico di Milano.

Patent Pooling

The formation of patent pools enables organisations with just a few items of intellectual property to join them with similar rights from other PROs. The resulting ‗bundle' can often be a much more attractive commercial proposition for a potential licensing partner. Patent pooling as a strategic approach was led by the German Patent Exploitation Agencies (PVAs) in Germany. It can be strongly facilitated by internal patent management software that enables each organisation to continue to manage its own ‗rights' and by the use of externally-facing portals that then offer the bundles to the commercial world. The Scottish Universities ‗Technology portal' (http://www.university-technology.com/) offers a useful example of a group of smaller universities pooling their technology offerings at a central location.

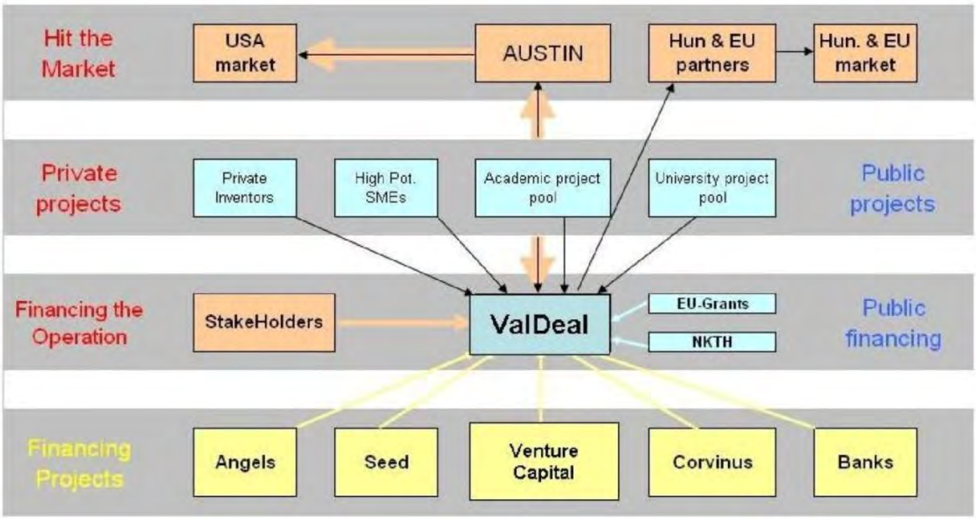
JOINING FORCES: CREATING CRITICAL MASS THROUGH PARTNERSHIPS

Knowledge Exchange activities require a diversity of skills and stakeholders. The challenge of combining forces is one that can often be achieved through carefully structured government support.
The UK Higher Education Innovation Fund (HEIF) enabled eleven HEIs in the South East of England to set up Commerciali*SE* partnership. Active participants included the South East of England Development Agency, Finance South East Ltd, the South East Sector Consortia and the SEEDA Enterprise Hub network. The structure of the Commerciali*SE* project is illustrated in Figure 3 below.

Figure 3: CommercialiSE Lead Partner Oxford Brookes University UK.

While Commerciali*SE* was limited to regional players, the Universities of Central Hungary have joined forces with a large consortium of regional, national and international stakeholders. The consortium is led by a private, regional organisation called ValDeal and includes the University of Austin Texas USA. The subsequent ‗complex environment of ValDeal' is illustrated by Figure 4. One outcome of this partnership is that technologies from the Hungarian Universities can ‗Hit the Market' in the USA very quickly.

Figure 4: The Complex business environment of ValDeal Hungary.



Summary and conclusions

Different Universities and PROs need to select their model of Technology Transfer based on the local environment, resources, strengths and aspirations. One size does not fit all! The question ―Why are we doing this and for whom?" needs to be reflected in the mode of operation and the location of the Innovation Unit. Strategic alliances can bring specialist skills and collaborations can bring critical mass while advances in IT can offer increased exposure when marketing new technologies. However, Technology Transfer and Knowledge Exchange are highly dependent on people and not processes; Governments need to be encouraged to help create cultural change and to develop and retain skilled individuals.

Literature:

[1] Van Eecke, P., Kelly, J., Bolger P. and Truyens, M. (2009) *Monitoring and analysis of technology transfer and intellectual property regimes and their use*, *Results of a study carried out on behalf of the European Commission* (DG Research)

Available for download at
http://www.liaison.tuc.gr/fileadmin/users_data/liaison/Library/IPR/Monitoring_and_analysis_of_technology_transfer_and_intellectual_property_egimes.pdf Last accessed 31.10.2011

Commission Recommendation adopted on 10 April 2008 on ―*The management of intellectual property in knowledge transfer activities and Code of Practice for universities and other public research organisation"*,

Commission Communication adopted on 4 April 2007 "*Improving knowledge transfer between research institutions and industry across Europe: embracing open innovation - Implementing the Lisbon agenda*" - COM(2007)182

WIPO a: "Guidelines on Developing Intellectual Property Policy for Universities and R&D Organizations"

WIPO b: "Creating and Embedding an IPR Policy in an Educational or publicly funded research and development institution"

All available for download at: http://ec.europa.eu/invest-in-research/policy/ipr_en.htm#3 Last assessed 01.11.2011

COLLABORATION BETWEEN INDUSTRY CLUSTERS AND ACADEMIA

Andrzej SCHAFERNAKER

Collaboration between industry clusters and academia is a vital linkage in the Triple Helix model of innovation. Many clusters in SE Europe form links with academic establishments but these partnerships are often more symbolic than useful for a variety of reasons. When countries in SE Europe where part of a socialist bloc, the State dominated everything and dictated cooperation between specific state controlled industry sectors and academia. Following the breakdown of the socialist bloc the bonds were broken to a large extent and large parts of industry developed on their own as private enterprises whereas academia focused on basic research and teaching. The weakening of the links was increasingly reflected in teaching becoming outdated and inappropriate to the needs of industry. Furthermore, applied research for industry requires funding and this largely disappeared because the State was no longer able to provide this and industry was financially weak. The scarcity of suitably educated specialists and lack of funding are clearly major blockages to innovation. Nevertheless valiant efforts are being made to overcome these challenges. The presentation provides examples of cooperation between clusters and educational establishments in Serbia, Croatia and Bulgaria. The Serbian example shows how the use of European research funding can foster innovative links between faculty and knowledge intensive enterprises. The Bulgarian example shows how cooperation between companies and educational establishments lead to new product development through harnessing the innovativeness of school and enterprises working together. In Croatia, industry is working closely with faculty to adjust the education and output of the university to match the needs of enterprises. Slowly but surely the problems are being tackled. The application of European models of Triple Helix innovation will take time but in the future innovation shall be stimulated at the focal point of the State, industry and academia working together.

Prezentation is in attached.

BIOTECHNOLOGIES OF TEXTILE FINISHING HAVING IMPLICATION ON REDUCING THE POWER CONSUMPTION AND POLLUTANTS FROM EFFLUENTS

Floarea PRICOP, Alina POPESCU, Petronela DRAMBEI & Mihai POPA

Abstract: *The economic development – ecologic equilibrium impact rises numerous and complex problems for the Romanian textile industry, too, being an important criterion in dwelling upon the research themes from the Research – Development National Institute for Textile and Leather.*
The ecologic textile technologies have an important place in the research projects elaborated within the national research programs.
The subject matter of environment protection became an essential component of the ***textile industry development strategy*** *from our country, one being able to find it in the objectives of the research works.*
As part of the project "The reducing of pollutants from the discharged effluents resulted from the textile industry technological processes, by way of ecologic technologies", the following have resulted:

- *a study concerning the polluting factors that are specific for the technologies of finishing cellulose textiles that contribute to the effluent polluting;*
- *the elaborating of modern techniques and technologies of reducing the pollutant quantity from the effluents resulted during the textile finishing;*
- *the elaborating of ecologic technological processes by: using* ***catalase type enzymes*** *in the finishing processes (cleaning, bleaching, dyeing) meant for yarns and cellulose woven fabrics,* ***dyes and ecologic auxiliaries*** *having reduced power, water and chemical consumption.*

The main advantages of using ***the catalase type enzymes*** *are associated with less severe reaction conditions, lower processing temperatures, shorter finishing times and the non – toxic and biodegradable products.*
The newly elaborated ecologic technologies lead to achieving the following socio – economic and environment effects:

- *the reducing of the number of technologic stages (stage accumulation);*
- *the reducing of the technologic process duration by 45 minutes;*
- *the reducing of the technologic consumption/kg of textile material by: 56 l water, 0.007 kWh electric power, 1.02 kg steam, 0.05 kg chemicals;*
- *the reducing of total costs/kg of textile material (water, electric power, steam, chemicals) by 0.293 Euro/kg of textile material;*
- *the improving of dyeing quality (increasing of colour fastness);*
- *the lowering of the effluent quality indicator values (pH, CCOCr, CBO_5, suspensions, sulphates, detergents) by about 30 ÷ 70%;*
- *the cost reducing for effluent pollutant removal by 2 ÷ 4 Euro/effluent.*

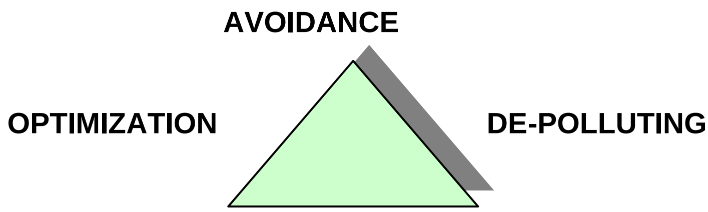
The new ecologic technologies are employed in the cellulose material finishing departments from the textile trade companies.

Key words: environment protection, textile biotechnologies, pollutants from effluents.

1. Introduction

Environment protection issues became an essential component of the **development strategy the textile industry** has, constituting an important criterion in the elaboration of research projects thematic.

Applied ecologic strategy can be synthesized in the triad:



generally following the line of avoidance and optimization first and then de-polluting.
Progresses registered on global plan in the synthesis, determination of **enzymatic bio-preparations** structure and the knowledge of mechanisms by which catalytic processes can take place lead to the enlargement of application scope the biotechnologies have in the textile industrial processes with the aim of elaborating some new technologies for ecological finishing that should assure a sustainable development.
Enzymatic bio-preparations constitute an alternative for the classical chemical products used in numerous technological processes

2. Experimental

Project Objective
Elaboration of modern techniques and technologies for the reduction of pollutants quantity from textile finishes resulting effluents.
Results Obtained
- the elaborating of ecologic technological processes by: using **catalase type enzymes** in the finishing processes (cleaning, bleaching, dyeing) meant for yarns and cellulose woven fabrics, **dyes and ecologic auxiliaries** having reduced power, water and chemical consumption;
- value reduction of polluting indicators and European Union norms observing;
- technological phases cumulating through bio-technological treatments (fig. 1; 2).

Aims
- Reduction of technological phases number (phases cumulating);
- Reduction of technological process time by 45 min;
- Reduction of technological consumptions / kg textile material by: 56 l water, 0.007 kWh power, 1.02 kg steam, 0.05 kg chemical products;
- Reduction of total costs / kg textile material (water, power, steam, chemical products) by 0.293 Euro / kg textile material;
- Dying quality enhancement (dye fastness enhancement);
- Value reduction of quality indicators for wastewaters (pH, CCOCr, CBO_5, waterborne, sulphates, detergents), by ca. 30 ÷ 70%;
- Cost reduction for wastewaters de-pollution by 2 ÷ 4 Euro/l wastewater

Enzymatic bio-preparations constitute an alternative for the classical chemical products used in numerous technological processes, presenting the following advantages:
- can replace the toxic auxiliary chemical products and are biodegradable, contributing to **surrounding environment protection** (CCOCr, CBO_5 reduction);
- accelerate reactions and act only over a specific substrate, assuring the **control of final effects.**

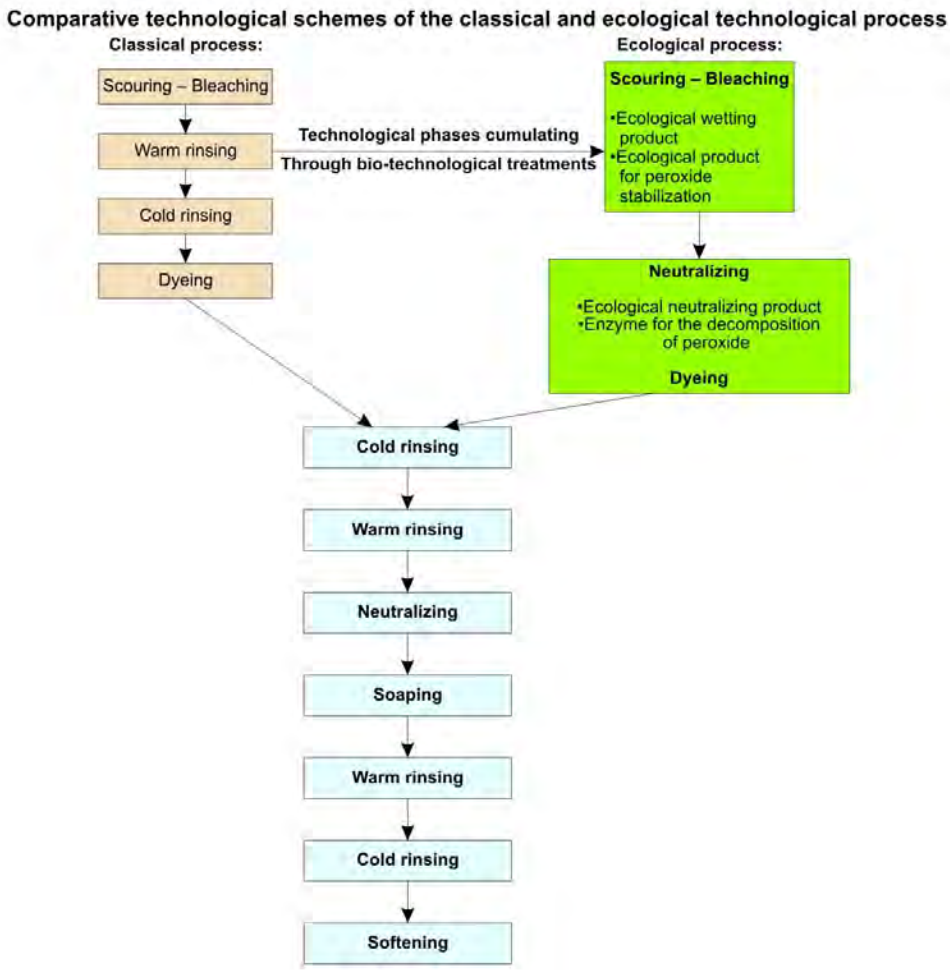


Fig. 1

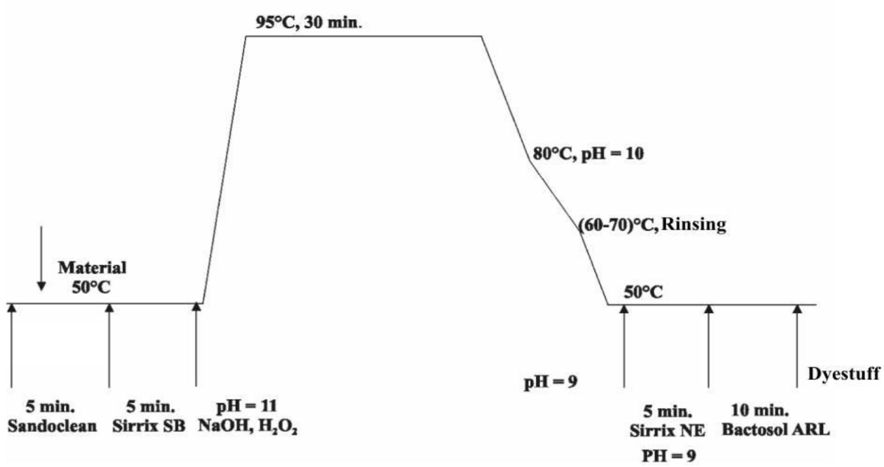


Fig. 2. Ecological process diagramme

Table1. Comparative analyses of wasterwater quality indicators from classical and ecological technological process

Test	pH	CBO_5 mgO_2/l	CCOCr mgO_2/l	Suspensions mg/l	Sulphates mg/l	Detergents mg/l	Residuum (mg/l)
P1 Wastewater – classical process	12,3	449,82	807,38	167	184,5	6,3	1810
P2 Wastewater – ecological process	7,6	201,9	275,8	11	92,9	5,7	1100
NTPA 002/2005	6,5-8,5	300	500	350	600	25	
Diminution of P2/P1 (%)	38,2	55,1	65,8	93,4	49,6	9,5	39,2

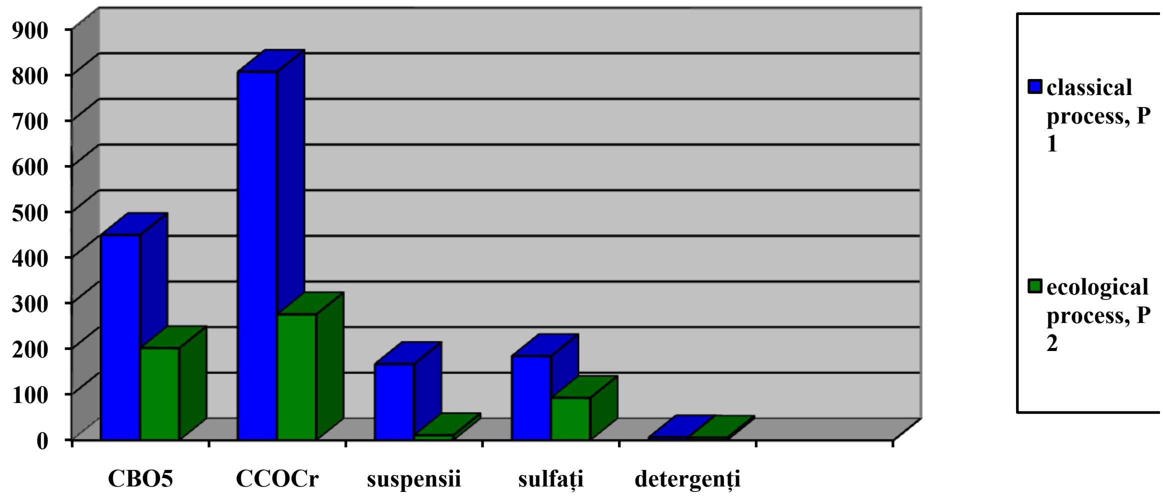


Fig. 3.

3. Conclusion

Enzymatic bio-preparations constitute an alternative for the classical chemical products used in numerous technological processes, presenting the following advantages:
- can replace the toxic auxiliary chemical products and are biodegradable, contributing to **surrounding environment protection** (CCOCr, CBO_5 reduction);
- accelerate reactions and act only over a specific substrate, assuring the **control of final effects.**

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NATURAL DYEING OF SOYBEAN FIBERS WITH MADDER, DROOPING BROME AND BUCKTHORN WITH THE AID OF NATURAL MORDANT

Arzu YAVAS, Gorkem GEDIK & Ozan AVINC

Abstract : *Eco-friendly production is a very substantial goal for many industries and also for the textile industry which deals with important criticisms regarding environmental issues. Especially textile dyeing and finishing operations, which can be very pollutant due to heavy chemical load in their waste water, are under surveillance. Therefore, greener ways of textile coloration are investigated and natural dyeing of textiles is recommended as an environmental friendly option. In this study, the main aim was to investigate the eco – friendly dyeing of soybean fibers. For this purpose, three natural dyes are applied with the aid of one natural and one chemical mordant. Color and fastness properties of naturally dyed soybean fibers were determined. Alum mordanted soybean fibers which were natural dyed with madder, buckthorn and drooping broom exhibited higher color yields than gallnut mordanted samples. However, the usage of gallnut natural mordant enables natural dyers to obtain different shade of colors with more eco-friendly natural coloration. Alum mordant usage for madder and drooping brome exhibited commercially acceptable wash fastness levels. In contrast, gallnut mordant usage for buckthorn and drooping brome resulted in commercially acceptable wash fastness levels. Rub fastness values are in the commercially acceptable range for all dyed samples. Gallnut mordant usage caused slightly better rub fastness values for madder and drooping brome dyeings. Natural gallnut can be stated as an useful mordant material for natural dyeing of soybean fibers.*

Key words: Soybean fiber, natural dyeing, madder, drooping brome, buckthorn, gallnut.

Introduction

Natural dyeing of natural fibers (wool, silk, cotton etc.) with madder is a well-known natural coloration method. Madder plant (*rubia tinctorum*) which is one of the most important plants for red color obtaining since ancient times is a part of *rubiaceae* family. The root of this plant contains anthraquinone derivatives (over thirty) as the colorants where the most common one is alizarin (C. I. Pigment Red 83) (Betchold and Mussak, R., Farizadeh et. Al., De Santis et. al.). In a former study (Gedik, G. et. al.), silk dyeing properties of drooping brome (*bromus tectorum*) were investigated. Silk fabrics, naturally dyed with drooping brome plant, exhibited high fastness and color yield properties. *Bromus tectorum* which has a wide growing area in the world is an annual plant from *poaceae* family (Gedik, G. et al.). Seared yellow fruits of buckthorn are used also as a natural dyestuff source. It is stated that different mordant usage leads to obtain various shades of yellow (Ozturk, I.).

Soybean which contains high amount of proteins has been one of the most important sustainable food materials all over the world since old times. This vegetable is also consumed as an easily accessible protein source for regenerated fiber production (Cook, J.G.). Soya bean fibers are claimed to have biodegradable, microbiocidal, non-allergic and anti-aging properties. Soya fiber has protein content up to 55% which consists of 18-22 different amino acids. Most common components are glutamic acid (23.7%), aspartic acid (13.0%), leucine (9.2%) and arginine (8.8%). These amino acids also exist in wool and silk‘s structure in different ratios (Choi, J. et. al.).

The similarity between soybean fiber and natural protein fibers was led us to investigate the natural dyeing properties of this rewarding fiber. Dyeings were performed with simultaneous mordanting of gallnut which is a natural mordant material. Thus, an eco–friendly fiber was dyed with an eco– friendly method. Besides gallnut, alum mordant was applied as a chemical mordant material to compare the effects of natural and chemical mordants on fastness and color properties, and to evaluate the advantages and disadvantages of natural mordant usage in this respect. Therefore, color properties were determined, washing, wet and dry rub fastness properties were also examined.

Experimental

Dyestuff extraction and dyeing procedure

Dyeing plants were separately treated with 100°C water in 1/20 plant/water ratio, for one hour, to derive dyestuff extraction. Afterwards, extraction was filtered and chilled at room conditions. Dyeing was carried out with this extraction which was directly used as the dyeing liquor. Simultaneous mordanting method was performed for both natural and chemical mordanted dyeings. Mordant materials were added to the dye liquor (5% and 10% o.w.f. alum and gallnut, respectively) at the beginning of the dyeing procedure where the liquor ratio was 1:40. Temperature elevated 4 centigrade degrees per minute up to 100°C. After proceeding the dyeing sixty minutes long at this temperature level, it was reduced to 80 °C and dyeing procedure was completed. Subsequent to dyeing, samples were washed for 5 minutes and then air-dried.

Colorimetric measurements

Color properties of naturally dyed soybean fiber fabric were examined using a DataColor 600 spectrophotometer under illuminant D_{65}, using a 10° standard observer. The CIELAB values, C^*, and h^o co-ordinates were measured and the *f(k)* color yield values calculated from the reflectance values at the appropriate wavelength of maximum absorbance (λ_{max}) for each dyed samples. Each fabric sample was read in four different areas and the average value was calculated.

Fastness tests

Wash fastness and rub fastness properties were determined. Wash-fastness test was carried out according to ISO 105:C06 A2S standard at 40°C with sodium perborate accompanied ten steel balls, in a M228 Rotawash machine (SDL ATLAS, UK). Both dry and wet rub fastness testing was performed following the ISO 105: X12 protocol. The assessment of color fastness of the dyed fabrics to washing and dry & wet rubbing (via staining of cotton rubbing fabric) was carried out using ISO grey scales.

Results and discussion

Color Properties

Colorimetric data and colors of natural dyed soybean fibers were presented on Figure 1 and Table 1. Color properties of dyed materials are shown on Figure 2.

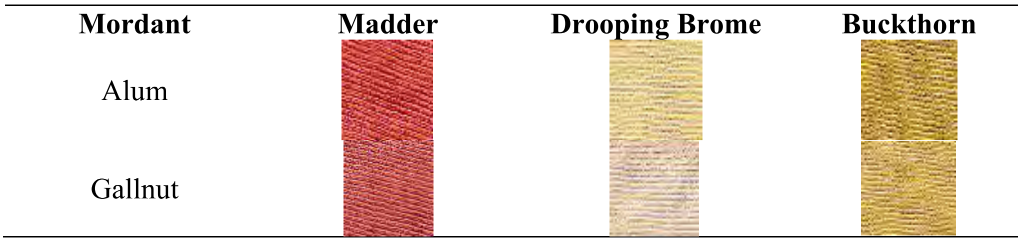


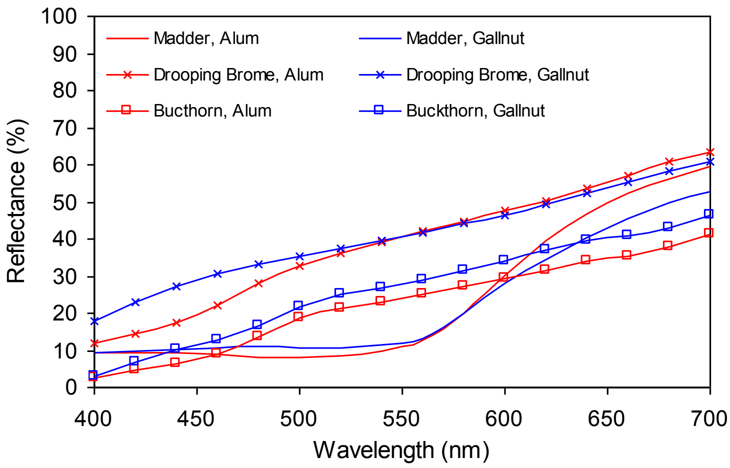
Figure 1 Colors of natural dyed soybean fabric samples

Table 1 Colorimetric data of natural dyed soybean fibers

Dyed Samples		*f(k)*	*L**	*a**	*b**	*C**	*h°*
Natural dye type	**Mordant type**						
Madder	Alum	56.2	47.8	32.8	20.2	38.5	31.6
Madder	Gallnut	48.5	48.2	25.6	16.6	30.5	33.0
Drooping Brome	Alum	16.0	69.7	2.9	29.1	29.3	84.4
Drooping Brome	Gallnut	10.5	70.2	3.9	16.4	16.8	76.8
Buckthorn	Alum	53.8	55.9	2.7	35.4	35.5	85.6
Buckthorn	Gallnut	35.7	59.8	3.6	31.7	31.9	83.5

The highest *f(k)* color yield (56.2) and chroma (38.5) were observed for alum mordanted madder dyeing of soybean sample (Table 1 and Figure 2). Also color yield and chroma values of alum mordanted samples of two other samples were higher than gallnut mordanted samples for the same natural dye (Table 1 and Figure 2). In a parallel line with color yields, alum mordanted samples had a slightly darker appearance, in regard to their *L** values. Clearly, alum mordant usage, for natural dyeing of soybean fibers with madder, bucthorn and drooping broom, is more suitable than gallnut mordant usage, in terms of the color yield, *f(k)*. However, natural gallnut mordant usage enabled to obtain slightly different shades than alum mordant (Table 1, Figure 1). Moreover, the usage of gallnut which is a natural material opens a gate for a chemical free environmental-friendly production.

(a)



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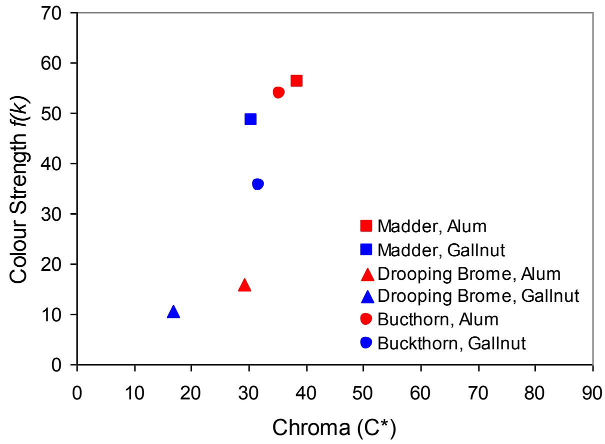

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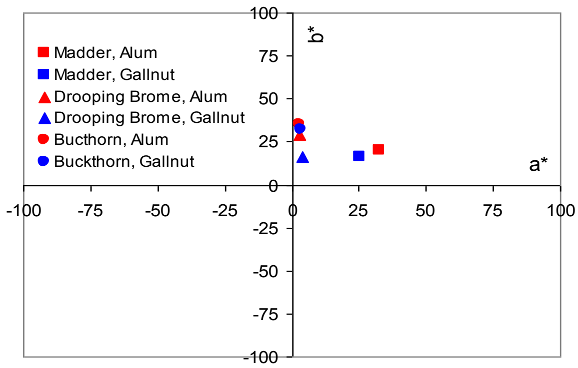

(d)

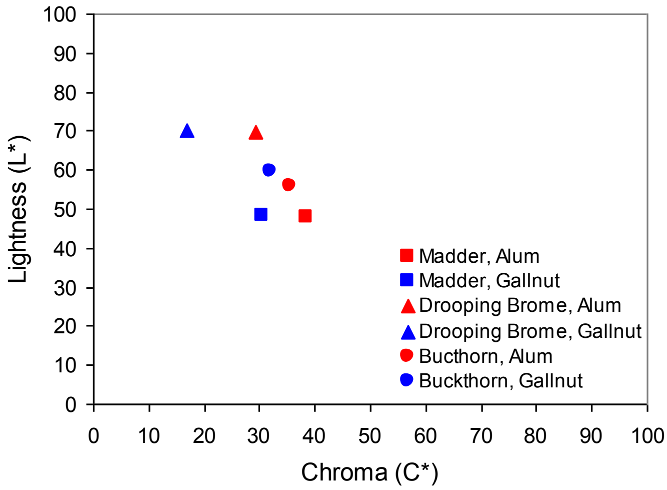

Figure 2 Colorimetric properties (a) wavelength-reflectance spectra, (b) f(k)-C, (c) a*-b*, (d) L*-C* plots*

Wash Fastness

Wash fastness properties are shown in Table 2. Drooping brome dyed soybean fabric sample accompanied with gallnut mordant exhibited excellent wash fastness performance by 5 grey scale rating for all fibers in the multi-fiber adjacent (Table 2). Also, wash fastness values of alum mordanted drooping brome dyeing are in commercially acceptable range. Only the cotton component in multi-fiber adjacent was stained by 4/5 grey scale grade in the case of alum mordanted drooping brome dyeing. Therefore, quite high wash fastness levels were obtained for drooping brome dyeing of soybean fibers.

Table 2 Wash fastness properties of natural dyed soybean fibers

Dyed Samples		**Wash Fastness Staining (C06-A2S)**					
Natural dye type	**Mordant**	Wool	Acrylic	Polyester	Nylon	Cotton	Acetate
Madder	Alum	4/5-5	5	5	4/5-5	4/5	5
Madder	Gallnut	3/4	5	4/5-5	3/4	4	3/4
Drooping Brome	Alum	5	5	5	5	5	5
Drooping Brome	Gallnut	5	5	5	5	4/5	5
Buckthorn	Alum	4/5	5	4/5-5	3/4	4	4
Buckthorn	Gallnut	4/5	5	4/5-5	4	4	4

Gallnut mordant usage had a negative effect, with up to 1.5 points lower values, on wash fastness values of madder dyed sample in compared to alum mordant (Table 2). The wash fastness values of gallnut and alum mordanted dyeing with buckthorn were approximately similar. Overall, alum mordant usage for madder and drooping brome exhibited commercially acceptable wash fastness levels. On the other hand, gallnut mordant usage for buckthorn and drooping brome resulted in commercially acceptable wash fastness levels.

Rub Fastness

Rub fastness properties of naturally dyed soybean fibers are shown on Table 3. Rub fastness values are in the commercially acceptable range for all dyed samples. Gallnut mordant usage caused slightly better rub fastness values for madder and drooping brome dyeings. Exactly same rub fastness performance (5 and 4/5 for dry and wet rubbing, respectively) was observed for gallnut and alum mordanted dyeing of buckthorn natural dye.

Table 3 Rub fastness properties

Dyed Samples		**Rub Fastness (X12) (Cotton Staining)**	
Natural dye type	**Mordant**	**Dry**	**Wet**
Madder	Alum	4/5-5	4
Madder	Gallnut	5	4/5
Drooping Brome	Alum	5	4-4/5
Drooping Brome	Gallnut	5	4/5-5
Buckthorn	Alum	5	4/5
Buckthorn	Gallnut	5	4/5

Conclusions

Alum mordanted soybean fibers which were natural dyed with madder, buckthorn and drooping broom exhibited higher color yields than gallnut mordanted samples. Also, the highest color yield value (*f(k)*) was observed for alum mordanted madder dyed soybean fabric. However, one should not forget that gallnut mordant is a natural material. Therefore, gallnut can be used for more eco– friendly natural dyeing. Furthermore, the usage of this natural mordant enables natural dyers to obtain different shade of colors.

Very good wash fastness properties were obtained for drooping brome dyeing of soybean fibers. Gallnut mordant usage had a negative effect, with up to 1.5 points lower values, on wash fastness values of only madder dyed sample in compared to alum mordant. As a final point for wash fastness values, alum mordant usage for madder and drooping brome exhibited commercially acceptable wash fastness levels. On the other hand, gallnut mordant usage for buckthorn and drooping brome resulted in commercially acceptable wash fastness levels. Rub fastness values are in the commercially acceptable range (between 4 and 5) for all dyed samples. Gallnut mordant usage caused slightly better rub fastness values for madder and drooping brome dyeings.
In conclusion, overall, gallnut can be used as a natural mordant material for more eco–friendly natural soybean fiber dyeing.

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EU LEGISLATION ON TEXTILE LABELLING – CASE OF SLOVENIA AND SOME OTHER MEMBER COUNTRIES

Urška STANKOVIČ ELESINI

Abstract: *The labelling of textile products in the EU member countries is subjected to the EU Directive 96/74/EC on textile names. According to the Directive, all textile products must be labelled with fibre composition. Other information, e.g. care instructions, size, dimensions, different warnings etc, is optional. However, the legislation of each member country varies, as well as the number of mandatory pieces of information which must be marked on products. The labelling of textile products in Slovenia has also been subjected to harmonisation according to the EU legislation since 1997. In 2004, when Slovenia became a member of the EU, a complete harmonisation of the Slovenian legislation with the EU legislation was established. Today, the only piece of information which must be marked on textile products is fibre composition. Does Slovenia (and other EU countries) have any problems with such labelling? Which institutions and committees are involved in the marking of textile products? What are the results of different research and analyses of the labelling of textile products in Slovenia? The results of numerous studies and final reports, and the answers to these and other questions are presented and explained in the paper.*

Key words: European Union, legislation, labelling, textile products, analysis.

1. Introduction

The labelling of textile products in the EU member countries is subjected to the EU Directive 96/74/EC on textile names. [1] Each member country has harmonised and implemented the Directive into its legislation. In accordance with the Directive, fibre composition must be labelled on textile products, while all other information is merely recommended, e.g. care instructions, size/dimensions, name and address of manufacturer, importer or supplier etc. According to their legislation, this information is mandatory in some EU countries (cf. Chapter 2) [2].

The labelling of textile products in Slovenia is regulated by the Rules on indicating fibre composition and textile names (OJ RS, 109/99) [3], including the amendments [4–9]. According to the Rules, textile products must be labelled with fibre composition, while other information is recommended. Despite the information being only recommended, it must be credible and written also in the Slovenian language.

The inspection over the accuracy of labelling textile products is performed by the Market inspectorate, which monitors the percentage of incorrectly labelled textiles and presents the results in reports (available on their websites). The inspection results are shown according to the proportion of incorrectly labelled textile products (and footwear) in Figure 1.

The percentage of incorrectly labelled textile products has decreased substantially since 2001, as can be seen in Figure 1. The reason for such a decrease can be found in the history of labelling, as it is elaborated in Chapter 3.

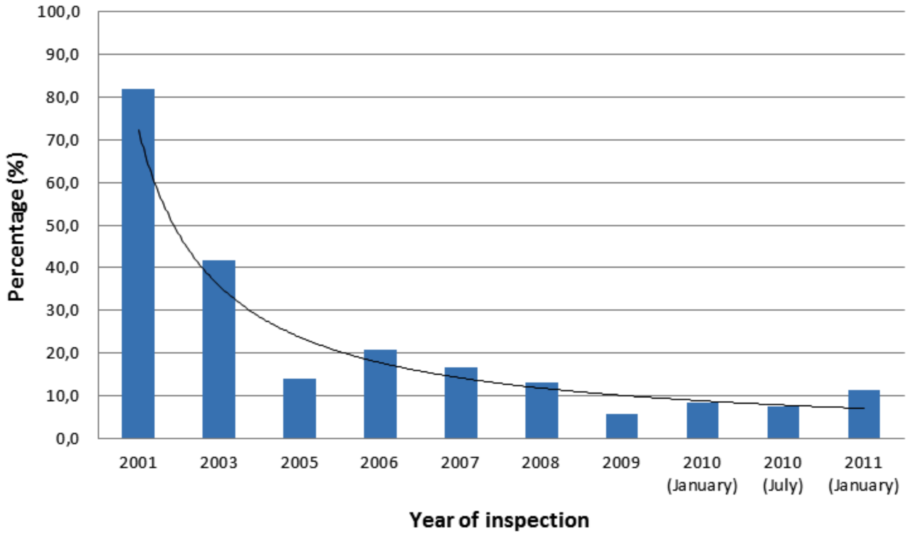

Figure 1: Percentage of incorrectly labelled textile products (and footwear) [10–18]

2. Textile labelling in eu member countries

As already mentioned in Introduction, the labelling of textile products in the EU member countries is governed by the Directive 96/74/EC on textile names [1]. In accordance with the Directive, fibre composition must be labelled on textile products, while all other information is recommended. In some EU countries, however, this information is mandatory according to their legislation (cf. Figure 2). [2]

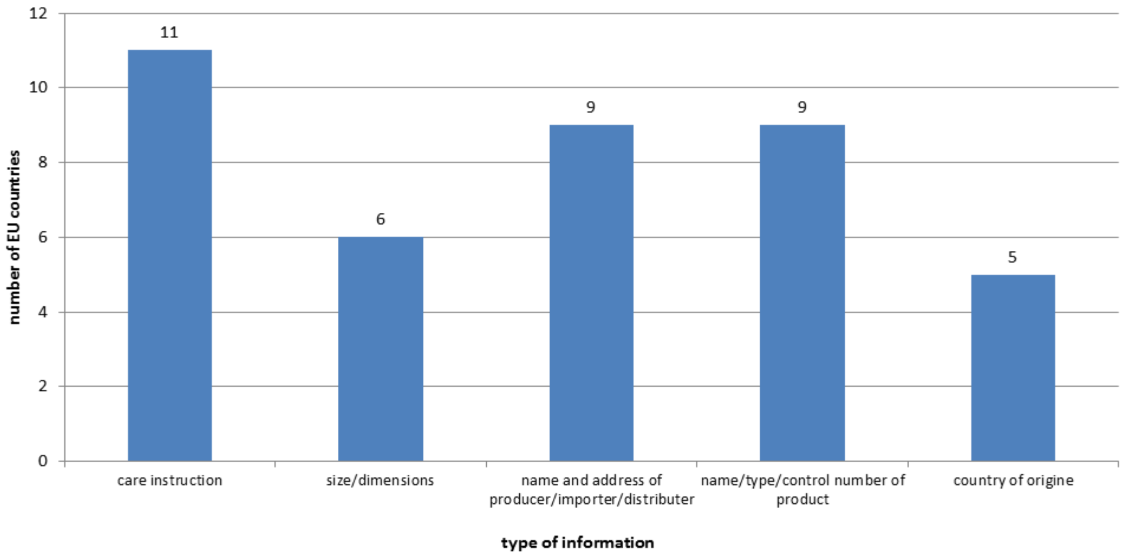

Figure 2: Number of EU countries where information other than fibre composition is mandatory

Depending on their national legislation, the EU countries implemented the Directive 96/74/EC as a regulation, rule, order, decree, directive or even a royal order or royal decree. In Slovenia, the Directive 96/74/EC was harmonised and implemented on the basis of §2 of the Law on technical requirements for products and conformity assessment (OJ RS, 59/99) as the Rules on indicating fibre composition and textile names (OJ RS, 109/99). The same as Slovenia, other countries have also implemented the Directive as a separate regulation according to a specific law, e.g. Consumer protection law, Commodity law, Trading law, Law against unfair competition etc.

The Directive 96/74/EC on textile names is supplemented by amendments to the technical progress. In 2008, a recast of the Directive was issued as the Directive 2008/121/EC (recast).

This year, the new Regulation on textile names is expected to include some minor changes in the labelling requirements:

- textile products containing leather or fur will be labelled with the notice ―non-textile parts of animal origin" to enable the consumers the identification of such products,
- customised textile products made by self-employed tailors will be exempt from mandatory labelling requirements,
- additionally, the process for a new fibre adaptation will be significantly shorter, since the producers will be given exact instructions for the preparation of the proposal,
- the new Regulation will also include the methods for determining the quantitative analysis of binary and ternary fibres, which have so far been listed in two separate directives.

3. TEXTILE LABELLING IN SLOVENIA

3.1 History of labelling

3.1.1 Textile labelling before the year 2000

Two regulations were in force in the field of textile labelling in Slovenia before 2000:

- Regulation on labelling, marking and packing of textile products (OJ RS, 11/96) and
- Decision on imported textile products which must be equipped with quality certificate (OJ SFRJ, 36/78).

According to the Regulation, textile products had to be labelled with approximately 5–10 pieces of information. Hence, a lot of textile products were labelled incorrectly.
When Slovenia became an associate member of the EU, the Decision was according to the European legislation considered discriminatory (valid only for imported but not for home-made products) and it presented a barrier to the free movement of goods. In consequence, Slovenia had to withdraw the Decision.

3.1.2 Textile labelling after the year 2000

At the end of 1999 and in early 2000, Slovenia got four labelling regulations as follows:

- Rule on labelling textile and leather products (Ur.l.RS, 3/2000) – Slovenian regulation,
- Rules on indicating fibre composition and textile names (Ur.l.RS, 109/99) – harmonised Directive 96/74/EC on textile names,
- Ordinance on the methods of quantitative analysis of binary mixtures of textile fibres (Ur.l.RS, 3/2000) – harmonised Directive 96/73/EC on certain methods for the quantitative analysis of binary textile fibre mixtures;
- Ordinance on the methods of quantitative analysis of ternary mixtures of textile fibres (Ur.l.RS, 3/2000) – harmonised Directive 73/44/EC on certain methods for the quantitative analysis of ternary textile fibre mixtures.

After the implementation of the four regulations above into the Slovenian legislation, a large amount of information was limited to five mandatory information items, i.e. product type (article), name of supplier, fibre composition, size/dimensions of a product and care instructions for a product. Despite the reduced number of mandatory information, the proportion of inadequately labelled products still remained too high. In 2001, 80% of the products were labelled improperly (cf. Figure 1).

In 2002, Textile and leather development monitoring committee was established at the Ministry of the economy. Since the labelling of textile products was on a very low level, the Committee started with education through various seminars, papers, consultancies etc for producers, distributers, suppliers,

traders, consumers and finally also for market inspectors who are still responsible for the surveillance of textile product labelling. In addition to all these actions, two important publications were published in that time: a booklet titled the Recommendation for textile and leather labelling, and three leaflets for textile, leather and shoe labelling (cf. Figure 3). At the same time, the research and analyses on the market were performed with the intention of establishing whether the situation on labelling has improved.

Figure 3: Leaflets and Recommendation

3.1.3 Textile labelling after the year 2004

The Slovenian Rule on labelling textile and leather product hindered the free movement of goods and had to be withdrawn when Slovenia became a full member of the EU, entering the European common market. After withdrawing the Rule, the only mandatory information to be labelled on textile products has been fibre composition, i.e. in accordance with the Rules on indicating fibre composition and textile names. Other information is optional, but recommended. However, another ―problem” emerged by withdrawing the Rule on labelling textile and leather product, i.e. a problem with leather products. There is no regulation about the labelling of leather products on the Slovenian level and not even on the EU level.
Of course, responses followed. The Textile and leather development monitoring committee was not pleased with the new situation. Numerous complaints came from the Slovene consumers‘ association, from the industry through the Chamber of commerce and industry of Slovenia, Chamber of craft and small business of Slovenia, as well as from other institutions. They considered that these changes are mostly in favour of those already labelling the textile products insufficiently and that a Slovenian consumer will not be able to get enough information about products.

3.1.4 And how are textile products labelled today?

In spite of the fears that textile products will be labelled poorly, they are not. When Slovenia joined the EU, competition put labelling on the right track. Suppliers have become aware that poorly labelled products are not appealing to consumers. Even if they end up buying poorly labelled products, subsequent problems can results in complaints. The labelling has become an important factor in the marketing of products.
The percentage of incorrectly labelled textile products sold directly on the market has decreased below 10%. Nevertheless, a new problem arises. Textile products are no longer offered to consumers only directly, but also through online catalogues and online shops. According to §8 of the Directive 96/74/EC on textile names, the following requirement must be met: ―The names, descriptions and particulars as to textile fibre content referred to in Articles 3

to 6 and in Annexes I and II shall be indicated in clear, legible and uniform print when textile products are offered for sale or sold to the consumer, and in particular in catalogues and trade literature, on packaging, on labels and on markings." According to this requirement, textile products which are sold through online catalogues and shops must also be labelled in compliance with the rules regulated by the Directive.
In 2010, research was performed on the labelling of textile products sold through catalogues and online shops. The research was performed by the Department of textiles in Ljubljana. In this research, over 500 products were examined and the conclusion was as follows: only 7% of all products sold through catalogues were labelled incorrectly, while as much as 44% of all products sold by online shops were labelled incorrectly. [19] The most common errors are presented in Figure 4. According to the results, the Market inspectorate started monitoring also the labelling of textile products sold by online shops.

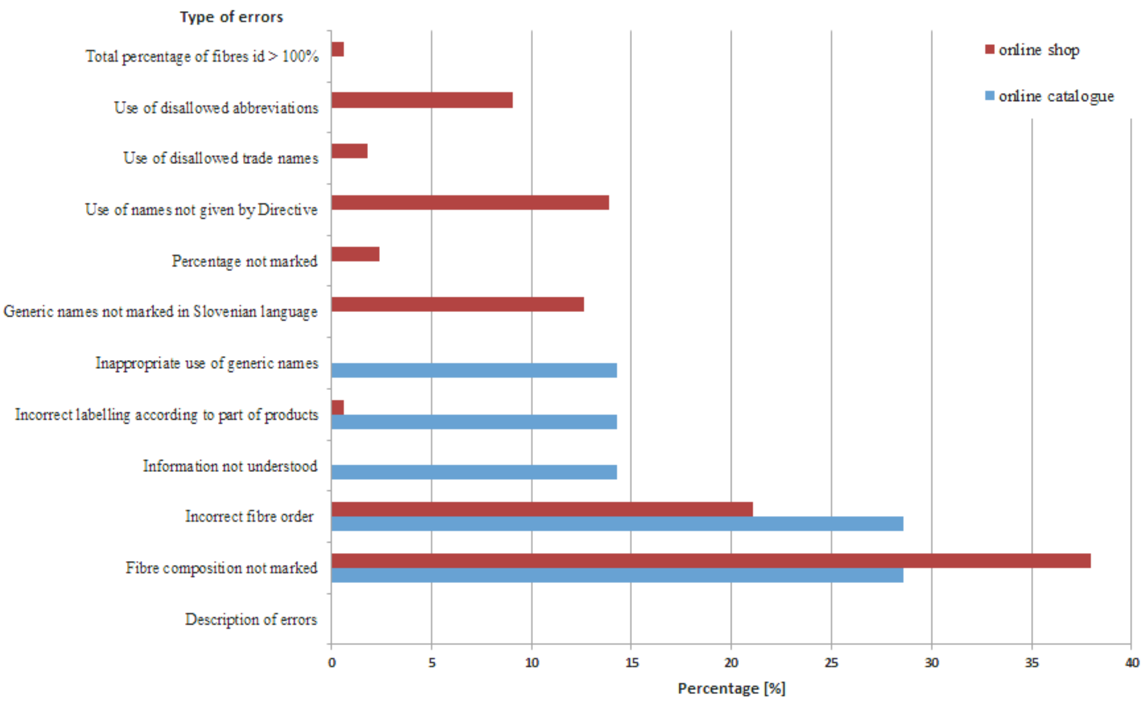

Figure 4: Most common errors on labelling textile products sold through online catalogues and shops

Even if the labelling of textile products is now at an enviable level, the Committee still have a lot of work to do. Furthermore, they are responsible for the monitoring, harmonising and implementing the changes of European directives on the labelling of textile products. In December 2010, the members of the Committee proposed a withdrawal of otter fibres from the Directive on textile names (the proposal was supported by 26 countries and goes now to further reading). Moreover, the Committee still participate at seminars, counselling etc and they actively participate in the maintenance of the textile labelling website contents (www.oznake-tekstila.si), released in February 2011 (cf. Figure 5).

Figure 5: Textile labelling website Oznake-tekstila.si [2]

4. Conclusion

In the paper, the regulations and requirements on textile labelling were presented on the case of Slovenia. Although Slovenia has not been a member of the EU for long, it has made impressive progress on the labelling of textile products. Since 2002, when the Textile and leather development monitoring committee was established at the Ministry of the economy, a lot of different activities have been taken up. This year, only about 10% of textile products were labelled incorrectly. In other EU countries, different ministries or textile institutions are responsible for the labelling, this role not being allocated to a committee such as we have in Slovenia. However, without the Committee, all these actions would not have been performed; therefore, we recognize the Committee as a very useful and important part of textile labelling in Slovenia.

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EXPERIMENTAL STUDIES OF THE DIMENSIONAL STABILITY OF COTTON AND WOOL HALF MILANO RIB KNITTED FABRICS

Nadya BUKHONKA & L. KOROLJOVA

Abstract: *The main objective of this research is to analyze dimensional stability of the cotton and wool yarn knitted fabrics. The fabrics are produced by the flat bed-knitting machine 10 gauge from the 74 tex cotton and 72 tex wool yarns. All measurements of the structures parameters are made on the fabrics after dry and wash relaxations in a washing machine (laundering). The results are showed that the type of the yarn influence on the main structure parameters differently what may be explained by the differences in the properties of the yarn.*

Key words: half milano rib, dimensional stability, dry, wash, relaxation.

Introduction

The geometry and dimensional stability of the knitted fabrics produced from different kind of yarns in generally has been the subject of investigations by many research workers. Motivation for that is the fact that change of dimensional characteristics of the knitted fabrics after knitting can create a lot of problems in garments especially those produced from hydrophilic fibres such as cotton and wool. Therefore it is very important to now behaviour of the fabric under different relaxation condition such as: dry relaxation, steaming, static soaking and washing with agitation, centrifuging and tumble drying. In general, these behaviour are depends on the friction and the mechanical properties of the fibres, yarn and structure of knitted fabrics [1].

Early investigations analysing effect of laundering on the knitted fabrics, generally concentrated on the influence of different kinds of yarn, fabrics structure and properties, loop length, knitting parameters, mechanical action of the washing machine on the cotton and wool knitted fabrics, number of wash cycles, water temperature, duration of wash time and others factors on the dimension stability [2-12]. The results of many investigations showed the dependence of dimension stability of the knitted fabrics by the type and diameters of yarn, loop length, type of the knitted structure, stages of relaxation and many others factors.

The differences in surface properties and dimensional stability of the fabrics depend more on structural parameters and fiber-fabric type than on laundering temperature [2-4]. Dimensional parameters of cotton 1x1 rib knitted fabrics made from cotton yarn after different relaxation treatments (wet and some kinds of laundering treatments) are depend on the fabric tightness $K = n\sqrt{t}/l$, (where n is the number of loops in the repeats, t – linear densities of yarns, l – the loop length) and the method of relaxation treatments used [5].

The effect of the different washing relaxation treatments on the dimensional stability of plain, 1x1 rib and interlock knitted fabrics from cotton yarn are investigated in the paper [6]. These fabrics were subjected to five cycles of different washing and drying relaxations which isolated the wash, rinse, spin, agitation and the effect of heat during drying. The results showed that changes occurring after washing relaxation were largely due to alterations in the loop shape, rather than yarn or loop length shrinkage. The changes occurring after laundering were largely caused due to the agitation during tumble drying. The agitation was found to have caused 34 % of the changes during laundering,

followed by the spin cycle during washing, which caused 24 % of the dimensional changes and distortion.
Dimensional properties of 1x1 rib knitted fabrics from cotton and cotton-spandex yarns after laundering had higher length shrinkages than their width shrinkages. Cotton-spandex rib fabrics showed higher length and lower width shrinkages than cotton rib fabrics [7].

The results of the investigations of the shrinkage of different cotton knit fabrics during the two methods of relaxation are showed that at least five cycles seem to be necessary to approximate the fully relaxed state [8].

More recently, experimental studies on the dimensional properties of half milano and milano rib fabrics with wool, acrylic and cotton yarn, using five different tightness values, were investigated in the paper [9]. Dry, wet, and wash relaxations were applied to the samples and after each relaxation, course-spacing and wale spacing were measured. Loop lengths were measured only after dry relaxation. The findings were that course spacing and wale spacing of the milano rib and half milano rib are increased linearly with increasing the loop length. High correlation coefficients of these linear regression equations were found.

The geometrical model for half milano rib fabric from wool yarn after dry and wash relaxations is proposed in the paper [10]. According to this model difference between the wale spacings of dry relaxed and wash relaxed half milano rib is small. Applaying this model also ensures that the sinker loops and the needle loops of plain course of half milano rib are not different in width. For milano rib and half milano rib fabrics the run-in ratio between rib course and plain course is a very important parameter. According to this model on to density of half milano rib fabric have influence diameter of yarn not type of relaxations. Also type of relaxations are not influence on the loop length for rib and plain structures in the half milano rib fabrics, but the thickness of half milano rib fabric depend on the type of relaxations.

The influence of the combination of the different type the interlacing on the structures repeat at height of combined knitted fabrics is investigated in the papers [11]. It is noticed that the structures and properties of the knitted fabrics depend on the type of knitted fabrics and on the order of it alternation in the repeat of knitted fabrics. Dimension stability of the missed jacquard knits produced from linen yarns were not caused by the type of the knitted structure [12].

The subject of investigation in this article is half milano rib fabrics produced by the flat bed-knitting machine 10 gauge from the 74 tex cotton and 72 tex wool yarns. Cotton and wool yarn are widely used sort of raw material made from natural fibers and used in production of kitted garments of different ultimate usage. The half milano rib fabrics are widely used for production of sportswear, sweaters' and technical knitted textile for different use.

This paper is part of the broader investigation program aimed to collect experimentally date which indicate behaviours of double weft knit structure in the conditions which are similar to real state of using. The finding may be used to construct the model for prediction dimensional behaviour of the knitted fabric structures from cotton and wool yarns.

Experimental Part

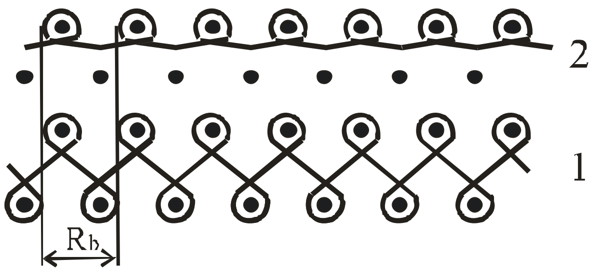
Graphical representation, structure of face and back half milano rib knitted fabric are presented on the fig. 1. Face and back sides of half milano rib knitted fabric are different (fig. 1, b and c). The structures repeat at height of a face side half milano rib fabric is characterized by consist of combination of two courses: rib and plain. The back sides structures repeat at height consist of only one course of rib fabric.

The samples of double knit fabrics were knitted on a 10 gauge flat bed-knitting machine with 200 needles in the front and 200 needles on the back bed of the machine from 74 tex cotton and 72 tex wool yarns.

The yarn (Italy) has the following characteristics:

1) *cotton:* breaking force 472 cN, elongation 3,9 %, tenacity 6,3 cN/tex;
2) *wool*: breaking force 706 cN, elongation 5,2 %, tenacity 9,8 cN/tex.

The following parameters in the process of knitting were used: the stitch cam, yarn tension and take-down were constant. The stitch cams were set up to 2,7 mm and were adjusted to produce knits with loop module ζ = 21 which was determined by the formulas $\sigma = \frac{l \cdot \sqrt{T}}{31,6}$, where l is the loop length (mm) and T is the yarn linear density [3]. This is normal value for commercially used fabrics.



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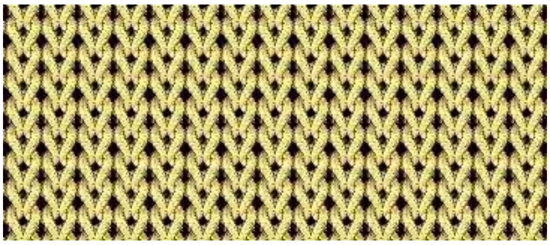

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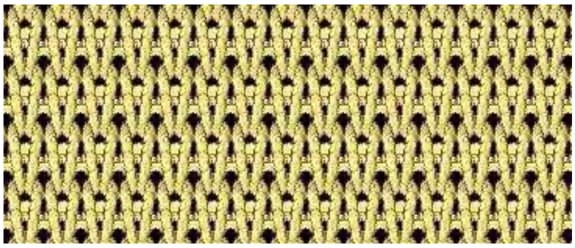

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Fig. 1. Graphical representation (a), structure of face (b) and back (c) half milano rib knitted fabric

Table. The dimensional changes of the main characteristic of the half milano knitted fabrics in the process of relaxation

Type of relaxation	$D_{h\,c}$	$D_{h\,w}$	$D_{v\,c}$	$D_{v\,w}$	$l_{1\,c}$, mm	$l_{1\,w}$, mm	$l_{2\,c}$, mm	$l_{2\,w}$, mm	$m_{s\,c}$, g/m^2	$m_{s\,w}$, g/m^2	M_c, mm	M_w, mm
DR1	57	59	79	47	5.77	5.56	5.65	5.16	234	189	1.43	1.40
DR10	57	56	79	51	5.81	5.30	5.64	5.01	235	187	1.42	1.41
WashR1	58	59	79	46	6.00	6.03	5.80	6.01	280	195	1.50	1.42
WashR10	58	50	79	54	6.00	6.27	5.90	5.56	287	201	1.60	1.48

After relaxation treatments the results of measurements of the loop pitch A and loop courses height B for face and back sides of half milano rib fabrics with cotton and wool yarns are presented on the fig. 2 where:
- $A_{f\,c}$, $B_{f\,c}$ – the loop pitch and loop courses height for face side of the cotton knit fabrics,
- $A_{b\,c}$, $B_{b\,c}$– the loop pitch and loop courses height for back side of the cotton knit fabrics,
- $A_{f\,w}$, $B_{f\,w}$ – the loop pitch and loop courses height for face side of the wool knit fabric,
- $A_{b\,w}$, $B_{b\,w}$ – the loop pitch and loop courses height for back side of wool knit fabric.

It can be seen from fig. 2 and table, that main parameter of these knitting structures depends on the type of the yarn. For example, independent of the type of relaxation, the loop pitches on face side of cotton knitted fabric are by 27 % bigger then loop pitches on the back side. The loop courses height on face sides are by 16 % smaller then the courses height on the back sides. It indicate that the type and numbers of treatments das not influence on the changes of the loop pitches and loop course height of booth side of half milano cotton knitted fabrics.

Results and Discussion

It seems that dry relaxation process of the fabrics depends on the characteristics of the mechanical forces in the process of knitting (friction forces and elastics deformation) of the yarns. Frictional forces at the interloping points of the loops prevent fabrics to reach strain-free state. Investigation of the mechanical properties of the yarns used in this experiment showed, that wool yarn has bigger breaking force (about 33 %) and elongation (about 25 %) in comparison with the cotton yarn. This property has influence not only on to knitting loops forming process but on the process of relaxations.

During wash relaxation process, water acts as agent which reduces friction at the interloping points. That process depends as well on the type of the yarn. The yarn is consisting of the fibers, spun and twisted in to the yarn. In dependence of the type of fibers, the quantity of water absorption and changes in the size of the fibers, are different. Wetness of fibers cause destroying intermolecular and macromolecular cohesion forces between fibers spun in to the yarn. Further wetting may cause changing the characters of the inter macromolecular links, displacement and disorientation same molecules or their parts and create necessary conditions for equilibrium among them. Under the stress imposed during that process, the part of the yarn in the loops, straightened in the plane of the fabrics begin to bent, and the part of the bended fibers begin to straightened or increase diameter of the curvature. On that way the elements of loop structures of the fabrics tend to reach state of conditional equilibrium in which the knitted structures may received the form and relaxed fabrics dimension.

The dimensional changes in the process of relaxation and stabilization of half milano rib fabrics after the 1th and the 10th dry (DR1, DR10) and wash (WashR1, WashR10) treatments are shoved in the next table where:
- $D_{h\,c}$, $D_{h\,w}$ - the densities in horizontal of cotton and wool knitted fabric;
- $D_{v\,c}$, $D_{v\,w}$ - the densities in vertical of cotton and wool knitted fabric;
- $l_{1\,c}$, $l_{1\,cw}$ – the loop length for the rib from cotton and wool yarn;
- $l_{2\,c}$, $l_{2\,cw}$ - the loop length for the plain from cotton and wool yarn;
- $m_{s\,c}$, $m_{s\,w}$ - the mass of $1m^2$ of the cotton and wool knit fabrics;
- M_c, M_w - the thickness of the cotton and wool knit fabrics.

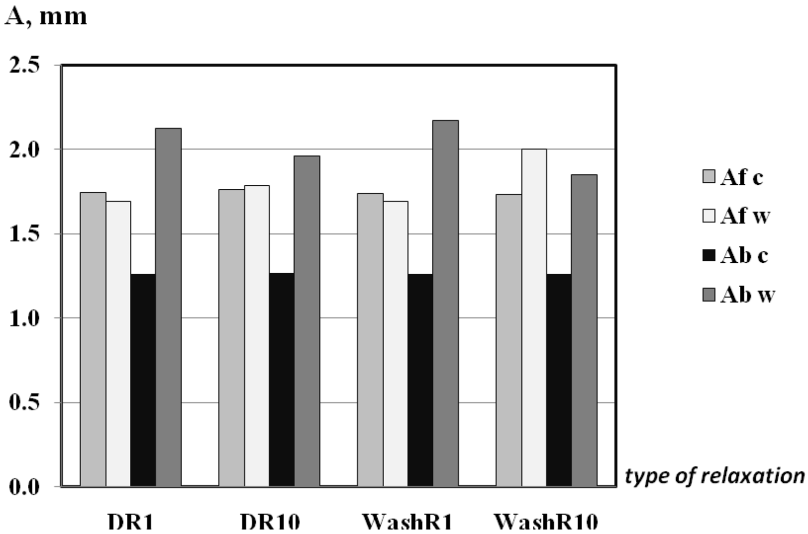
Table. The dimensional changes of the main characteristic of the half milano knitted fabrics in the process of relaxation

Type of relaxation	$D_{h\,c}$	$D_{h\,w}$	$D_{v\,c}$	$D_{v\,w}$	l_1 c, mm	l_1 w, mm	l_2 c, mm	l_2 w, mm	m_s c, g/m^2	m_s w, g/m^2	M_c, mm	M_w, mm
DR1	57	59	79	47	5.77	5.56	5.65	5.16	234	189	1.43	1.40
DR10	57	56	79	51	5.81	5.30	5.64	5.01	235	187	1.42	1.41
WashR1	58	59	79	46	6.00	6.03	5.80	6.01	280	195	1.50	1.42
WashR10	58	50	79	54	6.00	6.27	5.90	5.56	287	201	1.60	1.48

After relaxation treatments the results of measurements of the loop pitch A and loop courses height B for face and back sides of half milano rib fabrics with cotton and wool yarns are presented on the fig. 2 where:

- $A_{f\,c}$, $B_{f\,c}$ – the loop pitch and loop courses height for face side of the cotton knit fabrics,
- $A_{b\,c}$, $B_{b\,c}$– the loop pitch and loop courses height for back side of the cotton knit fabrics,
- $A_{f\,w}$, $B_{f\,w}$ – the loop pitch and loop courses height for face side of the wool knit fabric,
- $A_{b\,w}$, $B_{b\,w}$ – the loop pitch and loop courses height for back side of wool knit fabric.

It can be seen from fig. 2 and table, that main parameter of these knitting structures depends on the type of the yarn. For example, independent of the type of relaxation, the loop pitches on face side of cotton knitted fabric are by 27 % bigger then loop pitches on the back side. The loop courses height on face sides are by 16 % smaller then the courses height on the back sides. It indicate that the type and numbers of treatments das not influence on the changes of the loop pitches and loop course height of booth side of half milano cotton knitted fabrics.



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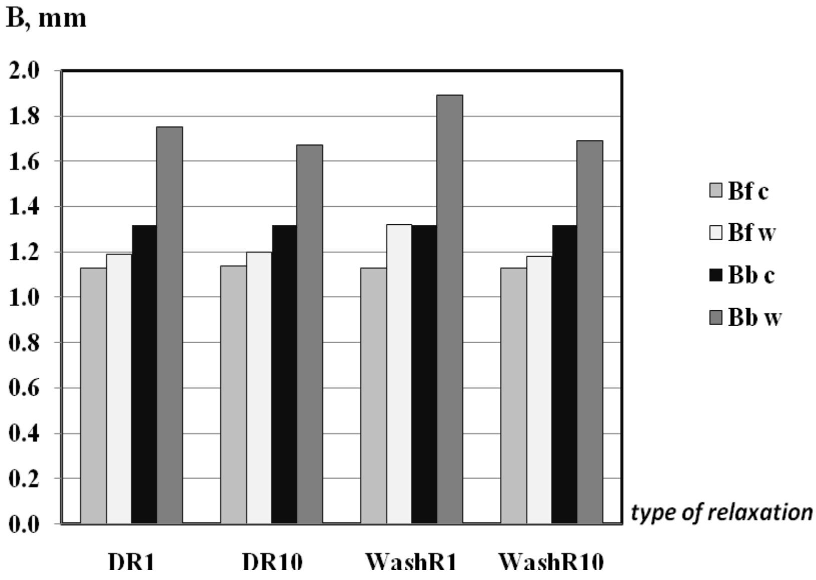

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Fig. 2. Diagrams of the loop pitch A (a) and loop courses height B (b) for face and back sides of the half milano rib fabrics from cotton and wool yarns

As to half milano wool knitted fabrics, after the 1th treatment of dry relaxation, the loop pitches on face side are smaller by 26 % then loop pitches on the back side, and after the 1th cycles of wash relaxation it reach 28 %. But with increase the number of dry and wash relaxation treatments, the difference between loop pitches of face side and of back side become smaller and smaller so as at the and the loop pitches of face side become larger than pitches on the back side. So after the 10th dry relaxation treatment loop pitch of the face side become lesser by 10 % compared to loop pitches of back side, and after the 10th treatment of wash relaxation loop pitch of the face side become bigger by 7 % compared to loop pitches of back side. At the same time the loop course height of the face side of the half milano wool knitted fabrics during full process of relaxation compared to the loop course height of the back side, become smaller by 43 %.

The results of measurements of the loop length for half milano rib fabrics after dry and wash relaxation are presented on the fig. 3, where:

- $l_{1\,c}$, $l_{1\,w}$ - the loop length for rib knit from cotton and wool yarns,
- $l_{2\,c}$, $l_{2\,w}$ - the loop length for plain knit from cotton and wool yarns.

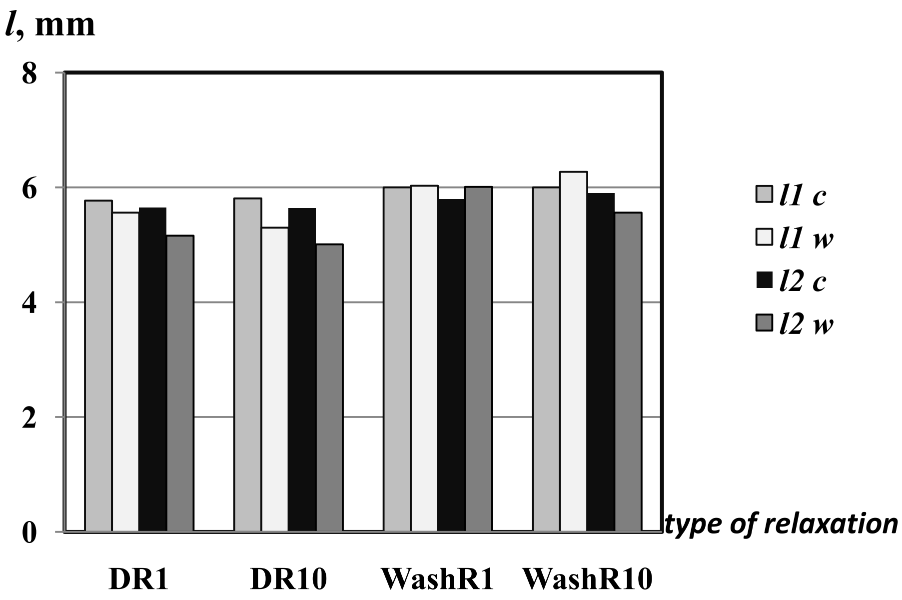

Fig.3. Diagrams of the loop length for rib (l_1) and plain (l_2) for half milano rib fabrics with cotton and wool yarns

From the diagrams of the loop length fig. 3 the following may be concluded:

- the loop length for rib l_{1c} and plain l_{2c} of the cotton knitted fabric during dry and wash relaxation are independent of the type relaxation and the number of their treatments;
- the loop length for rib l_{1w} and plain l_{2w} of the wool knitted fabric during dry relaxation is depend of the type of relaxation and number of treatments. The loop length for rib during 10th treatments of dry relaxation is decrease by the 5 %, the loop length for plain also decrease by the 3 %. After 10th treatments of the wash relaxations the loop length for rib is increase by the 4 %, and the loop length for plain – decrease by the 8 %.

The mass /1m^2 of the knitted fabrics for bout types of the yarn depend on the densities of knitted fabrics along courses and wale's, the type of relaxation, but not by the number of treatments. After dry and wash relaxations the mass/ 1m^2 of the half milano cotton knitted fabrics are bigger by 20 % than mass 1m^2 of wool knitted fabrics.

The mass of 1 m^2 of cotton knitted fabric after dry relaxation are bigger by the 20 %, after wash relaxation by the 30 %, than mass of 1 m^2 of wool knitted fabric. The thickness of cotton knitted fabric M_c is bigger by the 2 % than thickness of wool knitted fabric M_w. During dry relaxation the thickness of cotton and wool knitted fabrics are change by the 1 %. During wash relaxation the thickness of cotton knitted fabric M_c is increased by the 6 %, and wool knitted fabric M_w by the 4 %.

The results of measurements of the relaxation shrinkage of fabrics with cotton and wool yarns are presented on the fig. 4 where:

- SL_c, SW_c – the relaxation length and width shrinkage of the knit fabric with cotton yarn,
- SL_w, SW_w – the relaxation length and width shrinkage of the knit fabric with wool yarn.

As it could be seen from fig.4 the dimensional changes of the half Milano rib knitted fabrics made from cotton and wool yarn are linear with high coefficient of correlation. Direction of dimensional changes of the cotton and wool fabric are different and opposite to each other. The linear dimension of the cotton knitted fabrics, length wise and width wise are decreasing (shrinkage), and linear dimension of the wool knitted fabric length wise are decreasing to and width wise increasing.

During dry relaxation, the length and width shrinkage of the cotton and wool knitted fabrics are change up to 3 %. During ten cycles of wash relaxations length shrinkage of cotton knitted fabrics is increase from -1 to -3 %, and width shrinkage – from -8 to -10 %, the length of wool knitted fabrics is increase from -12 to -13 %, and width shrinkage is decrease from 12 to 10 %.

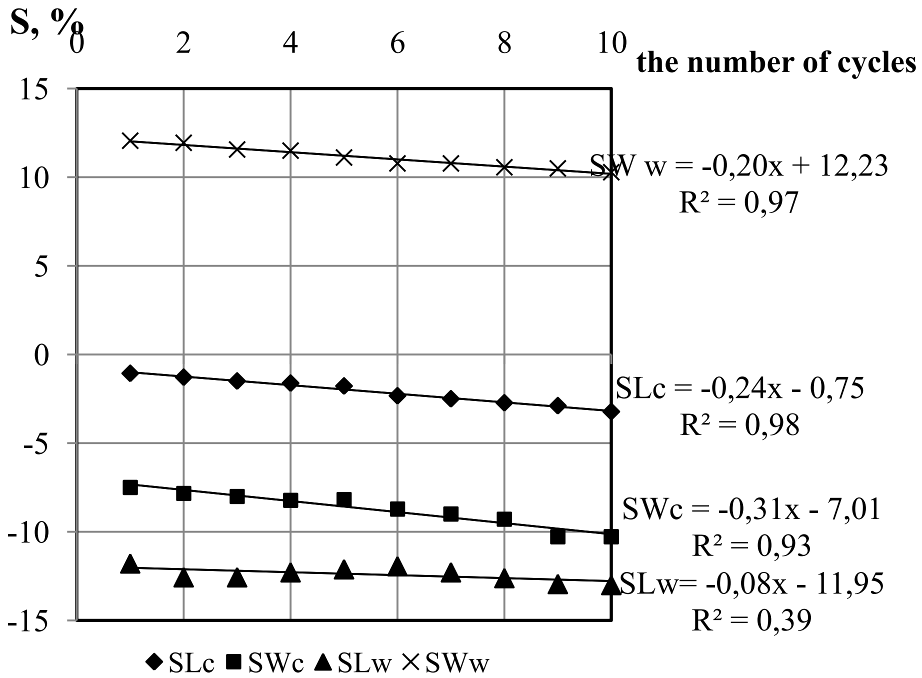

Fig. 4. Relation between the relaxation shrinkage of fabrics from cotton and wool yarns depends and number of washing cycles (treatments)

Conclusion

Analyzing results of investigation of main parameters of half milano cotton and wool knitting fabrics structure during process of dry and wash relaxations are depends on the type of yarn and state of the relaxation:

1. The loop pitch and loop courses height, the loop length for rib and plain knit fabric made from cotton yarn little depend of the type of relaxation and the number of relaxation treatments.
2. The main parameters of half milano fabrics knit structure made from wool yarn depend on the type of the relaxation and number of the treatments with higher sensibility on washing then on t

   he dry relaxation treatments. It could be partly explained by the physical-mechanical properties of the wool yarn.
3. Surface densities and thickness of half milano rib fabrics do not depend on the number of relaxation treatments, but depends of the type of relaxation and type of the yarn. During process of washing the main parameters of the knitted fabric structures are changing influencing the increase in the thickness and weights of the both: cotton and wool half milano knitted fabrics.
4. The finding may be used to construct the model for prediction dimensional behaviour of the knitted fabric structures from cotton and wool yarns.

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MONITORING STITCH FORMING PARAMETERS ON LOCKSTITCH SEWING MACHINE

Maja NOFITOSKA, Goran DEMBOSKI & Miguel Ângelo Fernandes CARVALHO

Abstract: *The industrial manufacturing of sewn products has always been one of the critical processes of the textile chain concerning quality assurance. Assuring the appropriate set-up and operations of all the machines, and the final seam quality, is a very complex task. Traditionally, this task is accomplished by empirical methods, with machine setting and quality control relying on the skills of operators and technicians. In this environment machine set-up acquires a great relevance.*
Data collection devices were positioned at appropriate locations of the lockstitch sewing machine for acquisition of information regarding thread tension; thread consumption and presser foot displacement during stitch formation.
A software program was created to provide on-line information and data analysis.
The papers presents the results of monitoring sewing machine parameters during stitch formation and discuss the behaviour of thread tension, thread consumption and presser foot displacement for different sewing speed and material variation.

Key words: sewing machine monitoring, thread tension, thread consumption, presser foot displacement.

1. Introduction

To be able to reduce percentage of defect garments we must monitor the sewing process. The occurrence of thread breaks, interlacing failing during stitch formation, thread consumption not being within the correct values to obtain a balanced stitch, not proper feeding of material for correct stitch density, bad condition of the needle causing material marking or yarn breaking during its penetration are all important information to guaranty seam quality during assembly of the whole garment.
The first studies on seam quality were carried out by Dorkin and Chamberlain in 1961 [1]. The relation of seam pucker occurrence, a common quality problem, with the behaviour of the feeding system was investigated and the operation of the feeding system was precisely described. In 1964, Chamberlain and Deery developed a method for measuring thread tension variation within the stitch formation cycle of a lockstitch machine [2]. The tension signals were analysed relating the occurring peaks to events in the stitch cycle and the values of the peaks. Greenberg in his study presented another instrument for the same purpose [3]. In his investigation, Johnson presented mathematical model for the movement of the presser-foot in a sewing machine, especially concerned on predicting the contact losses between presser-foot and feed-dogs [4]. A study of sewing dynamics, considering thread tension and thread consumption as two very important parameters to achieve good quality seams considering different machine set-up (sewing speed, needle, thread pretension) and material used (fabric and sewing threads), has been presented by Jones [5]. Meantime, several studies were directed towards investigation of the behaviour of thread tensions and its relations to seam quality. Jones and Munden describe the geometry and mechanics of the two-thread chainstitch, proposing a method for the measurement of both static and dynamic thread tensions [6], [7]. Horino *at al*. [8] and later Kamata *at al.* [9] carried out studies on thread tensions in lockstitch sewing machines. They examined the relationship between the needle and bobbin thread tensions, also observing the movement of the check spring, a component that is found in the needle thread path of lockstitch machines. Similar work was carried out by Onoue [10]. Chmielowiec and Lloyd [11] equipped a Pfaff lockstitch machine with sensors measuring presser-foot force and displacement, thread tension and needle penetration force. They were able to detect the effect

of ―presser-foot bouncing", and analyzed some correlation between presser-foot compression force and seam pucker. Alagha *at al.* [12] discussed the relation between fabric objective properties and sewing conditions, with the contraction and consumption of sewing threads. The stitch-formation process of a lockstitch sewing machine is investigated with the aid of transducers that facilitate real-time monitoring of the sewing cycle. Kennon and Hayes [13], found that retardation of the fabric-feed timing by up to 25° results in a lowering the stitch is forming tension which could have implications for modification of seam slippage and the reduction of tension-induced puckering. Carvalho *at al* analyzed the effect of pre-tension on the needle thread tension and thread consumption [14], [15].
The aim of this paper is to investigate effect of sewing speed and fabric structure variations on sewing thread tension, thread consumption and presser foot displacement.

2. Materials and methods

2.1 Materials

The materials investigated are 100% wool woven fabrics. The structural parameters of both fabrics such as: warp yarn count, warp density, weft density and weave are identical. The fabrics have only different weft yarn count: the first fabric designated C21YL has single ply weft yarn of lower count, while the second fabric C21YH has double ply weft yarn of higher count.
The particulars of fabric parameters are shown in Table 1.

Table 1: Investigated fabric particulars

Fabric	Fiber composition	Yarn count, warp [Tex]	Yarn count, weft [Tex]	Warp density [cm^{-1}]	Weft density [cm^{-1}]	Fabric thickness [mm]	Fabric weight [g/m^2]	Weave
C21YL	100% wool	15x2	24	31.2	27.6	0.29	167	2x1 twill
C21YH	100% wool	15x2	15x2	31.2	28	0.34	187	2x1 twill

2.2. Methods

A lockstitch sewing machine was equipped with several devices in order to acquire, store and analyse data describing the behaviour of the most important parameters involved in the formation of the stitch type 301, which is the most used stitch in sewing industry (fig. 1).

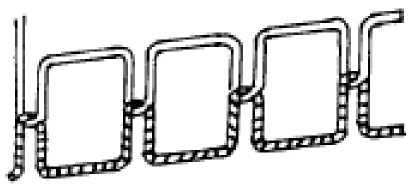


Figure 1: Empirical model of the sewing stitch type 301

The system consists of data collection devices (sensors - cantilever beams strain gauges, encoders, LVDT (Linear Variable Differential Transformer) and hardware for signal conditioning and processing). These devices are connected to a data acquisition board installed in a PC (fig. 2).

There is also a program (developed in *LABVIEW*), which allows the calibration of the devices, the on-line graphical display and signal processing functions. The program includes also basic statistical tools, in order to shorten the evaluation of the results.

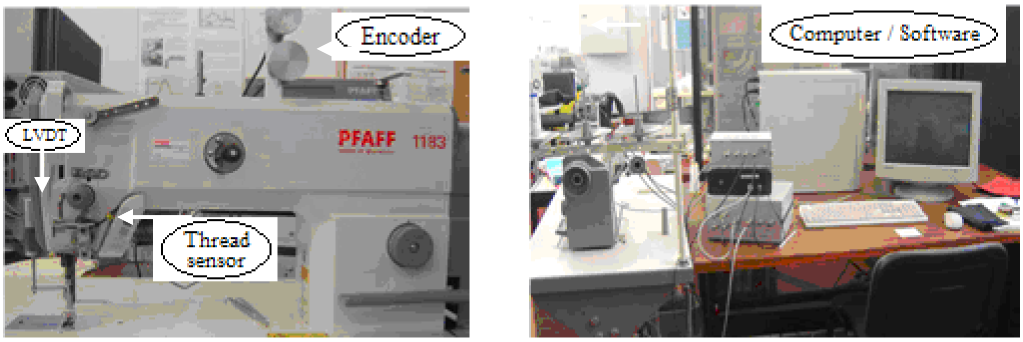


Figure 2: Positioning of the control devices in the lockstitch sewing machine and connection to pc

The strain gauge sensor was used to measure thread tension variation in needle thread and the thread guider was used to secure the contact between the sensor and the thread during stitch formation. The sensor is placed between the spring pre-tensioner and the needle in the path of the thread.
The sensor was specifically developed to dynamically measure and track quick variations of the thread tension. This high-sensitivity semiconductor strain gauge sensor has a silicone guider to assure the contact with the thread during stitch formation and to reduce the friction forces.
To measure needle thread consumption an encoder was positioned in the path of the thread. This way the total amount of thread used in the seam can be acquired and compared to other parameters for each experiment.
The sewing parameters for the investigation are shown in table 2.

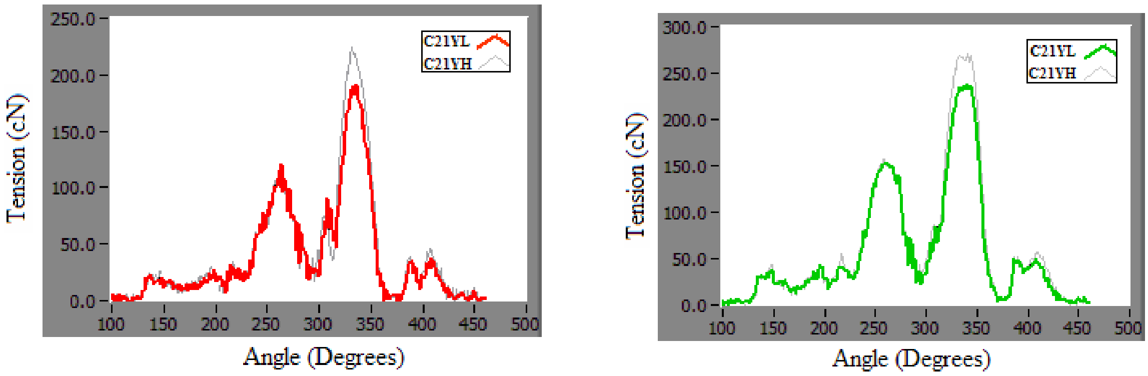
Table 2: Sewing parameters of the experiment

Machine speed	Sewing thread	Needle size
3000 spm	100% PES Tt=25tex	100 Nm
4000 spm		

3. Results and discussion

3.1. Effect of different sewing speed and material variation in needle thread tension and consumption

In order to evaluate only the influence of machine speed and material properties on needle thread tension and consumption, other machine set-up parameters were kept constant. Figure 3 and fig. 4 represent the results of thread tension variation for different sewing speed, 3000 stitches per minute and 4000 spm and different fabrics.



a) b)

Figure 3: Tension variation in stitch forming cycle with different sewing speed: a) 3000spm and b) 4000spm of fabrics C21YL and C21YH

At both speeds, the thread tension of fabric C21YH is higher than thread tension of fabric C21YL. The difference is most expressed at the tension picks where sample C21YH obtains tension of 225cN and C21YL 190.5cN for speed of 3000spm. Also, this fabric shows the higher thread tension of 270.7cN compared to the 236.8cN of the fabric C21YL at the speed of 4000spm.
This can be explained by the fact that the fabric C21YH has double ply weft yarn of higher count, greater thickness and higher weight (see Table 1) in relative to the fabric C21YL.

Figure 4 shows thread tension achieved for both fabrics at speeds of 3000spm 4000spm. Comparison of thread tension at various speeds shows notably higher thread tension registered for both fabrics at 4000spm compared to thread tension at 3000spm. So thread tension for both fabric increases with increasing machine speed.

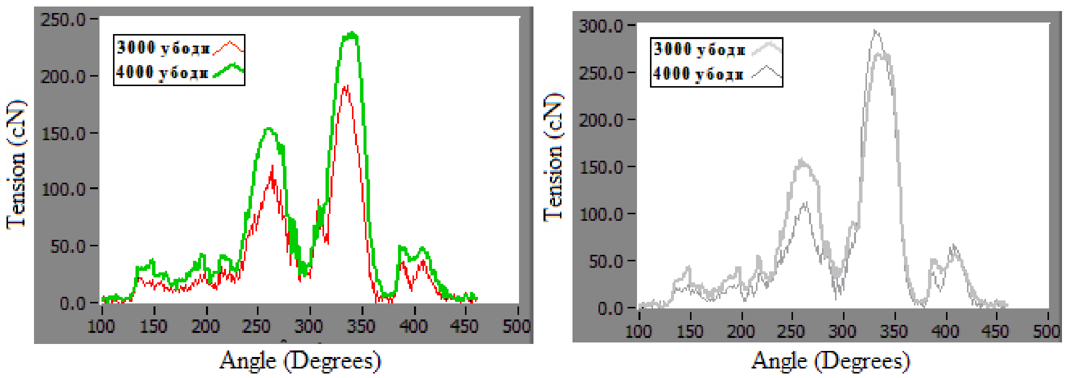


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Figure 4: Tension variation in stitch forming cycle with different sewing speed 3000spm and 4000spm for fabric a) C21YL and b) C21YH

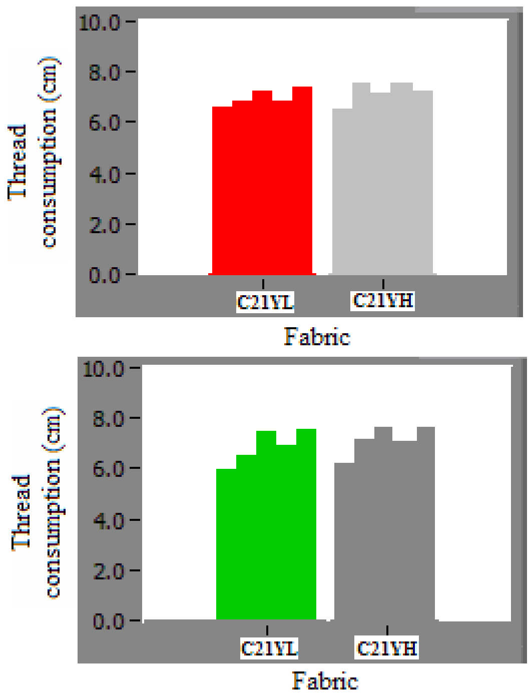

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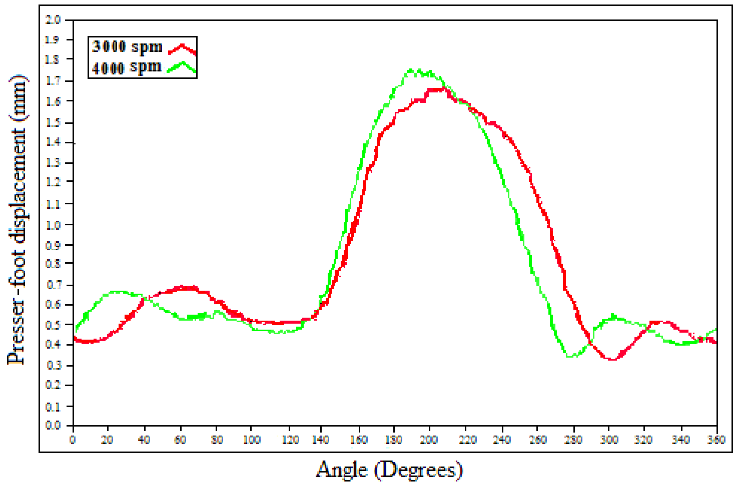
Figure 5. represent the results of thread consumption variation at sewing speeds of 3000 and 4000 spm for both fabrics respectively.

Sewing thread consumption of 5 experiments for fabric investigated showed slightly higher consumption for the fabric with double ply weft yarn of higher count, greater thickness and weight.

3.2. Effect of different sewing speed and material variation in presser-foot displacement

In a stitch forming cycle, at the beginning, the feed dog is at the throat plate level at approximately 80 degrees, then follows rising movement and the feed dog reach its maximum position at around 160 degrees. At approximately 260 degrees on its descending movement it is again at the throat plate level. During almost half period of the stitch cycle, fabric feeding occurs and during the other half, the stitch is formed. Therefore, a stitch cycle corresponds to a rotation of 360 degrees of the sewing machine main shaft. The beginning of the cycle (0 degrees) is marked when the needle is on its lowest position, after fabric penetration by the needle.
Figure 6 shows the presser foot bar displacement obtained for two plies seam for both investigated fabrics at various machine speeds.



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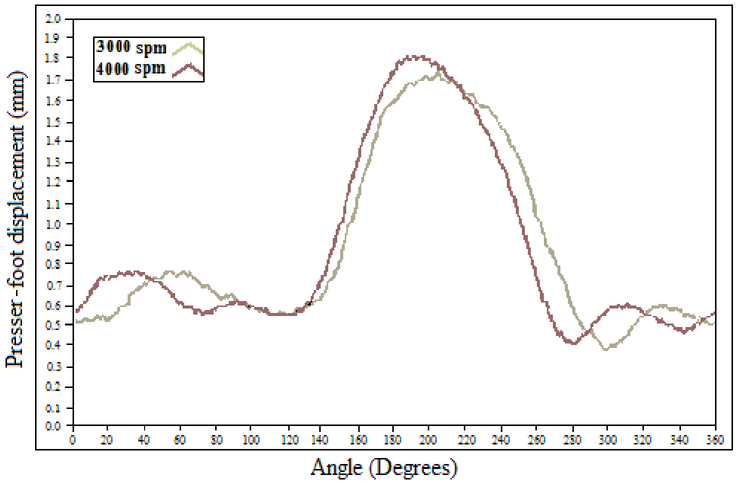

b)

Figure 6: Presser foot bar displacement obtained with the different fabrics at different speed, a) C21YL and b) C21YH fabric

From diagrams (fig.6) can see that the speed of 3000spm, fabrics has smaller presser foot displacement, C21YL have 1.664mm and C21YH has 1.704mm. While the speed of 4000spm has a greater displacement in fabric C21YL is 1.741mm and C21YH is 1.785mm. It can conclude that the presser bar displacement increases with machine speed.

4. Conclusion

The results of monitoring sewing machine parameters showed that sewing speed and material structure variations can affect needle thread tension, thread consumption and presser foot displacement.
Investigations showed that thread needle tension and the presser bar displacement increase with increasing the machine speed.
Monitoring the sewing machine parameters can be important tool in controlling fabric sewing behaviour.
For all machine's subfunctions, it is possible to obtain quantitative information which can be of benefit in monitoring seam quality and localizing and preventing sewing defects.

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RESEARCH ON WOMAN'S DRESS FITTING DESIGNED FROM DIFFERENT CONSTRUCTION SYSTEMS

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Abstract: *The paper gives the comparison of basic patterns and the appearance of woman's dresses made to measure a test person of German, Italian, English and American pattern making system.*
The comparison is presented by means of unmodelled basic patterns of woman's dress according to each individual pattern making system and photographs obtained by making unmodelled woman's dresses made to measure a test person of each particular pattern making system. Methods of body measurements, calculations of proportional measures and pattern making of basic woman's dress for each particular pattern making system are given.

Key words: pattern making system, clothing construction, basic pattern, woman's dress, body measures.

1. Introduction

In the past, clothing patterns were valuable and therefore a carefully hedged asset of each tailor. Their characteristics were passed orally from master to apprentice. Since the earliest, on the paper printed patterns had passed almost 500 years. Among the earliest known editions, it is possible to find works such as ―Spanish tailor's books” (1589) and ―Libro de Geometria Practica y Traca« (1618). In those works it is possible to find descriptions of the use of the material during tailoring and the patterns are displayed as a plot on the fabric of different widths. Detailed instructions for pattern constructing are displayed for the fist time in the book Descriptions des Arts et Métiers – Faites ou Approuvées Par Messieurs de I' Académie Royale des Science (1769). New scientific methods of measuring the human body were based on the human anatomy and caused the creation of the new methods of the construction of the patterns. To this date, different pattern construction systems have been developed with aim to the best possible fit of both basic patterns as well as design patterns.

2. Theory

The construction of the basic pattern and its modelling comprise those processes that are needed for the production of the pattern parts for the clothes production processes. During the patternmaking we face two actions: construction and modelling. The construction of the pattern marks the method of basic pattern construction, while the modelling of the pattern marks the process of transformation of the basic patterns by cutting and spreading and by transforming of darts.

For a successful creation of the basic pattern, regardless of the constructional system, the principal condition is the knowledge of the body measurements. Measurements that are needed for the basic patterns construction can be found on the measurement charts (typical for the patterns in the garment production companies), but they can also be measured on the person for which the clothes are being made (made to measure). Construction of the basic patterns in garment companies is nowadays based on the measures of the average person, who has average measurements of the chosen part of the population and an upright posture. Those measurements are obtained by anthropometric measurements of the population and are statistically treated.

The construction of the basic patterns distinguishes the principal body measurements (height, bust, waist and hip girth) and auxiliary dimensions (e.g. armhole depth, armhole width, etc.). Those measurements can be obtained in two ways:

- with measuring of all the measurements (principal and auxiliary),
- with calculating based on the measured principal body measurements (mostly bust girth) with the help of formulas, which depend on the constructional system.

Body height, bust, waist and hip girth are those measurements that are needed for the construction of the basic pattern of the woman dress in all of the constructional systems. Auxiliary measurement can be different.

In this contribution four pattern construction systems for construction of the woman dress basic pattern will be presented:

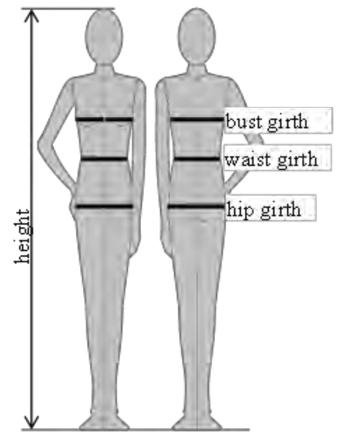
- German system of construction System M. Müller & Sohn Schnittkonstruktionen für Kleider und Blusen (M. Müller & Sohn, 1992) – *System 1*
- German system of construction, presented in the book Systemschnitt 1, Modeschnitte für Röcke, Blusen, Hemden, Kleider, Jacken, Hosen, written by Jutte Jansen in Claire Rüdiger (Jansen J., Rudiger C., 1994) – *System 2*
- Italian system of construction, presented in the book Il modellismo, written by Fernando Burgo (Burgo F., 1998) – *System 3*
- English system of construction, presented in the book Metric pattern cutting, written by Winifred Aldrich (Aldrich W., 2002) – *System 4*

Basic patterns in this study are constructed according to the rules of construction of selected construction systems and with use of equal body measurements. The basic patterns were constructed with strict instructions in order to avoid the influence of experience.

3. Experimental

3.1 Body measurements

Figure 1: Measurement point of the height, bust, waist and hip girth.



The majority of measures, needed for the construction of basic pattern for woman dress are similar. The measurements of the height, bust, waist and hip girth are preformed in the same way in all researched pattern constructing systems (Figure 1).

Differences appear during the measuring of the length and width on the back side of the body, and are needed for the construction of the basic pattern (Figure2). The distance from the nape to the armhole depth is, in the System 1 and 2, measured or calculated from the bust girth, and in the System 3 calculated

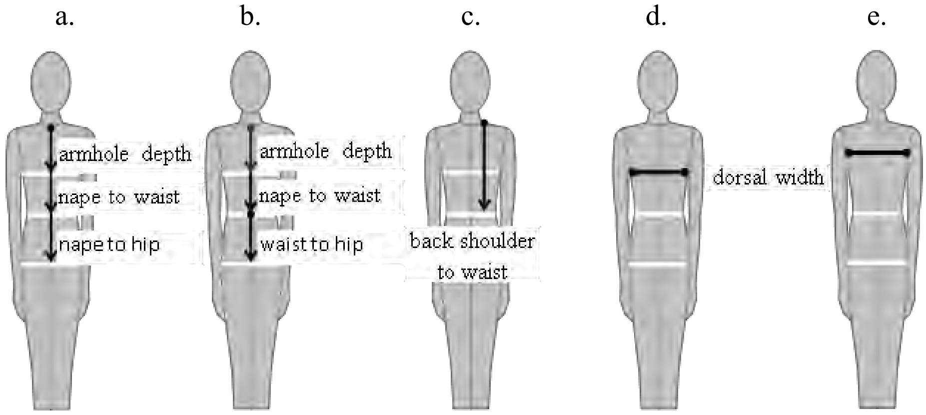


Figure 2: Measurements at the back side of the body a. armhole depth, nape to waist, nape to hips (Systems 1), b. armhole depth, nape to waist, waist to hips (System 2 and 3), c. back shoulder to waist hips (Systems 4), d. dorsal width (System 1), e. dorsal width (System 4)

from the chest girth. In the System 4, the distance is measured. Similarly is for the dorsal

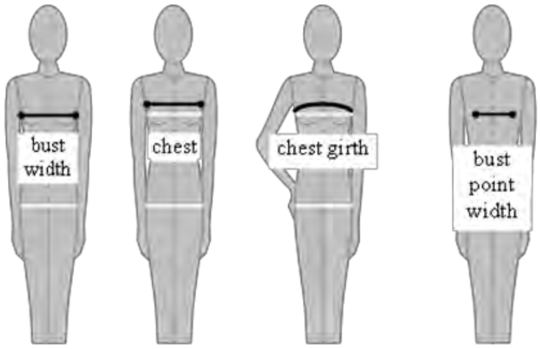


Figure 3: Measurement site at the front of the body a. bust width (System1), b. chest (System 3), c. chest girth (System 4), d. bust point width (System 3)

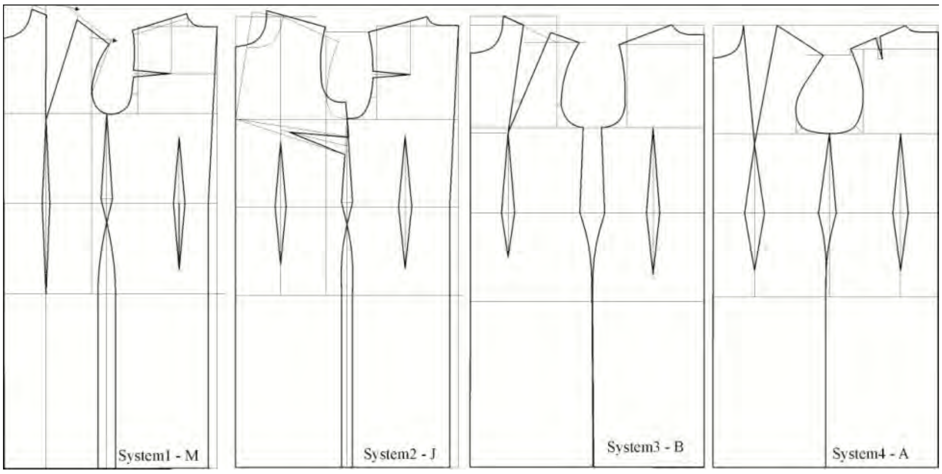
length. System 1 measures the distance from the nape to waist or calculates from the height, in the System 2 and 4, the distance is measured from the nape to waist. System 3 measures the distance between the neck (on the shoulder line) and waist. The distance from the nape and hip depth is measured by the System 1, Systems 2 and 3 are measuring the distance between waist and hip. In System 4, this distance measures between 18 and 20 cm. Dorsal width on the bust line width is measured by the System 1, System 4 measures it approximately 15 cm below the nape, while Systems 2 and 3 don't measure it at all.
On the front side of the body, the measurement can be different because of the differences in pattern construction Systems (Figure 3). For the bust width, the System 1 measures the distance between both hands across the breast, or calculates it from the bust girth. System 3 measures the chest, System 4 measures chest girth, System 2 doesn't measure at all. System 3 also measures the bust point width.

The differences appear during the measurement of the shoulder width, neck width etc. Systems 1 and 2 obtain some of auxiliary measurement from the measurement for the bust girth and height. The neck with can also be calculated from the measurement for the bust girth or neck size.

3.2 The constructions of the basic patterns

All studied systems firstly construct the back and then the front side of the basic pattern. Systems 1 and 2 are constructing from right to left, Systems 3 and 4 are constructing from left to right. Since the course of the construction doesn't affect the shape of the pattern, are all basic patterns presented on the figure 4 placed in the same way: the front part on the left side and the back part on the right side.

At the beginning of the construction, it is mandatory to draw a vertical line, which represents the centre back line. Afterwards, the position of the bust, waist and hip line need to be established and then the centre front line is determined. The basic pattern of a close fitting dress must fit the body across the bust. Measurements of dorsal, armhole and bust width have an influence on this part of the basic pattern. Armhole depth has an indirect influence on this distance.



a. b. c. d.

Figure 4: Construction of woman's dress basic pattern a. System 1, b. System 2, c. System 3, d. System 4

The Table 1 represents the methods of the acquisition of those measurements in the studied pattern construction systems and the differences among them.

It is mandatory to point out, that the basic patterns are constructed with equal principal measurements, which were measured on a test person. Considering the system of construction, the auxiliary measurement were calculated or measured. All basic patterns are constructed as close fitting.

Table 1: Calculated measures for armhole depth, back width and front (bust) width for woman's dress basic pattern construction

	Height: 164 cm	Bust girth: 92 cm	Waist girth: 77 cm	Hip girth: 98 cm
	Armhole depth	The length of the bust line (centre back –centre front)	Back width	Front (bust) width
System 1	1/10 bust girth + 10,5cm + ease	1/2 bust girth + ease	1/8 bust girth +5,5cm + ease	1/4 bust girth – 4 cm + ease
	20,2 cm	48 cm	17,5 cm	20 cm
System 2	1/10 bust girth +12cm	1/2 bust girth +3,5cm	1/8 bust girth + 6 cm	1/4 bust girth – 2,5 cm
	21,2 cm	49,5 cm	17,5 cm	20,5 cm
System 3	1/4 chest girth + 1 cm	1/4 bust girth –1 +ease + 1/4 bust girth + 1 + ease	1/2 of measured dorsal width	1/12 measured chest girth + 1/8 measured chest girth + 1 cm
	23,25 cm	49 cm	17,5 cm	11,95 cm
System 4	measured + 0,5 cm	1/2 bust girth + 5 cm	1/2 of measured half back width + 0,5 cm	1/2 chest measured + 1/2 dart width (from Standard Body Measurements (Aldrich W., 2002))
	23 cm	51 cm	17 cm	15,2 cm

Differences between the dimensions are the result of different methods of calculation. In the majority of measurement that are used for construction of the basic patterns, deviations occur regularly.

An important element of the basic pattern is dart. Its width is, in all the systems, fixed in a different way. On the Figure 3, it is seen on which part individual system determine the dart width. The measure for the dart width is, in the System 1 and 2, calculated (1/20 bust girth), System 3 measures 2 cm, while the measure is already given in the Body Measurements Table (Aldrich W., 2002) for the System 4 and depends on the bust girth.

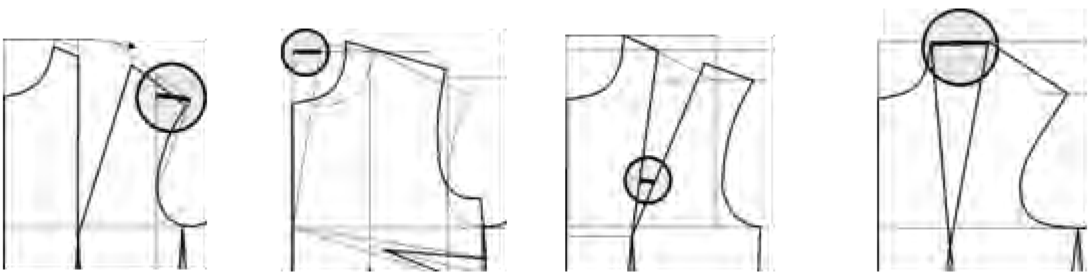


Figure 4: Position of dart measurement in a. System 1, b. System 2, c. System 3, d. System 4

All basic patterns have been constructed on the Optitex CAD pattern design system and sewn from the same material.

4. Results - comparison of the dresses according to the researched pattern construction systems

The comparison between basic constructions is shown on the test person, whose measures were used during the construction. The comparison of front and back sides of the basic pattern of the dress are shown on the figures 5 and 6, both of them are constructed according to the rules dictated by the construction systems.

Figure 5: Front side of the basic pattern: a. System 1, b. System 2, c. System 3, d. System 4

The comparison of the front parts shows that:
- Neck line fits the neck better in the Systems 1 and 4, in the Systems 2 and 3 it is too wide.
- The length of the shoulder part is fitting in the Systems 1 and 3, in the System 2 it is too long, in the System 4 it is too short.
- Armholes of the Systems 1 and 3 are better than those of the Systems 2 and 4.
- The upper part of the dress is too tight in the System 1 and too wide in the Systems 2, 3 and 4.
- The length of chest dart (bust point) is too short in the Systems 1, 3 and 4 and in the System 2, the length is appropriate.
- The waist part of dress is in all four systems too wide.
- The distance between the waist darts is fitting in the System 1; in the System 2 it is too big and too small in the Systems 3 and 4.
- In the hip part the dress fits the hip‘s shape only in the System 1; in all other systems it is too wide.

Figure 5: Front side of the basic pattern: a. System 1, b. System 2, c. System 3, d. System 4

5. Conclusion

The research will show that none of the construction systems gives entirely satisfactory answers. In the process of the construction of the basic pattern (and farther modelling) the past experiences of the patternmaker play one of the most important roles. Correctly measured body measures and the knowledge of the body shape of the individual are also crucial. In the construction of the basic pattern, it is very important also the addition for the ease. It had an influence on the width in the part of the bust, waist and hips. The width, the position and the form of the darts in the waist part are also very important and depends on the body shape.

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STRUCTURAL MULTI-LAYERED COMPOSITE TEXTILES MATERIALS

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Abstract*: Some general features and advantages of composite materials and their application are described. Emphasis is put on composite materials of partial or complete textile structures. Due to the specific use of structural multi-layered composite materials their mechanical and physical properties will be investigated. Materials intended for use as seat covers in motor vehicles will be investigated. Different raw materials and thicknesses of composite materials with either fabric or artificial leather on the face side will be investigated.*
According to the results obtained it can be claimed that abrasion resistance and braking forces are the highest in the composites with artificial leather on the the face side, while the modulus of elasticity is higher with fabric on the face side. It can be maintained that multilayered textile composites with artificial leather are more durable, but there is a possibility of baggy appearance in the place of a higher and longer load in comparison to the composites with fabric on the face side.

Key words: structural multi-layered composite materials, seat covers in motor vehicles, abrasion resistance, modulus of elasticity, braking forces.

1. Introduction

Due to extremely high friction and stress on the sitting areas deformations of car seat covers occur after some time. To reduce deformations, materials with high strength, abrasion resistance, and high modulus of elasticity should be used; at the same time they should be comfortable, soft and elastic. Despite the development of various new materials standard one-layered textile materials do not possess these properties simultaneously. This is the reason why they are replaced with multi-layered textile composite materials consisting of two or more surface materials, mostly of different materials. The goal is that the car seat cover retains its dimensions as long as possible, without visible deformations, and that this state lasts for the whole car life cycle. All components contained in the finished product affect the properties of multi-layered composites. The portion of each individual component may be different, which allows obtaining composites with targeted properties for predefined use. For the motor vehicle interior textile materials are mostly used on the face and the back side, while the inner layer is usually made of polyurethane foam. Due to material stress during sitting there is a gradual loss of elasticity of material.
After some time the one-layered material completely loses elasticity and stretches irrevocably as long as necessary, ie, as much as the seat construction allows. The emergence of the baggy appearance of the cover depends on strength, elasticity of material, size and application of force, weather conditions, material isotropy etc. Ergonomic car seat design, constructional seat cover form, place, position and type of the seam as well as physical and mechanical material properties affect the deformation of car seat covers [1-4]. The impact of seam and seam type on breaking force, elongation and modulus of elasticity in the warp and weft direction will be investigated.

2. Basic properties of composites in textiles

Composites consist of two or more components shaped into a complex structure in order to achieve specific properties.
They replace the standard materials (woven fabric, knitted fabric, artificial leather, etc.) whereby they achieve better performances and utility values.
The matrix is a basic material that determines the properties of composites. An addition to the matrix are materials with which the specific properties of composites are achieved. According to the portions of the matrix and additions, their shapes, sizes and mutual relations the property and the purpose of the composite is determined.

Characteristics of the composites with fabric depend greatly on weave, warp and weft density, yarn fineness and direction angle at which the load acts in relation to the warp and weft direction. Characteristics of the composites with artificial leather on the face side depend on raw material and physical-mechanical properties. By effects of external forces on the composite the internal cohesion forces resist more in the warp direction (longitudinal direction) in relation to the weft direction (transverse direction). Relaxation of internal forces in the state of stress starts earlier if the force acts under a specific ankle in relation to the longitudinal and transverse direction of the composite. This phenomenon defines the anisotropy of composites. Stress is expressed as the ratio of internal forces acting on the area unit of the sample [5-10].
When cutting the car seat cover, the general rule is to arrange the material in such a way that the longitudinal and transverse direction are the directions of the highest stresses. The position of the seam also affects the deformation intensity of the car seat cover. Unfortunately, it is impossible to obtain a car seat cover in one piece and to avoid seams. The seams are mostly found in bending places or just in the places where the stresses are the highest resulting in an even higher material deformation. The change of properties and the appearance of the material in the seam zones affect the life cycle of the car seat cover to a great extent. Therefore, it is necessary to determine the modulus of elasticity of these materials in the seamless and seamed places and to find the optimal seam. Degree of elasticity or Young's modulus of elasticity is expressed according to the following equation:

$$E = \frac{\sigma}{\varepsilon} = \frac{\frac{F}{S_0}}{\frac{\Delta l}{l_0}} = \frac{F \times l_0}{S_0 \times \Delta l} \qquad \left(N / mm^2\right)$$

where:

E - modulus of elasticity (N/mm^2),
σ - stress (N/mm^2),
F - breaking force (N),
ε - elongation at break (%),
Δl - elongation at break (mm),
l_0 - initial sample length (mm),
S_0 - transverse sample surface area (mm^2),
α - angle between Hooke's straight line and abscissa.

3. Experimental

Physical-mechanical properties of multi-layered materials with woven fabric, polyurethane and knitted fabric components were investigated. The raw material composition of the woven components is 100% polyester, and they are on the face side of the composite material and have different weaves. The samples with artificial leatehr differ only in the composite thickness or the thickness of artificial leather. Woven fabric and artificial leather are reinforced on the face side with polyurethane sponge and knitted fabric making a multi-layered product intended for making basic car seat covers. The samples differ only in fabric type and artificial leather thickness. The first fabric sample was woven in twill weave K2/2D, the second sample was woven in the combination of plain weave and rep weave forming cross stripes of the fabric, the third sample has a thicker artificial leather, while the fourth sample has a thinner artificial leather. The central layer has the same thickness in all samples, and it is polyurethane sponge. The knitted fabric of the same properties lies on the back.

Table 1. Basic parameters of multi-layered composites.

ted parameters and standards		Multi-layered composites			
		Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
		Fabric on the face		Artificial leather on the face	
Fabric density (threads /1 cm) ISO 7211	Warp	40 threads/1 cm	34 threads/1 cm	-	-
	Weft	17 threads/1 cm	26 threads/1 cm	-	-
	Back side of knitted fabric (wales/courses) stiches/1 cm	Dh= 9 Dv= 8			
Yarn count (tex) ISO 2060	Warp	40. 3 tex	42.8 tex	-	-
	Weft	Grey: 45 tex Black: 248.8 tex	37,4 tex	-	-
	Knitted fabric	20 tex			
Raw material composition	Upper comonent of the composite (fabric or artificial leather)	Woven fabric 100% polyester		Artificial leather	
	Component in the middle of the composite (sponge)	expanded polyurethane (PU)			
	Component in the middle of the composite (knitted fabric)	Plain single jersey			
Mass per unit area (g/m^2) ISO 3801		533	376	1054	749
Sample thickness ISO 5084 (woven fabric/ artificial leather + PU + knitted fabric) (mm)		2,27 (0,86+1,16 +0,25)	1,87 (0,46+1,16+ 0,25)	2,56 (1,15+1, 16+0,25)	2,14 (0,

					73 +1, 16 +0, 25)
Ball bursting strength, ASTM D 3787	F (N)	1606	1690	880	370
	ε (%)	37,3	26	29,3	28, 3
Fabric weave		Combination of plain weave and rep weave	Twill weave (K 3/2 D)		
Sewing thread		Fineness: Tt= 60×3 tex, raw material composition: 100% polyester, twist level: 416 turns/m, breaking force: 4852.76 cN, elongation at break: 17.77%			

Abrasion resistance of the samples was tested according to HRN EN ISO 12947-3 standard using the method of the determination of mass loss. The mass was determined on circular samples with a diameter of 38 mm. The samples were subjected to abrasion, and their mass loss was measured after 50,000 and 1000,000 cycles.
Breaking force and elongation at break were tested in the warp (longitudinal) and weft (transverse) direction using the strength tester made by Apparecchi Branca S.A in accordance with ISO 5081 standard. Seamless samples and samples with different seams with a stitch length of 5 mm were tested. To test breaking force and elongation at break, the samples were preapred according to EN ISO 1421:1998 and were stitched with seams No. 1.01.01, 2.02.03 and 4.03.03. The same strength tester was used for ball burst test in accordance with ASTM D 3787.
According to the obtained results and equation 1 the modulus of elasticity was calculated for each sample in the warp and weft direction.

Table 2. Loss of mass and appearance of the material face after abrasion.

Sample designation	Face of the surface material (abraded surface)	No. of the sample	m_0 (g)	m_{50000}		m_{100000}		After 100,000 abrasion cycles	
				m (g)	CV (%)	m (g)	CV (%)	Sample appearance	**Commentary**
I	Woven fabric	1	0.6597	0.6549	0.73	0.6424	2.62		After 100,000 cycles the sample surface is considerably worn which is the reason why the sample changed its colour.
		2	0.6605	0.6580	0.38	0.6450	2.35		
		3	0.6483	0.6458	0.39	0.6348	2.08		
		X	0.6562	0.6537	0.50	0.6407	2.35		

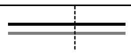
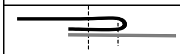
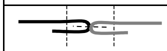
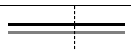
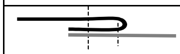
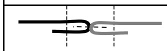
		CV	1.0399	1.1211	39.85	0.8272	11.26		
II	Woven fabric	1	0.4710	0.4688	0.47	0.4626	1.78		After 100,000 cycles the sample surface has hairy and brighter appearance with sporadic penetrations of the middle layer (PU)
		2	0.4744	0.4697	0.99	0.4604	2.95		
		3	0.4658	0.4623	0.75	0.4555	2.21		
		X	0.4501	0.4669	0.74	0.4595	2.31		
		CV	7.7686	0.8648	35.33	0.0791	25.58		
III	Leather	1	1.3226	1.3177	0.37	1.3121	0.79		After 100,000 cycles the sample is darker and shinier on the abraded place.
		2	1.3296	1.3271	0.19	1.3218	0.59		
		3	1.3164	1.3111	0.40	1.3091	0.55		

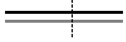
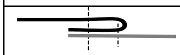
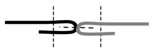
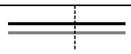
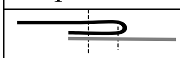
		X	1.3229	1.3166	0.32	1.3145	0.64		
		CV	0.4992	0.6888	35.49	0.5032	19.99		
IV	Leather	1	0.9195	0.9184	0.12	0.9154	0.45		After 100,000 cycles the sample is darker and shinier on the abraded place.
		2	0.9251	0.9224	0.29	0.9188	0.68		
		3	0.9118	0.9103	0.16	0.9077	0.45		
		X	0.9188	0.9170	0.19	0.9140	0.53		
		CV	0.7268	0.6723	46.78	0.6222	25.21		

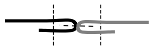
m_0= initial mass of the sample; m_{50000}= sample mass after 50,000 cycles; m_{100000}=sample mass after 100,000 cycles, X - mean value of mass (g), CV - coefficient of variation (%)

Table 3. Breaking force and elongation at break

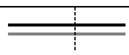
Sample		Breaking force (N)		Elongation at break (%)	
		In the warp direction	In the weft direction	In the warp direction	In the weft direction

			F_1 (N)	CV_1 (%)	F_2 (N)	CV_2 (%)	ε_1 (%)	CV_3 (%)	ε_2 (%)	CV_4 (%)
Sample 1	Seamless		2135	14.6	1210	13.2	31.7	10.6	24.9	14.2
	Seamed	 No. 1.01.01	605	12.5	540	13.7	19.4	8.5	20	12.6
		 No. 2.02.03	1005	16.3	920	13.8	23.8	12.9	27.9	13.7
		 No. 4.03.03	680	14.4	670	14.4	20.8	11.0	19.9	13.3
Sample 2	Seamless		1665	10.3	760	10.8	33.8	13.6	20.6	14.7
	Seamed	 No. 1.01.01	560	14.2	540	12.6	16.7	13.9	20.9	13.9
		 No. 2.02.03	950	16.0	765	14.6	23.5	14.2	23.8	14.4
		 No. 4.03.03	595	13.2	510	13.8	18.9	16.3	16.3	13.8
Sampl	Bez šava		715	11.4	480	11.3	39.4	11.9	52.5	12.4

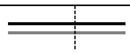
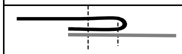
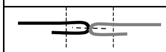
e 3 artificial leather thick sponge knitted fabric	Seamed	 No. 1.01.01	635	10.3	408	10.8	38.1	13.9	46.7	11.3
		 No. 2.02.03	605	13.2	390	15.1	36.9	10.6	45.9	14.8
		 No. 4.03.03	625	11.8	400	14.6	40.8	9.5	47.1	15.2
Sample 4 artificial leather th	Seamless		340	9.4	285	11.4	52.2	8.6	55.7	10.3
	Seamed	 No. 1.01.01	310	10.2	288	11.8	47.5	11.8	49.9	12.2
		 No. 2.02.03	285	14.4	250	13.9	40.6	14.4	46.6	15.3

in sponge knitted fabric patterned		 No. 4.03.03	295	12.3	258	13.0	46.6	10.5	52.7	14.9

F_1 - average value of the breaking force in the warp direction, F_2 - average value of the breaking force in the weft direction, CV_1 - variation coefficient of breaking force in the warp direction, CV_2 - variation coefficient of breaking force in the weft direction, ε_1- elongation at break in the warp direction, ε_2- elongation at break in the weft direction, CV_3 -variation coefficient of elongation at break in the warp direction, CV_4 - variation coefficient of elongation at break in the weft direction

Sample	Seam types		S_0 (mm^2)	In the warp direction		In the weft direction	
				Δl_1 (mm)	E_1 (N/mm^2)	Δl_2 (mm)	E_2 (N/mm^2)
Sample 1	Seamless		113,5	63.4	59,34	49.8	42,8
	Seame	 No. 1.01.01		38.8	27,5	40,0	23,8

	d	No. 2.02.03		47.6	37,2	55,8	29,1
		No. 4.03.03		41.6	28,8	39,8	29,7
Sample 2	Seamless		93,5	67.6	52,7	41.2	39,5
	Seamed	No. 1.01.01		33.4	35,9	41,8	27,6
		No. 2.02.03		47.0	43,2	47,6	34,4
		No. 4.03.03		37.8	33,7	32,6	33,5
Sample 3	Seamless		128	78.8	14,2	105.0	7,4
	Seamed	No. 1.01.01		73.8	13,4	93,4	6,8
		No. 2.02.03		77.8	12,2	91,8	6,6
		No. 4.03.03		81.6	12,0	94,2	6,6

Sample 4	Seamless		107	104.4	6,1	111.4	4,8
	Seamed	 No. 1.01.01		95.0	6,1	99,8	5,4
		 No. 2.02.03		81.2	6,6	93,2	5,0
		 No. 4.03.03		93.2	5,9	105,4	4,6

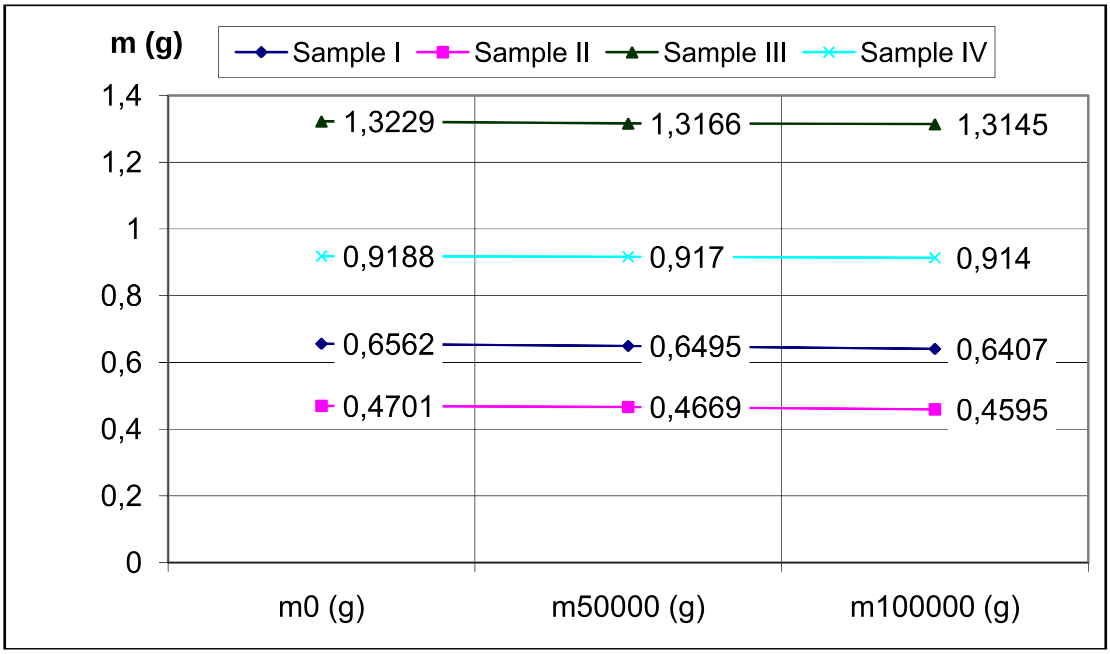


Figure 1. *Loss of mass caused by abrasion*

m - sample mass (g), m_0 - sample mass before the beginning of abrasion (g), m_{5000} - sample mass after 5,000 cycles of abrasion (g), m_{10000} - sample mass after 10,000 cycles of abrasion (g).

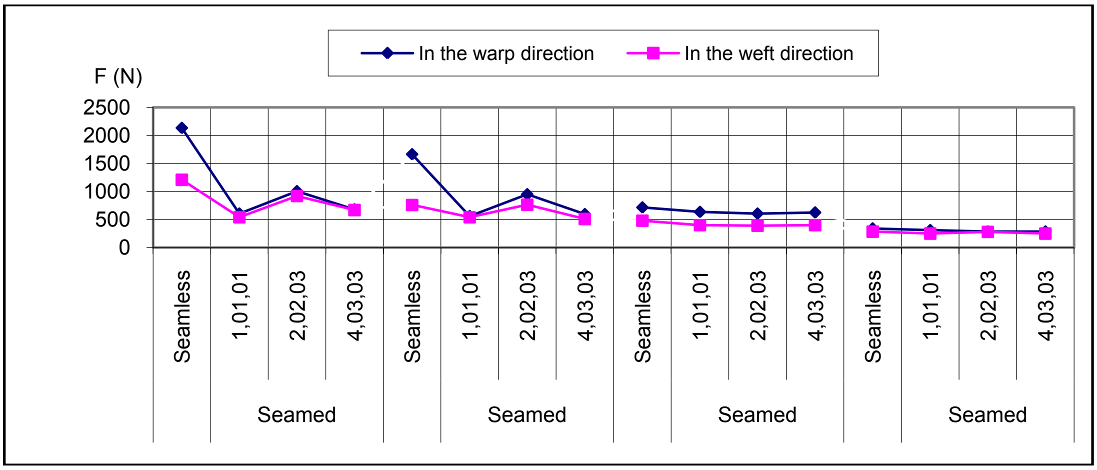


Figure 2. *Breaking force of the sample in the warp (lengthwise) and weft direction (crosswise)*

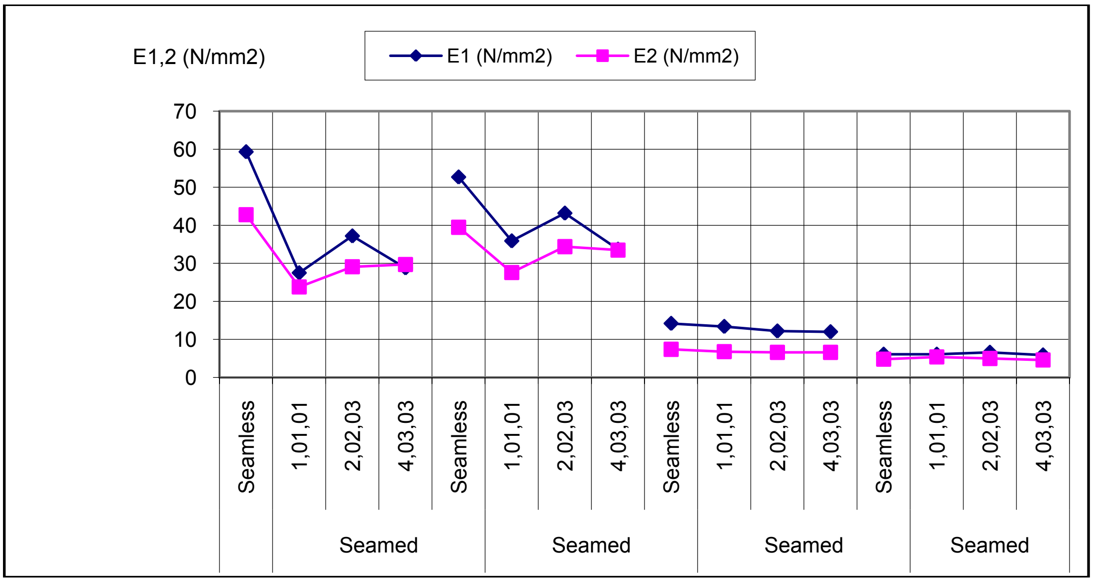


Figure 3. *Modulus of elasticity by samples*
E_1 – Modulus of elasticity in the warp direction (lengthwise) (N/mm^2), E_2 – Modulus of elasticity in the weft direction (crosswise) (N/mm^2)

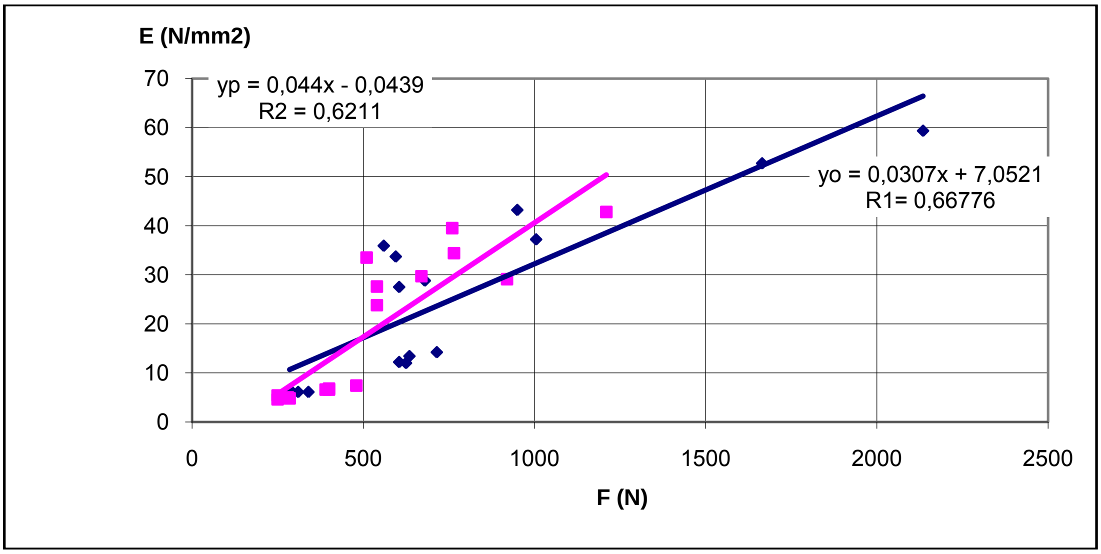


Figure 4. *Correlation coefficients and regression straight lines between breaking force (F) and modulus of elasticity E (N/mm2) in the warp direction*

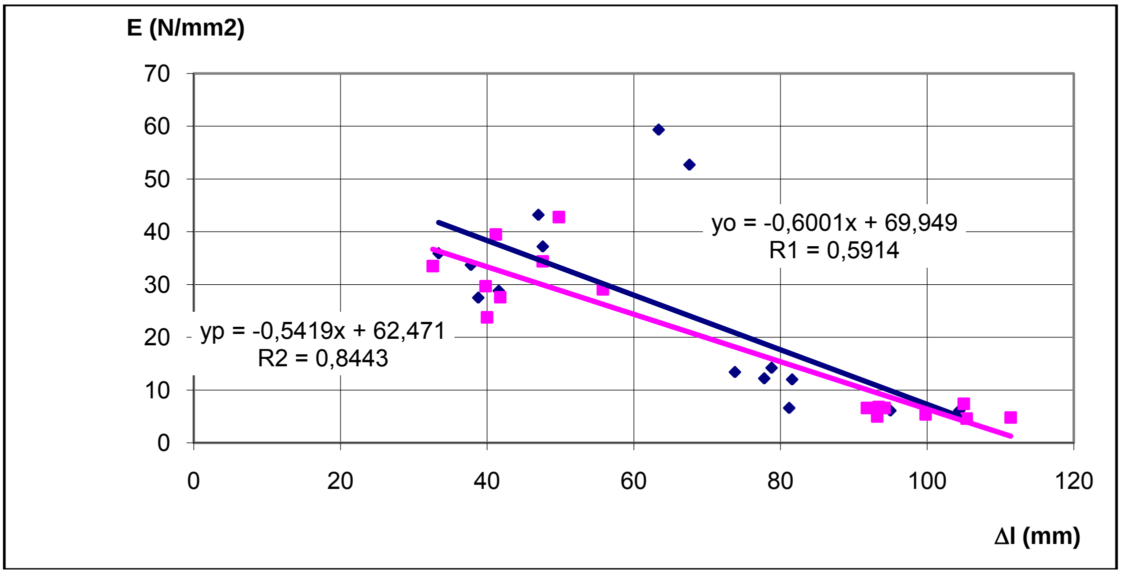


Figure 5. *Correlation coefficients and regression straight lines between modulus of elasticity E (N/mm^2) and elongation at break Δl (mm)*

4. Discussion of results

The results of physical and mechanical investigations of samples 1-4 are shown in Table 1-4 and Figures 1-5. Basic characteristics of composites are shown in Table 1. Samples I and II differ in woven fabric construction parameters. The first sample has a fabric woven in twill weave (K2/2D), while the second sample has a fabric woven in a combination of plain and rep weave. Samples III and IV differ in the upper layer type of the composite or artificial leather as well as in mass per unit area and total thickness. Sample III has the greatest mass per unit area (1054 g/m^2) and thickness (2.56 mm), and sample II has the smallest mass per unit area (376 g/m^2) and thickness (1.87 mm).

In accordance with the test results of ball burst strength (Table 1) the samples with woven fabric on the front side have higher forces (sample I 1606 N, sample II 1690) in contrast to the samples with artificial leather on the front side (sample III 880 N, sample IV 370 N).
Resistance to abrasion is relatively high for all samples, especially for the samples with artificial leather on the fabric face (Table 2, Fig. 1). Despite the difference in construction parameters of fabric samples I and II, their abrasion resistance is approximately equal. The weight loss after 10,000 cycles of abrasion for sample I was 2.35% and 2.31% for sample II. However, it is important to note that sample I after 5,000 cycles had a less weight loss (0.5%) than sample II (0.74%). After the next 5,000 cycles a greater damage of the upper layer and a weight loss was registered in sample II, where the first layer was completely abraded. In the samples with artificial leather on the face the weight loss was significantly lower, indicating a greater abrasion resistance compared to the first two samples with fabric on the face. A mass loss almost twice as great after 5,000 cycles was registered in sample III (0.32%) compared to sample IV (0.19%). After 10,000 cycles sample III still had a higher mass loss (0.64%), but with a smaller difference than in sample IV (0.53%). According to the appearance of samples III and IV after 10,000 abrasion cycles, it is evident that only a superficial part of the rough leather is worn out and the surface has become smooth and achieved a brighter and darker appearance. Thus, it can be claimed that the samples with artificial leather on the face are several times more resistant to abrasion than the samples with fabric on the face.
The breaking forces of the same samples sewn with different types of seams are different (Table 3, Fig. 2). The breaking forces in the warp direction for all seamless samples are greater than the breaking forces for the seamed samples. When comparing samples I and II with fabric on the face, seam no. 2.02.03 has the greatest breaking force, which was to be expected because only theses samples were sewn as a double and triple material layer. In the first two samples seam no. 1.01.01. has the lowest breaking force. In samples III and IV with artificial leather on the face the highest force was registered for seam number 1.01.01, while seam number 2.02.03 had the smallest one which is contrary to the first two samples. This phenomenon can be explained in such a way that joining the samples with artificial leather on the face weakens the seam because of folding; damages can also be caused because of the needle penetration through several layers. Therefore, it can claimed that joining the composite materials with fabric on their face is more appropriate to seam no. 2.02.03, while seam no. 1.01.01 should be avoided. For the composite materials with artificial leather on the face it is more appropriate to use seam no. 1.01.01, while seam no. 2.02.03 is inappropriate.
The breaking force of the sample in the warp direction is also distinguished according to the samples. The seamless samples also have the highest breaking force in almost all the samples. For samples I and II seamed samples with seam no. 2.02.03 have the highest breaking force, as well as in the warp direction. The samples with seam no. 1.01.01 have the lowest breaking force in sample I in the weft direction, while seam no. 4.03.03 has the breaking force in sample II. In samples III and IV the highest force is registered in the weft direction (or in the sample width)) for seam no.1.01.01, while the lowest breaking force is registered for seam no. 2.02.03, as well as in the warp direction or in the sample length.
The values of elongation at break for each sample are different and they mostly follow the course of the breaking force values. The elongation at break for the seamless samples in the warp and weft direction is mostly higher than the elongation at break of seams. In samples I and II the elongation at break is very similar and in the warp direction it ranges from 16.7% to 33.8%, and in the weft direction it ranges from 16.3% to 27.9%. The elongations at break for samples II and IV differ, and sample IV has a higher elongation at break for all seams and without seam in the length and width direction. In the warp direction sample III has an elongation at break ranging from 36.9% to 40.8%, and in the weft direction it ranges from 45.9% to 52.5%. Sample IV has an elongation at break ranging from 40.6% to 52.2% in the warp direction, and it ranges from 46.6% to 55.7% in the weft direction.
Modulus of elasticity is a crucial parameter for composites used for car seat covers. Sitting for long periods the stress of the car seat cover can cause a certain deformation in these places. To reduce deformations, it is necessary to choose the sample having the highest modulus of elasticity. According to the results obtained (Table 4 and Fig. 3) certain differences in the modulus of elasticity for each

sample and in the test directions are observable. Higher breaking force, smaller cross-section of the measured sample and lower breaking elongation give a higher modulus of elasticity (Eq. 1).
The modulus of elasticity in samples I and II is higher in the seamless samples in the warp and weft direction (39.5 – 59.34 N/mm^2) in relation to the seamed samples (23.8 – 43.2 N/mm^2). If the seamed samples are observed, a certain difference can be seen. In samples I and II the highest modulus of elasticity in the warp direction is registered for seam no. 2.95.01 (37.2 and 43.2 N/mm^2, respectively) and the lowest modulus of elasticity was registered for seam no. 1.01.01 (27.5 N/mm^2) in sample I, and for seam no. 4.03.03 (33.7 N/mm^2) in sample II. The modulus of elasticity in the weft direction for samples I and II is lower than in the warp direction. The highest modulus of elasticity was registered for the seamless samples (42.8 and 39.5 N/mm^2, respectively), while seam no. 1.01.01 deviates in the seamed samples where the lowest modulus of elasticity is registered. Samples III and IV with artificial leather on the front side have a considerably lower modulus of elasticity than samples I and II which have woven fabric on the front side. For sample III the modulus of elasticity in the width ranges from 10.4 to 12.3 N/mm^2 and it is almost twice as as high as in the sample width ranging from 5.7 to 6.2 N/mm^2. In sample IV this difference is considerably smaller, but it is still present, ranging from 11.7 to 13.8 N/mm^2 in the sample length, and in the width direction it ranges from 9.6 to 11.3 N/mm^2. According to the analysis of the result of the modulus of elasticity there is a relatively great difference between the samples with woven fabric and with artificial leather and a difference in the test directions of the samples, indicating material anisotropy, especially for the samples with woven fabric.
The regression coefficient between breaking force and elastic modulus in the warp direction is R_1 = 0.66776 and in the weft direction R_2= 0.6211 (Fig. 4). Because of a relatively great difference between samples and their wide scatter in the coordinate system regression coefficients can be considered relatively high. According to the linear regression it can be claimed that the elastic modulus increases by increasing the breaking force of the tested samples.
If elongation at break and modulus of elasticity are correlated, a relatively high correlation coefficient is noticeable, which is R_1 = 0.8443 in the warp direction, and R_2 = 0.5914 in the weft direction (Fig. 5). Due to a smaller scatter of values in the coordinate system, the correlation coefficient in the weft direction is considerably higher. According to the linear regression and the position of straight lines it is possible to claim that the elastic modulus decreases with increasing the elongation at break of the tested samples. The left side of the diagram shows a greater scatter of the values of the elastic modulus and elongation at break (samples with fabric). The right side of the diagram the values are very close and create a second group of values (samples with artificial leather). According to the figure, the elastic modulus of the samples with artificial leather ranges from 5 to 15 N/mm^2, and elongation at break although the elongation at break is relatively high in relation to the woven fabric and ranges from 70 to 110 mm.

5. Conclusion

In this work 4 samples of composites with three diverse materials were tested. The first two composites belong to the same group of composites (woven fabric-polyurethane sponge-knitted fabric) as well as the other two (artificial leather- polyurethane sponge - knitted fabric). The aim of this study was to examine the physical and mechanical properties by the groups and the samples, and the principal task was to investigate the strength and the resistance of the seam on the samples and to draw a conclusion of the results obtained. Resistance to abrasion of samples by mass loss is different. The samples with artificial leather exhibit several times higher resistance to abrasion than the samples with woven fabric. Seams present one of the biggest problems when it comes to durability of composites for a specific use. Seam no. 2.02.03 turned out to be the strongest and most elastic in the samples with woven fabric on the face, while in the same samples seam no. 1.01.01 gave the worst results. In the samples with artificial leather on the face the opposite is the case, seam no. 2.02.03 is the weakest, while seam no. 1.01.01 is the strongest. Thus, it can be concluded that the artificial leather is sensitive to bending and breaking of materials in several layers. When sewing a woven

fabric, a special needle with a rounded tip passes mostly among warp and weft threads and does not damage the fabric as much as the artificial leather.
Modulus of elasticity is one of the essential parameters of materials used for car covers. According to the results obtained the elastic modulus for samples with woven fabric is several times higher than in the samples with artificial leather. Modulus of elasticity is higher in the seamless samples in almost all samples. Differences among the seams mostly follow the course of the breaking force of the corresponding samples. It is important to emphasize that the differences between the warp and weft directions or by the length and width of the sample are higher in the samples with fabrics in comparison to the samples with artificial leather. Thus, the samples with fabric on the face show a higher anisotropy while it is less pronounced in the samples with artificial leather. Modulus of elasticity was calculated according to equation 1 with the included values of breaking force and elongation at break, which varied according to directions.
Because of its relatively high strength, abrasion resistance and ball bursting strength, elasticity, greater possibility of designing, comfort, ability of surface treatment and easy maintenance, the fabric will continue to be used in composites for seat covers, regardless of their anisotropic properties. The disadvantage of such composites is lower lifetime and higher anisotropy in comparison to artificial leather. The composites with artificial leather on the face also have some good features such as multiple higher abrasion resistance and lower anisotropy, respectively. Their disadvantage is low elasticity and risk of the so-called baggy shape and sensitivity on seams, especially seam no. 2.95.01.
The correlation coefficient for linear regression between breaking force and elastic modulus is relatively high and justifies the claim that elastic modulus increases by increasing the breaking force. Also, by bringing the elastic modulus into the linear regression relationship with breaking elongation the coefficient of correlation is relatively high, especially in the weft direction, which justifies the assertion that the elastic modulus decreases by increasing the elongation at break.

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PERACETIC ACID BLEACHING OF BAMBOO FIBERS

Gorkem GEDIK, Ozan AVINC & Arzu YAVAS

Abstract: *Bamboo fiber is a preferred material for textile industry nowadays due to its environmental friendly features and superior daily usage performance. In this study, eco-friendly peracetic acid bleaching is applied to 100% bamboo fabric and optimum bleaching process duration and peracetic acid concentration was investigated. Whiteness, yellowness and strength properties were determined. The bleaching process was carried out at 70°C and neutral pH condition for 30, 45 and 60 minutes with 2.5-10 ml/l peracetic acid concentrations. Also, exhaustion property of bamboo fabric, which exhibited the best whiteness performance, dyed with reactive dye is explored. The highest whiteness (82.4), the highest strength loss (18%) and the lowest yellowness (4.3) on bamboo fiber were observed by bleaching using 10 ml/l peracetic acid for 60 minutes. On the other hand, thirty minutes application of 2.5ml/l peracetic acid resulted in 79.6 whiteness and 6.1 yellowness with the lowest burst strength loss (14%). The latter process can be chosen as preferred peracetic acid bleaching conditions due to its less energy, chemical and time consumption.*

Key words: Peracetic acid, bleaching, bamboo, whiteness, yellowness, strength loss.

Introduction

There are two forms of bamboo fibers for textile uses. First one is the regenerated bamboo fiber which is derived from bamboo pulp via a similar method to viscose. The other one is the natural bamboo fiber. The main consumption of bamboo fibers is in the regenerated form (Liu, L. et. al., Yueping, W. et. al.). Bamboo plant is a very suitable source for organic textiles production since; no agricultural chemicals are required during its growth. Moreover, bamboo fibers are claimed to have superior end-use performance such as microbiocidal, good permeability and moisture absorption, UV blocking, and good handling properties. Also bamboo fiber is suitable for both weaving and knitting processes (Gun, A.D. and Tiber, B.). Bamboo is a cost-efficient material especially for towels and bathrobes due to aforementioned reasons. Since bamboo is a ‗green' material, peracetic acid bleaching, an eco-friendly bleaching method, of bamboo fabric was investigated in this study.

Peracetic acid, which is a strong oxidative due to its high reactivity, is a peroxy compound with two oxygen atoms linked together (Hickman W.S., Prabaharan, M.). The molecular formula of peracetic acid is presented on Figure 1.

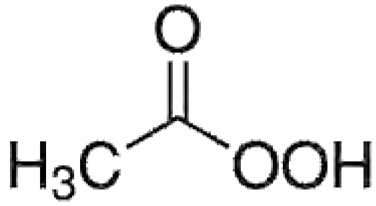

Figure 1 Molecular formula of peracetic acid (http://www.sigmaaldrich.com/technical-service-home/product-catalog.html reviewed on 08/08/2011)

Even hypochlorite has some advantages on processing and bleaching properties of textile materials such as cheapness, leading brilliant whiteness degrees and ease of application, it releases toxic halogenated organic compounds (AOX) in the effluent (Gursoy N. C. and Dayioglu, H). Oppositely with hypochlorite, peracetic acid (PAA) is an environmentally safe bleaching agent since it is decomposed to acetic acid and oxygen which are non toxic and can be tolerated by nature (Karmakar, S.R).

Whiteness is generally an important parameter especially for fabrics which are going to be printed and/or dyed in pale and/or medium shades or used as un-dyed. In this study, bleaching behaviors of peracetic acid on bamboo fibers were investigated. The aim was to bleach an eco-friendly fiber with an eco-friendly method. The optimum process duration and peracetic acid concentration were determined via whiteness, yellowness and bursting strength loss. Moreover, exhaustion property of bamboo fabric, which exhibited the best whiteness performance, dyed with reactive dye is explored.

Experimental

Bleaching

This study used single jersey knitted fabric which is derived from 30 Ne 100% regenerated bamboo fiber spun yarns. Solution of 40% peracetic acid in acetic acid (Sigma Aldrich) is applied to bamboo fabric samples at 2.5, 5 and 10 ml/l concentrations for 30, 45 and 60 minutes with 1/20 liquor ratio. Prabaharan M. *et. al.* stated that optimum bleaching with peracetic acid can be obtained at 50 – 90^{o} C temperature range with pH 7. Therefore, in this study, peracetic acid bleaching was also carried out at 70^{o}C and neutral pH condition (pH 7) using ATAC LAB DYE HT machine. Subsequently to bleaching, samples were cold rinsed for ten minutes and then dried at ambient conditions.

Bursting Strength

The bursting strength of bamboo fabric samples before and after respective bleaching processes was determined using SDL ATLAS M229 PnuBurst digital bursting strength tester. The average value of five bursting strength measurements was reported in kPa unit.

Whiteness and Yellowness Indexes

Following bleaching treatments, the whiteness (Stensby value) and yellowness (E313) of the bamboo fabrics were determined using a DataColor 600 spectrophotometer. Each sample was measured from four different areas, twice on each side of the fabric for consistency, and the average value was calculated.

Dyeing and Exhaustion Yield Determination

The sample with the best whiteness index value was dyed with C.I. Reactive Blue 235 at 2% owf concentration. Dye exhaustion was determined by UV spectrophotometer (Perkin Elmer) which measures the absorbance at the wavelength of maximum absorption (λ_{max}). The dye uptake was calculated by following equation:

$$\%E = ((A_o - A_1)/ A_o) \times 100$$

where, A_o and A_1 are the absorbance values of dye liquors at λ_{max} before and after dyeing operation, respectively.

RESULTS AND DISCUSSION

Effect of peracetic Acid Bleaching on Whiteness Properties

The most suitable peracetic acid bleaching process conditions were determined by varying peracetic acid concentration and process duration considering whiteness and bursting strength performance. Whiteness and yellowness properties of PAA bleached bamboo samples are shown on Tables 1 and 2.

Table 1 Change on whiteness and yellowness properties after different bleaching conditions (peracetic acid concentration and process duration)

Time	Stensby Whiteness Index				E313 Yellowness Index			
	Greige Fabric	Peracetic Acid Concentration			Greige Fabric	Peracetic Acid Concentration		
		2.5 ml/l	5 ml/l	10 ml/l		2.5 ml/l	5 ml/l	10 ml/l
30 minutes	64.7	79.6	80.5	81.1	15.9	6.1	5.6	5.4
45 minutes		82.0	81.5	80.7		4.9	5.2	5.1
60 minutes		80.4	81.6	82.4		5.7	5.2	4.3

Peracetic acid application to bamboo fabric was increased the whiteness up to 27.4% in a comparison with the greige fabric (whiteness value of 64.7). The highest whiteness value (82.4) was achieved by sixty minutes application of 10 ml/l 40% peracetic acid. However, the obtained whiteness values were very close to each other (Table 1). There is 3.5 % difference between the highest (82.4) and the lowest (79.6) whiteness values. Therefore, thirty minutes application of 2.5ml/l peracetic acid (40%) can be chosen as preferred peracetic acid bleaching conditions due to its less energy, chemical and time consumption.

The yellowness index values were in the parallel line with the whiteness results, yellowness was decreased after peracetic acid application (Table 1). Yellowness index of a greige fabric was 15.9 and the lowest yellowness value (4.3) was reached by sixty minutes application of 10 ml/l peracetic acid. As can be seen from Table 1, there is remarkable whiteness and yellowness improvement after bleaching with peracetic acid.

Effect of peracetic acid bleaching on Bursting Strength

Bursting strength properties of peracetic acid bleached bamboo samples are presented on Table 2 and Figure 2.

Table 2 Bursting strength values of peracetic acid bleached bamboo samples

Process duration	Bursting Strength (kPa)			
	Greige Fabric	Peracetic acid concentration		
		2.5 ml/l	5 ml/l	10 ml/l
30 minutes	350.26	300.46	293.82	288.32
45 minutes		301.4	292.7	287.12
60 minutes		299.95	292.15	286.37

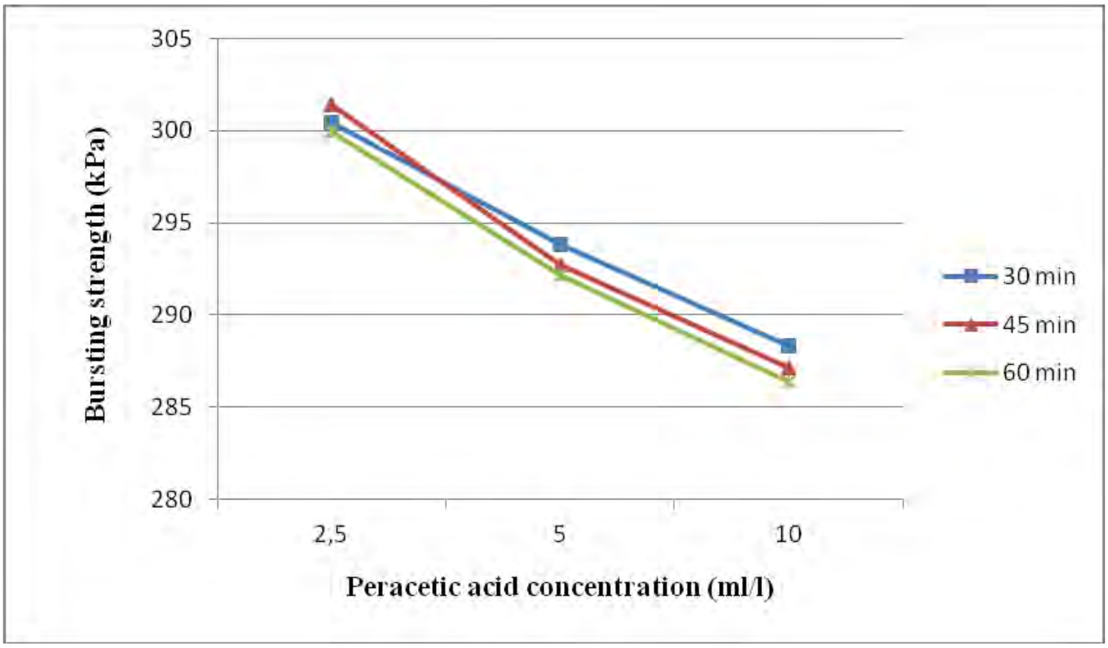

Figure 2 Change of bursting strength according to process time and peracetic acid concentration

A distinct reduction trend was observed (up to 18 %) on bursting strength values especially with the increase on PAA concentration. The worst bursting strength value of 286.37 kPa was obtained by 60 minutes application of 10ml/l PAA. Thirty minutes application of 2.5ml/l peracetic acid (40%) resulted in 14% reduction on bursting strength. Bursting strength values were very close to each other for the same concentration of peracetic acid used (Table 2, Figure 2). This fact was showed that peracetic acid concentration is more effective on strength properties of bamboo fiber than the process duration.

Dye Exhaustion in Reactive Dyeing

The sample which was bleached with 10 ml/l PAA concentration for sixty minutes was dyed with C.I. Reactive Blue 235 (Novacron Blue FNR) according to the process recommended by dye producer (Huntsman). After the measurements of absorbances at λ_{max} before and after dyeing, quite high dye exhaustion was observed by 97%.

Conclusion

The whiteness, yellowness and burst strength of greige bamboo fiber were 64.7, 15.9, and 350.26, respectively. The highest whiteness (82.4), the highest strength loss (18%) and the lowest yellowness (4.3) on bamboo fiber were observed by bleaching using 10 ml/l peracetic acid for 60 minutes. However, the obtained whiteness and yellowness values were very close to each other. Thirty minutes application of 2.5ml/l peracetic acid (40%) resulted in 79.6 whiteness and 6.1 yellowness with the lowest burst strength loss (14%). Therefore, 30 minutes application of 2.5 ml/l PAA can be recommended as a more economical and ecological alternative. Bleached bamboo fabric exhibited very good exhaustion yield with 97%.

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ASPECTS REGARDING ANTIMICROBIAL BEHAVIOR OF THE TEXTILE PRODUCTS CONTAINING AMICOR FIBERS

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Abstract: *The bioactive textiles are favourably assessed by the consumers who are willing to extra - pay for products that will protect their bodies against the microbe, fungus, Acarian aggression – which can induce the appearance of allergies, skin affections or neurological disorders. The clothing products accomplished of Amicor fibres preserve their antimicrobial effect after numerous washings (about 200), unlike the polymer – covered textile products that contain antimicrobial agents, retaining their antimicrobial effect after only several washings. The main objective of the research was the achieving of performant technologies and products having an ecologic impact over the environment and the human body, the promoting of the usage of raw materials that possess superior hygienic – functional characteristics, as well as antibacterial and antiallergic properties. As part of the present study, the antimicrobial activity of the Amicor fibres, the hose samples made of 60% Amicor fibres/40% cotton fibres, 65% wool fibres/35% Amicor fibres, as well as of the woven fabrics made of 60% Amicor fibres/40% cotton fibres was tested by the Kirby – Bauer method. The effected tests revealed the fact that the Amicor fibre samples and the textile products (hoses, knits and woven fabrics) presented an antibacterial activity as against the test microbes Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa. Finally, both the performances of the hygienic – functional characteristics of the accomplished textile products, and the positive impact over the environment were attained owing to the Amicor fibres and by means of the employed enzymatic finishing technologies.*

Key words: Amicor fibres, bioactive textiles, enzymatic finishing technologies.

1. Introduction

The textile products that are in contact with the skin absorb a large quantity of perspiration, and they become an environment that is favourable to bacterium proliferation, decomposing the perspiration at the same time with releasing certain unpleasant odours. Under these circumstances, there may appear problems associated with not only decolourizing and reducing the textile material resistance, but also with life environment problems.

The Amicor fibres are acrylic antimicrobial ones, with encapsulated antimicrobial agents, such as triclosan, and they prevent the bacterium developing and keep the body under hygienic conditions for a longer time, eliminating the possibility of unpleasant odour creating, freshening and facilitating the skin breathing. The triclosan capsules continuously migrate towards the capsule exterior, up to exhaustion, accomplishing thus a protection zone on the surface.

The clothing products made of Amicor fibres preserve their antimicrobial effect after numerous washings (about 200), as different from the textile products that are covered with polymers containing antimicrobial agents and preserve their antimicrobial effect after only several washings. For the present study Amicor fibres from Acordis Company in Great Britain have been used.

The main research objective resided in accomplishing advanced technologies and products having an ecologic impact over the environment and the human body, the promotion of using raw materials having superior hygienic-functional characteristics, antibacterial and antiallergic properties. There were obtained high quality knits in the conditions of a maximum efficiency and a positive impact over the environment.

2. Experimental

The Amicor fibres have been used for accomplishing yarns Nm 50/1, 60%/40% Amicor/cotton fibres, on a conventional spinning system. The adopting of the 60% Amicor percentage is in conformity with the indication of the Acordis Company, which guarantees, at this value, an optimum antimicrobial potential. The obtained yarns have been used for accomplishing both woven fabrics and knitted products. Amicor fibers have been used in blend with other fibers, too, such as: Lyocell, Rhovyl and wool, in order to be used for knit versions. The characterizing of the woven fabrics made of Nm 50/1, 60% Amicor/40% cotton yarns is given in Table 1.

Table 1:The physical-mechanical characteristics of the woven fabrics made of the Nm 50/1, 60/40% Amicor/cotton yarns

Current number	*Determined characteristic*	*UM*	*Version 1 cloth*	*Version 2 4 cloth + 3D2/2*	*Version 3 4 D2/3+ 3cloth*	*Version 4 combined*
1	*Mass*	*g/m²*	*159*	*161*	*157*	*164*
2	*Thickness*	*mm*	*0.5*	*0.51*	*0.456*	*0.576*
3	*Setting(density)* *- warp* *- weft*	*Yarns/ 10 cm*	*240* *150*	*140* *156*	*236* *153*	*252* *157*
4	*Traction resistance* *- warp* *- weft*	*N*	*662.0* *368.0*	*662.6* *371.2*	*676.6* *377.8*	*619.6* *366.4*
5	*Break elongation* *- warp* *- weft*	*%*	*8.5* *22.2*	*9.8* *22.6*	*10.6* *24.7*	*7.46* *20.7*
6	*Slipping resistance* *- warp* *- weft*	*N*	*36.80* *24.86*	*35.80* *25.72*	*37.30* *24.78*	*26.38* *15.18*
7	*Pilling*	*notes*	*5*	*5*	*5*	*4*
8	*Rubbing resistance (mass loss by rubbing, after 60 minutes)*	*%*	*5.2*	*4.8*	-	*1.4*
9	*Bending rigidity*	*mg x cm*	*83.7*	*84.6*	-	*94.6*
10	*Creasing recovery capacity (after 20 minutes)*		*111*	*102.5*	-	*96*
11	*Hygroscopicity*	*%*	*2.06*	*2.24*	-	*2.47*

Based on the data analyzed in Table 1, one can see that:
- for all the woven fabric versions the traction resistance is within the minimum limits imposed for the articles destined for clothing and/or underwear, min. 350 N;
- the slipping resistance of the yarns from the woven fabric is better for the linen weave version ;
- the rubbing resistance determined by the method of mass losing brings forth the superior characteristics of the linen weave fabric version ;

- hygroscopicity (a parameter that gives information referring to the comfort of a product) is correlated to the fabric structure (linen); the value of this increase at the same time with the increasing of the yarn floating.

Having in view the physical-mechanical, chemical, microbiologic characteristics of the accomplished and analyzed yarns, there have been established the type of structures of the knits and the utilization fields of these: hoses for children and adults, and knits for underwear and garment articles.

The physical-mechanical and aspect properties of the accomplished knits are presented in table 2:

Table 2. The physical-mechanical characteristics of the knit versions

No	*Version name*	*Mass g/m^2*	*Bursting resistance*	*Abrasion resistance*	*Pilling (notes)*
1	*V1 hoses of 65% wool + 35% Amicor, Nm 30/1*	*238.8*	*11.3*	*>10000*	*4*
2	*V2 hoses of 85% lyocell + 15% cotton, Nm 56/2*	*2228.2*	*5.03*	*>10000*	*4*
3	*V3 hoses of 100% lyocell, Nm 50/1*	*177.9*	*4.83*	*>10000*	*4-5*
4	*V4 hoses of 50% lyocell + 50% cotton, Nm 40/2*	*268.2*	*10.43*	*>10000*	*3-4*
5	*V5 hoses of 60%Amicor /40% cotton, Nm 50/1*	*203.2*	*2.56*	*>10000*	*3-4*
6	*V6 hoses of 100% Rhovyl, Nm 50/1*	*145.8*	*3.6*	*>10000*	*3*
7	*V7 hoses of 100% cotton, Nm 34/1*	*196.6*	*1.7*	*>10000*	*4-5*
8	*V8 Plain jersey derived from 60% Amicor /40% cotton, Nm 50/1+5% elastomer yarns*	*234.6*	*Not bursted*	*>10000*	*4-5*
9	*V9 plain jersey derived from 60% Amicor /40% cotton, Nm 50/1 + 5% elastomer yarns*	*260.9*	*Not bursted*	*>10000*	*4-5*

From the analysis of the correlation between the physical-mechanical and aspect of the accomplished yarns and knits, presented in table 2, results:

- uniform aspect of the knits, especially in the versions blended with Lyocell, Rhovyl and Amicor fibres of the wool type;
- very good abrasion resistance (>10000 cycles) that is due to both the yarn characteristics (high break resistance), and the corresponding settings of the knitting frames and the designing of certain adequate structure parameters of the utilization field;
- high elasticity degree owing to both using the plating yarns having a high elasticity (the PA 70/20 yarns and the elastomer yarns), and the adequate knit structures;
- good hygroscopicity for the versions containing Lyocell and Amicor fibres;
- reduced electrostatic charging leading thus to stress reducing.

New finishing technologies. Having in view the fact that the knit versions have, in their blend, cotton fibres that also contain non-cellulose accompanying chemicals (waxes, pectins, hemi – cellulose, lignin – a main component of seeds), which should be removed both for the sake of the knit aspect,

and for improving the comfort and dyeing parameters, it is needed that there should be achieved biocleaning processes as alternatives to the conventional cleaning procedures.
An enzymatic complex (amylase + pectinase) accomplished by the Centre of Microbial Biotechnologies BIOTEHGEN was experimented, with a view to the processes of biocleaning the cotton containing versions. In the conventional cotton precleaning, the alkaline boiling was used for the purpose of removing the natural waxes and the pectin from the fibres, and the water removing. Lately, this procedure having a negative impact over the environment, has been replaced by the technologic process of biologic pretreating, which is characterized by the possibility of compressing the enzymatic treating and alkaline boiling process into one stage. As part of the effected experiments, there was researched the influence of the ph and temperature over the finishing quality. Also, there were studied other important factors like: enzyme concentration; the introducing of certain complexing agents; the washing technique.
The effects of applying these biotechnologies were materialized by: the removing of the vegetal impurities from the cotton containing, knit versions, the reducing of the pectin content (from 1.5% to 0.39%), the containing of an adequate white degree at a concentration of enzymatic complex of 0.05 g/l, the temperature of $55^{o}C$, pH= 7, time 30 minutes, the increasing of the knit hydrophylicity (< 1 sec), the improving of the qualitative indicators of the used waste by reducing the value of the wastewater parameters, thus:
- for CBO_5 one can see a diminishing from 102 mg/l (the conventional finishing version) to **45 mg/l (the enzymatic biofinishing version);**
- for CCO-Cr one can see a diminishing from 270 mg/l O_2/l (the conventional finishing version) to **102 mg O_2/l (the enzymatic biofinishing version);**
- the ammonia nitrogen NH_4 was diminished from 26 mg/l (the conventional finishing version) to **6 mg/l (the enzymatic biofinishing version);**
- the reducing of the extractable substances with petroleum ether from 19 mg/l to 3 mg/l for the enzymatic biofinishing version;
- the reducing of the content of biodegradable anion-active synthetic detergents from 20 mg/l to 4.5 mg/l.

For the knit version made of Nm 50/1 yarns (cotton type 60% Amicor + 40% cotton), plated with PA 100/20 x1 den yarns, the following technologic stages have been carried out: washing, enzymatic prebleaching, dyeing.
The testing of the antimicrobial activity of the textile materials was effected at the Institute for Public Health from Bucharest, the Laboratory of Environment and Food Macrobiology, the obtained results are further on given.
The evaluating of the antimicrobial efficiency of the textile materials made of ecologic and bioactive yarns was carried out by the Kirby Bauer method – the test of the inhibition zone or the diffusion in agar. This method represents a preliminary test meant to detect the treating of the textile materials with migrating antimicrobial agents.
The test consists of placing a sample of textile material that was treated with the biocide substance in contact with an agar plate, on which a test micro organism was displayed. The antimicrobial agent from the sample migrates into the agar column, determining the inhibiting of the microbial growth around this and the forming of an inhibition zone. The antimicrobial effect is evaluated depending on the presence of the microbial growth on the sample and the inhibition zone from around the sample (measured in mm).
The evaluating of the antimicrobial effect it is done by detecting the microbial growth around and on the textile sample, and the inhibition zone, both for the blank assay and for the tested material, according to the table 3:

Table 3. The evaluation of the antimicrobial effect

Current number	*Microbial growth on the textile sample*	*Inhibition zone (W), mm*	*Evaluation of the antimicrobial effect*
1	*Absent*	*Noticeable, strong*	*Good, migrating biocide agent*
2	*Absent*	*Existing, weak*	*Good*
3	*Weak, 5% of the sample surface is covered with microbes*	*No inhibition zone*	*Satisfactory*
4	*Average, 50% of the sample surface is covered with microbes*	*No inhibition zone*	*Unsatisfactory, insufficient*
5	*Present*	*None*	*None*

When W>0 mm, and the textile sample is wholly protected by the test-microbes, it is considered a good antimicrobial effect. The control material should have no antibacterial effect.

3. Results and discussion

The testing of the fibre microbial activity by the method of the ribs that are parallel to the test – microorganism is reveled in table 4 and that by Kirby Bauer method with the test – microorganism is presented in table 5.

Table 4. The testing for Staphylococcus aureus and Escherichia coli

Sample number	*Sample nature*	*Microbial growth on the sample*	*Inhibition zone (W), mm*	*Evaluation of the antimicrobial effect*
1	*Hose (60% Amicor /40% cotton)*	*Staphylococcus aureus -Absent Escherichia coli-Present*	*Staphylococcus aureus - Present, big Escherichia coli-Absent*	*Staphylococcus aureus - Very good Escherichia coli-none*
2	*Hose (65% wool /35% Amicor)*	*Staphylococcus aureus -Absent Escherichia coli-Present*	*Staphylococcus aureus - Present, big Escherichia coli-Absent*	*Staphylococcus aureus - Very good Escherichia coli-none*

Table 5. The testing for Staphylococcus aureus, Escheria coli, Pseudomonas aeruginosa and Candida albicans

Sample number	Sample nature	Microbial growth on the sample	Inhibition zone (W), mm	Evaluation of the antimicrobial effect
1	Cotton type Amicor fibres	Staphylococcus aureus- Absent Escheria coli –Absent Candida albicans - Present	Staphylococcus aureus - Present, very big, clear, complete halo, W=20 Escheria coli - Present, very big, clear, complete halo, W=10 Candida albicans - Absent	Staphylococcus aureus – Good Escheria coli – Good Candida albicans - None
2	Hose (60% Amicor + 40% cotton)	Staphylococcus aureus- Absent Escheria coli – Present Pseudomonas aeruginosa – Absent Candida albicans - Present	Staphylococcus aureus - Present, W=7 Escheria coli –Absent Pseudomonas aeruginosa – Present, W=3 Candida albicans - Absent	Staphylococcus aureus -Very good Escheria coli – None Pseudomonas aeruginosa – Very Good Candida albicans - None
3	Hose (60% wool + 40% Amicor)	Staphylococcus aureus- Absent Escheria coli – Present Pseudomonas aeruginosa – Absent Candida albicans - Present	Staphylococcus aureus - Present, W=8 Escheria coli –Absent Pseudomonas aeruginosa – Present, W=3 Candida albicans - Absent	Staphylococcus aureus - Very good Escheria coli – None Pseudomonas aeruginosa – Very Good Candida albicans - None
4	Woven fabric (60% Amicor + 40% cotton)	Staphylococcus aureus- Absent	Staphylococcus aureus - Present, big halo, W=8	Staphylococcus aureus - Good

From the tests analysis presented in tables 4 and 5 can results that:
- The Amicor fibre samples, tested by the Kirby – Bauer method, presented an antibacterial activity as compared to the test microbes Staphylococcus aureus and - Escherichia coli, but they did not have an antifungal activity, as compared to Candida albicans;
- The hose samples (60% Amicor fibre/40% cotton fibres) and hose (65% wool fibres/35% Amicor fibres) tested by the Kirby – Bauer method had the antibacterial activity (bacteriostatic) as compared to the test microbes Staphylococcus aureus and Pseudomonas aeruginosa, and did not have a bacteriostatic and fungistatic activity as compared to Escherichia coli and Candida albicans, respectively. The same samples, tested by the methods of parallel stribs, brought forth identical results as against the test microorganisms.

4. Conclusion

1. The hose samples had an antibacterial activity as compared to the test microbes Staphylococcus aureus and Pseudomonas aeruginosa, but they had no bacteriostatic and fungistatic activity as compared to Escherichia coli and Candida albicans, respectively.
2. The woven fabric sample had a good antibacterial effect as against the test microbes Staphylococcus aureus and Escherichia coli.

3. The performances of the hygienic – functional properties of the knits, hoses and woven fabrics, and the positive impact over the environment were obtained by employing the Amicor fibres and the new finishing technologies (the treatments of enzymatically biocleaning the cotton - containing knits and hoses).

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MARKETING PROGRAM INSTRUMENTS IN THE CONTEXT OF FASHION PRODUCTS DESIGN

Gasovic M. & Brdaric M.

Abstract: *Product design has a key importance in creating and implementing marketing strategy. The integration of design and marketing leads to changes in marketing program. The design adapts to a product policy, life cycle phase, and place the product has in portfolio. Also, the design contributes to a product differentiation through price reduction or through a superior aesthetic appearance. Product distribution is often facilitated by adequate design of the product itself, as well as by design of its packaging. Product design is considered to be one way of communication with customer. Mutual understanding and cooperation between marketers and designers is particularly important when it comes to fashion products.*

Key words: product design, marketing program, fashion products, designers, marketers.

1. Introduction

Marketing program, as a set of tactical tools - product, price, distribution, promotion - serves achieving marketing goals in the short term. In other words, marketing program is the offer of the company, and its elements are means for implementing marketing strategy. Each instrument has its own function and value, but in order to form the optimal combination, marketing specialists need to have the adequate information from the market. The selected combination of instruments is not eternal and should be modified as a result of changes in environment or in the company. Taking into account that design is one of the key attributes of each product, any change in relation to design leads to changes in the marketing program. Design influences other elements of marketing program, as well. It affects the price level, facilitates distribution of products, and communicates with the environment. Previous claims suggest that close cooperation between marketers and designers is necessary in the entire process of creating fashion products, as well as their sales to final consumers. The main concern of the marketing specialist is the design and sales of fashion products to as many customers as possible. On the other hand, designers have to obtain information about the wishes and the requirements of target customers, which are usually provided by marketers of production and trading companies. Therefore, designers should be adequately instructed how to make their creations accepted, tested on the marketplace and, subsequently offered to wholesale and retail companies and end users. Although in practice conflicts over which business function should have a greater significance exist, the growing global competition forces the demonstration of equal respect for the design, sales and ultimately profits.

2. Design and development of a product as an instrument of marketing program

The basis of a product consists of marketing and other information, but also of the ideas created by the designer. Designers translate ideas into a prototype product, bearing in mind that the product is created for buyers, and not as a piece of art. After leaving the stage of materialization, the prototype of the product comes into production. Marketing is responsible for introducing new products to the market, while it is still in production. By doing this, customers get prepared for its launch. Parallel to reaction of customers, appears the reaction of the competition.

Product as an instrument of marketing program plays a leading role in customers attraction. Upon its success depends the overall success of the company. Customers requests and special wishes are forcing companies to continuous product development. The design has to create a product that is superior to competing products.

Fashion designers, led by their own ideas, but also by the influence of the target market, fashion, fashion forecasts, fashion magazines, media and events in music, film, painting, and so forth-are starting the design process.

Quality is the basic feature of every product and makes it an instrument of marketing. If the product meets the quality and total quality management aspects, only then it is efficient. Efficient is the product that fully meets the needs and wishes, while the optimal is the one that has a high competitive strength, which is contributing to business objectives, meets the interests of customers and society, as well. Positioning and stable position of the product on the market arises from the aforementioned elements.

2.1. Product design and product policy

Design is often considered as an additional attribute that is added to the sales level of a product. Marketers must keep in mind that the design is global and goes deeper than the exterior changes or physical appearance of the product. They tend to ignore the connection between the brand and graphic design. However, as a graphic designer is a participant in creation phase of the brand, this relationship is fundamental.

One of the inevitable elements of the product is packaging and it makes the first contact with the customer easier. Design is often integrated into the product through the packaging. Packaging policy includes making decisions about the nature, forms and sales goals that will influence the design objectives. Design improves product and its performance. This improvement concerns the external appearance of the product, perceived quality, satisfaction of users, functionality and, finally, originality.

A product is, at first, determined by its material attributes and physical structure: weight, life cycle, components, technology, etc. In modern business, there is almost no room for differentiation at the level of products physical appearance. It is usually done through packaging, branding or special features. The customer prefers a product according to its functional and symbolic aspects, exchange value and emotional impact. Design becomes a mean of achieving physical, functional and symbolic balance of the products. After the basic level, comes the level of technical or commercial product, which includes the brand, quality, packaging, user instructions and the like. The last level is a global or extended product which includes: installation, warranty, after sales services, financing and delivery.

The design is present in the product from its first level, physical characteristics of the product, and can be integrated at all three levels. Maintenance of the product cannot be separated from the quality of its conception. The role of design, related to the product is volatile, whereas the role of marketing is to decide at what level the design will be integrated into the product and to define the design attributes of the product.

2.2. Product design and product life cycle

As the product goes through the life cycle, a role of design changes. The design extends products survival on the marketplace, through its adaptation and adjustment of its performance during the life cycle. Design forms are going through divergent and convergent phases in the product life cycle. There is an aesthetic product cycle, which changes during its life on the market and each stage in the product life cycle corresponds to different design activities. Therefore, marketers have to make earlier study of each phase of the cycle in order to define appropriate design policies:

During the introduction, unique design is needed to draw customers attention on the oversaturated market. At this stage finding the optimum combination of form and function of the is product is conducted, with the help of observations of the first buyers products observations. As far as aesthetics is concerned, it is currently divergent.

In the period of growth, a unique product design is being replaced by other relevant characteristics, such as reliability of the product. Some modifications and product innovation are being done, in order to prepare product for its industrialization. Aesthetics becomes convergent and is integrated into the production process.

During the maturity phase, product design is important to highlight the efforts of repositioning or improvement of the performance. The focus is on connecting the most successful product attributes, as well as to study ways to allow customers greater choice or lower the price of the product. Design deals with product details or with their modifications.

In the decline phase, a study is initiated in order to gain the insight into the existence of new customer needs and new technology. Either, some radical modifications of the product happen and, new life cycle starts, or product is being withdrawn from the market. The design of the concept of the old, modified products or completely new products is defined.

The life cycle of the "classic" products cannot, always, be applied to fashion products. The life cycle of these products can be caused by the natural cycle of the seasons (weather), fashion trends (hit; fad) and styles that are updated several times again.

2.2. Product design and product portfolio

The design policy is changed according to the products position in portfolio. A company creates a family of products that have more or less, and the width and depth to cover the various market segments and, in that way, shares a risk between multiple products. Product portfolio reflects the goal of covering the market in terms of quantity and in terms of adaptation to variable behavior.

When it comes to fashion products, the final version of the product range, or portfolio management will be determined by the management of the company, together with designers, marketers, traders, etc.

Place the product has in the portfolio can be determined in several ways. In this paper is represented a method of Boston Consulting Group, also known as the BCG matrix. The products are classified according to two axes: relative market share and market growth rate. In this way, four types of products or four types of design policy is defined, [2]:
• Products "stars": a strategic segment that is characterized by rapid growth and design innovation.
• Products "cows": characterized by high profitability but slow growth and the design policy is carried out from day to day.
• Products "dogs": marketers are looking for ways to increase sales, while impact of the design is weak.
• Products ―problems": their profitability is low, which is the reason for the investment in products survival on the market, leaving the segment or re-segmentation, during which the strong influence of future designs can be felt.

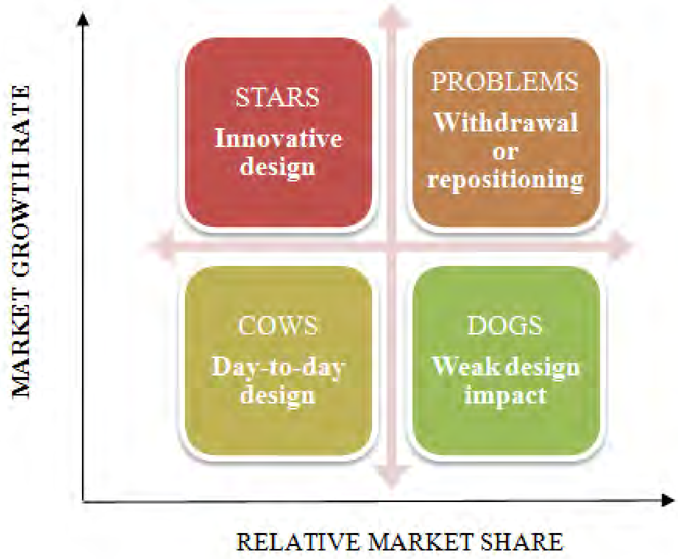

Figure 1. *Design strategy and BCG matrix*

3. Price as an element of marketing program in the context of product design

Price is the second most important instrument of marketing program. A significant part of marketing strategy and tactics is based on product price. Prices are a factor of manufacturers economic success, decisive factor in buying process and a powerful instrument in battle with the competition. Pricing policy is determined in accordance with general business policy and marketing strategy. As a result of its quality, price is organically related to the product, although its determination is influenced by other factors, too. The aim of determining the pricing policy is not to maximize the price, but to make it, in conjunction with other instruments, a powerful weapon for a battle with competition.

There are two ways of defining the marketing strategy when it comes to the price. The first one is to define the product quality, and then consequently set the appropriate price, while the second one is to define the price, which a certain level of quality will be based on. Marketing strategies are usually centered around the buyers purchasing power, in order to show to designers what price buyers can pay. Based on that, they create a level of product quality that is consistent with a given price. Reverse case occurs when a manufacturer develops a new level of quality products under the assumption that it corresponds to the purchasing power of customers. In this case, the price is being imposed to the market through the promotion and improvement of the distribution. The first case is more secure, while the second one is riskier.

When it comes to fashion products, in addition to costs, prices should reflect the type of fashion products that are offered, as well as to indicate the position of the product at the market. Sales and revenue depend on the prices at which products are sold. Design, by creating products, determines their production costs and thus the retail prices. The task of marketing is to define strategies and tactics for coping with diverse conditions on the market. There are two ways of forming designing policy, given the pricing policy, [5]:

- Price differentiation based on costs: The design, in this case, has the purpose of lowering prices of products. The function of design is involved in the cost structure. Design can reduce production costs in several ways: inverse design, or impact on suppliers to provide cheaper and more flexible components of the final product; the target functional analysis, which defines several product features, and then creates a target cost for each component, in order to be able ,

after comparing the expected and target costs, to identify areas where costs need to be reduced costs or increase functionality; technology engineering and systematic examination of factors that cause costs, with the aim of achieving the required quality standards at lower costs, which usually leads to redesign of some subassemblies or components .

- Price differentiation based on aesthetics: designing as confirmation of the price differentiation in comparison to a similar product or service. On the basis of superior aesthetic appearance of the product, the company is in a position to determine a higher price for this product. This kind of differentiation can be used as tool in negotiations with distributors.

4. Distribution as an element of marketing program in the context of product design

After the first series of products are produced, the main goal is to make their arrival on the market as quick as possible. In other words, the interest of producers is to minimize the time which product spends in the distribution. However, the length of that time is under the influence of internal and external factors. It is essential that the product reaches customers before the competing product does.

Distribution represents product flows from producer to customer. In conducting business policy, every company seeks to define specific and alternative marketing strategies for this instrument of marketing program. In that way, the strategy is being adapted to the business environment, especially to one of its factors, and that is competition. Customers always respond positively to the availability of the product, which is usually the field of competition. The distribution consists of two elements: the physical distribution and distribution channels and these two elements are organically connected.

Physical distribution (marketing logistics) includes activities of handling, packing, storing and transporting the product to the customer. Its task is to deliver a product of appropriate quality to the customer. The most important factor of this element is distribution cost and the aim is to minimize it. In this sense, design plays a key role. Products must be adapted to the physical distribution: shape, design, materials and the sensitivity of the product should comply with the conditions of product transport, loading, storage, etc. It is important that products are so designed that their quality remains the same, on its way from producer to customer.

Product design has to assure that the products are suitable for transportation and storage by their size, shape and weight. First of all, it refers to the possibility of transporting large quantities at minimal costs. The design can affect the efficiency of physical distribution by combining products of various sizes, but of similar shapes, and so on. To the greater efficiency of physical distribution contributes product packaging adapted to the nature and mean of transportation and product storage.

Distribution channels are the intermediaries that the manufacturer uses to deliver products from producer to customer. They have a broader sense of the logistics, and their main function is to make the product as possible as closer to the customer. Through the distribution channels the transfer of ownership over the product takes place - from the manufacturer through the wholesalers and retailers to final consumers. Sales are an important link in the cycle of reproduction, without which, neither the current cycle can be completed, nor the new one can be started. It involves direct contact with the customer. If the task of physical distribution is to deliver the product at the right time, right place and at the right price, then the task of sales is to sell products as soon as possible. The design of retail space, which represents an integral part of vendors design policy, must be also taken into account.

When it comes to fashion products distribution and sales channels, so called large customers play an important role. They have to forecast which products will be modern in the next season. Their relationship with designers is mutually beneficial: their company will gain credibility thanks to the fact that they sell creations of famous designer, and the designer will be provided with sales and prestige by selling his creations in fashion trade company of a high reputation.

It is necessary that designer creates a quality, efficient and competitive product. The competitiveness and product acceptance by customers are affected by the suitability of products quality and price. In that sense, marketing information are the guidelines for both design process and sales. Therefore, constant information exchange between design process and sales has to be established - through the marketing sector. If the level of quality or price deviates from the requested one, marketing has to act. In that way, the design process focuses and adjusts to the sales, as the common goal of design and marketing.

Design policy can increase the effectiveness of selling policy through sales staff trainings, by which the possibilities of aesthetics and graphic visualization are explained. Also, the design can influence the sales by improving the seller‘s interior design, which requires cooperation between sales staff and designers. The task of designers is to identify the power of sales forces and their permeability to the new concepts, as well as, to initiate action of their acceptance by using free samples or doing similar activities.

5. Promotion as an element of marketing program in the context of product design

Promotion is the communication process between companies and their customers. Without promotion, the customer will not receive the necessary information about a product, which will make it difficult to sell it. When it comes to the promotion, marketing is responsible for conducting research, as well as operational activities. The first activity is related to the provision of market information, and the other one is promotion implementation through its individual elements. The promotion is effective only if it is integrated with other elements of the marketing program.

The main subjects of the promotion are products and services, as well as the company itself. In both cases, the objective of promotion is to inform, persuade or remind the customer of product or the company existence. The effectiveness of promotion is most frequently associated with the increased volume of sales or profits made on that basis. Promotion influences the positioning of the company and its products on the market, which affects its long-term profitability.

There are four basic types of promotion: advertising, sales promotion, personal selling and publicity, although in contemporary literature the fifth form of promotion is mentioned: direct marketing. Marketing strategy, as a collection of plans, actions and tactics for achieving marketing objectives of the company, including the promotion of objectives, integrates these forms within the concept of integrated marketing communications into a single whole.

The design process must constantly tend to align promotion with production needs. At the stage of product materialization, characteristics that contribute to the promotion effectiveness, such as elements of aesthetic quality (size, color, shape, ornaments, etc.), must be especially emphasized, because they enhance the visual communication with customers. However, adapting products to the needs of promotion must begin with the idea. Ensuring the products suitability for the needs of promotion should result from the cooperation between the designers and marketers, though under the supervision of competent managers. Practice shows that the design can significantly improve the promotion, by highlighting products visual elements.

Design policy tends to ensure cohesion between product design and promotion. The design can be understood as a form of communication, which implies the existence of an obligatory connection between those two areas. The added value achieved by superior product design, can generate funds for investing in corporate communications. Creativity of design and publicity are often associated.

Graphic character or object is a permanent medium, for both internal and external communication. Product concept implies the use of aesthetics and the original aesthetics will be reproduced by the media and will valorize the investment in design. Therefore, the design manager is partly responsible for corporate communications.

For most fashion companies, promotion is the key for attracting the attention of customers and the establishment of customers‘ habits. In addition, regardless of what instrument of promotion is used, design plays a key role in shaping customers perceptions. Therefore, every fashion promotion plan stresses the importance of understanding consumer behavior and the process of its adoption. In this sense, a marketing manager in Levis, named Clark, claims that their design model helped sales of jeans more than their promotional videos.

6. Conclusion

Product design and its role in marketing strategy influence the process of determining marketing programs. For a long time, the design was inadequately interpreted by the marketing specialists, but its importance in the defining and managing of marketing programs is evident. The growing impact of product design on achieving marketing objectives leads to more serious consideration of the design during the execution of marketing strategies. Marketing specialists have to be aware of the way in which design affects the whole marketing program, but also its individual elements, whereas designers must take into account the goals marketers want to achieve with the given program. All elements of the marketing program are directly related to the product design which affects their functioning. Mutual understanding and cooperation between marketers and designers is particularly important in the fashion industry. The achieved results can certainly be improved if the designers accept that can marketers can help them improve the design process, and marketers recognize the fact that in the fashion industry design, except for meeting the requirements of customers, can also dictate them. Designers need to know that a wide range of products and profits, in the fashion industry, are not only a result of fashion collections that are presented on the catwalk and in magazines, but also of other (non-created) products, which are sold in fashion stores. Therefore, the recognition of the interdependence between marketing and design is based on equal interests of both parties for designing, customers and profits.

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ANALYSIS OF HORIZONTAL AND VERTICAL FORCES OF THE PRESSER FOOT OF THE SEWING MACHINE AT DIFFERENT SPEEDS OF SEWING TWO OR SEVERAL LAYERS OF RIB KNIT FABRIC

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Abstract: *The stability of the stitch length and hence the quality of the seam when sewing the rib knit fabric are affected by many factors: penetration force of sewing needles, selection and tension of the sewing thread , needle size and sewing needle point shape , and the type and conditions of the work piece feed. One of the main parameters the work piece feed are vertical and horizontal forces that occur between the work piece and the feed system. By measuring and analyzing these forces with different speeds and a different number of layers of the sewn knitted fabric a clearer picture of the extent to which individual factors influence the work piece feed, the ultimate quality of the seam and the finished product will be obtained.*

Key words: horizontal and vertical force, presser foot, feed system, measuring device, technological parameters.

1. Introduction

Nowadays various techniques of joining garment parts are in use, but joining with a sewing thread is still the mostly used and most important joining technique, especially due to its specific structure and physical properties when sewing knitwear. When sewing surface materials, it is necessary, as a result of the construction of the sewing machine, in order to create a sewing stitch as the basis for the sewing seam, that the material to be sewn should move with an exactly defined length to obtain a uniform stitch length which is the basic condition for a quality seam. Of course, the work piece can be moved only when the needle is not within the material, unless the needle feed is involved. The feed and presser foot system of the sewing machine act differently on the work piece, depending on surface property, thickness of the sewn material, compressibility, elasticity and seam direction. This results in different material movements reflecting in the deviation and change of the stitch length. Other technical and technological parameters and their harmonization affect the stability of the stitch length, such as:

- knitted fabric structure
- parameters of the sewing thread
- parameters of the sewing machine (sewing needle size and shape, sewing speed, sewing thread tension, type of sewing stitch [1]

One of the main factors of knitted fabric feed are vertical forces of the presser foot as well as horizontal forces occurring between the material and the feed system. By measuring and analyzing horizontal and vertical forces with a different number of the knitted fabric layers as well as with three different sewing speeds a clearer picture of the extent of individual factors affecting the fabric feed will be obtained as well as the final seam quality. If the inadequate fabric feed and the factors affecting its quality are observed too late, irreparable production faults will occur. Thus, the introduction of the adequate online system of monitoring the sewing process, i.e. seam quality, seam faults will be observed on time, resulting in the production of adequate and required quality with much less garments having a seam fault which will enhance productivity.

2. Knitted fabric feed and force analysis

Material feed is one of the key steps in the sewing process, especially when a heavy or slippery material is sewn at a high speed. In these cases the process parameters require a correct adjustment in order to avoid uncontrolled material movement and to obtain a symmetric seam and not to damage sensitive materials to which rib knitted fabrics belong. Vertical pressure by the presser foot on the material to be sewn is determined by adjusting the pressing lever to which the presser foot is attached and can be adjusted. This action, together with the feed system, generates horizontal and vertical force on the feed dog teeth. The action of the feeder, throat plate and presser foot moves the material. This action depends on the thickness, structure and elasticity of the material to be sewn as well as on the sewing direction which is especially important for sewing knitted fabrics. An increase in vertical and horizontal force friction is enhanced which is the reason why it is necessary to optimize the force of the presser foot in order to obtain the appropriate quality of the material feed. The force of the presser foot is statically adjusted. It is changed by an impulse contact of the feeder with the presser foot. This impact effect increases at higher sewing speeds. As a result of the total action of the system: needle bar, presser foot, feed system and material to be sewn clamping force arises generated by vibrations, making the material feed difficult (2). Without an appropriate feed and appropriate force of the presser foot sewing would be impossible. Too low a force of the presser foot causes uncontrolled material movement, whereby an increase of the sewing speed causes transport puckering of the lower layer of the material , while too high a force of the presser foot causes material damages, in particular on sensitive fine materials such as knitted fabrics. Shear or horizontal force performs the real fabric feed. Feed system generates this force. As opposed to shear force compression or vertical force from the bottom of the presser foot acts through the material (3).

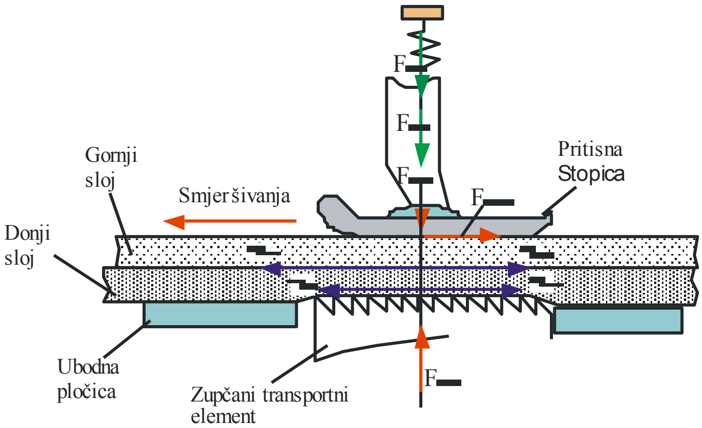

Figure 1: Forces acting on the material during the feed of two material layers

Donji sloj – lower layer, gornji sloj – upper layer, smjer šivanja – sewing direction, pritisna stopica – presser foot, ubodna ploĉica – throat plate, zupĉani transportni element – feed dog teeth

Compression force of the presser foot:

$$F_{pn} = F_N = F_o + F_g \tag{1}$$

where :

F_{pn} - compression force of the presser foot,

F_o - spring force,

F_g - gravitational force.

Spring force F_s is expressed in the form :

$F_s = cx$

where:

c - spring stiffness,

x - compression path.

Gravitational force can be expressed with the following equation:

$$F_g = m_{pn} g \tag{2}$$

where:

m_{pn} - mass of the presser foot.

Based on the expression (1) the frictional force between the upper layer of the material and the presser foot F_{T2} can be expressed as:

$$F_{T2} = F_{pn}\mu_2 = (F_o + F_g)\mu_2 = (cx + m_{pn}g)\mu_2 \tag{3}$$

where:

μ_2 - frictional coefficient between the upper layer of the material and the presser foot

The frictional force between the upper and lower layer of the material F_{T3} can be expressed as:[4]

$$F_{T3} = F_{pn}\mu_3 = (F_o + F_g + G_{m_2})\mu_3 = (cx + m_{pn}g + m_2 g)\mu_3 \tag{4}$$

where:

μ_3 - frictional coefficient between the upper and lower layer of the material

m_2 - mass of material 2.

The frictional force between the feed dog teeth and the lower layer of the material F_{T1} :

$$F_{T1} = [F_{pn} + (m_1 + m_2)g]\mu_1 = [F_o + F_g + (m_1 + m_2)g]\mu_1 = [cx + m_{pn} \cdot g + (m_1 + m_2)g]\mu_1 \tag{5}$$

where:

$(m_1 + m_2)g$ - gravitational force of the material part between the presser foot and the feed dog teeth

μ_1 - frictional coefficient between the feed dog teeth and the lower layer of the material,

m_1 - mass of material 1.

To accomplish the feed of the material, two conditions should be fulfilled in this case:

I $F_{T2} - F_{T3} = 0$ (6)

II $F \succ F_{T1} + F_{T2}$ (7)

where:

F_{T2} - frictional force between the upper layer of the material and the presser foot,

F_{T3} - frictional force between the upper and lower layer of the material,

F - tensile force or the force needed to transport the material,

F_{T1} - frictional force between the feed dog teeth and the lower layer of the material.

When the number of material layers increases, the number of forces acting on the material during sewing [4] increases too. Based on the analysis of forces when sewing two material layers, the following expression and the values of forces in sewing four layers of the material is used:

$$F_{T1} = \left[F_{pn} + (m_1 + m_2 + m_3 + m_4)g\right]\mu_1 = \left[F_o + F_g + (m_1 + m_2 + m_3 + m_4)g\right]\mu_1 = \\ = \left[cx + m_{pn}g + (m_1 + m_2 + m_3 + m_4)g\right]\mu_1 \tag{8}$$

$$F_{T1} = \left[F_{pn} + (m_1 + m_2 + m_3 + m_4)g\right]\mu_1 = \left[F_o + F_g + (m_1 + m_2 + m_3 + m_4)g\right]\mu_1 = \\ = \left[cx + m_{pn}g + (m_1 + m_2 + m_3 + m_4)g\right]\mu_1 \tag{9}$$

where:

$(m_1 + m_2 + m_3 + m_4)g$ - gravitational force for the material section between the presser foot and the feed dog teeth,

μ_1 - frictional coefficient between the feed system and the lower layer of the material.

To accomplish the material feed, the following two conditions should be fulfilled in this case :

I $F_{T2} - F_{T3} - F_{T4} - F_{T5} = 0$ (10)

II $F \succ F_{T1} + F_{T2}$ (11)

where:

F_{T2} - frictional force between the upper layer of the material and the presser foot,

F_{T3} - frictional force between the upper and middle layers of the material,

F_{T4} - frictional force between the lower and middle layers of the material,

F_{T5} - frictional force between the middle layers of the material,

F - tensile force or the force needed to transport the material,

F_{T1} - frictional force between the feed dog teeth and the lower layer of the material.

3. Experimental results

Experimental measurements were performed at the Faculty of Textile Technology, Zagreb, Croatia and at the Institute of Textile Technology and Process Engineering, Denkendorf, Germany, where the measuring system ITV was designed and made. It is used for testing individual factors which affect the formation of sewing stitches and seams. The goal is to find out ways of monitoring correct sewing machine functions which is manifested in seam quality. The measuring system makes it possible to measure sewing needle penetration force, forces of sewing thread tension, and horizontal and vertical forces of the presser foot of the sewing machine. The measuring system is composed of: universal double lockstitch sewing machine Pfaff 483 with a sewing speed of 6,000 stitches/min (the number of stitches is individually adjustable), impulse counter, signal cable, hand controller, digital to analogue convector, computer, monitor, graphic printer, analogue filter, signal amplifier, sensor of needle penetration force, sensor of sewing thread tension force, presser foot, sensor of presser foot horizontal force, and sensor of presser foot vertical force.
20 samples for each two-, three- and four-layered material were measured. The measuring instrument measured 50 values of horizontal and vertical forces for each measurement and statistically analyzed. The diagrams show results of 1,000 measurements of the values of forces. Afterwards, the results were statistically reanalyzed and shown in a 3D diagram {4].

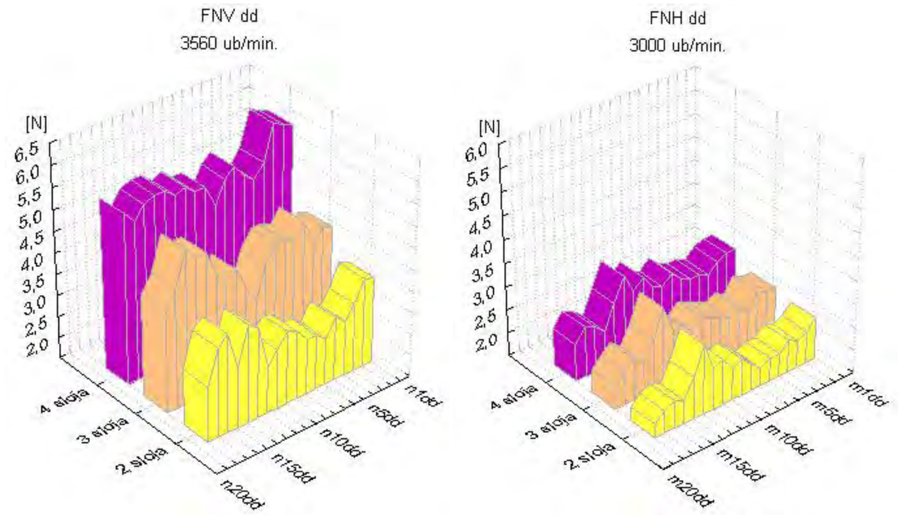

Figure 2. Diagram of the measured values of horizontal and vertical forces of the presser foot for the rib knit fabric sewn with 3,000 stitches/min

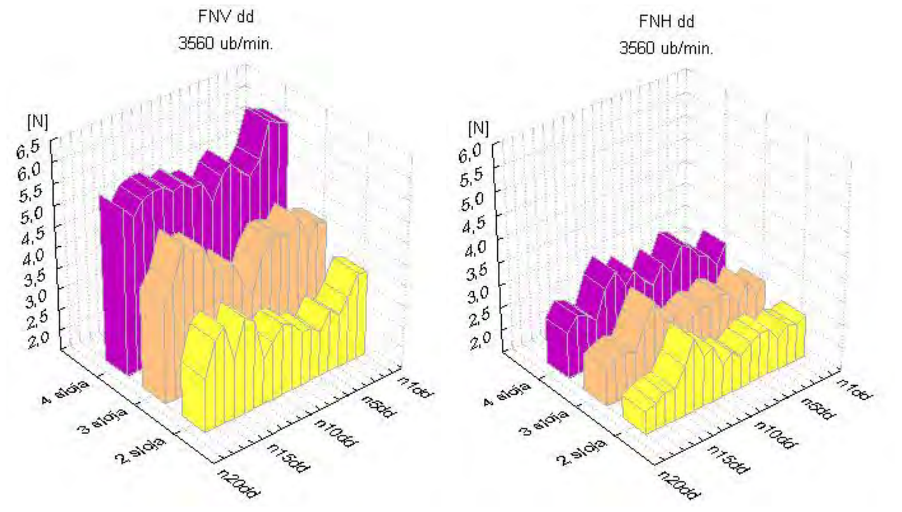

Figure 3. Diagram of the measured values of horizontal and vertical forces of the presser foot for a rib knit fabric sewn with 3,600 stitches/min

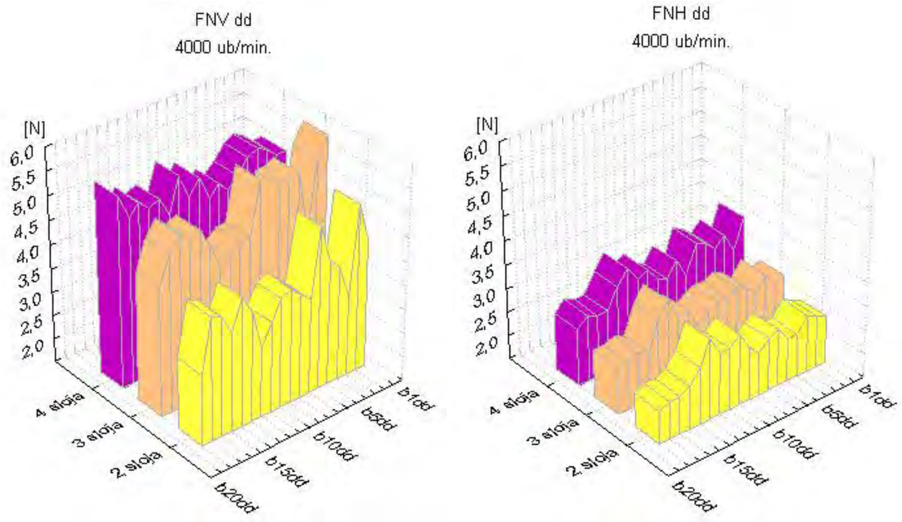

Figure 4. Diagram of the measured values of horizontal and vertical forces of the presser foot for a rib knit fabric sewn with 4,000 stitches/min [4]

4. Discussion and conclusions about the measured values of horizontal and vertical forces of the presser foot when sewing rib knit fabric

The measurements were made with three rotation speeds of the main shaft of the sewing machine: 3,000 stitches/min, 3,560 stitches/min and 4,000 stitches/min; two, three and four layers of the same material were stitched. The diagrams show that an increase in the speed of the main shaft increases both vertical and horizontal forces of the presser foot of the sewing machine. An increase in the vertical force of the presser foot of the sewing machine when increasing the number of layers of the same material using all three tested speeds of the main shaft of the sewing machine is particularly emphasized. Analyzing the mean values of the measured vertical and horizontal forces of the presser foot of the foot sewing machine when sewing rib knit fabric consisting of two, three and four layers, it was found that vertical forces were higher than the horizontal ones, and that these forces increased with increasing the number of layers to be sewn. On the basis of these results it can be found out that an increase in horizontal and vertical forces of the presser foot is greater when changing the speed from 3,560 stitches/ min to 4,000 stitches/ min, than in the case of an increase of the speed from 3,000 stitches/ min to 3,560 stitches/ min. It is more noticeable in stitching three and four layers of the same material. Therefore, it can be concluded that higher speeds and sewing thick materials significantly increase the vertical forces of the presser foot of the sewing machine. This can make the control of the fabric feed system impossible, and consequently the control of seam quality too. When we statistically analyzed the values of the vertical force of sewing rib knit fabric consisting of two layers of the same material, we concluded that the vertical force ranges from 2 to 2.9 N at 3,000 stitches/min, from 2.6 to 3.8 N at 3,560 stitches/min and from 3 to 5 N at 4,000 stitches/min. The measured values of the horizontal force of the presser foot for the rib knit fabric consisting of two layers in relation to a change in the speed of the main shaft range in intervals from 1.8 to 2.5 N at 3,000 stitches/min, from 2 to 3.1 N at 3,560 stitches/ min and from 2.2 to 3.2 N at 4,000 stitches/ min. Similar indications were obtained by sewing three and four layers of the fabric, from which it can be concluded that the vertical forces are much higher than the horizontal ones. The highest values were measured when sewing four layers of the knitted fabric and the speed of the main shaft of 4,000 stitches / min. [4].

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MY PERCEPTION OF THE SERBIAN GARMENT INDUSTRY

Mervyn TAUB

I was recruited to be an expert consultant for Serbian Economic Development Project from 2005 to 2008. I made 7 visits to Serbia totaling 19 weeks altogether. That is a sufficiently long time to get a very good perspective of the Serbian garment industry.

My purpose was to assist the factories to build their capacity, improve their productivity and their quality with the existing staff and equipment. The guiding principle was ―what can we achieve with what we have got?” We were very aware that the sewing industry was emerging from public ownership and that many of the new owners did not have access to funds to improve the existing equipment, so this is why this was our policy. ―What you do with what you got”.
I believe the factory owners responded to this policy favorably which is part of the reason we were so well accepted.

In my view the Serbian industry has several choices, each quite clear and different to the others.

1. The factories can choose to be the very best in their field and compete on that basis. There are shirt makers, socks factories and sweater makers who have world class operations. The goods they produce have excellent and consistent quality that can measure up to the highest standards. Some also offer in-stock programs to their customers so are able to fulfill re-orders for their customers overnight. Several of these factories are already successfully exporting their own brand to Europe and to the USA. This is truly commendable and takes enormous dedication from the owners and their staff. It also shows that with vision and leadership amazing results can be had.

2. The factories can decide to be the fastest and offer really quick turn-around times for orders. There is a viable and active market for factories that can quickly re-supply stores with merchandise. To import these goods from Asia is almost impossible in the time frame required, compared to the turn-around times that efficient and well run contractors can offer. These relationships are not easy to build but can be very profitable once the customer understands what can be done. There has to be abundant trust in each other. The customer may have to make difficult commitments for this to work at its best, but it can be done. I used to make garment-dyed shorts and shirts. We arranged with the customer to hold agreed levels of inventory. Then as the orders came in we took the sewn but un-dyed garments and sent these to the dye-house. We were able to deliver in 3 days. I have done the same thing where the customer held fabric at our warehouse so that we could start cutting within one hour of receiving the order, and be ready to ship in two weeks. The ―partnership” requires that the customer undertakes to use up all of the inventory in an agreed period of time. A supply chain like this is almost impossible to do from China or anywhere else.

3. Factories can choose to be the most efficient in a narrow range of garments and have the latest technology and automated equipment. This works best for long runs of basic garments like T-shirts, men‘s underwear, hosiery, and very standardized woven shirts. The whole emphasis is on efficiency and rapid turn around time. I would say this is the most difficult to achieve but there are factories in Serbia that could do this. It requires a total focus on productivity and quality, and very motivated management.

4. Factories can decide to focus on the local market and the customers in adjacent countries, and that too is a good choice. A strong local market can be an ideal opportunity for some manufacturers

who understand this market and have the finance to support this type of business. By combining all of the above ideas a factory can become a very successful supplier.

The future of the apparel industry in Serbia will depend primarily on the economic opportunities that the market offers. Smart business people will see these opportunities and be able to exploit these profitably. The government must be persuaded to pursue good trade agreements with other nations that reduce tariffs and encourage cross-border trade. Transportation must be easy and swift. Good roads to markets are essential. Documentation must be simplified as far as possible. Labor policy should welcome job opportunities and encourage easy employment regulations.

The second area that needs to be looked at is education. The production of apparel today is a science and has to managed by trained technologists. From design, to cutting, to specification preparation and sewing, to quality assurance and scientific quality sampling procedures, all of these need highly trained technologists. Furthermore courses are also needed covering international trade, banking and international payments, logistics and supply chain management, all of the knowledge that a 21st century executive will need to study and understand.

It is my belief that the basic infrastructure of post-secondary education exists already. What is needed now is for industry leaders and educators to sit down and plan out the courses that will meet the needs of a 21st century industry. These should ideally be a combination of classroom and on the job training, with students spending time in school and in the factories where they will work when they complete their studies.

So I would say that for Serbia, this is the way to go. Choose the type of factory and business you wish to be in, and go out to find and train the best people you can find. Push the government to follow business-friendly policies and to facilitate the training of the skilled managers this business will require. That is a big challenge. I am sure you can do it.

THE APPLICATION OF INDUSTRIAL ROBOTS IN THE PRODUCTION SYSTEMS OF TEXTILE INDUSTRY

Isak KARABEGOVIĆ & Darko UJEVIĆ

Abstract: _The paper includs an overview of the application of industrial robots in the world and by continent with special reference to the application of production systems in the textile industry. In the production systems of the textile industry, the application of industrial robots has not been used to the same extent as in the production process of other industries in which the problem of manipulating by the material was solved. This is because the textile material is elastic, while handling it flattens and stretches, making it difficult to achieve uniform transport, orientation and positioning, and even uniformly conducting during the production process of treatment by merging and similar actions present in the automation of the production process of the final product. Recently, the application of industrial robots in the textile industry production systems are increasingly being used, because of the development of new types of sensors and pins which performs the manipulation of textile materials, and will experience the greatest application in mass production and these are production processes of clothing production. The application of industrial robots in production systems of the textile industry can be grouped according to various technologies and various manufacturing actions. In the paper a certain number of examples of industrial robots in production systems of the textile industry is presented._

Key words: industrial robot, textil production system, textile industry.

1. Introduction

In the manufacturing process the foundation of all future factory concepts are intelligent machines and systems with different levels of complexity and more present today in the production process. The automation of processes and machines finds application primarily for the execution of production processes and management of machines but less in other also important productive activities such as: servicing of the workplace, the positioning of the workpiece and the like [3,4,5,6,7]. Robots are used for tasks that are repeated several times and which are considered monotonous in those processes that require high quality and high productivity. They are ideal for jobs that are considered difficult and inconvenient for people and jobs that are dangerous to their health. Different manufacturers have constructed a variety of industrial robots specifically for certain types of job tasks. The application of robotic systems in industry is the humanization of work, especially in jobs harmful to human health (work in contaminated areas, dust, high temperature, monotonous and chore work tasks). Robots find the application not only in industry but also in other areas of life.

2. The application of industrial robots in production processes in the world

The number of installed multifunctional robots and total number of industrial robots installed in Japan, USA, European Union, rest of Europe, Asia, Australia, is presented in Table 1. Statistical data listed in Table 1 were taken from: the International Federation of Robotics (IFR), the data of the UN Economic Commission for Europe (UNECE) and the Organization for Economic Cooperation and Development (OECD). This presentation should show the application of industrial robots in manufacturing processes in the world and to give an indication of the overall profitability and massive applications in all industries including the textile industry .. Users of industrial robots and potential users are generally interested to receive information on how an industrial robot can solve specific production problems in the production process and carrying out certain operations, and how these solutions are achieved [9,10,11,12]

Table 1. The installation and the total number of robots in 2008, 2009 and predictions of installations in the year 2012.

CONTINENT	The annual installation of the robots			Total installation of the robots		
	2008	2009	2012	2008	2009	2012
AMERICA	17.192	9.600	15.100	173.977	172.800	174.400
ASIA -AUST	60.294	35.900	54.000	514.914	509.000	523.000
EUROPE	35.066	22.600	34.200	343.700	346.100	357.300
AFRICA	461	300	500	1.784	1.800	1.700
TOTAL Σ	113.013	68.400	103.800	1.034.375	1.029.700	1.056.400

As the Table 1. shows, the total number of installed robots in industry in the United States from year to year remains unchanged, in Asia can be said that the number of installed industrial robots from year to year is retained at almost the same level, while in Europe the trend of application of robots has increased slightly. By the largest number of installed industrial robots the advantage has Asia, follows Europe and then America.

3. The application of industrial robots in the production systems of the textil industry

The development of industrial robots made the involvement of industrial robots in all production systems in the textile industry as well as in the process of making the final product, although the lattest process can use already derivative solutions which are used in other production processes. In the phase of research are the applications of industrial robots in all procedures and working operations of the production process and in primary and secondary production of the textile industry. Also the inclusion of industrial robots is present in the operations of testing materials, interactional manipulations, storage, transport, sorting and similar operations, and even the presentation of the garment in the form of robot models.

The application of industrial robots in cutting technologies in the textile industry as shown in Figure 1. Cutting procedures where low cutting forces for materials are used allow: a minor robustness of the robot‘s arm, reduce energy consumption and greater precision work. This is why more and more is used cutting such as laser cutting, ultrasonic, high frequency cutting, water jet cutting and mechanical cutting by rotating knife. In the textile industry has been present for about ten years. On the tool of robotic arm is placed the nozzle through which passes a very thin stream of water under very high pressure (about 400 MPa), Figure 1. Hydraulic device for obtaining a high pressure of water is located near to the robot. The company Stäubli Corporation has developed a device "waterjet" cutting textile materials (carpet, parts of car interiors) [1,3,7].

Figure 1. Industrial robot with a water jet cutting textile materials

The application of industrial robots in the technology of merging, the industrial robot has the advantage as a spacial multifunctional device (which can be reprogrammed) during merging in the space. This ability comes into play especially with so-called technical textile, which is much stiffer. In the scope of the application of industrial robots and new merging techniques develop: devices to capture that allow convenient handling of textile materials, small robotic sewing heads with access from one side (OSS), adjustable molds (dolls) for various volumes and types of clothing and connecting devices to capture, robotic sewing heads and the adjustable molds.

Figure 2. Sewing head on the arm of an industrial robot [7]

Due to high automation machinery for the production of nonwoven textiles are examples of applications of industrial robots. As an example, can be point out the use of an industrial robot with radial manufacture of textile braid, Figure 3. The system consists of an industrial robot KUKA which bears spindle where are intertwined textile materials (yarn, tapes, etc.).The robot leads the spindle through the middle of the machine for intertwining.

Figure 3. Production of textile braids robotised system of Herzog company [4]

As in the other technological processes robots are used to displace, transport and storage. In textile manufacturing robots are used for removing spools from machines and placing them on pallets, for placing spools on the head of machine, for rewinding the spools and similar tasks, Figure 4.

Figure 4. The application of industrial robots in the manufacturing process of textile production [7]

Taking, transmission, orientation, positioning and folding of the textile material is complicated due to its inherent characteristics, but by the development of the sensory comes to the application of industrial robots in the typical production processes as shown in Figure 5.

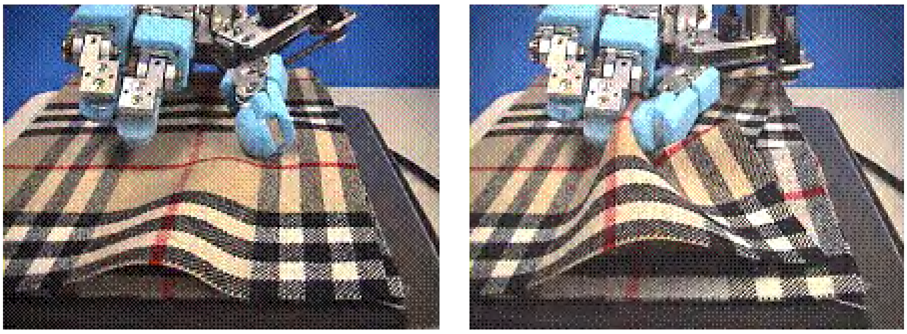

Figure 5. An example of the application of the industrial robot at capturing the textile material from the layers [3]

The development of robotics has for its goal to design a fully automated production lines as in the case of the other mass productions. Not only this eliminates expensive human labor, but it raises the quality, speeds up the process of labor and reduces waste. For such a production process, besides already mentioned solutions for merging textile workpieces, reliable solutions are needed for: inter-operational transportation, positioning, bringing and placing parts, disposal of finished products and etc. The first robotic system of clothing industry originated under the auspices of the Textile / Clothing Technology Corporation in the United States. The system consists of: automated taking of the tailored parts and placing them onto the transport unit, the visualization system for identifying parts of the garment, SCARA robot which aligns the edges and folds the garments, devices for transporting the workpiece to the robotic sewing station. Although this composition automates the smaller part of the technological process of sewing, it is significant because for the first time the fully automated production of the garment without the participation of workers was executed. That as the goal was realised for the first time. By this module effectively have been realized the robotized solutions of the following groups of technological operations: sewing the side seams, *step stitch*es and needling the waistband of the trousers, sewing the front and rear seams sleeves and hem, sewing front and back seams of the sleeves and sewing the hems, protection garments, sewing stitches of the back middle of the garments, sewing the sleeve‘s stitches of the lining fabric and sewing of the lateral seams of garments. An example of an automatic line production of the trousers is shown in Figure 6.

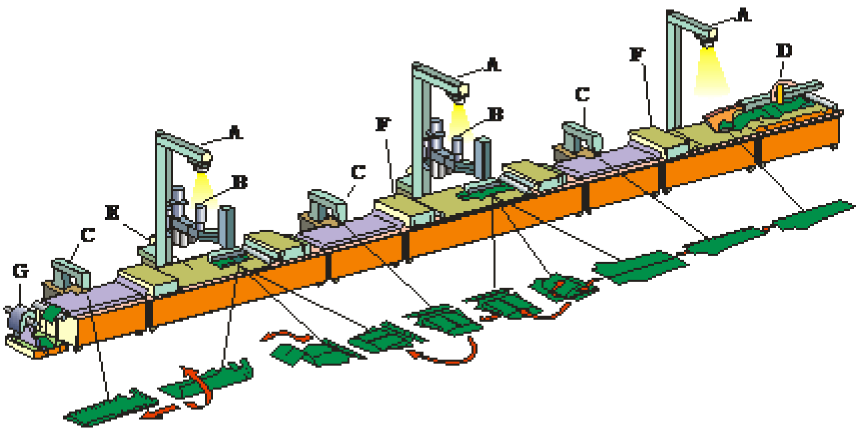

Figure 6. The automated production line for the production of trousers [1]

In Europe, the organization EUROTEX, with the project manager, has teamed up with the other major companies for making clothes, as well as with the companies from other areas. Their goal is to automate the production of the clothes. Schematic diagram of the production line is shown in Figure 7.

4. Conclusion

The introduction of industrial robots in manufacturing processes of textile industry is an indisputable necessity. It is known that the textile and clothing industry is an intensive industry regarding the labor and that the cost of labor and production in developed countries is high, which led to the disappearance of these activities in them. These countries are now looking for optimal solutions for balancing an automated production and employing people. Also requirements for small batches with lots of different clothing sizes, flexible manufacturing processes, production of the unique clothes on the industrial way, it will certainly benefit and accelerate noticeably wider use of robots in the technological processes of the textile and clothing industry.

Knowing the current development of the fashion industry, clothing engineering, and textile and clothing technology can be anticipated that future production processes of clothing still be never fully automated and robotic, nor will produce a larger series of garments. Mindset of the man of today is such that it can still be reconciled to drive mass produced car or mobile phone produced in an edition of millions of pieces, but for the clothing that worns, which protects him and which is closest to him and by that he can strongly express its individuality, independence or affiliation, can broadcast its views and atitudes. The man will be always searching for and striving to be unique and special, only one. Therefore, the designers of tomorrow days will create faster and faster new fashion details that can‘t be fast enough robotized nor it will be possible to produce it using robots.

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THE REGISTRATION OF INDUSTRIAL DESIGN IN THE REPUBLIC OF SERBIA

Nadežda LJUBOJEV & Siniša VARGA

Abstract: *One of the most importnant features of free market is competition. But competition is not uniform. There are many models businesses may compete among themselves on. As for modern markets, due to oligopolistic market stucture, non-price modes competition are dominant. One of them is produkt differentiation and one of the best ways to differ produkts of the same sort is trough industrial designing. In order to disble competitors to „wear borrowed plumes „ exclusive intellectual property right is provided for designers and their successors in title of industrial design is registered. The conditions and legal procedure for industrial design registration is the subject-matter of this research paper.*

Key words: industrial design, novelty, individual character, registration.

Introduction

The reason of legal regulation of industrial design is in economic value of esthetic shaping of goods. Economic value of esthetic shaping of goods cosisted of values of labour, time, knowledge, skilfulness and means invested in creation of industrial design as well as profits rising effects as a consequence of commercial use of industrial design. As for profit-related issues it is emphisized that the first impression on the products has being gotten upon their design that is in the marketing of immeasurable significance. Except that, industrial formating understands creation not any but nice-looking and likeable appearance of goods. Conferred to the area of doing business it means that products without any beauty are monotonous and they do not, that is from the marketing aspect the most important, attract attention of consumers. Therefore, since majority of people, more or less, feel natural need for esthetic, good-looking appearance of product serves to attract attention of consumers and influence their choice decision. Thereof the statement that "design can represent value for consumer and facilitate choosening" (Kotler, P.,1989).

By esthetic configuring of goods is possible to influence on consumers decision on choice because, the same as with trade mark, industrial design in customers' conscience generates psychologic effect. Though not in the sense of psychologic meaning of symbols but in the sense of inducing of pleasure engendered by esthetic experience. In other words, watching nicely shaped and fit out products people react emotional, i.e. make a judgment which administer to the final decision making on buying.

In respect to contribution of esthetic formation of goods to total marketing effects, work on creating and improving of esthetic quality of products is the subject of increased commercial interest. Industrial formating of goods is multidisciplinary activity. Creation of new appearance of goods understands application of knowledge from many areas such as: (applied) art, economics, marketing, psychology, sociology, esthetics, even ecology and customers security. Because of that esthetic formation of goods is economicaly very worthy and, at the same time, very complex activity. It is very true that for successful industrial design is necessary employ 'army' of vary experts. In relation to all of that it is necessary to provide legal protection of holders of results attained with such endeavor against parasite practices of those who do not want to invest enough time, money and efforts in esthetic modeling of goods.

Subject-matter of the industrial design rights

The subject-matter of industrial design rights is appearance of industrial or handicraft product. It is only a part of the industrial design conception as it is considered in design profession where industrial design is coherent unity of structural and functional elements of a product, including its appearance (Fruht, M., 1990). In industrial property law, however, industrial design is only overall visual impression left by industrial formating to informed customer or user of esthetic formed product. Subsequently, in the industrial property law, industrial design is deemed as a creation of exclusivelly esthetic character.

Industrial design is intellectual good because it is a result of intellectual creative labour which is possible to materialize on industrial or handicraft products countless times. It is exclusivelly of esthetic character because functional features and technical solutions at al are legally irrelevant in the sense of granting legal protection. In contrary legal protection of industrial design would extend to all products used for the same function. By regulating of industrial design as a legal notion confined to product appearance such danger is removed and subject of law has an exclusive right to produce goods of those appearance which the legally is protected, avoiding to obstruct anyone to produces goods which serve for the same function but of different appearance.

Albeit of intellectual character, industrial design is not an abstract or indefinable form. As a legal subject-matter, industrial design must be determiante. Industrial design is determined by visual characteristics such as: lines, contours, colours, shapes, textures, materials the product is produced of or decorated by, as well as their combinations (explanations of industrial design esthetic components find in: *Enciklopedija likovnih umjetnosti*, 1964; Fruht, M. et al.; Kuzmanović, S., 2008; Novaković, Lj., 2002; Vasiljević, M. R., 1999).

Requriments for registration

There are two general affirmative conditions which have to be fulfilled in order the right on industrial design would be granted. These are: novelty and individual character.

Novelty of industrial design

Industrial design is deemed as a new one if no identical design has been made available to the public before the date on which the design for which protection is claimed has first been made available to the public as well as before the date of filing of the application for registration of the design for which protection is claimed, or, if priority is claimed, the date of priority. The first question in connection with the novelty of industrial design is the question of identity of industrial design. Identity exists not only when comparable designs are the same - identic but also when they differ but not in intrinsic details. Intrinsic details of industrial design are those elements of industrial design which are dominant over appearance of a product. Inversely, immaterial details of industrial design are its less perceivable elements. Difference in immaterial details is a complex legal standard and has to be ascertain in every new case. It exists if informed user is not able to distinguish two designs on the first sight. For this legal standard is said that is complex because its contents are determined by two legal standards: *informed user* and *on the first sight*. Informed user is a phisical person to whom the design is directed. It means that informed user is neither manufacturer nor average consumer. They are regular users of the designed product who "have basic knowledge of product trend and availability and technical considerations, if any" (Bainbridge, D., 2007). On the first sight is a legal standard bz which is determined degree of informed user attention. Using described legal standard to determine identity of two designs has being done by spotting and compare differences but not similarities between them.

Industrial design is new unless have been made available to the public. One may make industrial design available to the public on many vary ways such as: publication, exibition, use in trade etc. Availability to the public does not have to encompass complete appearance but part of it enough to reproduce design in full. Industrial design is deemed available to the public as for its picture, drawing or shape of body. Availability of its oral or written description is not legally relevant saving that artistic reproduction of the design identical to the described one is possible. A disclosure of an industrial design has not being taken into account if an industrial design has been made availabe to the public by the designer, his successor in title or a third person as a result of information provided or action taken by the designer or his successor in title. This legal fiction is a temporary one - lasts for 12 months (so called *grace* period) and during the period persons authorised to claim protection are able to check marketing value of appearance and by virtue of that to decide is it worthy to invest effort, money and time in obtaining of exclussive legal protection. The same term is valid in the case of an industrial design disclosure beside designer or his successor in title volition (Art. 7(3) of 2002 Council Regulation (EC) on Community designs). Consequently, industrial design irremissible terminates to be new if available to the public has been made by the act of third person which is not in any legal or factual relationship with designer or his successor in title. But even then industrial design remains new if there is not possiblity that design become known to the business circles specialised in the sector concerned. Business circles specialised in the sector concerned are businesses registered for production and trade of designed goods as well as phisical persons - designers of those goods and firms where they are employed. But even in the case of availability of an industrial design to the business circless specialised in the sector concerned, industrial design remains legally new if it has been disclosed to a third person under explicit or implicit conditions of confidentiality.

So called *grace* period and esspecially prescription of relative publicity/confidentiality of industrial design tranquilize absolute effect of novelty but not convert it to relative one. This can be concluded particularly considering that "art of design" (Manigodić, M.,1988), along with a note on priority, contain all creations of industrial shaping comprised in industrial design applications filed anywhere, i.e. to any IP office in the world, regardless on their final legal epilogue.

Individual character of industrial design

The second general requirement for legal protection of industrial design is individual character. Industrial design has individual character if the overall impression it produces on the informed user differs from the overall impression produced on such a user by any design which has been made available to the public before the date on which the design for which protection is claimed has first been made available to the public or before the date of filing the application for registration or - if a priority is claimed - the date of priority. This requirment refers to creative work criterion, i.e. inventive contribution as an element for estimation if filed industrial design is eligible for registration. It means that industrial design consisted by simple summary of known appearances (e.g. calendar and thermometar) has not individual character. It does not mean that design must not be consisted from known esthetic elements. It does, of course. But it is very important that known esthetic components of design are combined on such a way that overall impression produced on informed user by that combination is different from overal impression produced by any other industrial design.

During esthetic formating of goods, designers are confined by technological and functional characteristics of products. Such stints are tolerate if appearance of the product is not solely dictated by its technical function.

There are two common rules for novelty and individual character. The first related to novelty and individual character of components and the second is related to moment when requirements for protection have to be fulfilled. In such a way, the legal protection of industrial design is not extended to those component parts which are not visible drugin normal use of a product, nor to those features of such part which are not visible when the part is mounted or which would not, in themselves, fulfil the requirements as to novelty and individual character. Normal use of a product is use of a product by final user excluding maintenance, servicing and repairing of a product. As for the second common rule, the moment when requirements for legal protection must be fulfilled is the moment of application filing i.e. moment of application priority, if claimed.

Apart from mentioned, there are examples where in comparative law as a requirement for granting of right to industrial design is laid down possibility of industrial or handicraft application. Application of industrial design in industrial or handicraft production is element of differentiation between industrial property law and copyright law. "In contrast to works of applied art where as a requirement for protection is not laid down industrial or handicraft application, as for industrial design this condition is *conditio sine qua non*" (Janjić, M., 1982). Therefore, in order to enjoy protection on the basis of industrial design law, picture, drawing or model have to be eligible for production in industry or by craftsmen. Otherwise, picture, drawing or model remain author's works and as such subject-matter of copyright only (Besarović, V., 1993).

Regardless if mentioned requirements for protection are fulfilled or no, industrial design can not be registered if:

1) publication or use of these is contrary to public policy or moral,
2) violate copyright or indutrial property right of the other person,
3) contain armorial bearings, flags and other State emblems, armorial bearings, flags, names or abreviations of international intergovernmental organizations, religious and national symbols as well as their imitations, unless authority approval is procured,
4) represents image of a person, unless explicit approval of the person is procured,
5) represents image of deceased person, unless alowance of its parents, spouse or children is not provided,
6) represents image of historical or other person, unless authority approval is procured and allowance of its consanguinity third degree relatives is provided.

THE LEGAL PROCEDURE FOR INDUSTRIAL DESIGN REGISTRACION

The registration of industrial design is the subject matter of a special administrative procedure that after application is filled is launched and conducted by authority that in the Republic of Serbia is Intellectual Property Office (IPO) in Belgrade.

The contents of industrial design application

The application of industrial design contain:
- request for industrial design registration,
- description of the industrial design,
- two-dimensional representation of industrial design.

The request for industrial design registration is filed in two copies on D-1 form.

The description of industrial design must be precise, concise and literally focused onto design. It means that an industrial design description should not contain data on construction an function of the product and its functional advantages with respect to congeaerous products as well as other similar data. Instead of that, an industrial design description firstly should contain assignement to esthetic characteristics of overall appearance of the product - appearance of the product in full and secondly descriptions of industrial design elements, especially those esthetic components which are distinctive and by virtue of which the discribed industrial design is dinstinct to any other known industrial design.

An industrial design description must be terminologically clear and readable. Clearness is attainable by using of art and geometry terminology. An industrial design description is readable if description is printed or typed on typing machine on the A4 paper format. Only one side of the sheet of paper is allowed to be used.

An industrial design description must contain:

1) information identifying applicant (on the left corner of the top of the page),
2) short and real but no commercial name of the designed product (centered),
3) information by virtue of which one may conclude that industrial design is new,
4) information on intented purpose of industrial design, if it is not deducable from the name of the designed product,
5) applicant's signature.

For every industrial design applicant must file two copies of the industrial design description. Videlicet, industrial design application may be filed as multiple. Towards Serbian law, one may file industrial design application for up to 100 designs, under condition that all of them are eligible to be applied on the same class products as it envisaged by Agreement establishing an international classification for industrial designes (Locarno, 1968). In the case of multiple application, it is necessary to write separate descriptions on a new sheet of paper (two copies) for every industrial design. By the way, applicant is not obliged that along to short and real name of a designed product or in any other part of the application denote the class of international classification. Classification has being done by IPO.

Ann industrial design description must be based on the industrial design representation. In that sense parts of descriptions contain numerical signs (arabic numbers written in brackets) identical to those contained in industrial design representation marking the component that is described.

The representation of industrial design must be filed in two copies. The first copy should be fixed or written in by computer in so called block-house - a bordered space located on the D-1 form reverse side on a such a way that around the representation must be left empty space the least 5 mm. The second copy, maximal dimensions 16x16cm is filed separately. The same as description, representation must be literally focused on industrial design. It means that industrial design representation must not contain image of any other thing, face or animal. Industrial design must bi represented so that all details are clearly visible. If it is not possible to be done by one representation, then is filed more representation of the same industrial design either from different angles or of different parts of designed product. In that case the rules on numbering are applied. Numbering of industrial design representation has being done by writing in two arabic numbers separated by full point towards general numerical queue (1.1, 1.2, 1.3,...). On the representation copy which is adhered to or written in by computer in the D-1 form reverse side numbering has being done on the front side and on the industrial design representation copy filing separately, numbering has been done on the reverse side. Additional rules on numbering are applied in the case of multiple application. In that case, the first number is the ordinal number of industrial design and the second number is ordinal number of the industrial design of the same ordinal number detail representation (1.1, 2.1, 2.2, 2.3, 3.1, ...). In any case, representations must be fixed on the D-1 form reverse side on that queue as they are numbered. For these purpose there are 20 "block-houses" available on the one form specimen.

Representation of the industrial design can be filed as a photograph or graphic reproduction of industrial design. Photograph must be of professional quality, with flat angles and neutral background. It must be got by virtue on photo negative or slide. It means that industrial design must not be represented by instant photograph, photograph retouched with ink or correcting fluid, photograph that is not suitable for offset reproduction or photocopy.

If applicant file industrial design representation in the form of graphic reproduction it must be original, of professional quality, made by equipment for technical drawing or by computer both on opaque white paper. Industrial design must be presented in perspective, but it is allowed to contain shadows due to reliefs presentation. Graphic reproduction must not be technical drawing where industrial design is presented in elevation views (projections) or cross-mode and especially it must not be a technical drawing that contain centerlines and dimensions. Graphic reproduction of industrial design must not contain explanations or legends (as those on maps) and must be siutable for offset reproduction.

Howsoever filed, industrial design representation must not be folded or stapled.

In some countries examiner is allowed to ask for a specimen of industrial design in order to better understand the description and feel texture or material. In Serbian law is prescribed that applicant is allowed to file a specimen instead of two-dimensional representation of industrial design. Maximal dimensions of such specimen are 26cm x 17cm x 3mm and it must not be heavier than 50 grams. Specimen is filed fixed on the paper (A4 paper size) and regularly numbered. Must not be folded. In such cases application will be deemed formally regular under condition that in next 6 months applicant file two-dimensional representation of industrial design prepared in accordance to law to IPO. Products that are suitable for spoilage or dangerous for storage will not be accepted as specimens.

After the application had been filed, the representation of industrial design can not be amended so that the scope and contents of it are essentially different from that as it described.

Application may be supplemented by:

1) Appointment of representative, if representative appointed.
2) Certified transcription of the application, if priority claimed,
3) Certification, if exhibition priority claimed,
4) Statement of designer(s) that (do)es not want that application contain his/her(their) name(s),
5) Statement on the legal ground for filing of application, if applicant is not designer,
6) Statement on appointment of common representative, if there are more applicants,
7) Proof that taxes are paid.

Conclusion

The reason for the legal protection of the results of industrial designing is in economic value of the esthetic shaping of goods. The subject-matter of the industrial design rights is appearance of industrial or handicraft product. There are two general affirmative conditions which have to be fulfilled in order that the right on industrial design is granted: novelty and individual character. Fulfillment of the mentioned requirements is the subject matter of a special administrative procedure that, after the application is filled, is launched and conducted by authority that in the Republic of Serbia is Intellectual Property Office (IPO) in Belgrade. The right on industrial design is granted for 25 years. During the period, commercial exploitation of the registered industrial design is reserved for the right holder(s) (and their successors in title) exclusivelly.

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VAT DYEING OF CASEIN FIBERS

Ozan AVINC, Gorkem GEDIK, Arzu YAVAS & Selim SAHIN

Abstract: *In this study, casein fiber fabric was dyed with IW and IN vat dyes. Color properties, wash and rub fastness performance of dyed samples were investigated. Fastness results of vat dyed samples were also compared with that of an acid dyed (with an acid half milling dye) sample. High wash and rub fastness levels were achieved by vat dyeing of casein fibers.*

Key words: Casein fiber, vat dyeing, acid dyeing, color properties, fastness properties.

Introduction

The raw material of casein fiber is skimmed milk which is a byproduct of butter production. Casein fibers are produced in staple form, since they are mostly consumed for blends with cotton, wool, rayon or synthetic fibers. The cross section of casein fibers is presented on Figure 1. Casein fiber brings in important features to blends such as soft handling, heat insulation and flexibility. Casein fibers are generally used in garment, hat and carpet production (Cook, J.G.). These kinds of uses of textiles may require high fastness values that can only be fulfilled by the vat dyes.

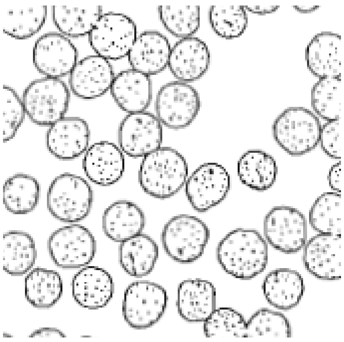

Figure 1 Cross section of casein fibers (Merinova™) (Cook, J.G.)

Vat dyes which provide very high fastness properties are an important dye class for cellulosic fibers (Choudhury, A. K. R., Aspland J.R., Perkins, W.S.). Even if these dyes are generally applied to cellulosics, in some cases, application range also covers protein fibers (Perkins, W.S., Rivlin, J.). Vat dyes are keto- substituted water insoluble pigments; therefore they must be reduced to water soluble leuco form which has affinity to fibers. After a proper penetration of dyes into the fibers, oxidation process is carried out to transform the water soluble dyes to their original water insoluble form in the fiber (Choudhury, A. K. R., Aspland J.R, Perkins, W.S., Rivlin, J., Broadbent A.D.). If a vat dye is reduced easily it will be oxidized difficult or vice versa (Broadbent, A.D.).

Vat dyes which are mainly indigoids, fused ring polycyclics or anthraquinone derivatives (Perkins, W.S.) are classified as IK, IW and IN types according to the substantivity of reduced dye and dyeing conditions such as dyeing temperature and chemical requirements. IK type vat dyes are carried out at low temperature and require small amount of alkali and high amount of salt, whereas IW dyes needs moderate temperature. IN dyes are applied at high temperature accompanied with high alkali usage without any salt requirement, also this group of vat dyes have high substantivity to cellulose. (Choudhury, A. K. R., Aspland J.R, Rivlin, J., Broadbent A.D.)

In this study, it was aimed to specify the vat dyeing performance on casein fibers. High fastness is generally required for textile products. Especially wash fastness is a key customer requirement for apparel goods (Karl U., and Freyberg P.). Therefore, the main goal was to obtain fast colors on casein fiber. Casein fabric was dyed with one IN and one IW vat dyes. Color properties and ISO washing (C06/A2S), and wet & dry rub (X12) fastness properties were examined. Moreover, fastness properties of 2% o.w.f. vat dyed casein samples are compared with 2% o.w.f. acid dyed (with Telon Red A2R, a half milling acid dye with medium molecular size) sample.

Experimental

Dyeing

One IW (C.I. Vat Red 10) and one IN (C.I. Vat Orange 2) dyes were applied to casein fabrics by pre-pigmentation method at 2% concentration to achieve medium depth of shades at 1: 20 liquor ratio. Molecular structure of dyes, dyeing procedure and the amount of chemicals used are shown on Figures 2 - 4 and Table 1, respectively. Dyeing process was carried out with ATAC LAB-DYE HT laboratory type exhaustion dyeing machine.

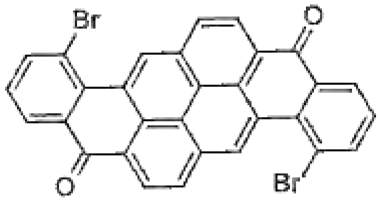

Figure 2 C.I. Vat Orange 2 [http://www.chemicalbook.com reviewed on 30/07/2011]

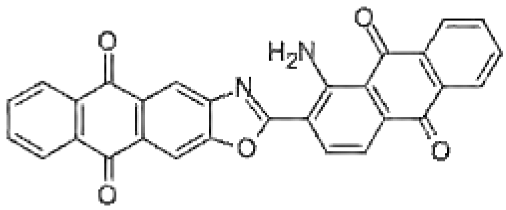

Figure 3 C.I. Vat Red 10 [http://www.chemicalbook.com reviewed on 30/07/2011]

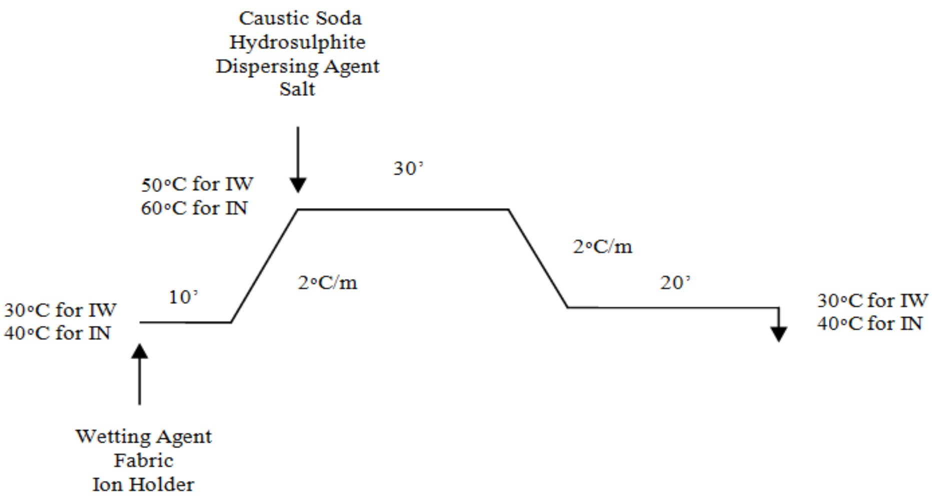

Figure 4 Dyeing procedure

Table 1 Chemical consumption

Dye Type and Concentration	Chemical Amounts					
	Caustic Soda (ml/l) (38°Be)	Hydrosulphite (g/l)	Salt (g/l)	Ion Holder (ml/l)	Wetting Agent (ml/l)	Dispersing Agent (ml/l)
IW %2	7	3.5	12.5	3	1	1
IN %2	13	4.5	-	3	1	1

Colorimetric Measurements
CIELAB color properties were determined with Datacolor 600 spectrophotometer under D65 standard day light (10° observer). *K/S* color strength values were calculated according to Kubelka - Munk equation.

Fastness Tests
Washing, wet & dry rub fastness tests were performed according to ISO 105 C06 A2S and ISO 105 X12 standards, respectively. M228 Rotawash machine (SDL ATLAS, UK) was used for wash fastness tests.

<u>Results and discussion</u>

Color Properties
Observed color yield values by *K/S* and CIELAB values of L^*, a^*, b^*, C^*, and h^o of vat dyed casein fiber fabric samples are given on Table 2. Orange and red shades were obtained with C.I. Vat Orange 2 and C.I. Vat Red 10, respectively. This shade difference can also be seen from a^*, b^*, and hue angle (h^o) values of dyed casein fabrics (Table 2). Casein fabric dyed with C.I. Vat Red 10 exhibited slightly higher color yield than that of dyed with C.I. Vat Orange 2.

Table 2 Colorimetric properties of vat dyed casein fiber fabric

Dye Type	*K/S*	*L**	*a**	*b**	*C**	*h°*
C.I. Vat Orange 2	7.6	56.3	40.0	44.6	59,9	48,1
C.I. Vat Red 10	10.1	42.8	45.9	10.3	47,0	12.6

Wash Fastness
Wash fastness properties are shown on Table 3. Casein fiber fabric sample, dyed with C.I. Vat Orange 2, exhibited excellent wash fastness properties by 5 grey scale grade for both staining and the shade change. Dyed casein fiber fabric sample with C. I. Vat Red 10 exhibited quite good wash fastness properties by 5 gray scale rating for most of the fibers in the multi-fiber. 4/5-5 gray scale rating for wash fastness staining is observed only for the polyester and nylon component of the multi-fiber adjacent (Table 3). However, one should not forget that these values are still in the commercially acceptable range which is above gray scale rating of 4. This performance is expected from vat dyes, since fastness values of anthraquinone vat dyes are generally around 4-5 (Rivlin, J.).

Table 3 Wash fastness properties of vat and acid dyed casein samples

Dye	Wash Fastness Shade Change	Wash Fastness Staining (C06-A2S)					
		Wool	Acrylic	Polyester	Nylon	Cotton	Acetate
Vat Orange 2	5	5	5	5	5	5	5
Vat Red 10	5	5	5	4/5-5	4/5-5	5	5
Telon Red A2R	3	4	5	4/5-5	2/3	3/4	4/5

Although casein fiber is one of the protein fibers, wash fastness properties of acid dyed casein sample with a half milling acid dye is not satisfactory; nylon and cotton staining and shade change values are below the commercially acceptable range (equal to/above 4) (Table 3). Vat dyeing of casein fiber resulted in better wash fastness values than that of acid dyeing.

Rub Fastness

Dry and wet rub fastness properties are presented on Table 4. Dry & wet rub fastness values of vat and acid dyed casein samples are varied between 4 and 5. Vat dyed sample with C.I. Vat Orange 2 steps forward with the best rub fastness values among other samples studied. Wet rub fastness value of acid dyed sample is the worst one with 4 in the studied dyes; however, this value is still commercially acceptable.

Table 4 Rub fastness properties

Dye	Rub Fastness (X12) (Cotton Staining)	
	Dry	Wet
Vat Orange 2	5	4/5-5
Vat Red 10	4/5-5	4-4/5
Telon Red A2R	4/5-5	4

Conclusion

7.6 and 10.7 color yield values were obtained via vat dyeing of casein fibers with C.I. Vat Orange 2 and C.I. Vat Red 10 dyes, respectively. Wash fastness properties of casein fabric sample dyed with vat orange 2 were excellent. Moreover, sample dyed with vat red 10 exhibited commercially acceptable fastness values. Better wash fastness results were achieved with vat dyeing than acid dyeing (with a half milling dye). Rub fastness properties were similar for all vat and acid dyed samples. High wash and rub fastness levels can be achieved by vat dyeing of casein fibers.

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MODELING OF WEFT MOVEMENT IN PNEUMATIC LOOM CHANEL

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Abstract: *On the basis of previous research, the paper presents mathematical model of weft movement in pneumatic loom channel. The model is an improved version of one of the already existing model of V. I. Ljubovicki [2,3], and D.T. Stojiljković and… (4) present Abel's differential equation of the second order. The solution of the model gives an expression for weft velocity change in a pneumatic loom channel. In the model of V. I. Ljubovicki velocity is approximated by linear function, and in the model of D.T. Stojiljković i … (I) velocity is approximated by polynomial of the 15th degree. In this paper velocity is approximated by exponential function with a relative error of less than 3%. The values obtained been compared with experimental data from literature [2,3]. It has been found that the model adequately describes yarn velocity change in a pneumatic channel of a weaving loom.*

Key words: weft, pneumatic loom, modeling.

1. Introduction

With modern technology development many new processes of weft through shed were perfected. One of them in pneumatic transport. Therefore, need appears for dynamic modeling of this process. This matter is dealt with by a great number of research in the world, so in absence of possibility of experimental research, some of those results were also used in this paper.
In Fig.1 the scheme of weft transport through shed in pneumatic looms is shown. The weft is brought through the directing device to the weft tube of the jet. Before the transport starts, the weft is still, with section of length **h** protruding from the jet. By compressed air stream which is brought to the jet, the weft is set into motion and transported through the shed.

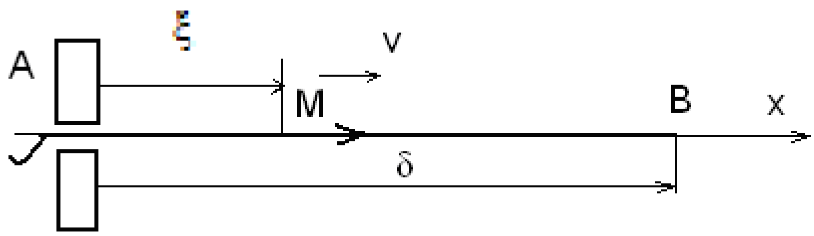

Fig.1

2. Mathematical model

In paper [1] theory of yarn movement through pneumatic loom channel in Lagrange coordinates given. On the basis of this theory, differential equation of yarn movement has the form:

$$\frac{1}{\mu}\cdot\frac{\partial F_z}{\partial \xi}=\frac{du}{dt}-F\,, \qquad (1)$$

where: μ – length mass of the yarn in kg/m,
F_z – yarn stretching force in N,
ξ – current coordinate,
u – velocity of yarn movement in m/s,
t – time in s,
F – force of mutual action of yarn and air stream (aerodynamics force) in N.

Under supposition that speed of air stream is less than the speed of movement of sound in the air,in papers [2 and 3] detailed examinations of F force were made. If yarn is placed along the air stream axis, illustration 1 and if pressure (p) and density (ρ) of air are constant, then the vertical aerodynamic force is determined on the basis of expression:

$$F=\frac{1}{2\cdot\mu}\cdot C_x\cdot\rho\cdot\pi\cdot d\cdot v_x^2\,, \qquad (2)$$

where: C_x – coefficient of yarn aerodynamic resistance,
d – yarn diameter in m,
ν_x – velocity of air stream movement in m/s.
Coefficient C_x is determined by experiment in the following form as wll [2 i 3].
Aerodynamic force F can be expressed in the following form as well:

$$F=k\cdot(\nu-u)\,, \qquad (3)$$

where: $k=\frac{1}{2\cdot\mu}\cdot\rho\cdot\pi\cdot d\cdot\alpha_1\,,$
$\alpha_1=C_x\cdot\nu_x\,,$
$\nu=\nu(\xi)$ - velocity of air in m/s.
The differential equation (1) can now written in the form:

$$\frac{1}{\mu}\cdot\frac{\partial F_z}{\partial \xi}=\frac{du}{dt}-k\left[\nu(\xi)-u(t)\right], \qquad (4)$$

After integration, the equation (4) acquires the form:

$$\frac{F_z}{\mu}=\frac{du}{dt}\cdot\xi-k\cdot\left[U(\xi)-u\cdot\xi\right]+\vartheta(t)\,, \qquad (5)$$

where: U(ξ) – function obtained by integration of function ν(ξ),
ϑ (t) – arbitrary function which is to be determined.

Function u(t) and ϑ (t) are determined on the basis of border conditions: at he guiding end of the yarn $F_z\big|_{\xi=\delta}=0$, at passing of the jet $F_z\big|_{\xi=0}=F_{z0}$. This condition depends on the mode of bringing the yarn into the yet. In modern looms, yarn is brought from respective drum by the free loop. Starting from these conditions, it can be supposed that the stretching force of the yarn at point $\xi=0$ is equal to the stretching force of the yarn in the part which is attached to the moving section, i.e.:

$$F_z\Big|_{\xi=0} = F_{z0} = \mu \cdot u^2 . \qquad (6)$$

In the condition (6) is replaced by the condition (5) $\vartheta = \left[u^2 = k \cdot U(0)\right]$, is obtained, i.e.:

$$\frac{F_z}{\mu} = \frac{du}{dt} \cdot \xi + k \cdot u \cdot \xi + u^2 - k \cdot U(\xi) + k \cdot U(\xi) + k \cdot U(0) . \qquad (7)$$

Having in mind the yarn velocity is equal $u = \frac{d\delta}{dt}$, and border condition $F_z\Big|_{\xi=\delta} = 0$, differential equation is obtained which describes the movement on the guiding end of the yarn in pneumatic loom channel in the form:

$$\delta \cdot \ddot{\delta} + k \cdot \delta \cdot \dot{\delta} + \dot{\delta}^2 - k \cdot U(\delta) + k \cdot U(\xi) + k \cdot U(0) = 0 \qquad (8)$$

This is Abel's differential equation of the second order.

3. Determining the yarn movement velocity

The Fig.2 shows how the air stream velocity **V** depends on cureeent coordinate ξ which is obtained by experimental research of V. I. Ljubovicki [2 and 3].

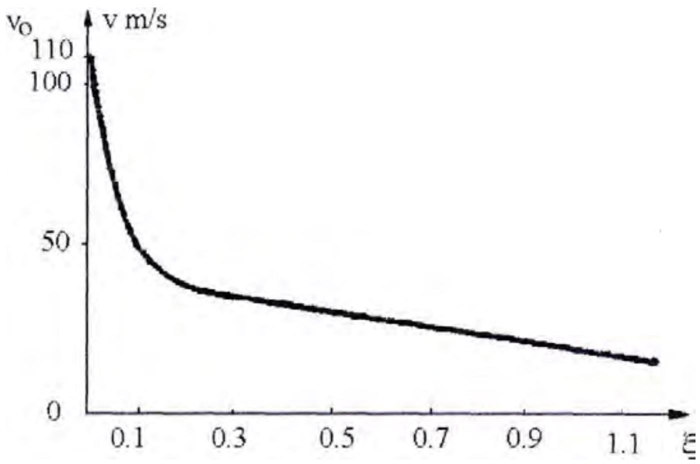

Fig.2

In these papers V. I. Ljubovicki has divided the distribution of stream movement velocity in pneumatic loom channel obtained by experiments into two areas, and approximated it in each area by linear function. In the paper (2) the function of velocity is approximated by polynomial the 15th degree (model I).
In this paper the velocity distribution is approximated in general case by function (model II):

$$v(\xi) = \xi_0 + A_1 * \exp(-\xi / t_1) + A_2 * \exp(-\xi / t_2) + A_3 * \exp(-\xi / t_3) , \qquad (9)$$

where ξ_0=-29,64875; A_1=40,355; t_1=0,04906; A_2=72,00924; t_2=61,722; A_3=27,50223; t_3=0,04878.
In this case, function U(ξ) is equal:

$$U(\xi) = \int v(\xi) * d\xi = \int (\xi_0 + A_1 * \exp(-\xi / t_1) + A_2 * \exp(-\xi / t_2) + A_3 * \exp(-\xi / t_3)) * d\xi =$$
$$= \xi_o * \xi - t_1 * A_1 * \exp(-\xi / t_1) - t_2 * A_2 * \exp(-\xi / t_2) - t_3 * A_3 * \exp(-\xi / t_3)$$

(10)

because U(0)=0.
If we pass from current coordinate ξ to coordinate δ, mathematical model of yarn movement in pneumatic loom channel is obtained in the form

$$\delta\cdot\ddot{\delta}+k\cdot\delta\cdot\dot{\delta}+\dot{\delta}^2-k\cdot(\xi_o*\xi-t_1*A_1*\exp(-\xi/t_1)-t_2*A_2*\exp(-\xi/t_2)-t_3*A_3*\exp(-\xi/t_3))=0$$
(11)

Replacement $\dot{\delta}=y$, $\ddot{\delta}=y\cdot y'$, is introduced, equation (11) reduced to the equation:

$$\delta\cdot y\cdot y'+y^2+k\cdot\delta\cdot y+\dot{\delta}^2-k\cdot(\xi_o*\xi-t_1*A_1*\exp(-\xi/t_1)-t_2*A_2*\exp(-\xi/t_2)-$$
$$-t_3*A_3*\exp(-\xi/t_3))=0 \quad (12)$$

which after arranging can be written in the following form:

$$y*y'=-\frac{y^2}{\delta}-k*y-\frac{k}{\delta}\cdot(\xi_o*\xi-t_1*A_1*\exp(-\xi/t_1)-t_2*A_2*\exp(-\xi/t_2)-t_3*A_3*\exp(-\xi/t_3))=0$$
(13)

New replacement is introduced: $w(y)=y*\delta; w'=y'*\delta+y; w=\delta*\dot{\delta}$, so

$$w*w'=y*\delta*(y'*\delta+y)$$
$$w*w'=-k*w*\delta+k*\delta*(\xi_o*\xi-t_1*A_1*\exp(-\xi/t_1)-t_2*A_2*\exp(-\xi/t_2)-t_3*A_3*\exp(-\xi/t_3))$$
(14)

By introducing the new function $w=z(\delta)-\frac{k\cdot\delta^2}{2}; w'=z'-k\cdot\delta$, the following is obtained:

$$z*z'-z'*\frac{k*\delta^2}{2}=-k*\xi*(\xi_o*\xi-t_1*A_1*\exp(-\xi/t_1)-t_2*A_2*\exp(-\xi/t_2)-t_3*A_3*\exp(-\xi/t_3))$$
(15)

Now the new function is introduced in the following manner:

$$z(\delta)=a(\xi)$$

$$\xi=\int(\text{-k}*\text{x}*(\delta_0*\delta\text{ - t}_1*\text{A}_1*\exp(\text{-}\delta/\text{t}_1)\text{ - t}_2*\text{A}_2*\exp(\text{-}\delta/\text{t}_2)\text{ - t}_3*\text{A}_3*\exp(\text{-}\delta/\text{t}_3))\,\text{d}\delta=$$
$$=\text{-k}*((1/3*\delta_0*\delta\text{\textasciicircum}3\text{ - t}_1\text{\textasciicircum}3*\text{A}_1*(\text{-}\delta/(\text{t}_1*\exp(\delta/\text{t}1_1))\text{ - }1/\exp(\delta/\text{t}_1))\text{ -}$$
$$\text{- t}_2\text{\textasciicircum}3*\text{A}_2*(\text{-}\delta/(\text{t}_2*\exp(\delta/\text{t}_2))\text{ - }1/\exp(\delta/\text{t}_2))\text{ - t}_3\text{\textasciicircum}3*\text{A}_3*(\text{-}\delta/(\text{t}_3*\exp(\delta/\text{t}_3))\text{ - }1/\exp(\delta/\text{t}_3)))$$
(16)

So the following linear equation is obtained, which separates the variables:

$$a\cdot a'-a'\cdot\frac{k\cdot\delta^2}{2}=1 \quad (17)$$

The solution of which has the form:

$$a^2-a\cdot k\cdot\delta=2\cdot\xi+2\cdot C_{1.}. \quad (18)$$

As $a = z = w + \frac{k \cdot \delta^2}{2}$, by arranging (18) the following is obtained:

$$w^2 - \frac{k^2 \delta^4}{4} = 2 \cdot \xi + 2 \cdot C_1$$

als as $w = \dot{\delta} \cdot \delta$, the following is obtained:

$$\dot{\delta}^2 \cdot \delta^2 - \frac{k^2 \cdot \delta^4}{4} = 2 \cdot k \cdot \sum_{i=0}^{n} a_i \cdot \frac{\delta^{i+3}}{(i+1) \cdot (i+3)} + 2 \cdot C_1$$

$$\dot{\delta} \cdot \delta^2 - \frac{k^2 \cdot \delta^4}{4} = 2 \cdot (\text{-k} * ((1/3 * \delta_0 * \delta\text{\^{}}3 - t_1\text{\^{}}3 * A_1 * (-\delta/(t_1 * \exp(\delta/t_1)) - 1/\exp(\delta/t_1)) -$$
$$- t_2\text{\^{}}3 * A_2 * (-\delta/(t_2 * \exp(\delta/t_2)) - 1/\exp(\delta/t_2)) - t_3\text{\^{}}3 * A_3 * (-\delta/(t_3 * \exp(\delta/t_3)) - 1/\exp(\delta/t_3))) + 2 \cdot C_1$$

…………………………………………………… (19)

The constant C_1 is determined from the initial conditions, for $t = 0, \delta = h$,h_0=0 and $\dot{\delta} = 0$, i.e.,

$$2 \cdot C_1 = -\frac{k^2 \cdot h^4}{4} - 2 \cdot k \cdot \sum_{i=0}^{n} a_i \cdot \frac{h^{i+3}}{(i+1) \cdot (i+3)} \quad \text{……..} \quad (20)$$

$$2 \cdot C_1 = -\frac{k^2 \cdot h^4}{4} + 2 \cdot \text{k} * ((-t_1\text{\^{}}3 * A_1 * (-h/(t_1 * \exp(h/t_1)) - 1/\exp(h/t_1)) -$$
$$- t_2\text{\^{}}3 * A_2 * (-h/(t_2 * \exp(h/t_2)) - 1/\exp(h/t_2)) - t_3\text{\^{}}3 * A_3 * (-h/(t_3 * \exp(h/t_3)) - 1/\exp(h/t_3)))$$

(20)

$$\delta^2 \dot{} \cdot \delta^2 - \frac{k^2 \cdot \delta^4}{4} = 2 \cdot (\text{-k} * ((1/3 * \delta_0 * \delta\text{\^{}}3 - t_1\text{\^{}}3 * A_1 * (-\delta/(t_1 * \exp(\delta/t_1)) - 1/\exp(\delta/t_1)) -$$
$$- t_2\text{\^{}}3 * A_2 * (-\delta/(t_2 * \exp(\delta/t_2)) - 1/\exp(\delta/t_2)) - t_3\text{\^{}}3 * A_3 * (-\delta/(t_3 * \exp(\delta/t_3)) - 1/\exp(\delta/t_3))) - \frac{k^2 \cdot h^4}{4} +$$
$$+ 2 \cdot \text{k} * ((-t_1\text{\^{}}3 * A_1 * (-h/(t_1 * \exp(h/t_1)) - 1/\exp(h/t_1)) - t_2\text{\^{}}3 * A_2 * (-h/(t_2 * \exp(h/t_2)) - 1/\exp(h/t_2)) -$$
$$- t_3\text{\^{}}3 * A_3 * (-h/(t_3 * \exp(h/t_3)) - 1/\exp(h/t_3)))$$

If (20) repliced by (19) the expression for velocity of yarn movement in the pneumatic loom channel is obtained in the form:

$$\dot{\delta} = \frac{1}{\delta^2} \cdot \sqrt{\begin{array}{l} \frac{k^2 \cdot \delta^2}{4} + 2 \cdot (\text{-k} * ((1/3 * \delta_0 * \delta\text{\^{}}3 - \text{t}_1\text{\^{}}3 * \text{A}_1 * (-\delta/(\text{t}_1 * \exp(\delta/\text{t}_1)) - 1/\exp(\delta/\text{t}_1)) - \text{t}_2\text{\^{}}3 * \text{A}_2 * \\ * (-\delta/(\text{t}_2 * \exp(\delta/\text{t}_2)) - 1/\exp(\delta/\text{t}_2)) - \text{t}_3\text{\^{}}3 * \text{A}_3 * (-\delta/(\text{t}_3 * \exp(\delta/\text{t}_3)) - 1/\exp(\delta/\text{t}_3))) - \frac{k^2 \cdot h^4}{4} + \\ + 2 \cdot \text{k} * ((-\text{t}_1\text{\^{}}3 * \text{A}_1 * (-h/(\text{t}_1 * \exp(h/\text{t}_1)) - 1/\exp(h/\text{t}_1)) - \text{t}_2\text{\^{}}3 * \text{A}_2 * (-h/(\text{t}_2 * \exp(h/\text{t}_2)) - 1/\exp(h/\text{t}_2)) - \\ - \text{t}_3\text{\^{}}3 * \text{A}_3 * (-h/(\text{t}_3 * \exp(h/\text{t}_3)) - 1/\exp(h/\text{t}_3))) \end{array}} \tag{21}$$

4. Analysis of the results obtained

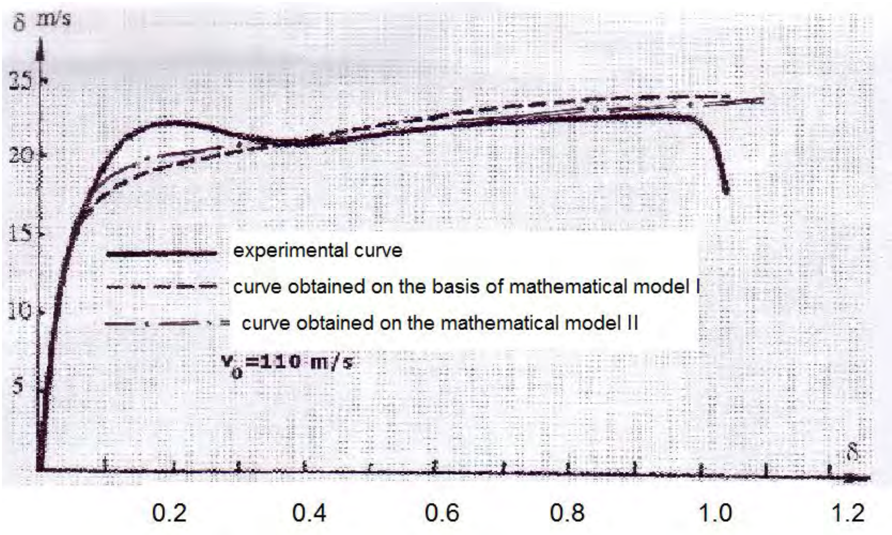

Fig.3

On the basis of experimental results in [2 i 3] brzine of air stream velocity shown in illustration.2, aproximate function V=V(ξ) in the form of polinomial of 15th degree is obtained (model I). Aft first approximation the relative error was lees than5%. (k=1.5734834·10^{-8}, h=0.015m).
U ovom radu aproksimacija je izvršena eksponencijalnom funkcijom (9) pri ĉemu je relativna greška manja od 3%. (k=1.5734834·10^{-8}, h=0.015m).
In Fig.3 the results of theoretical and experimental research of yarn movement velocity in pneumatic loom cahannel are shown.
From Fig.3 it can be seen that the model follows well the yarn movement velocity in pneumatic loom channel. Deviations of experimental results from theoretical results are somewhat greater in the part passage 0.1 do 0.3m. Examinations were perfomed for cotton yarn of length mass T_t=15.4x2 tex. Model II D.T. Stojiljkovića and ... give the best results and deviations from the experimental results are less than 5%.

5. Conclusions

In this paper, on the basis of experimental research of airflow velocity through pneumatic loom channel, the mathematical model of yarn transport through loom channel was stated. The mathematical model is Abel‘s differential equation of second order for the subject case, given durinf work. By comparing experimental with theoretical results of research of yarn transport velocity, it was found that the model II of D.T. Stojiljković i.. describes the real process well. The model received can be used as well for determining of yarn stretching force during its transport through pneumatic loom channel.

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UNWINDING YARN FROM CONIC PACKAGES

Stanislav PRAČEK

Abstract: *Yarn unwinding from a package is important in many textile processes. The stability of the unwinding process has a direct influence on the efficiency of the process and on the quality of the end product. During the unwinding, the tension is oscillating. This is especially noticeable in over-end unwinding from a static package, where the yarn is being withdrawn with a high velocity in the direction of the package axis. In the case of conic packages the angular velocity of unwinding depends not only on the winding angle as is the case for cylindric packages, but also on the apex angle. We will show that the dimensionless angular velocity depends very little on the apex angle. The apex angle, however, also determines the effective radius of the package at the lift-off point, therefore the angular velocity can be proportionally highe.*

Key words: conical packages,oscillations, winding angle, yarn unwinding, angular velocity.

1. Introduction

When the yarn is being unwound from a cylindrical package, the angular velocity of the yarn forming the balloon depends on three parameters: the package radius, the unwinding velocity, and the winding angle. Particularly important is the last parameter, since it is closely related to the oscillations of the tension in the yarn(Kothari & Leaf, 1979 ; Fraser & Ghosh & Batra, 1992 ; Fraser, 1992; Clark & Fraser & Sharma & Rahn, 1998) . In this paper we will investigate the unwinding from conic packages and the role of another parameter: the apex angle.

2. Theoretical part

We study the unwinding from conic packages (Fig. 1). We denote the apex angle by α and the winding angle by ϕ. In the present context, the winding angle is defined as the angle between the tangential line on the package surface which is perpendicular to the package axis and the line tangential to the yarn at the lift-off point. The smallest radius of the package is c_0 and angle of conic α.

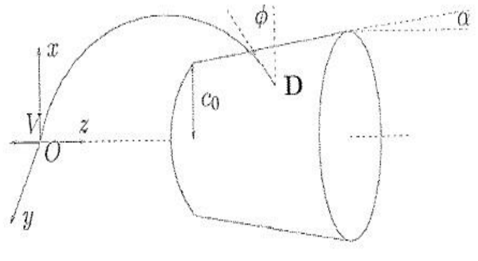

Figure 1: Yarn unwinding from a conical package.

In conical packages the relation between the angular velocity of the yarn during unwinding ω, the unwinding speed V and the package radius c at the lift-off point, where the yarn lifts off from the package surface, is (Praĉek, 2002):

$$\omega = \frac{V\cos\phi}{c(1-\cos\alpha\sin\phi)} \tag{1}$$

Here ϕ is the winding angle and α is the apex angle of the conical package. From the simplest theory of the yarn unwinding which doesn't take into account the air drag nor the Coriolis force, we know that the tension is proportional to the angular velocity squared

$$T_0 \propto \omega^2 \tag{2}$$

This expression is only approximately true. A better estimate could be obtained from the full equation of motion for the yarn, but no simple analytic expression can be obtained in this case. In addition, a balloon limiter is usually used during the unwinding. This device limits the radius of the balloon, thereby reducing the centrifugal force on the yarn in the balloon and consequently the tension is lower as well. For this reason we performed experimental measurements to determine the relation between the tension and the angular velocity. We measured tension for parallely wound cylindrical packages of different dimensions and for different unwinding velocities.
We performed a series of measurements for different unwinding velocities *V* and package radii *c*.

In building this model we make a few assumptions:

1. The length of the yarn in the balloon has no effect on the tension.
2. We neglect the residual tension of yarn in the package, which is related to the stiffness of the winding.
3. The winding angle and the number of the threads are approximately constant in the number of the layers whose unwinding will be simulated.

3. Practical part

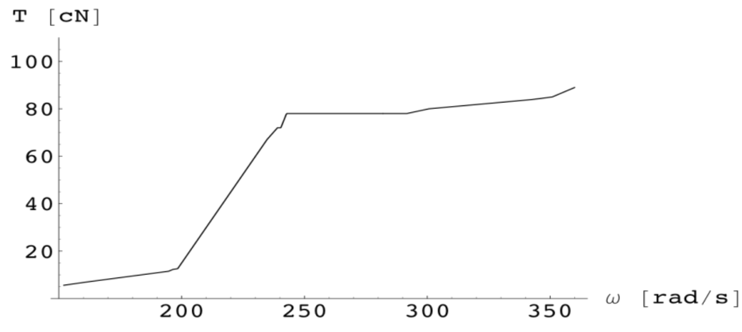

Fig. 2: Dependence of tension T on angular velocity ω of the yarn

Dependence of T on ω, based on experimental results for cylindrical parallely wound package with cotton yarn 41.6 tex.

A few comments about the dependence of T on ω (Fig. 2) are in order. At low ω, up to approximately ω = 240 rad/s, the tension increases approximately quadratically, which is to be expected from the formula in Eq. (2). After the limiting value of ω = 240 rad/s, the tension is bounded and increases only slightly. This is a direct consequence of using the balloon limiter in the measurements: at the limiting value of the angular velocity the radius of the balloon becomes large enough that it is limited by the balloon limiter. The centrifugal forces then no longer increase with ω and the tension can only grow due to the yarn friction with the surface of the limiter and other less controllable reasons. Since similar balloon limiters are also used in the actual industrial process, it is advantageous to take them into account in our model.

We now present the results of the simulations. In Fig. 3 we show the tension during unwinding from conic packages of different apex angles. As expected on basis of Eq. (1), in the range of apex angles of conic packages, the effect of package shape is rather small.

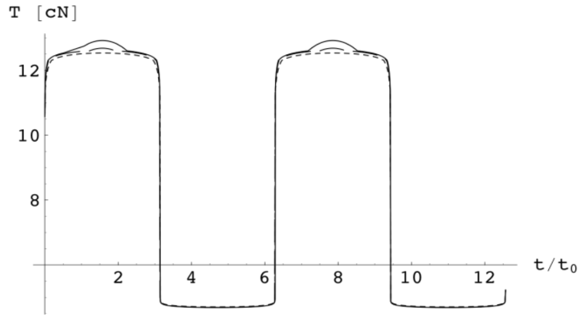

Fig. 3: Tension for conic packages of radius c = 200 mm and winding angle $\phi = 10$ at unwinding velocity V = 2000 m/min for different apex angles. $\alpha=0°$ solid line, $\alpha=5°$ dashed line, $\alpha=10°$ dotted line.

In Fig. 4 we compare a package with alternating layers with a regular cross wound package. The unwinding velocity is 2000 m/min, the package radius is 150 mm and the winding angle of cross wound layers is 10°. As expected, the parallely wound layers significantly reduce the tension that would otherwise possibly lead to yarn breaking. The alternating layer packages would therefore allow unwinding at greater unwinding velocities compared to conventional cross wound packages.

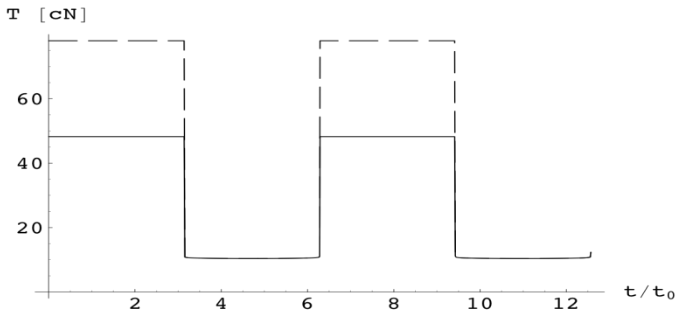

Fig. 4: Tension in packages with alternating layers (solid line) and in conventional cross wound packages (dashed line). Unwinding velocity V = 2000 m/min, package radius c = 150 mm, winding angle $\phi = 10°$.

The oscillations of the tension are related to the oscillations in the angular velocity of the yarn. The amplitude of the angular velocity oscillations can be obtained as

$$\Delta\omega = \omega_{\max} - \omega_{\min} = \frac{V}{c}\frac{\cos\phi}{1-\sin\phi} - \frac{V}{c}\frac{\cos(-\phi)}{1-\sin(-\phi)} \\ = \frac{2V}{c}\tan\phi. \tag{3}$$

In the region of interest, i.e. for $\phi < 25°$, we can approximate $\tan\phi \sim \phi$, so we have

$$\Delta\omega \approx \frac{2V\phi}{c}. \tag{4}$$

According to this expression, the amplitude of angular velocity oscillations is approximately proportional to the unwinding velocity and the winding angle and inversely proportional to the package radius.

In Fig. 5 we plot the amplitude of oscillations of the tension as a function of the winding angle and the package radius for a constant unwinding velocity V = 2000 m/min. Oscillations become very large for increasing value of the winding angle. For packages of small radius, c = 70 mm, unwinding is only safe for winding angle below $\phi = 5°$.

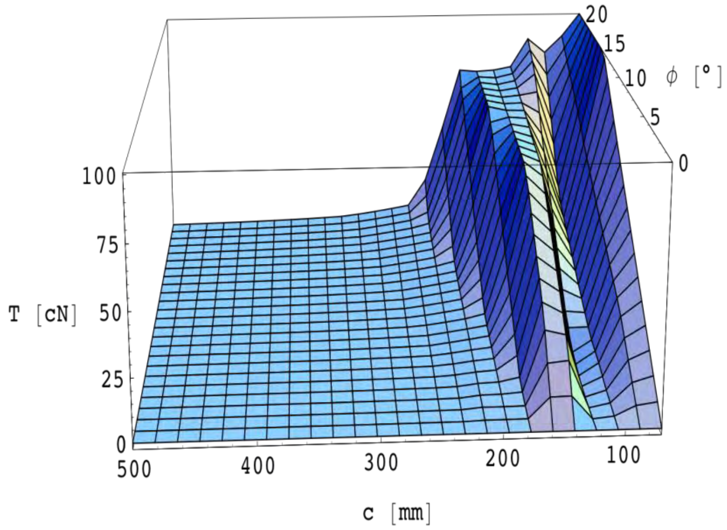

Fig. 5: Amplitude of oscillations as a function of the winding angle ϕ and the package radius c for constant unwinding velocity V = 2000 m/min.

In Fig. 6 we show the amplitude of oscillations as a function of package radius and the unwinding velocity for a constant winding angle $\phi = 5°$. The curves of constant amplitude are simply straight lines, as expected, since at constant winding angle the amplitude depends only on the ratio *V*/*c*. This is a useful rule of thumb. We can opt for small package radii and reduce the unwinding speed, however for unwinding at large unwinding speeds it is necessary to increase the radius.

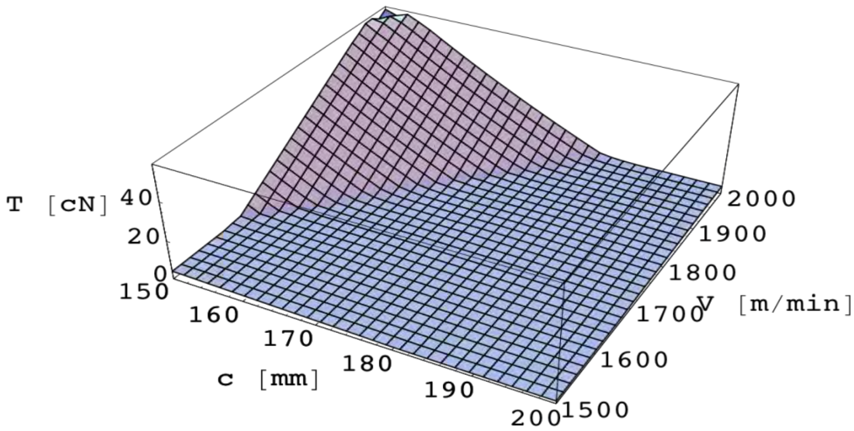

Fig. 6: Amplitude of oscillations as a function of package radius c and the unwinding velocity V for the winding angle of $\phi = 5°$.

4. Conclusion

We have shown that a combination of theoretical modelling and empirically determined relation between the yarn tension and the angular velocity of the yarn.
We have reached the following conclusions:

- Oscillations of tension are smaller in packages with small winding angle (parallel-wound packages), but for such packages yarn slips can occur during unwinding.
- Alternatively, the oscillations of tension can be reduced if only those layers of yarn that are unwound backwards are parallely wound.

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MAXIMIZING FUSIBLE INTERLININGS BONDING STRENGTH BY OPTIMIZING THE FUSING CONDITIONS

Saska GOLOMEOVA, Goran DEMBOSKI & Sonja KORTOSHEVA

Abstract: *In this paper, Taguchi robust design methods were applied for optimization a fusing process conditions to maximize the bonding strength between a fabric and a fusible interlining before and after laundering process. Four parameters, including type of fusible interlining, fusing temperature, pressure, and time were selected to optimize the quality of fused textile system. Nine experiments were performed with respect to the L_9 orthogonal design for the Taguchi method. The results show a considerable improvement in the S/N ratio as compared to the initial condition. Taguchi method proved convenient in determining the optimum fusing conditions for the maximization of the bonding strength.*

Key words: Taguchi method, fusible interlining, optimization, bonding strength.

Introduction

Fusible interlinings are support materials, which are very important for the essential apparel quality. Fusible interlinings improve the formability of top fabric. They give not only a beautiful silhouette, but also a steady form to garment deformed from bending and shearing deformation on wearing (Cooklin ,1990, Cooklin, 2006). The bond strength between fusible interlinings and top fabric is important because consumers want to keep shape retention after repeated laundering. Review of the literature indicates that an increase in pressure or amount of pressure cycles leads to the formation of comparatively strong initial bond strength in textile systems but these become unstable after mechanical treatment (Percinlic, 1997, Gutauskas *et al*, 1996).

A good fused textile system can be produced when a right fusible interlining is chosen for a given fabric and when optimum fusing conditions are determined. In this study, we determined a optimal fusing conditions to maximize a bonding strength using Taguchi method. It offers a simple and systematic approach to optimize design for performance, quality and cost. Signal to noise ratio and orthogonal array are two major tools used in robust design. Signal to noise ratio, which measures quality with emphasis on variation, and orthogonal arrays, which accommodates many design factors simultaneously (Simpson, 2000, Ross, 1996). In this study we used ―L9(3^4)" orthogonal array because four factor (type of interlining, temperature, pressure, time) are taken as independent variables with, each variable having 3 level values. These factors can be easily controlled. Selection of the levels was based on the interlining's fusing parameters what were given in the specification by interlinings producers. (Mavruz et al, 2010).

Methods

Taguchi method was applied to define the best fusible interlining and optimal fusing conditions for one type of fabric for man's shirts and three different fusible interlinings. The experiments were carried out with four factors at three levels, as shown in Table 1. Selection of the levels is based on the interlinings fusing parameters specifications. This orthogonal array is chosen due to its capability to analyze the interactions among factors.

Table 1 Factors and levels

	Levels		
Factors	**I**	**II**	**III**
Fusing interlining(A)	FI-1	FI-2	FI-3
Temperature (B)	150 °C	160 °C	170 °C
Pressure (C)	1 bar	2 bar	3 bar
Time (D)	12 s	15 s	18 s

The fusing process was carried out in factory conditions, on continuous fusing press type Gygli TPR8M751R. The bonding strength of fused textile system was tested on tensile testing machine Tinius Olsen HT 45, in accordance with the ASTM D 2724 standard. Six fused samples were produced at each fusing conditions, three before and three after laundering process, (ASTM D 2724, 2003). The laundering process was taken as uncontrollable noise factor. For the bonding strength of fused textile system, higher value means better quality (Roy, 2001). Thus, for calculating each S/N ratio we used equation:

$$S/N = -10 \log \left(\frac{1}{n}\sum_{i=1}^{n}\frac{1}{y_i^2}\right)$$

where: n is the number of experiments in the orthogonal array and y_i the i^{th} value measured.
In this study all calculation were made using 'Statistica 9' program.

Findings

S/N ratios calculated for each experiment are shown in Table 2. The obtained values for bonding strength are located between 2,233 and 9,990. The S/N ratio of fused textile system shows a difference of 7.8, depending on fusing conditions.

Table 2. Experimental layout using an L_9 orthogonal array table and S/N ratio of experimental results

Exp. no	Factor and level (Fusing conditions)				SN ratio
	A	B	C	D	
1	FI-1	150	1	12	8,144
2	FI-1	160	2	15	8,177
3	FI-1	170	3	18	9,990
4	FI-2	150	2	18	2,233
5	FI-2	160	3	12	2,471
6	FI-2	170	1	15	3,039
7	FI-3	150	3	15	5,923
8	FI-3	160	1	18	5,740
9	FI-3	170	2	12	5,692

Discussion

Analysis of SN ratio, including sum of squares, average of S/N ratio and contribution are shown in table 3. From the calculated value of the sum of squares of each factor, we can see that factor A (type of fusible interlining) has the largest value at 57,491 (95,67%). Then follows factor B (temperature) with value of 1,255 (2,09 %), factor C (pressure) with value of 0,891 (1,48 %) and the last is the factor D (time) with value of 0,457(0,76 %). Whether errors can be pooled for separate fusing parameters can be determined based on the sum of squares of the S/N ratios according to the method suggested by Taguchi. The parameters C and D are pooled into error parameters considering the relatively small values of their sums of squares, indicating no significant influence on the bonding strength of the fused textile system.

Table 3 Analysis of the SN ratio of experimental results

Factor	Degree of freedom, f	Level	Sum of squares	Average of SN ratio	Contribution P	Pooling
U					5,712	
A	2	A1	57,491 (95,67 %)	8,771	3,058	N
		A2		2,581	-3,131	
		A3		5,785	0,073	
B	2	B1	1,255 (2,09 %)	5,434	-0,229	N
		B2		5,463	-0,249	
		B3		6,240	0,528	
C	2	C1	0,8912 (1,48 %)	5,641	-0,071	Y
		C2		5,367	-0,345	
		C3		6,128	0,416	
D	2	D1	0,457 (0,76 %)	5,436	-0,276	Y
		D2		5,713	0,001	
		D3		5,988	0,275	

After error pooling, of the C and D factors, ANOVA test (F-test) is performed to determinate the effects of the A and B factors, as shown in table 4.

Table 4. Anova table for the S/N ratio

Factor	Sum of squares	Degree of freedom, f	Mean square,V	F_0=V/V(e)	F_t (2,4,0,90)
A	57,491	2	28,745	85,297	4,32
B	1,255	2	0,627	1,86	
E	1,348	4	0,337		

Based on the results of ANOVA analysis, only the factor A has significant influence on bonding strength because $F_0 = V/V_{(e)}$=85, 297> F_t (2,4,0,90). Thus, the optimum level for factor A with highest value S/N is A1, fusible interlining FI-1.

The estimated value of the S/N ratio for fused textile system under optimum fusing conditions is:

$$\overline{S/N} = U\ (S/N) + Pop\ (A1) = 5{,}712 + 3{,}058 = 8{,}770$$

The prediction interval of the optimum S/N ratio is:

$$S/N = \overline{S/N} \mp t_{fe,1-\alpha}\sqrt{(k+1/\gamma)Ve} =$$

$$8{,}77 \mp t_{(4,0,95)}\cdot\sqrt{\left(\frac{3}{9}+\frac{1}{6}\right) x\ 0{,}337} = 8{,}77 \mp 2{,}132 \text{ x } 0{,}915 = 6{,}855 \div 10{,}72$$

$$\kappa = \frac{\sum f}{\sum n} = \frac{1+2}{9} = \frac{3}{9}$$

Because experimental values that gives the estimated optimum conditions, is exactly matched in the experiment, as shown in table 3, an experiment verifying the estimated optimum conditions is not necessary. Because S/N ratio under optimum conditions is 9,99 (experiment no. 3, table 3), which is located in the prediction interval, we can conclude that this analysis and obtained results can be verified. Expectation of loss under the optimum fusing conditions and current fusing condition taken as experiment number 5 (type of interlining FI-2, temperature 160°C, pressure 3 bar, time 12 s), shown in table 3.

$$S/N_O - S/N_C = 8{,}77 - 2{,}471 = 6{,}299 = d$$

$$L_C/L_O = 10^{\,6{,}299/10} = 4{,}26$$

The results show that the expectation of loss from the bonding strength of the fused textile system in optimum conditions can be improved 4.26 times over the expectation of loss with the current fusing conditions.

Conclusion

In this study, the optimization of fusing conditions to maximize the bonding strength of fused textile system was done using the Taguchi method. Experimental design with one shell fabric and three fusible interlining was performed. It was found that most significant factor for bonding strength of fused textile system is factor A (type of fusible interlining). Also optimal fusing conditions were established for given set of parameters. The expectation of loss of the bonding strength of fused textile system using optimal conditions can be improved by 4,26 times over current fusing conditions. The application of Taguchi robust design proved successful in defining the optimum fusing conditions and the best fusible interlining.

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RHEOLOGICAL MODELLING OF COTTON YARN EXTENSION

Vasilije PETROVIĆ, Dragan STOJILJKOVIĆ & Jovan STEPANOVIĆ

Abstract: *On the basic of experimental data which are obtained in standard research conditions for yarn extension, and models which are obtained from literature, rheological model for cotton yarn (yarn count = 14 tex) was set up. On the basic of rheological model for researched yarn, some rheological equations which give mutual connection between force, tension, relative lengthening and their derivatives per time were deduced and solved. The average mistake during the process of modeling was less than 5%.*

Key words: rheological yarn models, cotton yarn, elastic deformations, Leseric's model.

1. Introduction

The introduction of new technological accomplishments has caused the increase of machinery production. However, due to the fact that machines work at high speed, different forces cause high yarn loadings [1,2]. Yarn transportation within the technological processes has become automatic to such extent that, in some cases, we can notice complete automation. That is the main reason for mathematical modeling of mechanical characteristics of yarn as well as the processes of its transportation. These models should, on the basic of theoretical and experimental results, give the possibility of closed systems of automatic management synthesis [1,2]. The usual opinion about re-reeling machine synthesis is that the values of active forces which represent 25% of yarn brakeage force values can be used as inherent parameters. Namely, there is an opinion that the yarn can be loaded by yarn tension force whose value is not more than 25% of yarn brakeage force value. However, the increasing speed of machines can cause yarn deformations. It means that the value of 25% doesn't have to provide yarn refining within the elastics area of its deformations. Therefore, the dependency between tension and relative lengthening, i.e. the dependency between force and relative lengthening (SI- characteristics) should be one of the main factors in modern description of yarn mechanical characteristics. This dependency represents an insight into the yarn behavior under the load force. Besides that, on the basic of this curve, we can come to appropriate conclusions related to yarn behavior for different values of the force. Characteristic, force-relative lengthening, depending on the row materials structure of the yarn, has the shape of straight, concave, convex line, concave in the shape of the letter S, and convex line in the shape of the letter S.

These curves are good basic for defining the exact value of tension force which causes greater deformations than allowed. That value is very important because if we had an opportunity to monitor the tension force of the yarn during the process of rewinding, we could compare these values and set them as the basic of automatic management of the process of yarn rewinding. In this way, we could obtain data about yarn tension and it would also be the foundation for setting up the system, so that the tension force always has the value which can prevent yarn of being overloaded beyond the limits of elastic deformations. The complete analysis of SI curve during the process of yarn rewinding would, of course, give us information about the influence of lagging deformations in the yarn, which, due to long relaxation times, can't disappear immediately. Therefore, the analytical expression for this curve is a necessity[3].

2. Rheological yarn models

The most important characteristics that should be anticipated during the yarn transportation is its behavior upon the tension force, which, to a great extent, depends on its structural characteristics restricted by the terms of its production and rewinding [4,5,6,7,8,9,10,11]. The accurate defining of yarn

tension force, which will cause elastic, high plastic and plastic deformations on it, is of great importance for projecting optimal speed of its transportation.
During the process of forming and refining the yarn is subjected to different loadings (tensioning, pressuring, twisting, rolling etc.). These loading usually act simultaneously. Yarn‘s resistance to these loadings depends on its structure and raw material structure. When external forces act on a yarn, some yarn‘s particles separate or come together resisting, in that way, internal forces which act among its particles. In modern technologies there are a lot of these problems related to re-shaping and flowing of solid bodies and liquids. Increasing need for solving these problems has fostered the development of a new area in science-rheology.

In order to determine characteristic behavior of cotton yarn, it is necessary to set up the dependency between the load, which acts on observed yarn, and its deformations. This process is basic for differential equations needed for describing yarn behavior. We can gain these equations on the basic of mechanical models. In this way, we can imitate any kind of real material deformation by simple model or the imitation can be preformed by a complex model that is made of several simple models. Thus, the rheology is defined as the field of science engaged in physics of deformation, and its main goal is connection between force i.e. tension and deformation caused by these forces. It means that rheological equations are set up for tested cotton yarn as well as for connection between tension, deformation and their derivatives per time. In this way, rheological models of cotton yarn, which are gained from experimental results, are set up as well as elasticity and viscosity coefficients and defining the relation between tension and relative lengthening. This procedure enables modeling of this with relatively little mistakes in relation to experimental results. That is why these models represent a reliable foundation for defining of active forces values. Accurate values of active forces can be determined in this way.
Simple models which are used for describing elastic, high-elastic and plastic deformation are the ones defining properties of material that can not be found in nature, but whose characteristics, under certain loadings and external influences, can reflect the real material behavior. Taking ideal materials for the foundation of explanation is necessary because of complexity of deformations which occur when the yarn is subjected to the loading. In order to describe and explain these occurrences, it is necessary to idealize real processes.

Rheological model for elastic material is elastic spring (Hook‘s spring). This material acts in accordance with Hook‘s law at axle load. Rheological model for viscous material is a piston moving in oil (Newton‘s body). Ideal plastic material is represented by Saint Venant‘s body. Plastic material doesn‘t resist plastic deformation, and if it is not subjected to loading, it behaves as hard material. When this material is subjected to loading, it results in flowing.
As real materials (for example, cotton yarn), more or less, include elements of all these models, it is necessary to establish another type of material called high-elastic material. This material, if subjected to loading, simultaneously shows the properties of elastic bodies and viscous liquids, which means that its tension depends on deformation speed and quantity. This type of deformation is typical for fibers due to their structure resulting from characteristic molecular structure. The special characteristics of fibers, as well as other high-elastic materials, are: immediate elasticity, sliding at constant tension, tension relaxation at constant deformation, lagging elasticity and permanent deformation.

By combining these models, we can gain more complex models. Thus, ordinal bond between Hook‘s spring and Newton‘s body is used for making Maxwell‘s model (M = H---NJ). Parallel bond between Hook‘s spring and Newton‘s body, is used for making Calvin‘s model (K = H/NJ), which can be often found in the literature as Calvin-Fojgt‘s model. So far, as far as textile materials are concerned,

rheological models have been used for describing fibers in literature. While describing yarn and other textile materials, we should take care of their behavior in different circumstances. In other words, established rheological models for these materials in certain circumstances can, under different circumstances, become unsuitable for modeled material. Due to the complex structure of these materials

and their behavior, we should take care of the influence of these materials' structure as well as the environment in which they are tested during the process of modeling.
Established rheological models for yarn can rarely be found in literature. One of them has been set up for cotton yarn (count 21 tex) [2]. Elastic area in this model has been described by Maxwell's model, while the other area has been described by Bjurg's model which has been set up by Maxwell and Calvin's models that were connected by parallel bond.
Differential equation describing the connection between tension and cotton yarn deformation has the following shape:

$$r_n\sigma^{(m)}+....+r_1\sigma'+r_o=q_m\varepsilon^{(m)}+q_{m-1}\varepsilon^{(m-1)}+...+q_1\varepsilon'+q_o\varepsilon \qquad (1)$$

Where is:
$r_i, q_i -$ Different coefficients
$\varepsilon^{(m)}, \varepsilon^{(m-1)}, \varepsilon', \varepsilon -$ *Deformation and its derivatives per time*
$\sigma^{(m)}, \sigma^{(m-1)}, \sigma', \sigma -$ Tension and its derivatives per time

If in equation 1 only coefficients q_o and r_o differ from 0, we can gain the model of Hook's spring with elasticity modulus equal to:

$$E=\frac{q_o}{r_o}$$

$$\sigma=E\cdot\varepsilon$$

If coefficients q_1 and r_o differ from 0, we can gain Newton's body model, i.e.

$$\eta=\frac{q_1}{r_o};\sigma=\eta\cdot\varepsilon'.$$

If the coefficients q_1, r_o, r_1 differ from 0, we can gain Maxwell's model, where is:

$E=\dfrac{q_1}{r_1}-$ Elasticity modulus

$\eta=\dfrac{q_1}{r_o}$ Viscosity coefficient

$\tau=\dfrac{r_1}{r_o}-$ *Relaxation* constant, where the deformation is described by:

$$\varepsilon'=\frac{\sigma}{\eta}+\frac{\sigma'}{E}.$$

2.1. Setting up of the rheological model of cotton yarn

Rheological model is set up on the basic of experimentally obtained values of the force in relation to lengthening for tested cotton yarn. These values are the basic for setting up the

rheological model of this yarn which, in an appropriate way, describes its behavior during the process of tension within standard research conditions. This model is obtained by combining elementary rheological models in such way that they are arranged in appropriate position depending on obtained yarn behavior values during the tension process.
On the basic of obtained force mean values i.e. stress for cotton yarn and by combining the basic rheological models, rheological model – Leseric's body has been set up (Fig. 1.)

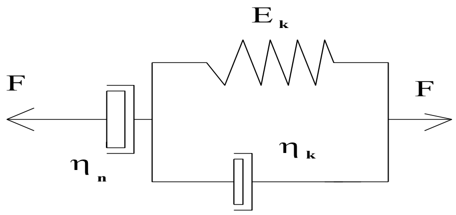

Fig. 1 Leseric's model

Leseric's body (L) represents ordinal bond between Newton (N) and Calvin's models (K) [1,2,3]:

$$L = N---K \tag{2}$$

Deformation velocity of Leseric's body is equal to the sum of deformation velocities of Newton and Calvin's bodies:

$$\dot{\varepsilon}_L = \dot{\varepsilon}_N + \dot{\varepsilon}_K \tag{3}$$

Where is: $\dot{\varepsilon}_N$ - Deformation velocity of Newton's body,

$\dot{\varepsilon}_K$ -Deformation velocity of Calvin's body

Deformation velocity of Newton's body is equal to :

$$\dot{\varepsilon}_N = \frac{\sigma}{\eta_N} \tag{4}$$

Where is: η_N - Viscosity coefficient of Newton's body.

Deformation velocity of Calvin's body is equal to:

$$\dot{\varepsilon}_K = \frac{\sigma}{\eta_K} - \frac{E_K}{\eta_K} \cdot \varepsilon_K \tag{5}$$

Where is: E_K -elasticity modulus of Calvin's model

η_K -viscosity coefficient of Calvin's model.

After differenting the expression (5) per time and its substitution in the expression (3), as well as after substitution of expression (4) to (3), the following expression for deformation velocity of Leseric's body is obtained:

$$\dot{\varepsilon} = \frac{\sigma}{\eta_N} + \frac{\sigma}{\eta_k} - \frac{E_K}{\eta_K} \cdot \exp\left(-\frac{E_K}{\eta_K} \cdot t\right) \cdot \left[\varepsilon_o + \frac{1}{\eta_K} \cdot \int \sigma \cdot \exp\left(\frac{E_K}{\eta}\right)\right] \tag{6}$$

Where is:

ε_0 - starting relative lengthening

E_K -elasticity modulus of Calvin's model,

N_k-viscosity coefficient of Maxwell's model.

By differenting per time and arranging the expression (6), we gain differential equation of rheological model of cotton yarn in the following shape:

$$\ddot{\varepsilon} \cdot \cdot \eta_K + \dot{\varepsilon} \cdot E_K \cdot \eta_K = \dot{\sigma}(\eta_N + \eta_K) + \sigma \cdot E_K \tag{7}$$

During the tension which is conducted on dynamo meter Instron, deformation velocity has constant value so it can be written in the following shape:

$$\dot{\varepsilon} = \frac{\Delta l}{l_0} \cdot 100 = \frac{v}{l_0} \cdot 100 = \text{const.} \tag{8}$$

Where is: l_o -starting test tube's length

V – the velocity of dynamo meter's clamps

As, in this case $\dot{\varepsilon} = \text{const.}$ and $\ddot{\varepsilon} = 0$, equation (7) can be written in the following form:

$$\dot{\sigma}(\eta_K + \eta_N) + \sigma \cdot E_K = \dot{\varepsilon} \cdot E_K \cdot \eta_N \tag{9}$$

By solving the differential equation (9) we gain the expression (10):

$$\sigma = -C \cdot \exp\left(-\frac{E_K}{\eta_K + \eta_N} \cdot t\right) + \eta_N \cdot \dot{\varepsilon} \tag{10}$$

Integrating constant C is defined from starting conditions for t = 0 and $\sigma =$ 0. As the relaxation coefficient $\tau_r = (\eta_n + \eta_K)/E_K$, the dependency tension-time has the following form:

$$\sigma = \eta_N \cdot \dot{\varepsilon}\left[1 - \exp\left(\frac{t}{\tau_r}\right)\right] \tag{11}$$

By substituing $t = \varepsilon \cdot l_0 / 100v$ into the expression (11), we gain the dependency $\sigma(\varepsilon)$ in the following form:

$$\sigma = \eta_N \cdot \dot{\varepsilon}\left[1 - \exp\left(\frac{l_o}{100 \cdot v \cdot \tau_r} \cdot \varepsilon\right)\right] \tag{12}$$

3. Experimental testings of curve F-ε

- Worsted cotton yarn which was used for experimental research had the yarn count *T_t= 14,19tex, twist number T_m=900m^{-1}* and count variation coefficient *C_v= 7,69%.*
- Experimental testings of curve **F-ε** were carried out in standard conditions on dynamo meter Textechno, with the mean velocity of dynamo meter's clamps *v=0,0021* [m/s]. The testing was carried out under standard conditions (sample length *l_0=0,5m, t= 20±2^{0}C, RH= 65±2%*). In order to achieve constant humidity and tension relaxation, the yarn was kept in standard conditions for 24 hours. The testing was carried out on 120 samples. Test tubes were taken in
- arbitrary intervals, but not less than 2 [m]. Force – relative tension curves have been obtained. The mean value of the force for each percentage of relative tension was calculated.
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– The yarn is a linear creation whose length is much bigger than its area. Taking into consideration that $\sigma = F/A$, it can be said that observed yarn has got a unit area. In that case, we can observe curves $\sigma - \varepsilon$ as curves **F-** wher e is F– unit force.

– Figure 1 shows measured values of yarn tension‘s unit force for appropriate percentage of relative tension.

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– Figure 1 the representation of experimental results of yarn tension‘s unit force for appropriate percentage of relative tension.

ε [%]	0.25	0.50	0.75	1.00	1.25	1.50	1.75
F [cN/tex]	0,889	2,119	3,211	4,112	4,931	5,625	6,328
ε [%]	2.00	2.25	2.50	2.75	3.00	3.25	3.50
F [cN/tex]	6,821	7,312	7,791	8,421	9,143	9,792	10,020
ε [%]	3.75	4.00	4.25	4.50	4.75	5.00	5.25
F [cN/tex]	10,732	11,011	11,301	11,792	12,183	12,427	12,751

Where is:

– ε [%] - yarn tension in [%]

– F [cN/tex]- measured force values in [cN/tex].

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4. Modelling of yarn behavior during the process of tension

If we substitute values obtained from experimental conditions in equation (8) for the velocity of dynamo meter‘s clamps v = 0,0021 m/s and starting lengths of test tubes, we gain the value for deformation velocity of the yarn during the process of tension on dynamo meter $\dot{\varepsilon} = 0{,}42 m/s$.
If we assume that dynamic viscosity coefficients for Newton and Calvin‘s models in Leseric‘s model have the same value, we can gain the following values:
deformation velocity of the yarn during the process of tension on dynamo meter $\dot{\varepsilon} = 0{,}42 m/s$.
viscosity coefficient $\eta = 596{,}5476\ cN{\cdot}s$ *i*

relaxational constants $\tau_r = 9{,}73451 s$.

On the basic of experimental data and dependency obtained from rheological model for cotton yarn, the following equation was obtained by approximation:

$$F = \frac{0{,}06465 \cdot \varepsilon}{\varepsilon - 0{,}333} + 17{,}5058119 \cdot \left[1 - e^{(-0.24449107 \cdot \varepsilon)}\right]$$

Relative mistakes of experimental and calculated values for unit force can be defined according to the following expression:

$$W = \left| \frac{F - F_m}{F} \right| \cdot 100 \quad (\%)$$

Where: F – experimentally measured values of unit force in cN/tex,
F_m- force values calculated from established rheological model in cN/tex.

Figure 2 represents theoretical values of yarn tension's unit force which were calculated on the basic of prior established rheological model as well as relative mistake.

Figure 2: The representation of theoretical results as well as relative mistake

ε [%]	0.25	0.50	0.75	1.00	1.25	1.50	1.75
Fm [cN/tex]	0,852	2,225	3,073	3,925	4,736	5,502	6,224
W [%]	4,131	4,982	4,289	4,549	3,952	2,185	1,646
ε [%]	2.00	2.25	2.50	2.75	3.00	3.25	3.50
Fm [cN/tex]	6,904	7,544	8,174	8,714	9,247	9,749	10,220
W [%]	1,210	3,171	4,564	3,474	1,134	0,439	2,000
ε [%]	3.75	4.00	4.25	4.50	4.75	5.00	5.25
Fm [cN/tex]	10,665	11,088	11,476	11,846	12,193	12,521	12,830
W [%]	0,625	0,695	1,550	0,456	0,078	0,759	0,620

Where :

ε [%] - yarn tension in [%]
Fm [cN/tex] - force values calculated from established rheological model in cN/tex and
W [%] - the mistake of calculated force values in relation to experimentally obtained force values in [%].

If we use experimental and calculated values for unit force, we can represent their compared values in the shape of a chart in the picture 2:

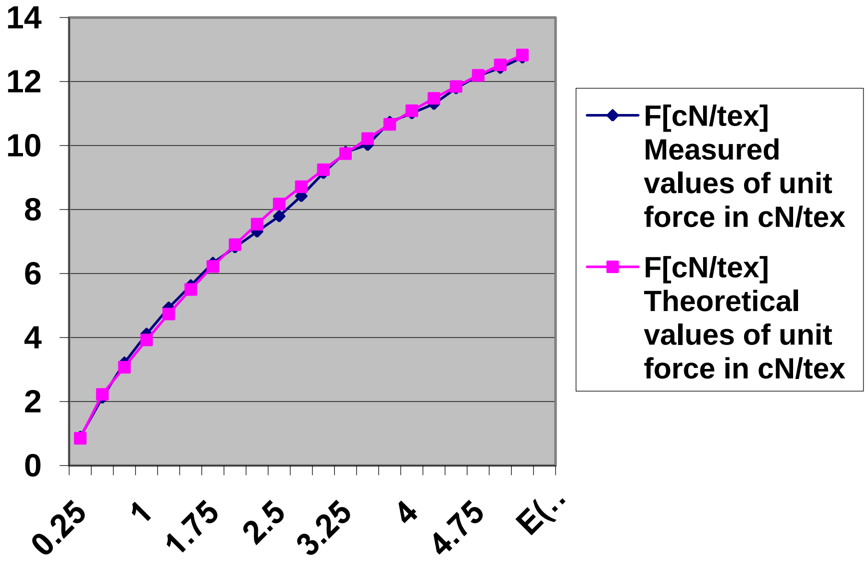

Figure 2:

If we use experimental and calculated values for unit force, we can show the mistake occurred during the yarn behavior modeling in the shape of a chart in the picture 3:

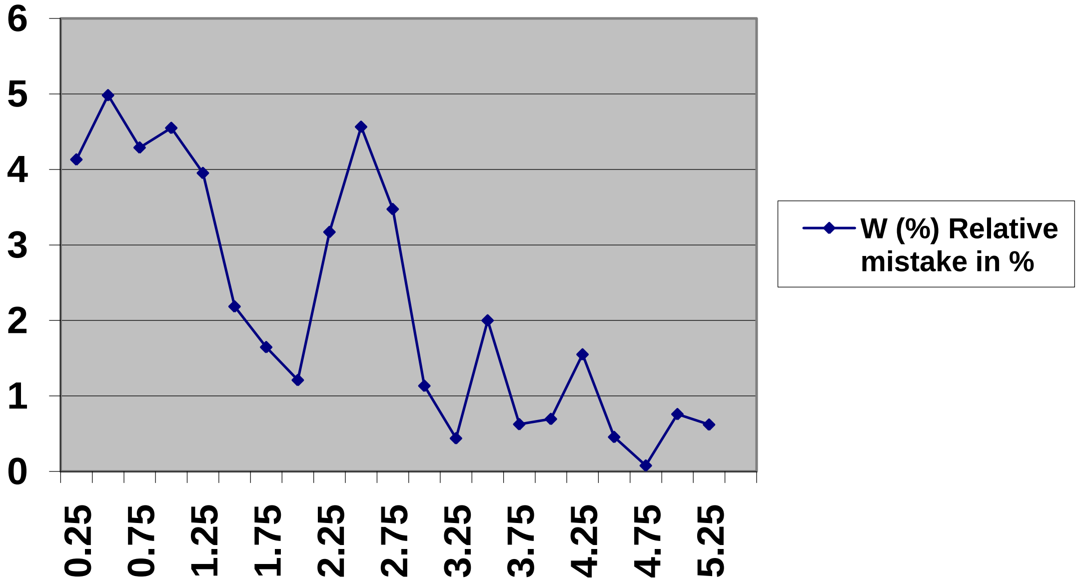

Figure 3: The representation of relative mistakes calculated from experimental values for unit force.

5. Conclusion

According to experimental data for yarn extension in standard conditions of testing, by combining familiar elementary rheological models, existing rheological models for yarn extension, appropriate differential equations for tested cotton yarn have been derived and solved. In that way, we have gained the dependence between unit force (tension) and relative extension.

During the testing of yarn extension which was carried out on tens meter Textechno, deformation velocity is constant. In many cases, in industrial conditions of refining and formation of yarn, for example in the process of weft pulling through the shed at the loom with projectiles, deformation velocity of yarn is not constant, which depends on the process of formation and refining of yarn itself.

If the rule of yarn deformation velocity changing is known, and it can be determined from yarn refining conditions, on the basic of rheological model the curve F-ε, i.e. σ-ε for those yarn refining conditions can be determined. For those conditions the values of some coefficients which occur in rheological equations should be determined. On the basic of these dependences, some projecting of individual yarn refining processes should be carried out, i.e. it is possible to carry out the simulation of yarn refining process itself. During the process of projecting, the area of elastic deformation should not be exceeded. Up to now, the yarn refining processes have been projected on the basic of assumption that maximum allowed force of yarn tension is 10 to 25% from tearing force. In that way, we can avoid purchasing very expensive equipment for dynamic testing of yarn extension process. Appropriate assumptions and limitations should be also taken into the consideration.

Further researches in this field should be directed to setting rheological models on the basic of force data, i.e. tension-relative extension which are gained from dynamic yarn loading,i.e.loadings which are equal or similar to real yarn loadings during the refining process. In that way, working parameters during yarn refining should be determined in more precise and more reliable way.

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IKIII JOB DESCRIPTION

Igor KRESOJA

Verticalization / Retail

The distribution and market conditions in the last 15 years has drastically changed. It‘s no longer enough, "only" producing the goods but it is very important to create an optimal structure to connect all the points that are important from design through the production, deliveries, products presentation and the turnover of products. This course includes:

- Design and concept of the vertical system (Store, Shop-In-Shop, Soft-Shop)
- Transport planning
- Planning structure (quantity, value, delivery)
- Training of sellers
- Etc.

Marketing

- Brand management
- Concept, structure, design and marketing of a campaign
- Strategic brand positioning
- Defining a Brand Identity
- Concept and implementation of the standard‘s books
- The structure and strategy creation for internal and external communication
- Plan and coaching media (Photo-shooting, Print-media, film, etc.).
- The web site concept (structure and design)
- Operational service of classic marketing agency
- Etc.

Visual Merchandising

- The concept and structure of the product presentation
- Visual Merchandising Manual
- Training sellers in the product presentation
- Concept and design of decoration
- Etc.

Product Management

- Collection Structuring for the vertical process
- Training of designers and designer‘s team structuring (designers and product managers)
- Optimization of collections in styling and design

PROJECT COOPERATION WITH COMPANIES

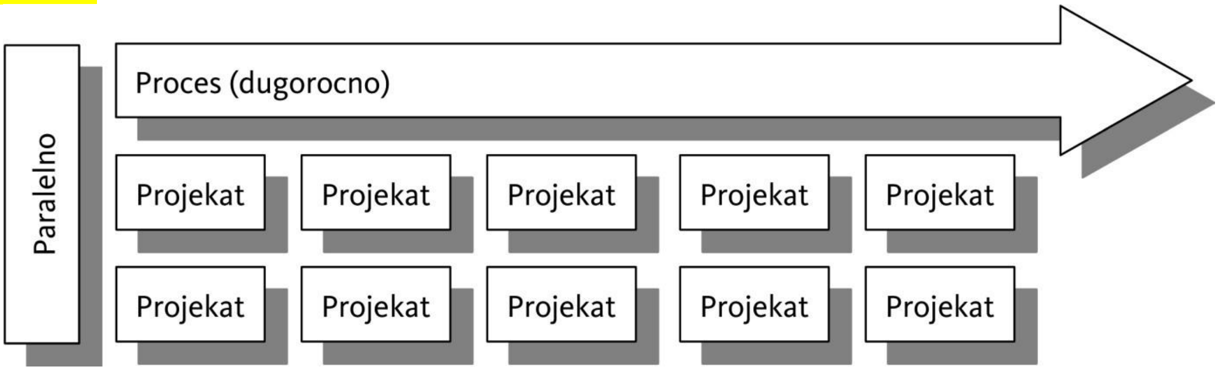
The current situation:

- Operating Internal Systems are not connected ideally (Retail, PM, Marketing, VM)
- Communication with the final customer and to the market is not clear
- The collection and brand potential is not used 100%
- The identity has been lost

The cooperation system...

Schematic diagram:

Process (long – term)
Project
Parallel



Process

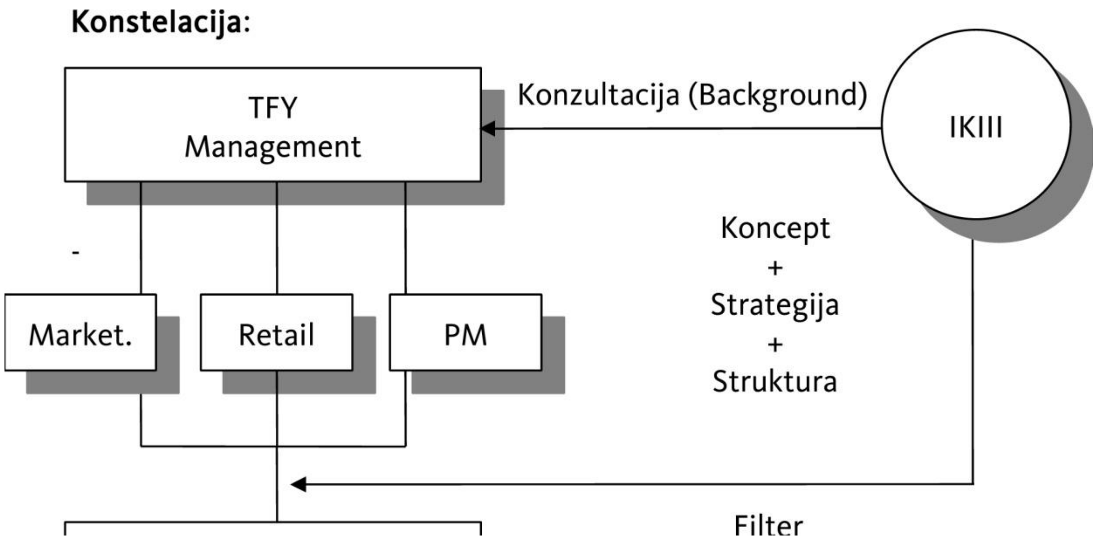
- Topics of process are ...
- Corporate Identity (logo, branding)
- Creating a Company Identity
- Optimization of the product
- Optimizing sales
- Visual Merchandising (concept)
- Etc. ...

Projects

The process creates various projects that can be for example:
- New interior design
- Layout and prepress
- Image
- Trailer
- The web site concept
- Etc.

Integration Services ...

konstelacija	**constellation**
konzultacija	**consultation**
strategija	**strategy**
struktura	**structure**
filter	**filter**
kupac	**customer**
trziste	**market**



Kupac + tržište

Planned Results

- All operating systems are ideally linked
- Communication to the customer and the market is clear
- USP brand and the collection is clearly
- TFY has again a clear identity

RELATIONSHIP MARKETING AND PROVIDING CUSTOMER SATISFACTION

Dragan ĆOĆKALO, Dejan ĐORĐEVIĆ & Sanja STANISAVLJEV

Abstract: *Relationship marketing represents a marketing concept whose key output is sastisfying customers and other groups of interest. The research included 84 companies and 37 experts from Republic of Serbia had a goal to confirm a theoretically defined model for providing satisfaction of customers requirements. Also the goal of this research was to incorporate customers satisfaction into relationship marketing as an integral part of theoretically defined model and to show, in that way, that the mentioned concept can be accepted and implemented in Serbian economy. This paper presents these parts of research.*

Key words: relationship marketing, customer satisfaction, process.

1. Introduction

Modern society demands from companies to take full moral and legal responsibility for their activities, especially in protecting both customers' interests and the environment. Modern business philosophy implies that an organization is responsible for its actions and activities towards all agens in its surroundings. New marketing paradigm represents marketing directed towards improving relations with customers that is based on data base, interactive marketing and web marketing. This modern marketing concept demands from companies to take an effort and find out the needs of a selected market in order to satisfy customers' needs more efficiently and successfully than competitive companies and to do all that in the way which maintains and improves wellfare of customers and the whole society. Relationship marketing represents a considerable step ahead in approaching marketing, going from thinking about it only in categories of conflict and competition towards categories of cooperation and interdependence.

The term "relationship marketing" (RM) was first introduced by Berry (Berry 1983) in a services marketing context. Managing relationships is, however, nothing new in business. Many entrepreneurs do business by building and managing relationships without using the term relationship marketing. RM, defined as marketing activities that attract, develop, maintain, and enhance customer relationships (Berry, 1983; Grönroos, 1994), has changed the focus of a marketing orientation from attracting short-term, discrete transactional customers to retaining long-lasting, intimate customer relationships. Many firms have established RM (or loyalty) programs to foster customer loyalty towards their products and services (Schiffman and Kanuk, 2004). The basis of RM has been described best as the formation of ―bonds" (links) between the company and the customer (Roberts et al., 2003). As the existing literature suggests business can build customer relationships by initiating one or several types of ―bonds", including financial, social, and structural (Berry, 1995; Williams et al., 1998; Lin et al., 2003). However, much should be learned about the relationship between ―bonds" initiated by a company and customer perceptions and behavior (Gwinner et al., 1998). This connects RM with some terminologically and conceptually researched phenomena which can be considered as crucial for this

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research. They are: values, creating values for customers and customer satisfaction. The results are customers‘ loyalty and general improvement of company‘s performances. The question of measuring customer satisfaction represents one of the key issues of this paper, as well as the research itself.

Evans and Laskin (1994) present a model of effective marketing process which, in some way, shape everything said before in a coherent whole. They define RM as ―the process whereby a firm builds long-term alliances with both prospective and current customers so that both seller and buyer work toward a common set of specified goals" (Evans & Laskin, 1994). It is also emphasized that achieving the ―goals" of RM can be realized through: (1) understanding customers' needs, (2) treating customers as partners (3) providing satisfaction of all customers' needs by employees; this may demand initiative and efforts on the part of employees that exceeds norms of the company and (4) providing the best quality according to customer's individual needs. Efficiently positioned RM will lead towards the following positive outputs: (1) high percentage of satisfied customers, (2) higher loyalty of customers, (3) customers' perception on products/services higher quality and (4) increasing profit of a seller company. RM is a continual process which demands the following from companies: (1) continual communication with customers (provides correct definition of requirements) and (2) to integrate RM process into strategic planning (enables better resource management and anticipation of future customers' needs).The model is in a cyclic form with three sub-processes: (1) inputs (understanding customer expectations, building service partnerships, empowering employees and TQM); (2) positive outputs (customer satisfaction, customer loyalty, quality of products/services and increased profitability); (3) checking phase (customer feedback and integration). Brookes and Little (1997) enhance the explanation of the effective marketing process by saying that this concept is based on data base management, interactive market communication and web marketing.

The main directions of this research, from the standpoint of business, are: relationship marketing with customers which deals with the influence of customers‘ satisfaction on competitiveness and realized profit; methods for measuring customers‘ satisfaction and techniques which enable implementation of such data in the strategy and, in that way, improve relations between companies and customers.

2. Objectives of the research

Primary objective of this research is to establish: facts, attitudes and opinions concerning introduction and providing quality management system in the Republic of Serbia economy – modeling of measuring process and monitoring customers' requirements, as well as specific experts' requirements in the sphere of quality.

Secondary objective – customers' satisfaction should be explained from the standpoint of relationship marketing concept:

- how much modern Serbian companies take care about customers' satisfaction and requirements,
- if they recognize the elements of relationship marketing in their own business activities and how they evaluate them concerning their business significance,
- how they manage and organize the recognizing processes of customers' requirements together with measuring customers' satisfaction; what methods they use,
- how they incorporate the effects of researching, monitoring, measuring and analyses in their own business.

3. The sample, collecting and processing of research data

Target groups in the research are:

- companies (production and/or services) which are, in harmony with the primary objective, certified according to the standards of quality management (ISO 9000 series of standards) and which work and have residence in Republic of Serbia, namely quality managers and/or marketing managers from these companies, as a primary group,

- experts, in the sphere of quality and/or marketing, as a control group.

Surveying of available companies and experts was primarily realized by e-mail survey. The reasons for choosing this kind of survey are fast responding and costs, which are lower than postal survey or some other kind of interview; considering the main characteristics and problems (the greatest respond, which goes from 20 to 30%, and sometimes does not go over 5%, so the sample is not representative) (Hanic 1997). The survey included about 600 companies and 100 experts.

For the sake of survey it was created a special questionnary (taking care of methodology of the research); communication principle was: one questionnary – one company/expert.

The invitation to take part in the research accepted 84 companies and 37 experts. The sample is representative because it includes more than 5% companies in Republic of Serbia which have the certificate ISO (JUS ISO) 9001:2000. Reference data on certificate number was taken from the The ISO Survey 2006 (ISO 2007), the last available one during the research realization. Here, 1551 certified companies are mentioned.

The survey was mainly realized in November and December 2007 and in January 2008.

The structure of the surveyed companies was:

- According to ownership structure the companies were mainly private (61 (72,6%)), then public (10 (11,9%)), socially owned (8 (9,5%)) and other (5 (6%));
- According to the field of work: agriculture, hunting, forestry and water management 3 (3,4%), ore and stone mining 1 (1,1%), manufacturing industry 46 (52,3%), electrical, gas and water generation and supply 5 (5,7%), building construction 9 (10,2%) wholesale and retail trade ; motor vehicles, motorcycles and house-ware/personal repair 8 (9,1%), traffic, warehousing and connection 3 (3,4%), administration and defence ; compulsory social insurance 2 (2,3%), education 3 (3,4%), health and social care 3 (3,4%), other communal, social and individual services 5 (5,7%);
- According to the size: micro 6 (7,2%), small 8 (9,5%), middle 38 (45,2%), big 32 (38,1%);
- Position of the interviewed: director 10 (11,9%), leading manager 49 (58,3%), consultant 3 (3,6%), others 22 (26,2%);

The structure of the interviewed experts:

- The majority of the interviewed were male (31 (83,8%)),females made only 6 (16,2%);
- The greatest number of the interviewed were over 50 years of age 13 (41,9%), 11 (35,5%) were between 30 and 40, and the smallest number made those between 40 and 50 years of age 7 (22,6%). Six experts did not answer this question;
- Level of education: the majority were PhD (15 (40,6%)), experts with Master‘s degree and Bachelors made (10 (27%)) and 2 (5,4%) of the experts had college diplomas;
- Occupation (answered 22 (59,5%) of the interviewed): the majority were university professors/college professors - 11, five experts were employed as consultants, there were 2 assistants and 2 technologists, 1 director,1engineer and 1programmer;
- Position of the interviewed in their organizations (answered 36 (97,3%)): directors 5 (13,2%), leading managers 10 (26,3%), consultants 1 (2,6%), owners 2 (5,3%), others 20 (52,6%).

During checking phase of statistically relevant differences in the answers of different- size-companies (types of companies: 1 – micro and small, 2 – middle and 3 – big), the data types which appeared in the survey caused the application of two different methods of statistic analyses:

1. Kruskal Wallis – one-way analyses of the variant among the ranks for data types of lower level (nominal), as well as with data without beginner‘s presumption on the existence of a certain distribution (most frequently normal);
2. One way ANOVA – one-way analyses of the variant, but in this case for more superior data of interval level, such as significance grades.

ANOVA was also used in comparison of companies (total) and experts‘ data.

It was taken that evaluation limit of reliability results, t.i, probability which enabled claiming that the data were error consequences or random variations was p = 0,05. This means that for p ≤ 0,05 exists statistically significant difference in results.

It was determined that significant statistic exception in the answers of companies and experts (in generally) didn't exist, therefore, there is no discussion on this matter.

Where appropriate, in processing and analyses of the research results, Pareto analyses was used in order to sort the answers according to degree of importance both for the companies and experts. Research results presented in final report (Ćoćkalo 2008), t. i., in this paper, include the answers that belong to categories ―very important" and ―important". The category "other" was neglected.

4. Research results

Research results point at the fact that the majority of companies 63 (80,8%) (out of 78 (92,9%) that responded) apply relationship marketing. This fact was confirmed by the experts; 32 (91,4%) (out of 35 (94,6%) who answered) said that it was possible (in some way) to apply relationship marketing concept in domestic companies.

Both companies and experts consider input elements of relationship marketing concept significant, or significant enough, which the table 1 presents.[1]

Table 1 *Comparative review - average grades of significance of input elements in relationship marketing concept*

Input elements of relationship marketing concept	Average grades of the interviewed in companies	Average grades of the experts
Understanding customer expectations	4,31	3,88
Building service partnerships	3,92	3,42
Empowering employees	3,66	3,71
Total quality management	3,76	3,26

What in degree the analyzed companies are conscious of their customers' expectations and also the experts' estimation concerning the ability of the companies to work in our conditions. Structurally, the opinions do not differ, although the average grades of agreement between customers' expectations and delivered value vary: 4,19 (companies) – 3,05 (experts). This question was answered by 82 (97,6%) companies and 36 (97,3%) experts.

Further on, it was expected that companies and experts express their opinions on the values delivered to customers, through products and/or services. 70 (88,6%) of the interviewed in companies out of 79 (94,1%) and 17 (56,7%) experts out of 30 (81,1%) point at: quality, functional characteristics and reliability.

About the conditions for active participation of the employees in organization's activities (in relation to relatioship marketing) 4,79 (94,1%) companies and 35 (94,6%) experts expressed their opinions (Figure 1).

[1] In the research (survey), the significance scale with five levels was used (grade): **1**-particularly weak, **2**-weak, **3**-satisfying, **4**-significant, **5**-particularly significant.

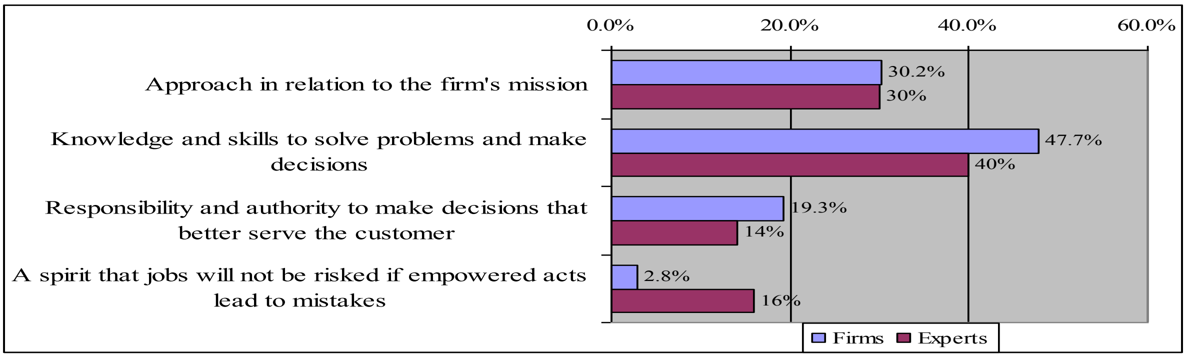

Figure 1. *Conditions for active participation of employees in relationship marketing concept*

Comparative review of the average grades which the interviewed gave about the significance of output elements in relationship marketing is presented in Table 2. It should be emphasized that all the elements were evaluated as significant both by companies (81 (96,4%) of the interviewed answered) and experts (35 (94,6%) of the interviewed).

Table 2. *Comparative review of average significance grades of output elements in relationship marketing concept*

Output elements of relationship marketing concept	Average grades of the interviewed in companies	Average grades of the experts
Quality of products/services	4,64	4,06
Customer satisfaction (effects: complaints, repeated purchase, recommendation)	4,44	4,26
Customer loyalty	4,04	4,09
Increased profitability	4,19	3,91

The part of the questionnary related to the processes of identifying expectations, monitoring and measuring customers' satisfaction had to provide insight in several elementary questions:
– how the companies, generally, carry out processes,
– to establish management and organizational division of responsibility over processes,
– to establish the best methods, techniques or activities for data obtaining and analyses,
– the ways at which the results of researching needs, especially customers‘ satisfaction influence business and relationship marketing realization.

The experts had to confirm, in some way, the companies' attitudes from the standpoint of their knowledge, experience and affinity by aswering the questionnary.

When they were asked to say if they had a special defined process for identification of customers' expectations, the majority of the interviewed in companies, 66 (79,5%) out of 83 (98,8%), gave positive answers. A part of them 14 (16,9%) connected this process to some process in their organization, only in 3 (3,6%) companies, this process was not defined at all. Similar structure of the answers was given by experts: 31 (83,8%) of them said it was necessary to define this process and only 6 (16,2%) of them thought that this process could be joined to some other process.

The situation is similar when the process of monitoring, measuring and analyses is in question: 69 (82,1%) of the interviewed in companies said that this process existed as separately defined one, 14 (16,7%) said that it was a component of some other process and only 1 (1,2%) thought that it didn‘t exist. This time, the experts were almost unique in opinion that the process had to be separately defined and only 3 (8,1%) of the interviewed said that it could be a part of some other process.

It is interesting to notice the moving of responsibility (both companies and experts agree in this) from marketing top manager, for the process identification of expectations, towards sale top manager, for the process of monitoring, measuring and analyses. Especially expressed significance of organizational units (sectors) can be noticed: trade/sale, marketing, development sector and quality sector.

Generally, it is good to realize both research of needs and expectations and measuring satisfaction in all mentioned phases, taking care that going from definition of policy and objectives towards post-sale and service activities the focus of these activities is moving from research of needs and expectations towards measuring satisfaction.

The most important methods and activities are customers' interviewes, especially personal interview and postal interview. The least attention, in opinion of the interviewed, is paid to monitoring of products in use.

Customers' satisfaction is integrated in business of the whole organization. This is, according to the research, the reality in Serbian companies. 81 (96,4%) companies and 36 (97,3%) experts confirmed this fact in their answers. The encouraging fact is that the –system of award and punishment " is almost completely excluded in companies (5 (2,5%)), while the experts do not consider it at all.

With a certain difference in opinions, the companies and experts give advantage to corrective/preventive measures and planning, while the least attention is paid to collective experience.

5. Conclusion

Organization management directed towards building relations with customers should result in achieving loyalty of customers. Making supply that overcomes consumers' expectations creates a positive interaction between consumers and products. Final result of this interaction is a satisfied and positively surprised consumer. Relationship marketing is a concept that implicits a long-lasting relation based on mutual interests of companies and customers, in such a way that both sides (seller and buyer) are focused on common objectives. Relationship marketing is, in its basic form, present in domestic companies, which this research has showed.

Customers' satisfaction represents a key output of relationship marketing, therefore a significant attention as paid to this phenomenon in Serbian companies. Identification of expectation and monitoring, measuring and analyses are the processes by which customers' satisfaction is integrated in relationship marketing.

This research has showed that there are certain differences concerning the following questions: how relationship marketing is set and led, what methods are used in integration of customers' satisfaction in relationship marketing and, further on, how relationship marketing is integrated in the process of strategic planning in the organization.

Serbian companies should pay a special attention to implementing new approaches to marketing, both in conceptual and in organizational sense. Here, we think about a broader acceptance of a new marketing model, characterised by technological developmant and also about the model of integrated marketing communication, which represents a communicational component of marketing.

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APPLYING OF DIFFERENT TYPE AND NUMBER OF LAYERS OF INTERLINING FOR GETTING DESIRED SHAPES OF GARMENT

Dragana GRUJIĆ, Svjetlana JANJIĆ & Ivana MILOŠEVIĆ

Abstract: *This paper is to show how different types and number of layers interlinings can significantly affect the shape of the garment. Accordingly, two models of women's dress are made (dress with creases – MOD 1 and dress with a collar - MOD 2) for which were used two different basic fabrics (OT1 and OT2) and two types of adhesive interlinings (MP1 and MP2). The ingredients of fabric with label OT1 are: 97% cotton and 3% elastane and for the other fabric with label OT2 is 100% polyester. Adhesive interlinings with label MP1 presents a fabric with dotted coating of polyamide thermoplast. MP2 presents nonwoven textile product obtained by connecting wiring systems of viscose yarn with thin polyester filaments below melting point, which serves as well as a thermoplastic. The physical and mechanical properties of: the fabrics, the adhesive interlining and of the compound fabrics - adhesive interlining, were examined. Based on these results, the resistance of obtained forms of clothing ,during use and maintenance, is determined. The results of testing dimensional stability and creasing angle of composite (compound fabrics - adhesive interlining) show good stability of the obtained form of clothing, which is very important information for manufacturers of apparel.*

Key words: forms of clothing, adhesive interlining, fixing, dimensional stability, creasing angle.

1. Introduction

The quality of clothing is reflected not only in meeting the aesthetic and functional requirements, but also the beauty of the flow, appropriate stability of forms, feel comfortable when worn and the ease of care. The desired properties of fabrics can be achieved by its stabilization of particular adhesive interlining which is fixed to a specific area of clothing. Fixed part as a composite has while specific properties in relation to the basic cloth and adhesive interlining, as a result of interaction and behavior of the basic fabric and adhesive interlining, actually their mechanical and physical properties of the compound composite. For the quality of clothing is particularly important knowledge of mechanical and physical properties of the basic fabric and adhesive interlinings, because on the basis of these properties can be determined the touch of a fixed part and its further production and service properties (Gershak J., 1997).

2. Theory part

Today, the production of garments can not be imagined without the process of fixing, thus obtain the desired forms of clothing and increases the quality of finished garments. However, errors that may occur due to bad choice of types of interlining, thermoplastics and fixing parameters considering the base material in most cases can not be seen immediately after the fixing process, but only when worn and at the latest after washing or dry cleaning (C. Trajkovic. et al., 2005).
The basic condition for embeding of adhesive interlinings in the clothing is to achieve lasting strength of compound interlinings with basic material, because clothing, besides wearing, must withstand more washings or dry cleanings during use. This could be achieved by proper choice of the correct type of interlining with adhesive coating for each particular type of base material, and especially by the proper and accurate operation during fixation.

2.1 The types of interlinings and their impact on the form of clothing

For adhesive interlinings can be said that they are carriers of thermoplastic adhesive by which the basic fabric is associated with interlining. Thermoplastic adhesives can be applied to various textile backing,such as fabrics, nonwoven textiles and knitwear. Textile backing can be of various raw material compositions and structures (different types of fibers, yarns of different fineness for the warp and woof, weave, wires density and surface masses). To create an interlining can be used all textile fibers that can be processed at a temperature of 120 to 180 ° C. The basic characteristic of all materials used for making interlining is their low surface mass ranges from 30 to 240 g / m², while the surface mass of non-adhesive interlining ranges from 200 to 300 g / m².
Interlinings are intended: to improve the ability of shaping clothes, to obtain the appropriate form and elasticity of fabrics, to improve the appearance and behavior of clothes during wearing. (Kim SJ et al., 1996). The desired characteristics of made clothing will depend on, besides the known mechanical properties of selected basic fabric, primarily on the right choice of adhesive interlinings.
Therefore the adhesive interlinings have not only a great influence on the touch of made clothes, but also on the aesthetic appearance and shape of clothes, dimensional and shape stability, functionality, and its final use. About choosing the appropriate interlinings can be decided on the basis of compatibility:
- basic characteristics that determine the properties of certain interlining in the process of fixing and final use;
- mechanical and physical properties of the adhesive interlining in relation to the used basic fabric.

Among the main characteristics that determine the properties of adhesive interlinings are interlinings type and structure as the supporting material, as well as the type and coating of thermoplastic. Thermoplastics, which are mainly used in clothing industry are: the polyamides, polyethylene, polivinilacetat, copolymers of ethylene and vinyl acetate, polyvinyl chloride-based thermoplastics (Trajkovic, C., 1997). The type and structure of interlinings, which is selected in view of the surface mass and the thickness of the base fabric, determine the mechanical properties of adhesive interlinings and affects the final service properties of fixed pieces of clothing. The type of thermoplastic which acts as a connective element between the base fabric and interlinings causes its usefulness.

2.2. Characteristics of the process of fixing adhesive interlinings

Connecting adhesive interlinings and the base material is performed under the influence of heat and pressure for specific time. The resulting compound has to withstand all subsequent phases of the technological process of making the garment and all loads in the use and maintenance of the garment. Fixed part as a of compound composite, occurs due to the combining adhesive interlinings with the main fabric in the process of fixing, so that appropriately softened thermoplastic due to the pressure, partiallybut uniformly, impress into the layers of basic fabric and interlinings and firmly connects them. The strength of the resulting compound depends on the adhesion of thermoplastic to the fibers in fact to basic fabric and interlining and on cohesion within the thermoplastic as a polymer, Fig.2.

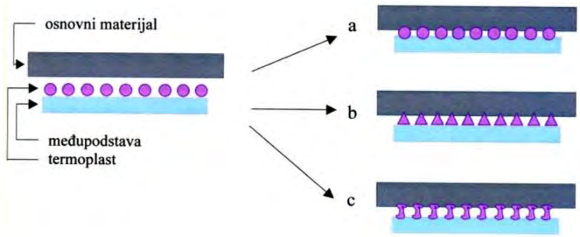


Figure 2: The quality of the compound depends on the cohesion and adhesion (B. Lukic et al., 2002)
a) a good of compound, b) weak adhesion, c) weak cohesion

The resulting of compound composite, which is the building block of a sophisticated quality clothing, must in addition to the aesthetic and functional requirements to meet the requirements of mechanical properties. These are: the quality and the strength of of compound, elasticity, constancy and shape stability and a nice flow.

2.3. Possibilities of evaluation of some quality parameters of the look of finished garment

The rating of "quality look" of garments is one of the most important tasks in the field of clothing engineering. Today, some mechanisms are proposed to be used for the assessment of "quality look" of the garment, which includes the following activities (Zevc-Pavlinic D.et al., 2007) :

- identifying and defining the factors that affect the "quality look" of garments,
- examination and define criteria for the subjective assessment of "quality look",
- establishing a connection between the received quality, subjective evaluation and control of the manufacturing process,
- examination of factors such as mechanical and physical properties of textile materials and their impact on "quality look" of clothing and at the end, the development of a new model that is based on an objective evaluation of "quality look" of garments, starting from the mechanical and physical properties of textile materials of which clothing is made.

The quality of a garment can be achieved depending on the behavior, comfort and aesthetic appeal. Researches of dependence "quality look" of virtual garments of fabric properties has shown that there is a statistically reliable dependence "quality look" of the properties of stretching, shearing and friction (Grujic D.et al., 2010).

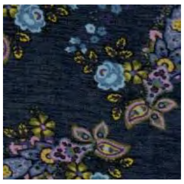
3. Experimental

The purpose of this paper is to show how the use of different types and number of layers interlinings can significantly affect the shape of the garment. Consequently, two models of women's dresses that are made from different fabrics and interlining were examined, on which are the well-recognized differences in the very form of clothing.

3.1. Used materials

For the examinations performed in this paper are used two basic types of fabrics and two types of interlinings. Labels and appearance of the investigated samples are shown in Table 2.

Table 2. Labels and appearance of the used basic fabrics and interlinings

Basic fabric		Adhesive interlining	
OT 1	OT 2	MP 1	MP 2
	 		

3.2. Methods of examination

By applying of standard methods were examined physical and mechanical properties of fabrics adhesive interlining and fabric-interlining of compounds, such as: raw material composition (ISO 1833), the surface mass (ISO 3801), the density of wires (ISO 7211-2), breaking force (ISO 1394-1), dimensional stability (ISO 6330) and creasing angle (DIN 53890 and JUS. F.S2.018). According to the conventional procedure was carried out fixing of the certain cutting parts (folds, collars and sleeves), as well as samples for testing of the properties of compounds - the basic fabric and adhesive interlining - of compounds the basic properties of adhesive interlining fabric, on the phase fixed press. Because the tested fabrics have a smooth surface structure, the pressure was constant and amounted to 4•104 Pa. Fixing cotton fabric (OT 1) was carried out at a temperature of 160 ° C, while polyester fabric (OT 2) at a temperature of 120 ° C in duration of 10 seconds.

3.3 Forms of dress depending on the construction and types of applied adhesive interlining

To determine the impact of construction and application of various kinds of adhesive interlining to the finished appearance of the garment, two models of women's dress have been selected (MOD 1 and MOD 2), which are made from two types of fabrics (OT 1 and OT 2) and two types of adhesive interlinings (MP 1 and MP 2), Fig. 3. Different forms of dresses are obtained by gluing (fixing) of different types of adhesive interlinings on some parts of dress cutting plans, where the different compounds were formed of the basic fabric and interlining materials tab. 3.

Table 3. Overview of of compounds of the basic fabric - adhesive interlining

Label of compound	Description of compound	Labels of materials of the compound
SP 0	OT 1	OT 1 – bordeaux cotton fabric
SP 1	OT 1 – MP 1	OT 1 – bordeaux cotton fabric MP 1 – interlining PA
SP 2	OT 1 – MP 2 (2 sloja)	OT 1 – bordeaux cotton fabric MP 2 – interlining PES/ viscose
SP 3	OT 2 – MP 1	OT 2 – polyester fabric in pattern MP 1 – interlining PA (collar)
SP 4	OT 2 – MP 2 (3 sloja)	OT 2 – polyester fabric in pattern MP 2 – interlining PES/ viscose (collar and sleeves)

Dress with folds (MOD 1) a b c

Dress with collar (MOD 2) d e f

Figure 3: The appearance of female dress models with various types and number of layers of interlinings

a) MOD 1 whith the compound SP 0; b) MOD 1 whith the compound SP 1; c) MOD 1 whith the compound SP 2; d) MOD 2 whith the compound SP 3; e) and f) MOD 2 whith the compound SP 4

4. The results and discussion

This chapter shows the results of testing the properties of fabrics tab. 4, and adhesive interlining, tab. 5, as well as the compounds of basic fabric - adhesive interlining, tab. 6, and explained the impact of studied traits for getting different forms of clothing. In Table 7. are shown tests of creasing angle of fabric with the label OT2, and compounds labeled SP3 and SP4, and the mean value of the quality grade - K (%) on the fig.4. etc.

Table 4. Results of testing properties of the basic fabric

Examined property		Label of sample	
		OT1	OT2
Raw material composition, %		97 % cotton / 3 % elastin	100 % polyester (PES)
Surface mass, g/m^2		120	45
Density of weaving, wire/cm	warp	48	41
	welf	28	43
Breaking strength, N/5 cm	warp	451.26	204.38
	welf	184.76	96.47
Breaking elongation, %	warp	12.83	26.00
	welf	32.50	28.50

Results of examinations of dimensional stability of fabrics and compounds showed that the shrinage by the warp and welf while washing at 40 º C and while ironing at 150 ° C is less than 1%.

Table 5. Results of examinations the properties of adhesive interlinings

Examined property		Label of the sample			
		MP1	MP 2	MP 2 (2 layers)	MP 2 (3 layers)
Raw material composition, %		100 % polyamide	70 % viscose / 30 % polyester		
Surface mass, g/m^2		30	70	126	190
Breaking strength, N/5cm	longitudinally	138.98	145.52	106.28	500.31
	transverse	57.23	70.31	116.09	245.25
Breaking elongation, %	longitudinally	93.17	21.00	33.67	20.33
	transverse	74.33	19.50	21.67	26.33

Table 6. Results of examinations the properties of compound basic fabric - adhesive interlining

Examined property		Label of compound basic fabric - adhesive interlining			
		SP1	SP 2	SP 3	SP 4
Surface mass, g/m^2		150	246	70	236
Breaking trength, N/5 cm	warp	591.87	730.95	318.83	608.22
	welf	264.87	344.99	81.75	309.02
Breaking elongation, %	warp	13.83	14.80	32.50	25.00
	welf	36.00	32.00	21.50	24.83

Table 7. Results of examinations of creasing angle for basic fabric (OT 2) and compound SP 4

Oznaka uzorka			Creasing angle – α [º]			
			α_5	α_{60}	α_0	K [%]
OT 2	WARP	face	163	167	153	78.86
		back	166	169	159	82.94
	WELF	face	166	174	148	79.48
		back	169	172	162	86.00
SP 3	WARP	face	141	152	117	54.89
		back	154	158	144	70.22
	WELF	face	155	161	141	70.07
		back	165	171	151	79.69
SP 4	WARP	face	160	165	148	75.37
		back	162	166	152	77.88
	WELF	face	163	168	151	78.30
		back	156	164	138	69.85

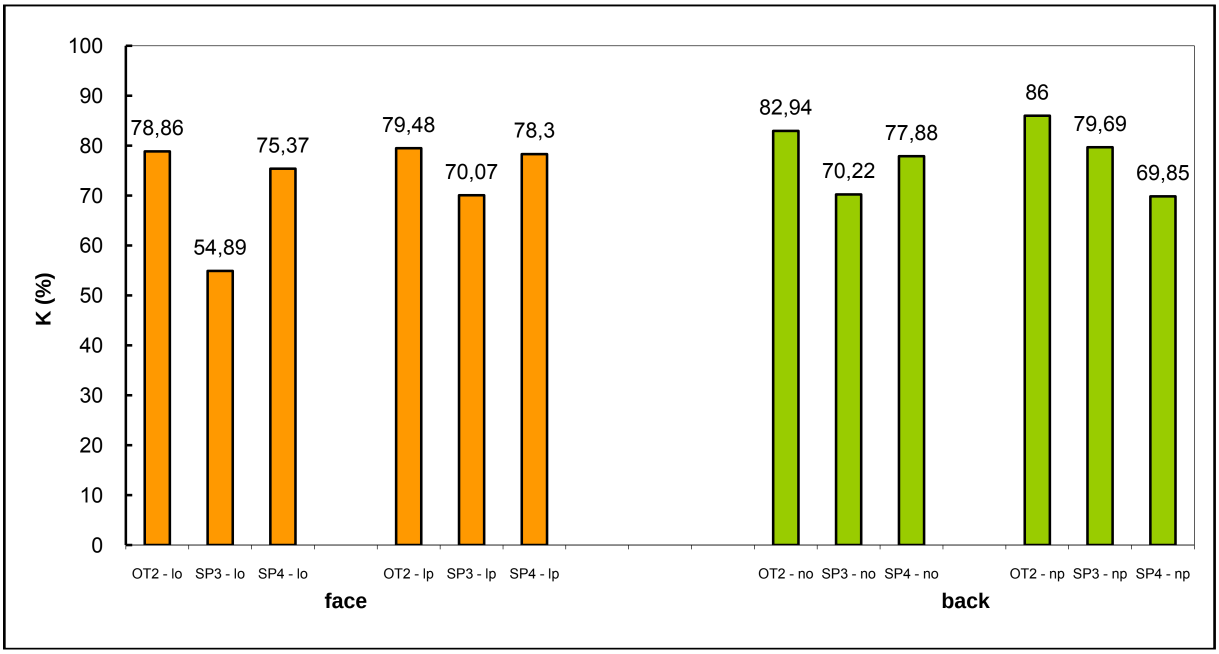


Figure 4. Mean values of quality grade – K (%) of basic fabric OT 2 and compound SP 3 i SP 4

Based on the dress looks labeled MOD1 and MOD2, figure 3, it is evident that by the use of different constructions, types and number of layers of adhesive interlinings various forms of clothing can be achieved. In models MOD1 good look of folds is made at compound SP1, figure 3.b, the desired look at compound SP2, figure 3.c, while folds of the dress without adhesive interlinings, figure 3.a, there are no satisfactory form. In figure 3.b and 3.c almost no noticeable difference in the form of clothing, although the surface mass of compound SP2 is higher by as much as 96 g / m² from the compound SP1, table 6, as much as 96 g / m² from the compound SP1, table 6. The influence of surface mass on the form of clothing is evident for models labeled MOD2, because the surface mass of the basic fabric labeled OT2 (45g/m2) is less than the fabric OT1 (120 g/m2), therefore only by using multiple layers of interlinings (SP4) the desired form of clothing is achived, figure 3.e and 3.f. Also, the use of adhesive interlinings with the less surface mass MP1 in compound with the basic fabric with the larger surface mass (OT1) achieve a satisfactory form of clothing, figure 3.b. At MOD2 is a very noticeable difference in the form of dress where is used the fabric of the same surface mass, figure 3.c with a compound SP3 and figure 3.e and 3.f with a compound SP4, as well as the impact of layered interlinings which makes stiffness of the garment‘s parts. Based on examination of usable characteristics during the maintenance, in fact, the shrinkage was examined while washing at 40°C and ironing at temperature 150°C, which was less than 1% for the basic fabric OT2 as well as for compound SP4, it could be concluded that the model labeled MOD2, regardless of the number of layers interlinings, have good stability of the form during maintenance.

Based on the of test results and the creasing angle and the calculated quality grade (K) for OT2, SP3 and SP4, table 7. and figure 4, can be seen that the creasing angle and quality grade (K) at compound SP3 are the lowest, except for weft of the fabric‘s back where the value is higher compared to SP4. When making women's clothing labeled MOD2, the compound SP3 is used commonly. But test results showed that the compound labeled SP4 has a lower tendency to wrinkle and greater value of quality grade. This means that the preferred form of feminine dress MOD2 with a compound SP4 have a constant shape during use, in fact, obtaining the form of clothing in this manner may find practical application.

5. Conclusion

Based on theoretical considerations and the study of the impact of the fixing parameters and of the type of adhesive interlinings to the effects of fixation and the form of garments, which were carried out within this paper, may be made the following conclusions:

- The desired form of clothing is achieved by using several layers of adhesive interlinings, in fact, the form of clothing wih appropriate stability during use and maintenance is obtained.
- The surface mass of the basic fabric and adhesive interlinings have a significant impact on the final form of clothing.
- The creasing angle of the fixed pieces of clothing is smaller for compound SP3 compared to compound SP4, so that leads to the conclusion that the preferred form of female dress labeled MOD2 with the compound SP4 is going to have a satisfactory resistance of form during use.
- Fixing the basic fabric with adhesive fixing interlining at temperatures 160 ° C, by the pressure $4 \cdot 10^4$ Pa is achieved good dimensional stability and satisfying strength of the compound, because after washing at 40 ° C there was no separation of layers of materials and desired form of clothing was retained.

By different constructions of garments, **by the** use of adhesive interlinings with different surface mass, as well as **by** several layers of adhesive interlinings, different forms of clothing can be gotten.

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COMPATIBILITY OF POLYPROPYLENE FIBRES WITH ADDED MICROCAPSULES AND LUBRICANT

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Abstract: _The paper presents the compatibility of polypropylene fibres with incorporated microcapsules and added lubricant. The shell of microcapsules was composed of melamine formaldehyde resin, while the core was made of paraffin. Polyolefin as the lubricant was also added to polypropylene fibres to provide better distribution of microcapsules. The mass ratio of polypropylene, lubricant and microcapsules was 90 : 5 : 5. The compatibility of these three fibre components was determined with the following methods: Fourier transform infrared spectroscopy, differential scanning calorimetry, scanning electron microscopy and melting point determination. The following results are shown in the paper: the presence of any possible new bonding in the polypropylene fibre with the lubricant, the change of melting and crystallisation enthalpy by adding the lubricant into the polymer mixture, possible miscibility of the polypropylene polymer with the lubricant and the change of the melting point when mixing polypropylene with the lubricant._

Key words: polypropylene, microcapsules, lubricant, Fourier transform infrared spectroscopy, differential scanning calorimetry.

1. Introduction

Making synthetic fibres with different additives enables the addition of new properties to the existing fibre. However, sometimes these additives alter the basic fibre properties, influencing the final material properties. The compatibility of the fibre polymer and additives thus has to be studied already in the early stages.
Adding solid additives into fibres is a very common modification method of thermoplastic fibres. The main disadvantage of the process is the grouping of dry additives into clusters and their incompatibility with the basic polymer. This problem can be partially overcome by using a lubricant, which is also often added into the melting polymer mixture. Various sources of literature research (Richter E. et al, 2000) indicate that low-viscous lubricants are frequently used in the manufacture of synthetic fibres, playing the role of a dispersing agent in the fibres. Lubricants quickly and effectively wet the surface of solid particles, e.g. colour pigments. In the case of solid clusters, the lubricant reaches the empty spaces which are inaccessible to the melt of the base polymer. In this way, the solid particles separate from each other due to the stronger intermolecular forces between the surface of hard particles and the lubricant. Individual particles are further surrounded by the lubricant and therefore prevented from re-grouping into clusters.
The lubricant allows better spinning of fibres and by containing a dispersing agent, it can regulate a more homogenous distribution of the solid particles in fibres and partially prevent their clustering into larger agglomerates.
When selecting a lubricant, it needs to have a similar chemical structure as the fibre polymer, since a phase separation and fibre breaks during the fibre production process occur otherwise.

2. Research methods

2.1 Samples

In this research, the following materials were used:

- fibre forming polymer: polypropylene (Hostalen PPU 1080 F),

- two additives:
  - polyolefin lubricant (Tegomer P 121), and
  - microcapsules (shell: melamine formaldehyde resin, cavity: paraffin with melting temperature 50 °C).

Polypropylene (PP) fibres with added lubricant and microcapsules were formed in a laboratory spin-draw device. The mass fraction of the lubricant and microcapsules in the fibres was 5%.

The compatibility of PP fibres with the lubricant and microcapsules was examined with the following research methods:
- melting point determination,
- differential scanning calorimetry,
- Fourier transform infrared spectroscopy, and
- scanning electron microscopy.

2.2 Melting point determination
The fibres were heated to their melting point with a thermo-microscopic apparatus. The influence of heat on the fibre shrinkage and the occurrence of the fibre phase transition were observed (mechanical melt liquid state, starting melt temperature and final melt temperature).
The electrical melt heating table used was Mettler Hot Stage FP 82 HP and the microscope Mettler FP 90 Central Processor.

2.3 Differential scanning calorimetry
Differential scanning calorimetry (DSC) is a method used to study some physical properties of crystalline polymer materials, e.g. heat capacity and phase changes of a material. The measurement results give a thermal transition temperature and heat between the released or consumed heat (enthalpy of thermal transition).

The apparatus used was Pyris 1 (Perkil Elmer). The measurement parameters were chosen as follows:
- heating temperature range: 0–190 °C, followed by a 1-minute retention at 190 °C, and
- cooling to 0 °C,
- heating rate and cooling rate: 5 °C,
- atmosphere: N2,
- sample mass: 10 mg.

2.4 Fourier transform infrared spectroscopy
The vibration spectra of chemical groups present in fibres were recorded with the Attenuated Total Reflectance – Fourier transform infrared spectroscopy (ATR-FTIR). The presence of new bonding, detected in the fibre mixture (PP : lubricant – 95 : 5) was determined.
The apparatus FTIR System Spectrum GX (Perkin Elmer) was used.

2.5 Scanning electron microscopy
The morphological differences between PP and lubricant in fibres, as well as the incorporation of solid microcapsules into the PP matrix were observed with scanning electron microscopy (SEM).

The apparatus JSM 6060 – LV (Jeol) was used.

3. Results

3.1 Melting point determination

The results of the melting point measurement of PP fibres with the lubricant and microcapsules are shown in Table 1.

Table 1: Melting temperatures of PP fibres with added lubricant and microcapsules.

Parameter	Spinning mixtures			
	PP	lubricant	PP + 5% lubricant	PP + 5% microcapsules + 5% lubricant
T_m (softening point) [°C]	160.5	110.5	160.0	159.7
T_m (starting point) [°C]	161.4	110.9	161.2	160.9
T_m (final point) [°C]	**163.8**	**114.3**	**163.5**	**164.3**

3.2 Differential scanning calorimetry

The results of the DSC analysis are shown in Tables 2 and 3, and in Figure 1.

Table 2: Results of DSC analysis (heating) of PP fibres with added lubricant and microcapsules.

Sample	ΔH_m [J/g]	T_m [°C]	$T_{m,\,s}$ [°C]	$T_{m,\,f}$ [°C]
PP	91.99	167.60	120.00	175.00
lubricant	95.35	104.76	15.00	118.00
PP + 5% lubricant	92.58	166.40	120.00	173.00
microcapsules	119.31	48.30	15.00	55.00
PP + microcapsules	91.88	166.17	120.00	173.00
PP + microcapsules + lubricant	87.43	165.40	120.00	173.00

(ΔH_m – melting enthalpy, T_m – melting temperature, $T_{m,\,s}$ – starting point of melting temperature, $T_{m,\,f}$ – final point of melting temperature)

Table 3: Results of DSC analysis (cooling) of PP fibres with added lubricant and microcapsules.

Sample	ΔH_c [J/g]	T_c [°C]	$T_{c,\,s}$ [°C]	$T_{c,\,f}$ [°C]
PP	–98.83	116.72	95.00	130.00
lubricant	–87.75	97.93	15.00	115.00
PP + 5% lubricant	–95.91	115.92	95.00	130.00
microcapsules	–128.49	32.69	8.00	52.00
PP + microcapsules	–92.27	121.07	95.00	130.00
PP + microcapsules + lubricant	–92.57	117.06	98.00	132.00

(ΔH_c – enthalpy of cold crystallisation, T_c – temperature of cold crystallisation, $T_{c,\,s}$ – starting temperature of cold crystallisation, $T_{c,\,f}$ – final temperature of cold crystallisation)

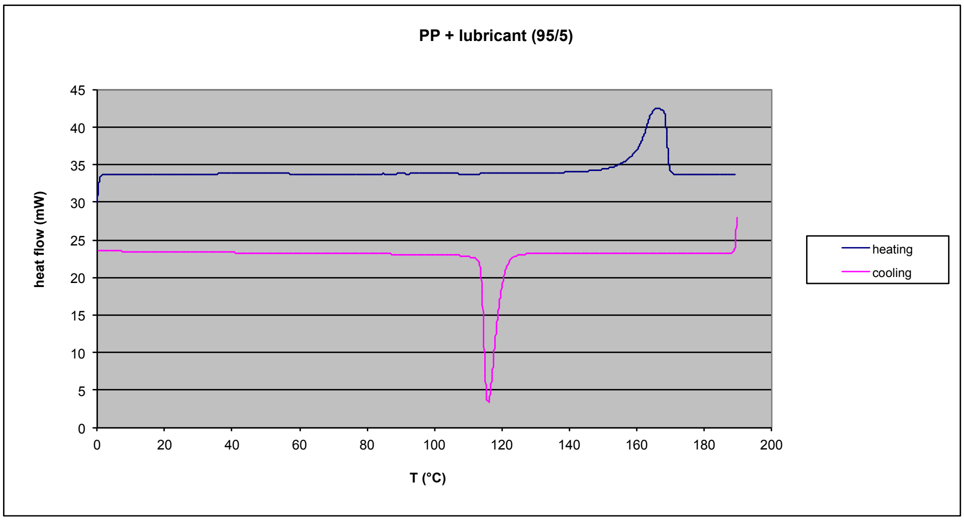
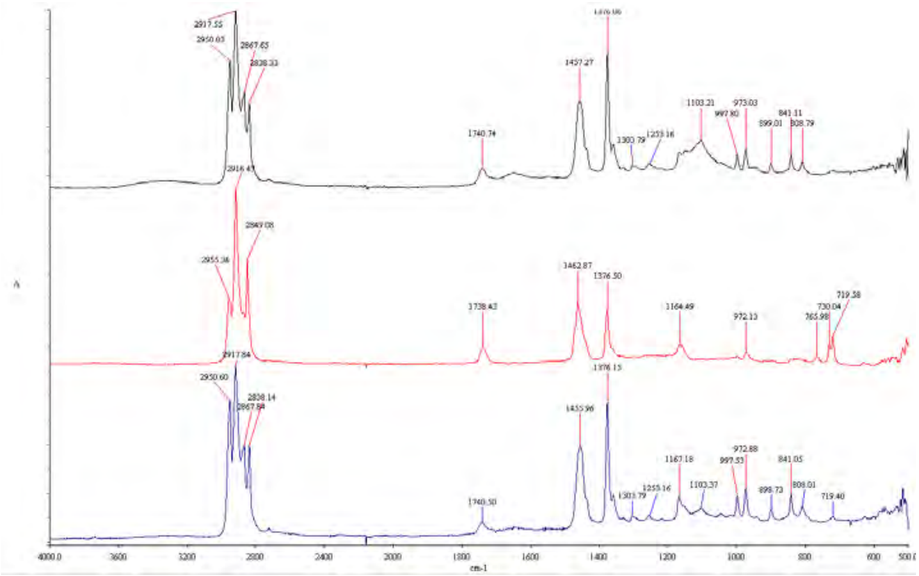


Figure 1: DSC diagram of PP fibres with added lubricant and microcapsules (95 : 5 : 5).

3.3 Fourier transform infrared spectroscopy

IR spectra of PP fibres, microcapsules, lubricant, PP : lubricant fibres (95 : 5), PP : microcapsule fibres (95 : 5) and PP : lubricant : microcapsule fibres (90 : 5 : 5), respectively, are shown in Figures 2 and 3.



PP

lubricant

PP : lubricant (95 : 5)

Figure 2: FTIR spectra of PP fibres, lubricant and PP : lubricant fibres (95 : 5).

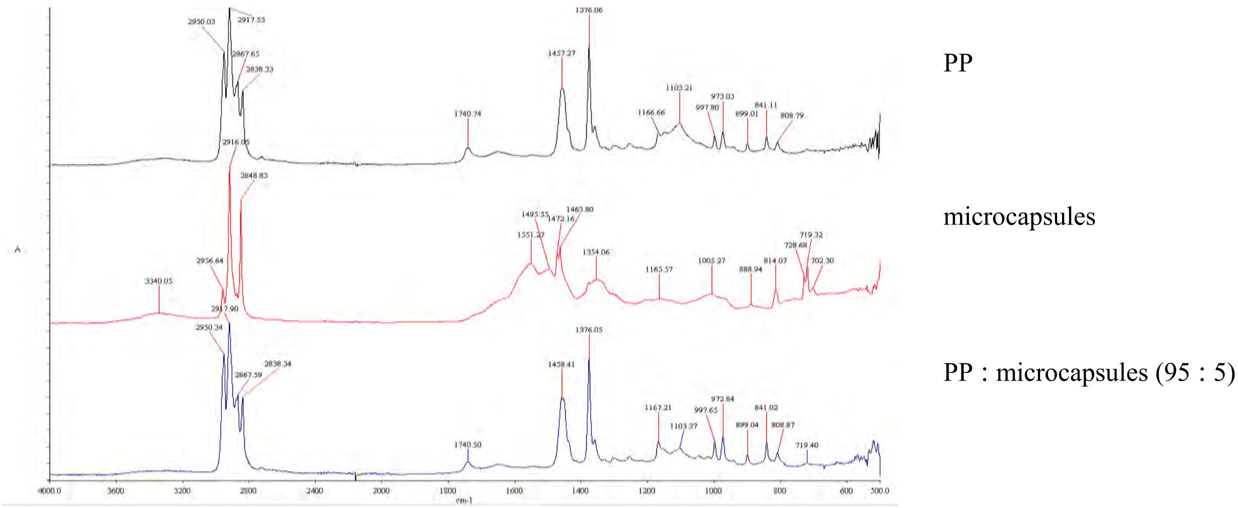


Figure 3: FTIR spectra of PP fibres, microcapsules and PP : microcapsule fibres (95 : 5).

3.4 Scanning electron microscopy

The morphology of the inner structure of PP fibres with the lubricant and microcapsules is shown in Figures 4, 5 and 6. The longitudinal splitting of fibres was performed.

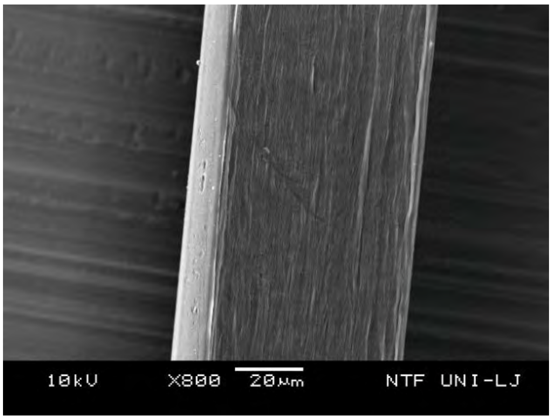


Figure 4: PP fibres (SEM, magnification: 800×).

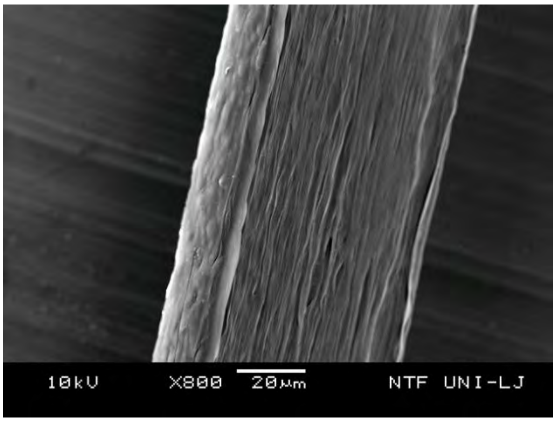


Figure 5: PP fibres with lubricant – 95 : 5 (SEM, magnification: 800×).

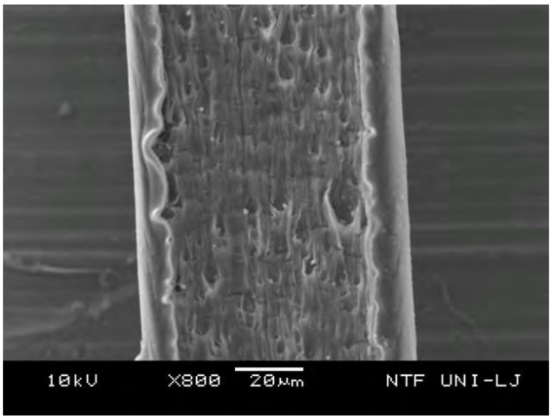


Figure 6: PP fibres with lubricant and microcapsules (SEM, magnification: 800×).

4. Discussion

From the results of the melting point measurements, it was established that the melting temperature of wax is significantly lower than the melting temperature of polypropylene (Tm wax: 114.5 °C and Tm polypropylene: 163.8 °C). Despite the small proportion of wax in the fibre (5%), a decrease in the melting temperature of polypropylene : lubricant and polypropylene : lubricant : microcapsule fibres is indicated (163.5 °C, 164.3 °C). The melting temperatures of samples obtained with the differential scanning calorimetry analysis were slightly higher, reflecting the diversity of the used apparatus.
The answer to the question whether the lubricant is compatible with polypropylene can be found in the curves of temperature versus the heat flow by means of the differential scanning calorimetry analysis. Figure 1 reflects only one thermal transition during the melting (heating) and cold crystallisation (cooling) of the polypropylene : wax (95 : 5) sample. This proves that the mixture components of polypropylene/wax are compatible with each other, since the number of thermal transitions demonstrates the homogeneity or heterogeneity of the fibrous component. The differential scanning calorimetry analysis also shows that the change in the enthalpy of cold crystallisation is reduced by adding a lubricant and microcapsules into the fibre (–95.91 J/g and –92.57 J/g). Similarly, the melting enthalpy change is reduced with the addition of the lubricant and microcapsules into the fibres (91.88 J/g and 87.43 J/g). The latter suggests that the degree of crystallinity in polypropylene fibres reduces with the presence of additives.
The Fourier transform infrared spectra demonstrate that in the mixture of polypropylene : lubricant (95 : 5), no new peaks of spectra occur, which confirms the fact that polypropylene is bonded to the lubricant only in a physical and not chemical way, through chemical bonds. Similarly, the same can be stated for the mixture polypropylene : lubricant : microcapsules (95 : 5 : 5).
The morphology of polypropylene fibres with added lubricant and microcapsules is modified as it can be seen from the morphology of the longitudinal splitting of fibres. In the case of polypropylene fibres, the fibrils are densely layered with each other, while the addition of the lubricant causes an uneven distribution, creating large voids. This phenomenon can be attributed to different viscosity of polypropylene versus wax during the fibre spinning. With the addition of microcapsules, the fibre morphology is further altered, as microcapsules act as a foreign body in the fibre. From Figure 6, it appears that microcapsules hinder the linear flow of the polymer melt and cause the formation of a small ―pocket" where they are safely ―stored".

5. Conclusion

Not all methods are suitable for the demonstration of the compatibility of the polymer with additives. Therefore, in this study, only those methods were selected for which the compatibility of the polymer with lubricant and microcapsules can be proved. It was established that the lubricant is compatible with the polymer, while the microcapsules act as a foreign object.

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COMPREHENSIVE OVERVIEW OF THE TRANSFER PROPERTIES OF CLOTHING MATERIALS

Zenun SKENDERI & Ivana SALOPEK ČUBRIĆ

Abstract: _There is a number of different textile parameters that in a certain way affect the thermophysiological comfort. One of them is the transfer of heat and moisture trough the material structure. The aim of this paper is to present an overview of transfer properties for different materials that are used for the production of a variety of clothing items. The materials range from those intended for the production of next-to-skin wear (single jersey knitted fabrics), woven fabrics for the production of formal wear, leathers and furs. The paper discusses the differences in the heat and water vapour resistances of observed materials and indicates the crucial factors that affect differences in the behavior of material considering the transfer properties._

Key words: transfer properties, knitted fabric, woven fabric, leather, fur.

Baselines of comfort

According to ASHRAE standard, the comfort is defined as a state of mind where a person expresses the satisfaction with the environment (ASHRAE, 1996). The physiological comfort range for a person wearing clothing ensemble with insulation of 0.6 clo can be achieved without any additional body heat transfer mechanisms (like shivering, vasoconstriction, vasodilatation or sweating), within 22.2 to 25.5ºC. The comfort outside defined basic comfort one is provided by adding or removing additional garments. Each change in the environmental temperature for a 1ºC is compensated by the change of 0.18 clo of clothing insulation (Goldman, 2007).

The thermal equilibrium between the human body and environment is established if there is a balance between the rate of heat production and the rate of heat loss. The heat production refers to the difference between the total rate of energy production and the rate at which the external work is performed. The rate of heat loss is a sum of different processes that include radiation, convection, evaporation, dry respiration, conduction and storage of heat in the body. It is quite difficult to maintain the heat balance as there is a number of factors influencing the heat exchange processes. A number of expressions were established to describe the processes involved in the comfort equation. As seen from the comfort model, the total comfort is correlated with the heat balance (HB) that is defined by the radiation (R), convection (C), conduction (K) and evaporation (E), (Fig.1). The parameters that affect the staten relate to the following:
- environment: radiant temperature (t_r), air velocity (v), air temperature (t_a), air pressure (p_a) and pressure on skin ($p_{sk,s}$), …
- body*:* skin wettedness (w), skin temperature (t_{sk}), DuBois area (A_{Du}), the part of skin included into the transfer by radiation (A_r/A_{Du}) and skin emissivity (ε_{sk}), …
- textile: clothing insulation (I_{cl}), clothing area factor (f_{cl}), clothing temperature (t_{cl}), …

Besides the mentioned parameters, there is a number of different parameters of textile that in a certain way affect the thermophysiological comfort. One of them is the transfer of heat and moisture trough the material structure.
The aim of this paper is to present an overview of transfer properties for different materials that are used for the production of a versity of clothing items. The materials range from those intended for the production of next-to-skin wear and formal wear to leather and fur.

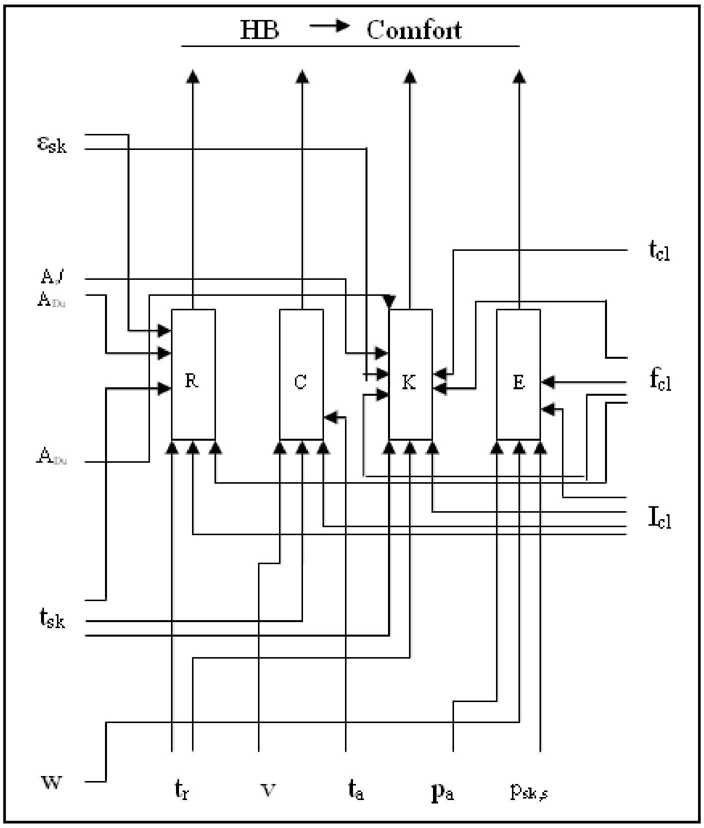

Figure 1: Comfort model

Measuring technique

The SGHP (Sweating Guarded HotPlate) system measures the heat and water vapour resistance – parameters that also affect the total comfort. It consists of the following parts: metal plate fixed to a conductive metal block containing electrical heating element, temperature controller, heating measuring device, water dosing device, environmental sensors and software. The metal plate is heated to 35ºC and the air is ducted to flow across and parallel to the upper surface of heated plate. The heat flux trough test specimen is measured after the steady-state conditions have been reached. During the measurement of water vapour resistance, the metal plate is covered by water vapour permeable and liquid impermeable membrane, so no liquid water contacts the specimen to be investigated. The water that simulates sweat is fed from the water dosing device trough channels mounted into the face of the heating block to the metal plate. The heat resistance (Rct) and water vapour (Ret) resistance is further determined according to the following formulas (ISO 11092, 1993):

$$R_{ct} = \frac{\left(T_s - T_a\right)}{\frac{H}{A}} - R_{ct0} \tag{1}$$

$$R_{et} = \frac{\left(p_s - p_a\right)}{\frac{H}{A}} - R_{et0} \tag{2}$$

where: R_{ct} - dry resistance of sample only (m^2K/W), T_s - hotplate surface temperature (K), T_a - ambient temperature (K), H/A - zone heat flux (W/m^2), R_{ct0} - bare plate dry resistance (m^2K/W), R_{et} - evaporative

resistance of sample only (m^2Pa/W), p_s - saturation vapour pressure at hotplate surface (Pa), p_a - ambient partial vapour pressure (Pa), R_{et0} - bare plate evaporation resistance (m^2Pa/W).

According to the ISO standard, (ISO 11092), during the Rct tests, the air temperature and relative humidity are set to 20°C and 65% R.H., while during the Ret tests, the conditions are set to 35°C and 40% R.H. The air velocity should be constant during both dry and wet measurements at 1 m/s.

Resistances of different materials

In order to illustrate the behaviour of different materials, primarily considering their ability to transfer the heat and water vapour from the human skin to the environment, a number of different materials was observed; i.e. knitted fabrics, woven fabrics, leather and fur (Table 1).

Table 1: Overview of materials

Number	Designation	Type	Description	Thickness, mm
1.	K1	KNITTED FABRICS	Single jersey knit, cotton yarn	0,4
2.	K2		Single jersey knit, cotton yarn	0,5
3.	K3		Single jersey knit, cotton/modal yarn	0,4
4.	K4		Single jersey knit, cotton/modal yarn	0,5
5.	K5		Single jersey knit, viscose yarn	0,3
6.	K6		Single jersey knit, viscose yarn	0,4
7.	K7		Single jersey knit, lyocel yarn	0,4
8.	K8		Single jersey knit, lyocel yarn	0,5
9.	K9		Single jersey knit, polyester yarn	0,4
10.	K10		Single jersey knit, polyester yarn	0,5
11.	K11		Single jersey knit, cotton + elastane yarns	0,4
12.	K12		Single jersey knit, cotton + elastane yarns	0,5
13.	W1	WOVEN FABRICS	Twill weave, woolen yarns	0,3
14.	W2		Plain weave, Woolen + silk yarns	0,4
15.	W3		Twill weave, Woolen + polyester yarns	0,4
16.	W4		Plain weave, Woolen + polyester + elastane yarns	0,5
17.	W5		Plain weave, Woolen yarns	0,5
18.	W6		Twill weave Woolen + polyester yarns	0,5
19.	L1	LEATHER	Cow skin lining	1,3
20.	L2		Pig skin lining	0,7
21.	L3		Hydrophobed cow skin lining	1,2
22.	L4		Split cow hide	1,3
23.	L5		Split cow skin hide for insoles	2,4
24.	L6		Felt for insoles	2,3
25.	L7		2-layer composite face material	3,0
26.	L8		2-layer composite for insoles	5,5
27.	L9		Thermoplastic toecap	1,4
28.	L10		Cow skin for the footwear face	1,8
29.	F1	FUR	Lining fur, nature	20,0

30.	F2		Lining fur, colored	15,0
31.	F3		Medical fur	18,0

The overview of the presented values for the heat and water vapour reistances (Fig. 2-5) indicates the ranges that are common for each observed group of materials (Skenderi 2010, Salopek Ĉubrić 2010, Akalović 2011). As seen, the lowest values, that correspond to the knitted fabrics intended for the production of next-to-skin clothing, are in the range 0,010-0,028 m^2KW^{-1}. The values of heat resistance for the presented woven fabrics are reasonably higher (i.e. 0,072-0,088 m^2KW^{-1}), considering the fact that those materials are used for the production of suits, i.e. spring/autumn clothing collection.

The values of the heat resistance for the leather materials are up to 0,13 m^2KW^{-1}, while for the furs the same reaches up to 0,77 m^2KW^{-1}. Regarding the leather materials, it was found that lining materials - cow and pig skin, have nearly equal values of resistance to heat transfer, which is appropriate to the use of these materials. Material for covering insoles - split cow hide shows the value of resistance to heat transfer suitable for materials for making inner parts of the shoe. Materials for insoles - split cow hide and felt provide approximately equal values for the resistance to heat transfer. Face materials - textile composite and cow nappa lower leather show lower resistance values to heat transfer. Thermoplastic toecap material, in accordance with the use, shows that the values of resistance to heat transfer are approximately equal to the values of other inner materials.

Regarding the furs, higher values of resistances are accomplished for the linings. The reason for such behavior should be found in the density of the hairs that increases the resistances. At the other hand, relatively lower values for medical fur, among the materials in observed group, are in correspondence with expected behavior for such materials when used in the decubitus linings.

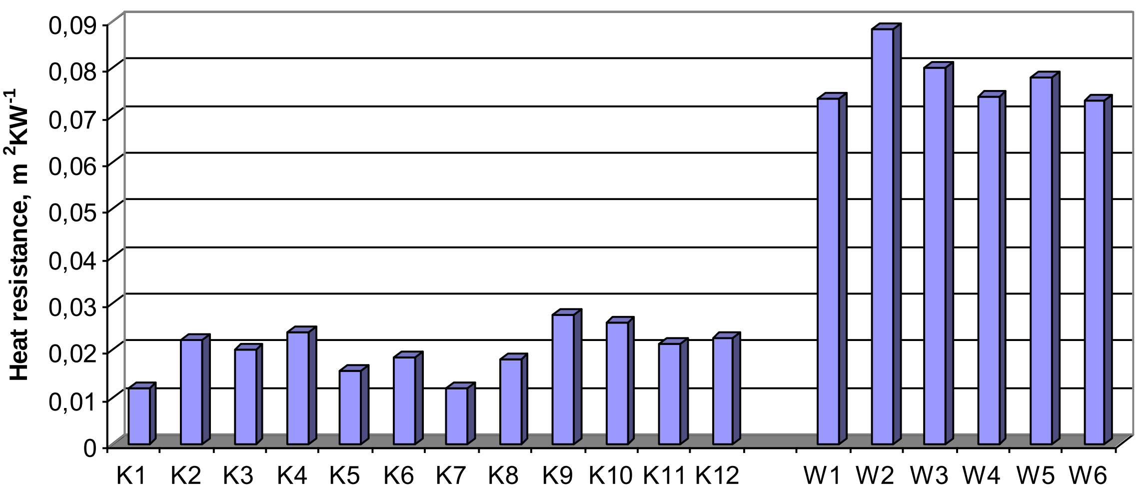

Figure 2: Heat resistance of knitted and woven fabrics

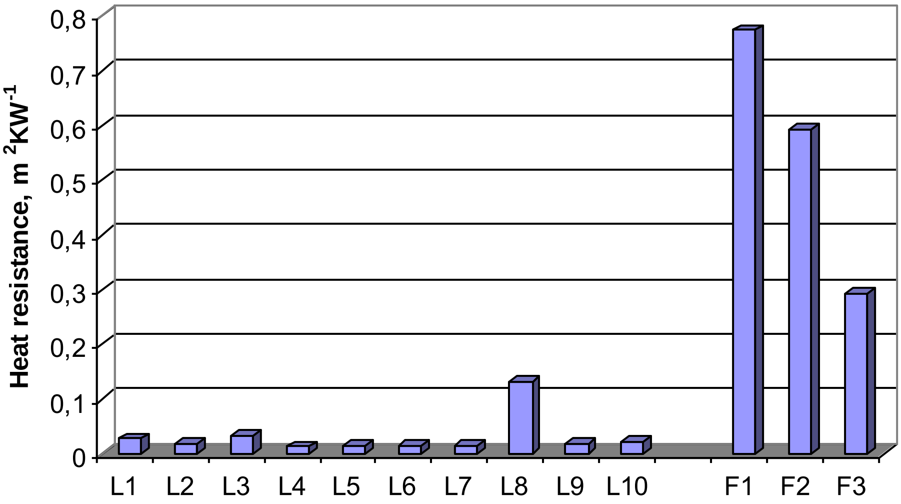

Figure3:Heat resistance of leather and fur

The water vapour resistance of choosen knitted fabrics are in the range 2,9-7,0 $m^2Pa\ W^{-1}$. It is well seen how the small differences in the thickness (due to the changes of yarn count and loop density) result in significant changes of water vapour resistance (samples K1:K2, K3:K4; K5:K6; K7:K8; K9:K10). The change goes up to 28%. Even higher impact has the addition of the elastane yarn in the structure. It is seen trough the values obtained for the samples K11 and K12. Those samples are, according to the yarn used and fabric structural parameters, similar to the sample K2. The fact that there is additional yarn, increases their resistance to the water vapour transfer, in comparison to the simple structures, over 60%. Although the observed fabrics have tighter structure than knitted fabrics, their values of resistance are similar, i.e. in the range 2,9-4,2 m^2PaW^{-1}.

Among the group of leather materials, there are two samples with extremely higher values that reach up to 250 m^2PaW^{-1}. Those samples are 2-layer composite face material and thermoplastic toecap. The resistance of fur materials to the transfer of water vapour is in collision with their heat resistance, i.e. the highest value is obtained for lining F1 and lowest for medical fur.

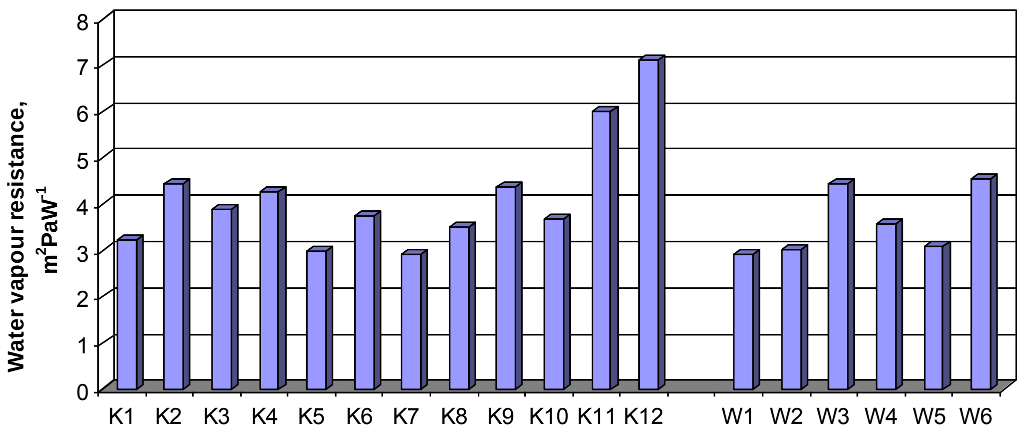

Figure 4: Water vapour resistance of knitted and woven fabrics

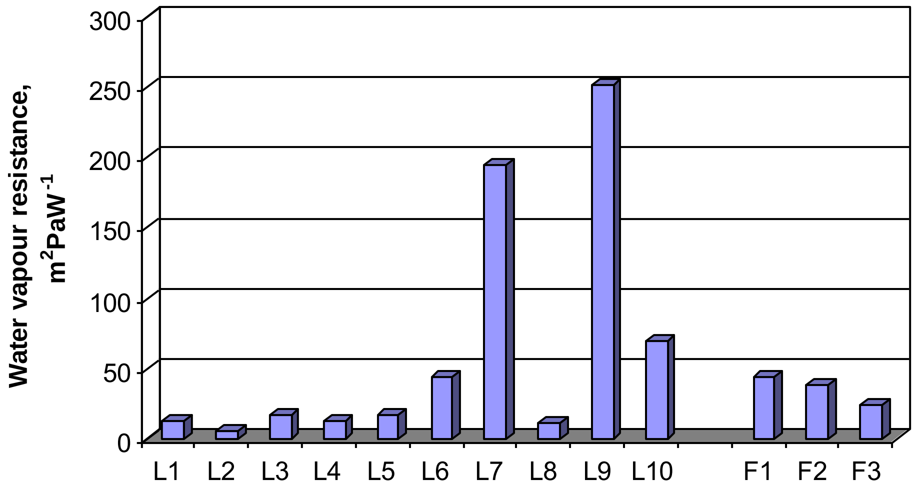

Figure 5: Water vapour resistance of leather and fur

Concluding remarks

The presented overview has indicated ranges of heat and water vapour resistances for the characteristic materials within four observed group of materials intended for the production of clothing. The ranges are as follows:

- knitted fabrics (for next-to-skin wear) 0,010 - 0,028 m^2KW^{-1} and 2,9 - 7,0 $m^2Pa\ W^{-1}$,
- woven fabrics (formal wear) 0,072-0,088 m^2KW^{-1} and 2,9-4,2 $m^2Pa\ W^{-1}$,
- leather 0,01-0,13 m^2KW^{-1} and 5,6-250,0 m^2PaW^{-1}
- fur 0,29-0,77 m^2KW^{-1} and 24,1-43,6 m^2PaW^{-1}.

The information about the behaviour of different materials, regarding the transfer of heat and water vapour, should be used as the basis for definition of satisfactory transfer properties. In that way, such cognition makes a challenge for textile experts to project fabrics that will enhance the comfort-related characteristics of ready-to-wear clothing.

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UNWINDING YARN FROM CYLINDRICAL PACKAGES

Stanislav PRAČEK

Abstract: *Computer modeling is a valuable tool in the search for the optimal package shape. We demonstrate a mathematical model for simulating the unwinding from cylindrical and conic packages. We show how the winding angle and the apex angle influence the angular velocity of the yarn during the unwinding. Since the centrifugal forces on the yarn in the balloon depend on the angular velocity, this velocity has a large influence on the tension that we wish to reduce.*

Key words: cylindrical packages, winding angle, yarn unwinding, angular velocity, unwinding speed.

Introduction

During the yarn unwinding from a stationary package, the yarn slides on the surface of the package before it lifts off to form a balloon. The point where the yarn begins to slide is known as the unwinding point, while the point where the yarn lifts off from the surface is known as the lift-off point. On this section of the yarn, i.e. between the unwinding point and the lift-off point, the tension in the yarn drops from its value in the balloon (at the lift-off point) to its residual value, defined as the tension of the yarn inside the package.

Theoretical part

The problem of yarn motion on the package surface during the unwinding can be treated in analogy with the motion of the yarn forming the balloon between the lift-off point and the eyelet, through which the yarn is being pulled.

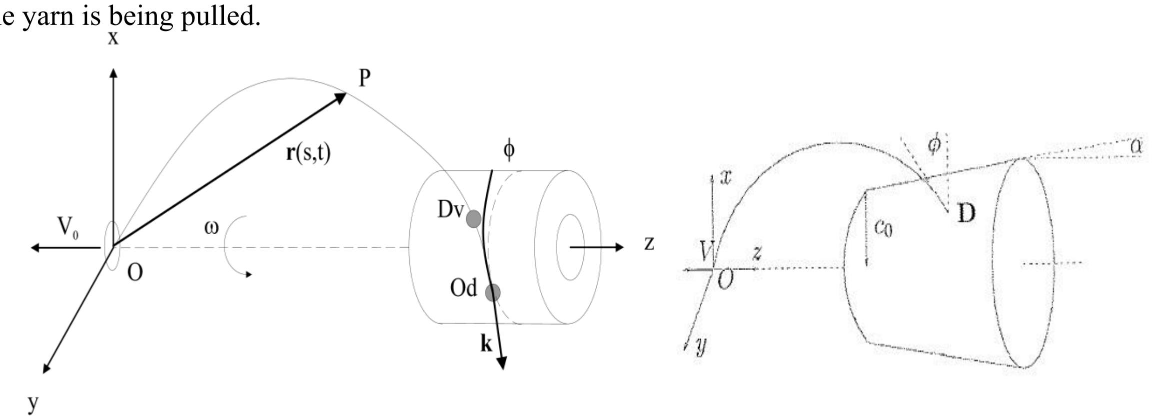

Fig.1. Mechanical setup in overend yarn unvinding from cilimdrical package.

The yarn is being withdrawn with velocity V through an eyelet, where we also fix the origin O of our coordinate system (Fig.1). The yarn is rotating aroun the z axis with an angular velocity ω. At the lift-off point Dv the yarn lifts from the package and forms a balloon. At the unwinding point Od the yarn starts to slide on the surface of the package. Angle ϕ is the winding angle of the yarn on the package.

The general equation of motion for the yarn was derived and justified in one of the previous works (Padfield, 1958; Barr & Catling, 1976; Kothari & Leaf, 1979 ; Fraser & Ghosh & Batra, 1992) :

$$\rho(D^2 r + 2\omega \times Dr + \omega \times (\omega \times r) + \dot{\omega} \times r) = \frac{\partial}{\partial s}\left(T\frac{\partial r}{\partial s}\right) + f \qquad (1)$$

The position vector r points from the origin of the coordinate system to a chosen point along the yarn, ρ is the linear density of the yarn mass, ω is the angular velocity vector of the spinning coordinate system in which the yarn is being described and which points along the z-axis, D is the operator of the total time derivative which follows the motion of the point inside the spinning coordinate system, $D = \partial/\partial t|_{r,\theta,z} - V\partial/\partial s$, T is the mechanical tension, f is the linear density of external forces. In the part of the yarn which forms the balloon, f is the air drag force:

$$f = -\frac{1}{2}c_u \rho d|v_n|v_n, \qquad (2)$$

where c_u is the effective air-drag coefficient, d is the yarn diameter, $v_n = v - (v \cdot t)t$ is the normal component of the yarn velocity (t is the unit tangent vector to the yarn at the given point).
When, We study the unwinding of yarn from a cylindrical package (Figure 1). The yarn in the layer which is being unwound has a winding angle ϕ. We will show that the winding angle determines the angular velocity ω, if the unwinding velocity V and the package radius c are known. The derivation is applicable in the quasi-stationary approximation which consists of neglecting the variation of system parameters (in particular of the winding angle ϕ) during a single period of the balloon motion around the z axis.

Simulation model

On cylindrical packages the angular velocity depends od the winding angle ϕ according to relation(Praĉek, 2002):

$$\omega = \frac{V}{c}\left(\frac{1}{\cos\phi} - \tan\phi\right)^{-1} = \frac{V}{c}\frac{\cos\phi}{1-\sin\phi} \qquad (3)$$

In deriving this expression we neglected the variation of yarn length in the balloon during the time interval when two layers unwind.The dimensionless angular velocity can obviously be expressed as:

$$\Omega = \frac{\cos\phi}{1-\sin\phi} \qquad (4)$$

According to our simple model the dimensionless angular velocity thus only depends on the winding angle which will change with time because this angle is different for layers that are unwinding from front towards rear edge and those that are unwinding as the unwinding point moves from the rear towards front edge. The dependance of Ω on the winding angle is shown in Fig2.

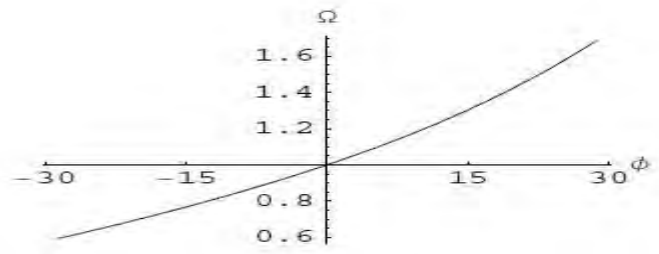

Fig.2 Dependence of Ω on the winding angle (Kong, X. M.,1997).

During unwinding the lift-off point moves up and down the package. We can presume that the winding angle is approximately constant in the middle of the package and it changes at the edges of the package where its sign is reversed. To describe the time dependence of the winding angle we must look for a periodic function, because motion of the point is periodic to a good approximation. The most known periodic functions are trigonometric function, such as sine function. This function should be modified so that it will change only slightly when the point moves up or down the packages. We can achieve this by raising the sine to a low fractional power, say 1/40 (we have to be careful about the signs, so we take absolute value of sine function and restore the sign using the signum function:

$$f(t) = sign(\sin t)\left|\sin t\right|^{\frac{1}{40}} \tag{5}$$

The diagram of this function is shown in fig.3.

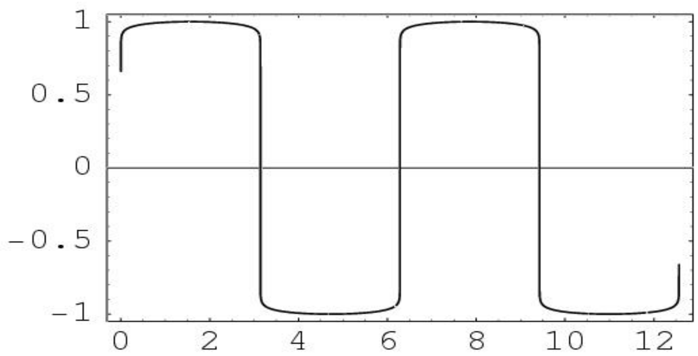

Fig. 3: Model function for winding angle.

The physical reality is somewhat different (Jakšić, D.,2001), especially in cross-wound packages, made using circumferential driving of the tube. The diagram shown in Fig. 3 would apply to precision wound cross-wound packages, made using direct driving of the tube. The loops would then lie next to each other.
If we considered a few loops of the rear end of the tube, before the next layer starts to unwind in the direction of the front end, and a few loops from the front end of the tube, before the next layer begins to unwind in the direction of the rear end, then we would obtain the diagram in Fig. 3. In this case we would have to neglect all the loops in between.

Speaking of the unwinding process, we are mostly interested in the maximal tensions in the yarn and the oscillations of the tension as a function of the unwinding speed. We aim to achieve the highest possible speed, while keeping the tension in the yarn and oscillations as low as possible.

3. Practical part

We now present the results of the simulations. We investigated the effects of different unwinding velocities V, package radii c, and the winding angles ϕ.

In Fig. 4 we show the tension during the unwinding at V = 1500 m/min and at radius c = 100 mm for different winding angles. For densely parallely wound packages (ϕ~0) the tension is constant, as expected, since in parallely wound packages the angular velocity is approximately constant. In cross wound packages the velocity is time dependant. When the yarn unwinds backwards the angular velocity is higher as when the yarn unwinds forwards, which follows from Eq. (3). Since the tension strongly depends on the angular velocity, we obtain oscillations in the yarn tension. The abrupt change in the tension occurs when the lift-off points reaches an edge of the package. Such changes strain the yarn and can lead to damage. In the most extreme case, the yarn can break. In designing new package types it is therefore necessary to limit both the maximum tension in the yarn and the amplitude of oscillations during unwinding.

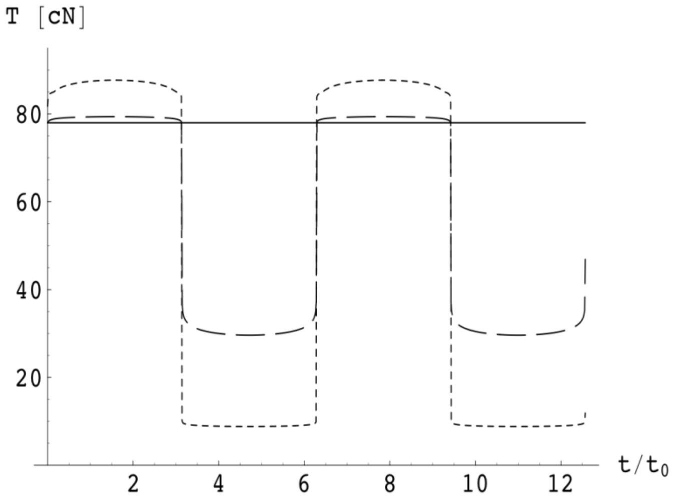

Fig. 4: Tension in the yarn during unwinding at V = 1500 m/min and at radius c = 100 mm for different winding angles: ϕ=0° (solid line), ϕ=10° (dashed line) and ϕ=20° (dotted line).

In Fig. 5 we show unwinding from a similar package, but at higher unwinding velocity V = 2000 m/min. Tensions are in this case very high. Unwinding from such packages might not be possible.

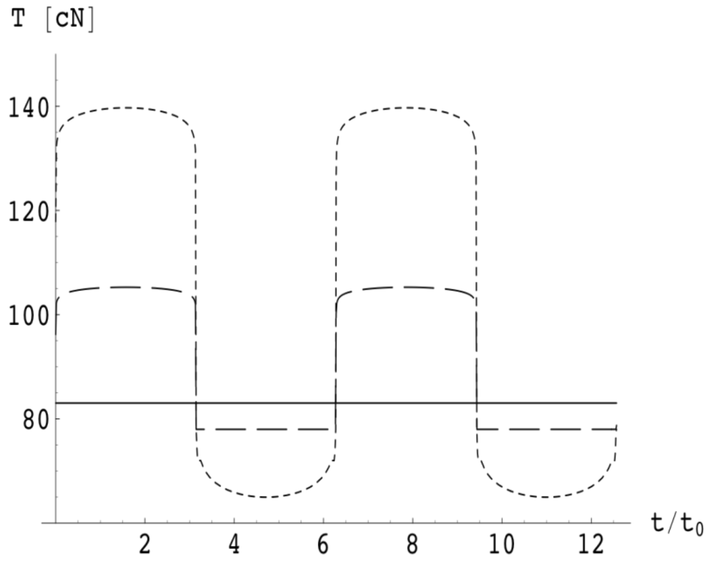

Fig. 5: Tension in the yarn during unwinding at V = 2000 m/min and at radius c = 100 mm for different winding angles: ϕ=0° (solid line), ϕ=10° (dashed line) and ϕ=20° (dotted line).

In Fig. 6 we show a 3D plot of tension as a function of time and package radius. For large radius packages the tension is significantly reduced. Therefore it is still possible to unwind at very high unwinding velocities from packages with sufficiently large smallest radius (as determined by the radius of the tube on which the yarn is wound). We have determined that the minimum radius should be around 150 mm in order to keep the tension below 50 cN.

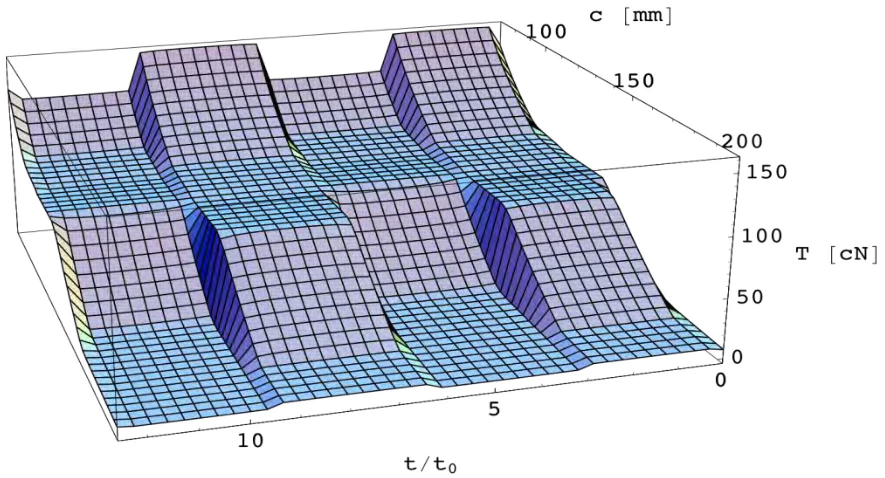

Fig. 6: Tension in the yarn as a function of package radius. V = 2000 m/min, ϕ=5°.

This limiting value of 50 cN is chosen so that the largest deformation in the yarn is in the elastic regime, i.e. the tension in the yarn should be below 10% of the breaking tension. The values were determined experimentally. During unwinding tests we achieved up to 17 % of the breaking tension without affecting the mechanical properties of the yarn: the breaking tension of the yarn after unwinding was not reduced. We determined the breaking tension to be 4.5 N = 450 cN, from which follows the estimate of 50 cN for the maximum allowable tension.

4. Conclusion

We have shown that a combination of theoretical modelling and empirically determined relation between the yarn tension and the angular velocity of the yarn.
We have reached the following conclusions:

- In cross-wound packages, when the yarn unwinds backwards the angular velocity is higher as when the yarn unwinds forwards, which leads to oscillations in the yarn tension. Abrupt changes of tension occur at the edges of the package.
- Unwinding at high velocity (2000 m/min) from regular cross-wound packages is impossible for package radii below 150 mm.

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IMPORTANCE OF CLUSTER ASSOCIATION OF PRIVATE SECTOR AND EDUCATIONAL INSTITUTIONS ON CLUSTER EXAMPLE OF FASHION AND CLOTHING SERBIAN INDUSTRY

Sladjana MILOJEVIC

The Cluster of the fashion and clothing Serbian industry was founded not so ago, September 2010 by the association of companies, scientific-research and educational institutions in order to improve market access and consequently increase the chances of success. The companies in the Cluster Fakts are: Ivkovic, Belgrade, Tiffany Production, Cacak, Jasmil, Arilje also the founders of the Cluster, then, Luna, Pozarevac, Eminent, Subotica, Baba kids, Belgrade, PS fashion, Cacak, Passage Pancevo, Jagger, Kragujevac , Leonardo, Ada, Sanateks, Sjenica, Garman Arilje, Soda sport Arilje and educational institutions: Technical Faculty ―Mihailo Pupin" in Zrenjanin, the Univrtsity of Novi Sad, the Faculty of Applied Arts Belgrade and the College school of Textile Design and Management, Belgrade. The purpose of the Cluster is to provide economic entities faster development and continuous cooperation with educational institutions for mutual interests. It is easier to operate in that way than it would be outside the Cluster, and together affect the strengthening of competitiveness and visibility of the textile industry. The essence of association is exchanging knowledge and experiences between the cluster members, as well as business networking, the strengthening of specialization, the development of joint projects and to increase efficiency and productivity on that basis.

In order to work and act professionally the Cluster Fashion and Clothing industry of Serbia established and completed the phase of founding and organizing first: 1) the Cluster Office was established and organized, 2) established organizational and procedural policy, as well as the Cluster structure, 3) a monitoring success program was established, 4) marketing materials and tools were developed and standardized 5) the possible sources of funding were identified.

It is very important for the Cluster that besides basic funding through the cluster membership fees, identify additional sources of funding, in order to be able to implement projects that are extremely important for the Cluster's development, as well as raising the competitiveness of cluster members and cluster members who cannot finance in full. Right now, the Cluster is in the final phase of implementing the project "Establishing an innovative virtual Fakts Cluster Center ", through which member companies and educational institutions are in direct interaction and connection through the Forum. The purpose of the Forum, we built, and through which the professors of educational institutions and designers, working in the member companies have direct and constant communication and knowledge exchange. This project was realized by joint participation of the member companies of the Cluster Fakts, as well as the Ministry of Economy and Regional Development of Serbia.

The Cluster Fashion and Clothing Industry of Serbia was founded as an association of the companies and educational and economic institutions from the fashion and clothing industry, as well as the other persons, institutions and educational organizations relevant to this area, in order to achieve the objectives in development, protection, promotion, growth, improvement and harmonization of interests , labor, and business activities of its members, and other business entities, institutions, organizations and persons connected with this area, as well as fashion and clothing industries in general.

Characteristics of the Cluster's shared vision include:
• To become the leading source in encouraging and supporting innovations in textile companies in Serbia, through partnerships with institutions in public and private sectors;
• National (local and regional) and international presence of textile industry;
• The focal point for increasing competitiveness through increasing awareness of the performance standards, certification (quality) and success, and in return increased the economic (and other) success

of the members;

• To serve as a "common voice" of the members to the third persons, both political and economic;
• Constantly generating new marketing opportunities, which would be converted into sales promotion and the potential profitability of the member companies;
• Raising the image of Serbian textile industry as a whole;

The conclusion of the latter is that the vision of the Cluster fashion and clothing industry of Serbia is to be the leading organization in supporting and strengthening the overall economic competitiveness of companies in the fashion and clothing industry and textile industry in Serbia.

The mission and role of the Cluster that contribute to the shared vision achievement include:

providing with organizational, logistical, expert, infrastructural, institutional, technical, software and other assistance and support to the continual development and improvement of products‘ quality and services, innovation and competitiveness of the cluster members, as well as fashion and clothing industry in general.

So far the Cluster, with the help of GTZ, the German government and the EU SECEP project, has managed to lay the foundations of strategic planning that helped the Cluster to identify strategic objectives and basic principles of the action plan. The identified targets are to be used to measure the success of the organization's activities through its development.
So far, through the planning process the following issues on which we have to work in four key areas have been identified:
- Administrative and Organizational Development
- Marketing and Promotion
- Human Resources
- Joint projects and financial strategy of the Cluster development is focused on:

- Increasing visibility and strengthening of the organization and the entire industry in public and private sectors,
- Human resources
- Commercial development of networking and shared services
- Reaching medium and long term financial sustainability of the Cluster fashion and clothing industry.

For the Cluster members, the most important activity that contributes to the development of business cooperation and shared services is applying equally to human resources development and encouraging exports.
It is not just the development of the human resources, but professional development is also of great importance for the Cluster members, as well as the education of potential employees, which includes the foundation of active and continuous cooperation with educational institutions and contributing the creation of new or modified vocational education programs. In order to solve the increasing shortage of skilled workers in the companies of its members, and to provide opportunity for students who want to build a career in the clothing industry, the Fakts cluster‘s members presented a program of practical training for students at VTSŠ DTM in Belgrade. Four firms, the Cluster members, participate in this program, in which students are to be joint with leading clothing companies based on technical needs of the

companies and human resource needs, taking into account the student's commitment and geographical living location in relation to the factory. The benefits of this project for all our cluster members, both schools and firms in the cluster, are obvious. The students have developed and learned new skills during professional practice, while the other companies have developed a new potential workforce that is to be used as competitive advantage in the future. This is a great advantage for the students to have closer practical insight in garment industry and its companies through the cluster‘s associations. At the same time, the private sector firms of our cluster have a tremendous advantage due to the gain of invaluable insight into the future workers in each of these companies.

In order that cluster properly develops and strengthens its social role as a non-profit organization, designing and creating the organizational structure of the cluster was needed, which aimed to offer a balance of ability to adapt to changing market conditions (both structural and undertaken activities), stability and persistence in meeting goals.
The cluster has the status of legal entity. The bodies of the cluster are:

1) Assembly;
2) The Steering Committee and
3) A Representative (A Cluster Manager).

The Assembly is the supreme organ of the cluster, which make all the most important acts of the cluster (such as the Statute and other regulations), determines attitudes and gives guidelines for the cluster, appoint and dismiss the Steering Committee and a representative (a cluster manager), consider and approve a financial plan and annual financial report, as well as other activities determined by the Statue and the Law.

The Steering Committee is managerial and an executive authority, which manages the cluster and ensure the implementation of its objectives. The Steering Committee implements operational activities and realize planned, implemented, business, professional, technical, and current tasks of the cluster, including all issues related to the conduct of affairs, current affairs and activities of the cluster, except the matters within the competence of the Assembly.
The Steering Committee is consisted of five members, appointed or dismissed by the Assembly and chosen among the members of the Cluster Association.

The Cluster manager or director is also a legal representative of the cluster. He has full executive powers in the legality of the cluster. The cluster manager is responsible for cooperation with the public institutions, associations, business companies, educational, vocational and other subjects. The Cluster Manager‘s responsibility is connected to the fulfillment of the objectives and management of the cluster‘s work and activities.

The Cluster has an advisory body - the Council, which gives the opinions of major issues related to fashion and clothing industry, as well as the work of the Association. The Council members are not the members of the cluster.

The Cluster may form the professional services, working groups, committees and the other bodies to carry out administrative, technical, professional and other tasks for the cluster.
Depending on a need, the Cluster may form the appropriate working groups (for example a membership Working Group / expansion of the network, a Working Group on Financial and Administrative Affairs, a Working Group for marketing and promotion, a Working Group for project activities. These working groups undertake the activities within its competence conduct appropriate analysis and submit the relevant initiatives and proposals to The Steering Committee. The Working groups have narrow responsibilities focused on the objectives fulfillment, which is the purpose of establishing. Actually, their founding and closing after the achievement of goals gives the cluster dynamism.

In order to strengthen the current position in the domestic market of fashion and clothing industry, it is necessary to improve cooperation with scientific and educational institutions in order to profile workforce efficiently, which would be compensation for the current lack of narrowly-skilled staff. The Cluster members are also planning further development and strengthening the exchange of expertise and know-how, strengthening innovations, improving the quality and productivity. They are interested in interconnections in the field of purchasing raw materials, providing specialized services, and other form of joint appearances, that would give them above-average competitiveness compared to the other companies in this sector.

The Cluster members are interested in entering and business expanding on the Russian market, as well as the markets of neighboring countries, such as Macedonia, Croatia, Slovenia, and markets of the other European countries (the Czech Republic, the Netherlands, Sweden, Denmark, Slovakia and others).The Entry into the international market or business expand abroad is planned through the joint provision of information on market trends, technology trends, business networking, joint participation in international exhibitions, joint exhibition openings and sales rooms, distribution centers and joint marketing promotion through which would be achieved significant cost savings, as well as an offer enrichment with regard to update the production program and the possibility of specialization. The Cluster members are interested in education and training, as well as in the joint research and development, because these are the basic prerequisites for raising their competitiveness especially in the international market. In this regard, by establishing an innovative project Center, the Cluster had a joint activity of 10 member companies and three educational institutions, important for a common approach to an innovative on-line service. This activity amounted to over 10 million dinars. This service is of a great importance for the research, development and exchange of mutual knowledge of the cluster members.

The cluster Fakts participates in the project of the German government ORF through which accomplishes the goal of establishing contacts and cooperation of the Cluster fashion and clothing industry of Serbia with the other similar organizations in the region and exchanging and transferring knowledge between producers, as well as scientific and educational institutions from the participating countries in the project (Bulgaria, Macedonia, Bosnia and Herzegovina, Albania and Serbia). It is the project of the German government GIZ / ORF cluster fashion clothing industry that enables international cooperation in researching, developing and exchanging of knowledge. ORF project started in July 2011 and is planned to last up to February 2013.

The Cluster of clothing and fashion industry of Serbia has also received an invitation to join the SEE EU IPA with a consultancy firm in Germany and Austria as well as holders of the EU project SEE, with the participation of Italy, Greece, Bulgaria, Romania, Albania and Serbia - and our Cluster. A project has been launched with the aim to strengthen the competitiveness of the textile industry in the region and ensure the accurate database of textile manufacturers in the region to facilitate communication and obtain new business and expand cooperation. The project is to include the faculties of Bologna and the other academic institutions in the region, members of the cluster, in order to start the exchange of technological knowledge and expertise of education in the textile sector of teachers and students. Within the project it is also planned to share our experiences and knowledge of the participating countries. The project is to be submitted at the 4th Call in December 2011.

Probably, one of the biggest drivers for associating the textile companies into the cluster is the apparent lack of professional staff which causes the constant struggle of the cluster members in their efforts to maintain and increase productivity. There is a gap between the vocational education programs and staff capacity of graduates from the local universities and vocational schools.

In this sense there are several critical areas identified: designers, modelers, managers, manufacturing / textile engineers, seamstresses and sales managers.

In cooperation with **THE COLLEGE OF TEXTILE – DESIGN, TECHNOLOGY**

AND MANAGEMENT - DTM and DTM German Organization for Technical Cooperation in June 2010 so-called "Summer Camp" was organized, during which the courses of standardization, design, management and the like were held. On this occasion the local experts were trained, who later in September 2010, independently and in cooperation with the cluster members, organized a similar course for the standardization in Arilje. The course has proved to be very effective and necessary for the efficient management of local companies. The previously mentioned joint project has confirmed that there have to be activities that would focus on overcoming the lack of skilled workers in the labor market.
In this sense, the cluster is to focus its activities on identifying opportunities for cooperation and taking the initiative to introduce the projects and activities, which would have as a result overcoming the shortage of profiled labor force.

This program is certainly planned as a long-term initiative, in which the cluster would:

• Examine the member companies of the constraints and needs in the field of the expertise and labor force development;
• Examine and engage in dialogue with the academic institutions and vocational schools of the cluster on their willingness and opportunities for the labor force development;
• Identify funders and technical support that will be obliged to bind the partnership between the public and private sectors in the textile industry;

Currently, several companies have the program which should assist in learning and acquiring trade practices in the production of textiles in Serbia. Such practices should be promoted and also identify problems related to such programs. Also, it is necessary to connect the cluster members, and the National Employment Service, universities and schools in activities relating these issues. Further, the best practices should also be pointed out and shared to maximize the profits of these trainings.

The current project of our cluster "Establishing a virtual design innovative Center of the Cluster of fashion and clothing industry of Serbia" has a great impact on the labor force development. Through the trainings and consultations, the level of knowledge and competence of professionals, employed in the textile companies in the fields of Visual Merchandising and Product Management, is increased. In these programs, students from modern clothing and textile design, textile and clothing design, clothing technology and management departments will be involved, in order to acquire new knowledge in these areas. Also, the project will conduct seminars for teachers in order to meet the needs of business entities that are not satisfied by existing vocational education and training programs. This project should motivate teachers at faculties to improve the existing vocational education and training programs and adjust to the real needs of companies in the textile industry as much as possible.

The Cluster of the Fashion and Clothing Industry of Serbia is planning to take part in the cross-border cooperation project with the possibility of the equipment procurement, primarily to serve laboratories for testing the quality of fabric development and innovation development in educational institutions. Since the cluster has not officially approved this project yet, I am cannot speak about the details but it is evident that there are plans related to the additional benefit of the member companies and educational institutions, and there are strategies for the cluster development plans based on mutual benefits of the private sector and educational institutions.

We come to the conclusion that the certain program initiatives undertaken by the cluster association, not only leads to synergistic effects of educational institutions and the private sector, but also directs the Cluster towards meeting important strategic goal which is the human resources development in the textile industry in Serbia, with an ultimate goal of the education system becoming compliant with the real textile industry needs.

ONE OF THE STRATEGIC OBJECTIVES OF THE CLUSTER FAKTS IS:	SUCCESS INDICATOR:
Human Resources Development	The education system in conformity with the needs of industry, a system of permanent education personnel in the medium term

A good Cluster example of clothing fashion industry is the cluster that works properly and has a constant cooperation with industry and educational institutions and in which all partners and participants are equal.

TYPES OF FASHION DESIGN

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Abstract: *Subject of this paper is a description of the differences between the forms of fashion design in recent decades and the development of fashion. Fashion design has been existing with a lot of diversities, but there are general fashion fields identified with their specific features. It is essential to define these features to those who are in fashion as professionals, and consumers, who can often be misled. The aim is to describe in simple way the basic picture of the general field of fashion.*

Key words: High fashion, clothing, mass clothing, fashion designers, fashion designers.

1. Introduction

Fashion design is applied in different ways and in different volume, depending on what customers and what end it is intended to, and above all limited and defined by economic sustainability. Once the economic factor did not limit and define the purpose and use of modern design to such extent as it does today. The main guiding principles of fashion design used to be creativity, purpose and objectives. With really great offer, potential buyers are often misled; they can quickly get the wrong impression about what each kind of fashion design is and who it is intended to. So we have three important, general areas, which cover the entire area of fashion design and that, in their own way, affect the appearance of people, at the present time. These are: high fashion, garments (ready to wear) and mass ready-made clothing. [18]

2. High fashion (Haute Couture)

The term haute couture is very often misused. Under this term various forms of fashion design are considered which hardly ever fall into high fashion. High fashion is almost unique implementation of an idea, usually made to order for a specific client. During the manufacture of high fashion garment special attention is paid to the precision of the workmanship and finishing. It is made of premium materials and the price is not a limiting factor. It is understood that multiplication of such garment item is not possible. Haute couture was dominant until 1950 in the last century, by which time "created to the measures" approach to fashion design was prevalent. Today, many companies claim to produce haute couture but they do not fulfill the criteria. The term haute couture is initially tied to the work of English designer Charles Frederick Worth, who was active in Paris in mid XIX century [2]. Later in modern France, haute couture officially becomes a protected term, with clearly defined standards. Association of Parisians high fashion dates back to 1868 when it was founded. It still exists in the French Fashion Federation, among ―ready to wear" and haute couture fashion designers. The Federation was founded in 1973 and also includes a men's fashion association-union ("ready to wear"), and women's fashion association-union , "ready to wear―fashion designers and "fashion worker" tailors-(eng . couturier). Both unions are associations established the same year as the federation. The Federation has had its own school for education of professional staff since 1928. Today, the Federation is responsible for contracting dates and location of the French Fashion Week. A very important activity of the said Federation today is to establish and dictate industry standards of quality and use of the word "haute couture". Members of this federation are now almost all the names of the fashion world that dictate the trends. Some of the most famous names would be: Balenciaga, Christian Dior, Costume National, Elie Saab, Emanuel Ungaro, Escada, Givenchy, Issey Miyake, Jean Paul Gaultier, Kenzo, Louis Vuitton, Miu Miu, Nina Ricci, Rochas, Sonia Rykiel , Stella McCartney, Valentino and many others. [3] Today, the vast majority of these names survive thanks to the leadership teams of designers and reorientation towards other directions of modern design. Unfortunately, for almost none of the above names the field of high fashion and the dominant direction is no longer the main source of income, because very often the benefit is much lower than the production costs. High fashion today is only complementary to their aura of luxury products like perfumes, shoes, etc. and is a promotional tool for their ready-made collection of which they make very high profits. [20]

2.1. Fashion creators

How did fashion creators become fashion designers and what it actually means to be a fashion creator? Fashion creator is a term the use of which is beginning to become obsolete, because even those who once were essential fashion creators, when at the time of great productivity and creativity influenced the fashion world are becoming fashion designers. Fashion designers are limited by the market laws and a key factor that limits even their creativity and productivity is the economic factor, the money. The main measure of their success is the profit they make with a collection consisting of a fully non-creative solutions, because the largest mass of people are not willing to take great challenge of fashion value, therefore most of the profit is made with ordinary, already seen things. Fashion designers are like a small army that can be at a time replaced by a new generation, because there are clearly established, postulates what is required, what is the deadline for it and the only responsibility is reflected in the amount of profit the designer brings to the company. Fashion creators were skilled in their jobs and have earned name in fashion over their quality. The quality was reflected in the development except in the sense of creativity or style, a combination of form, color and material. This kind of quality that true fashion creators once provided, of course is not accessible to the general population and therefore today large profits cannot be made out of quality. Quality level of the creators is simply not economically justified and is completely unprofitable option. When the fashion creator gained fame and respect of his peers, he would directly influence the fashion, everybody would tend to look up to his conception of the next season. Today, fashion houses tend to fit into forthcoming trends forecasted by experts in which you cannot find fashion designers but creators you can. [17]

Picture no. 3.2 Dior, Philip Treacy, Thierry Mugler [8; 9; 10]

Value of fashion creators and of their high fashion creations can be seen today in museums around the world while the work of fashion designers, unfortunately, ends up as a recycling secondary raw material or as a second hand (used) clothing. The application of high fashion innovativeness and creativity reaches its maximum in relation to other areas of fashion design.

Picture no. 3.3 Museums of high fashion: Exhibitions of Capucci`s [12] and Valentino`s work [11]

3. Ready to wear (Pret-a-porter)

This area of fashion design is a transitional area between haute couture fashion design and mass market fashion design the so called mass-produced readymade clothing.

Picture no. 3.4 Women [13] and men styles [14] "ready to wear"

This term shall mean items of clothing that are made with minimum or no manual phases; all made in mechanical, industrialized production stages. Quality level is relatively low, not to mention the thousands of pieces and that is why this group falls in the middle, or mid-high pricing category of clothing you can buy from the furthest, individual customers.
Most often, manufacturers, fashion houses in the field of fashion design of this type present their new collections at fashion weeks or in the form of internal presentations to their already established regular customers and distributors. [4] Most companies now on the market of the fashion world fall in this group because it is the fastest turn of profit. It is known in this field that there are no deviations from the design which needs to be classic, sometimes sporty, and always representing a trend of fashion or pronounced direction in it. They are using pre-established forms, simple cuts. Styles always come in standard sizes, and there is no possibility of modifications and alterations to suit the client or customer desires. Offered sizes fit most people. Manufacturing costs are reduced to a minimum. Typically, companies in this field over time either switch to the mass-produced clothing or decide to limit their series, although not offering a unique, but yet clothing of higher quality than the mass-produced ready-made one. Most often all the big names of high fashion sooner or later step into this realm of fashion design since it provides the best source of funding because of the frequent turnover (minimum 4 times per year). When companies move from 4 to 12 or even 13 collections a year (including a festive collection which is produced for

the intended period around New Year) they usually decide to move to mass-produced ready made clothing. Today's freelance fashion designers dealing with exclusively copyrighted work could also be classified in the very beginning in rankings of all members in this field of fashion design. Their creations are usually made in very small quantities. There are honorable exceptions that make just one piece in one size and they are designers who can be included in high fashion. Unfortunately, fashion designers who work in the field of ready to wear clothing, but keep to their copyright activity with authentic personal touch, all over the world, usually end up in other fields of fashion design because of the economic non-profitability of the author's work. In addition to profit, the largest spending funds on advertising and marketing are found in this area. [19]

4. Mass market fashion

Mass market fashion is a term that appeared only recently. Previously there was no production in the range of mass- production, what is today the production reality. Mass fashion is intended for a large number of people and the same models are sold in several countries, sometimes on different continents. Fashion brand name – brand in production and market terms – misses the point because the labels are attached and removed if necessary; selling the same piece under another name is the reality. This ready made clothing industry starts production of at least several thousand pieces of a garment, for less than thousands of pieces is not possible to start the production as it is intended solely for mass sales, and so it is the only way how it can be profitable. This type of fashion design covers a wide range of customers, ready-made is available in standard sizes, usually made of cheap materials and not so satisfactory quality. [6]

Picture no. 3.6 Mass market fashion is often presented like goods on market and often is sold on markets [15]

The main criterion is to produce "affordable fashion”, to make the fashion available for the lowest classes of society also. Most often the creations of famous names in fashion are only simplified for their cheaper production, which sometimes create the paradox that, for example one shirt is cheaper than bread which people need to eat every day. Creativity factor practically does not exist because recycling the creations of the existing competitors in other areas of fashion design is the main idea. Minimum prices lead to a complete reduction of importance of the design in this area; design becomes virtually meaningless because it is reduced to the margins of existence. Sometimes they wait for a season to pass to confirm which models are the dominant trends and popular names in fashion and then the modified designs are put into production. There is no possibility for any of the textile and clothing products not to be marketed; even after one or two seasons such a collection can be found at much lower prices. One of the most known brands in the field is H &M, for this brand has been designed by famous names of the fashion world such as Stella McCartney, Cavalli and others. [7] In this way good creations become available for everyone, you can wear something designed by a top expert in fashion and get it for less money. The quality, of course, cannot be measured but the need to wear the brand, something that has a known name, something that is fashionable, trendy and comfortable for everyone, is absolutely and completely satisfied. By cooperation of the top names in fashion and companies of mass market fashion this area of design is further promoted and customers who once move into this area hardly ever decide to buy something of a better quality coming from other levels of fashion design.

Picture no.3.7 Example of mass market fashion [16]

In this field of fashion design least attention is given to funds that are spent on advertising and marketing, because price is the only key criterion that attracts many customers even with the minimum advertising funds. Thanks to this area of modern design you can see people dressed uniformly; it no longer matters whether you have gone abroad to buy an article of clothing because as soon as you return you see the same article of clothing worn by someone who bought it at a nearby market. Also, you can buy an article of clothing in a boutique in your country for an affordable price while your friend bought the exact same piece in, for example America, at a very high price. For such a low price category it would be really too much to get a unique, but the current fashion and comfort, with no emphasis on quality, you can have for sure with the massive market fashion.

Picture no 3.8. Examples of mass market fashion [5]

3. Conclusion

These general areas of fashion design influence each other, they will be transformed in the future. They will intermix, some will completely die and some will lead to the formation of new fields. A trend of individualization, diversity and possibility of creating own style by the client out of already offered solutions that are adaptable to everyone is to be expected. Does this mean that anyone who wants so will be able to taste the fruits of high fashion? It remains to be seen. Until then, it is important for consumers and people in the profession to be educated in the general characteristics of the fashion design fields.

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CLOTHES ANCIENT GREECE

SrĎanCAKIĆ & Stanislava SINĐELIĆ

Abstract: *Ancient Greece was a country of great thinkers and philosophers, and as such, had a supporting role in the development of modern civilization. The customs and clothing of this age also had a huge impact on the development of society and the creation of one of the greatest civilizations in human history. Culture, art and philosophy of ancient Greece influenced the development of later civilizations, especially in modern, democratic world.*
Leaving the rich cultural heritage, has enabled us to, studying their writings, archaeological finds and art, with great success reconstruct the very epoch, her art, even the clothes of the ancient period.

Key words: Greece, Peplos, Hitone, Himation, Petasos.

Clothes ancient greece

Ancient Greek clothing was made by hand, usually woven on home looms, so that the same piece of cloth could be used as an article of clothing, but also as an overlay in the household. By studying the cultural heritage of the ancient Greeks, it was particularly vases and sculptures. We can safely say that the fabric of this time were painted intense colours and decorated with intricate and complex designs. In general, clothing for women and for men consisted of two parts: tunic dresses-called **peplos** (**πέπλος**) or **hiton** (**χιτών**), (Figure 1, 2 and 3) and mantle called a **himation** (Figure 4 and 5).


Figure 1.


Figure 2.


Figure 3.

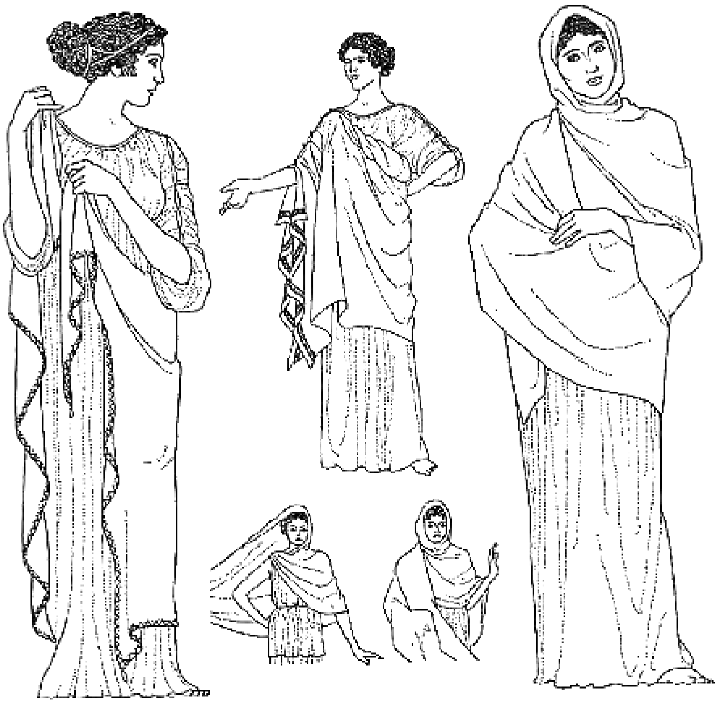

Figure 4

Figure 5

Peplos is a large, rectangular piece made of heavy fabric, usually made from the wool. With the folded top edge (Apoptygma) (Figure 6), falling to the waist.

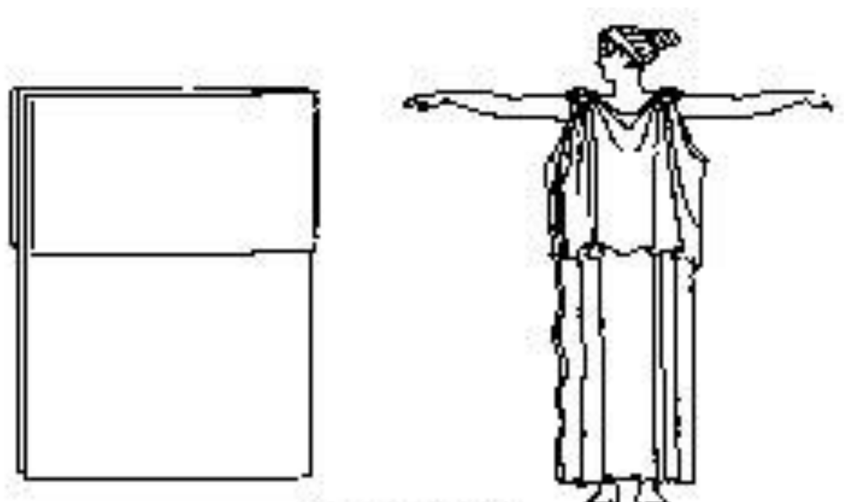

Figure 6.

Figure 7.

The shoulder is usually attached with a brooch, or fibulae (Fig. 7 and 8).

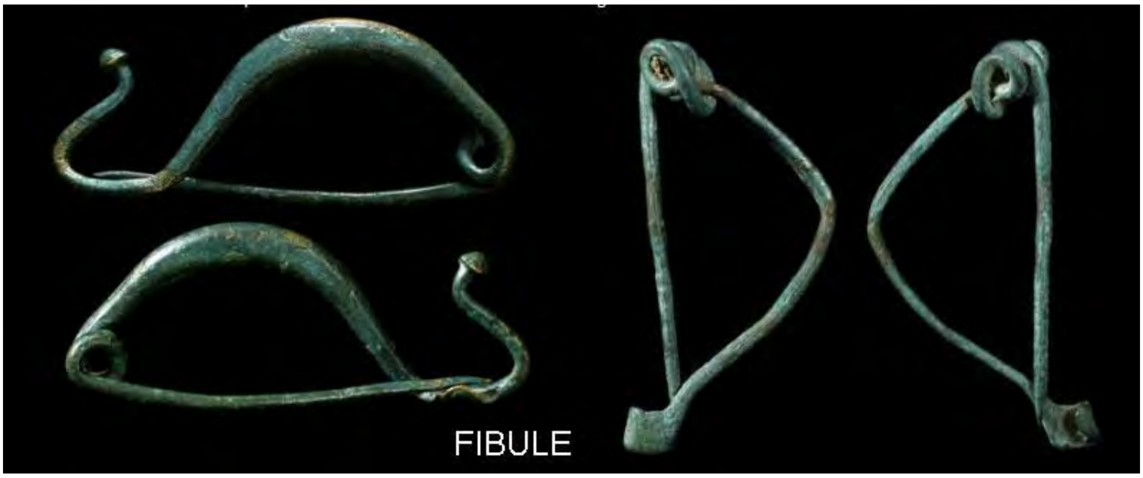

Figure 8.

He could be with openings on both sides of the body, or with an opening on one side, so that the other party sew.

Hitone (Figure 9, 10, 11 and 12) is made of materials such as easy, plain canvas. It was also a long and very wide rectangular piece of cloth, thrown over one shoulder, or attached quilted shoulder. It is usually tucked in the waist. It is usually wide enough that it can form sleeves, and shoulders are attached with fiibule or decorative brooches.

Figure 9

Figure 10.

Figure 11.

Figure 12.

Peplos and hiton also fell to the floor, and were long enough to escape across the waist, creating a kind of decoration known as **Kolpos** (Figure 13 and 14).

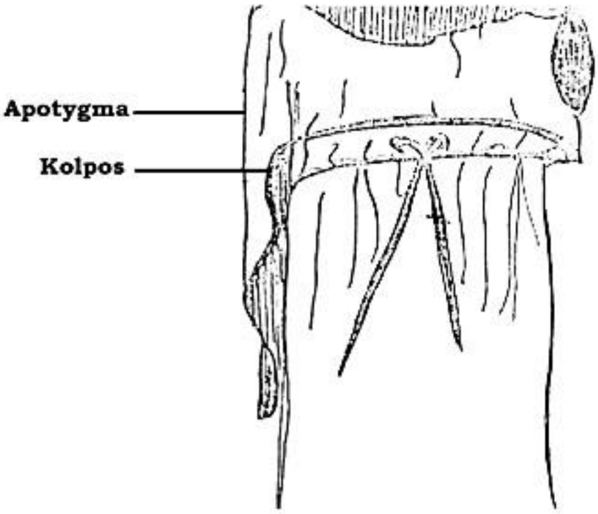

Figure 13.

Figure 14.

Men in ancient Greece wore hilton similar to that worn by women, but shorter and usually it went back to the knee (Fig. 15 and 16).

Figure 15.

Figure 16.

Exomis is a type of short hiton, attached to the left shoulder. It was used for training, riding, or when we do the hard work (Figure 17 and 18).

Figure 17

Figure 18

Himation (mantle) is a rectangular piece of heavy fabric, usually made of wool, or linen.. Himation was rectangular, woolen piece of cloth, which was usually attached a buckle on the left shoulder, leaving his right arm free. Married women wore the himation as a scarf. Himation has also served as a blanket. It was made in red, black, brown and purple. The edges sometimes had ornaments, woven or exported. These ornaments are called parife. (Fig. 19, 20 and 21).

Figure 19.

Figure 20.

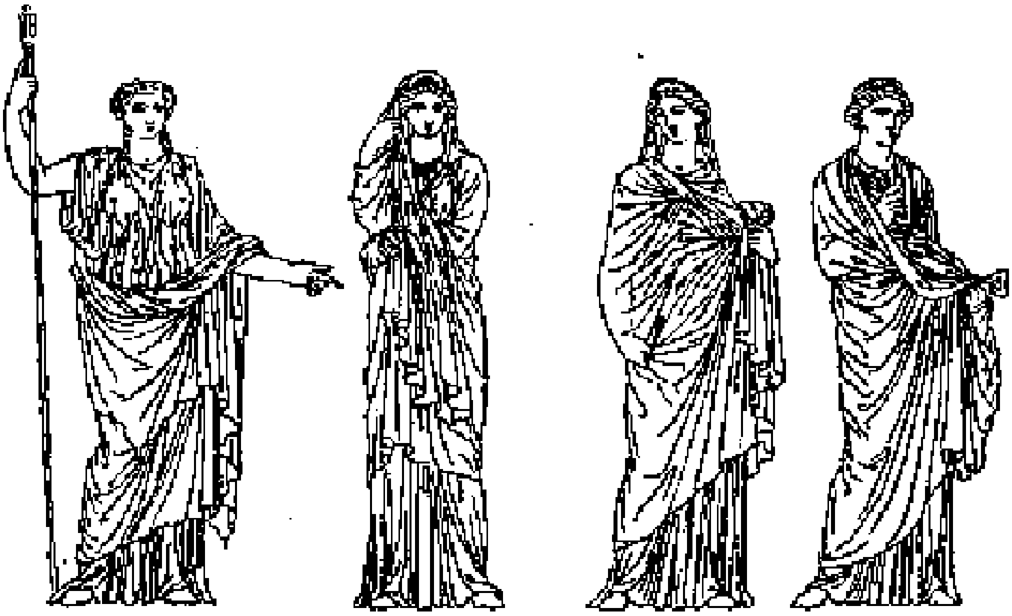

Figure 21.

Women wear and **epiblemu** (scarf) over peplos or hiton (Figure 22).

Figure 22

Young men often wore short riding cloak, **Hlamis**, made of wool, usually painted in purple (Fig. 23). Mainly worn in combination with short hiton, or was the only piece of clothing.

Figure 23.

Greek men wore hats with wide brims (petasos). Women are rarely given the type worn hats with flat brims and very high peak (Figure 24 and 25).

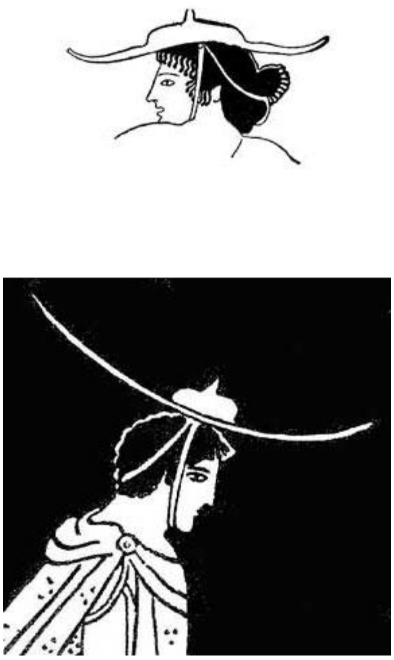

Figure 24.

Figure 25.

Footwear

Men and women in ancient Greece wore leather shoes. These are mostly sandals, slippers, shoes and boots made of soft leather. At home, they were often barefoot (Fig. 26 and 27).

Figure 26.

Figure 27.

Materials

It is usually used wool clothing but can also be linen or cotton. Wool could be woven from very coarse to very soft, and clothing is decorated with draping and tying. All types of Greek clothes were rectangular in shape.

Colour

During this period, colours were very strong and intense, obtained from the use of plants, such as green, indigo blue, yellow, purple, dark red... Also represented were the colours that are received from the land. The motives for ornamentation ranging from strictly geometric forms, to stylized plant motifs, ivy leaves, bay leaves and the like. However, we now know that the temples were painted a very vivid colours, as well as clothing. The Greeks really like the colours and a lot of attention was given to the colours and painting their clothes. Kos them is also popular and white linen. Women generally wore yellow clothing. Black paint was worn in mourning. Farmers have dyed their clothes different shades of colours provided by the earth, mostly black and gray clothes. The soldiers were mostly represented by a dark red colour, symbolizing that way the blood on the battlefield.

Doric Hiton

Doric hiton was made of wool and vegetable dyed colours, usually indigo and saffron. The upper edges of the garments are folded across the chest, attached to the shoulders, with holes placed on the sides so that the weapon is available and detected (Fig. 28, 29, 30 and 31).

Figure 28.

Figure 29.

Figure 30.

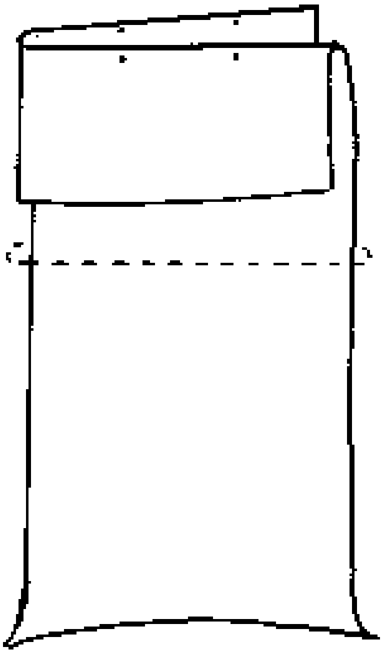

Figure 31.

Ionic Hiton

This clothing is of Phoenician origin and is often synonymous with women's clothes Greeks. Ionic hiton is made of very thin woven wool or linen and tailored so that the material folds in half, and stitching left for the hand. This clothing was very rich and fancifully draped, and sewing was also part of the decorations and help with the draping. Typically, lower, left part of the garment was open, while the rest would be stitched on the side (Fig. 32, 33, 34 and 35).

Figure 32.

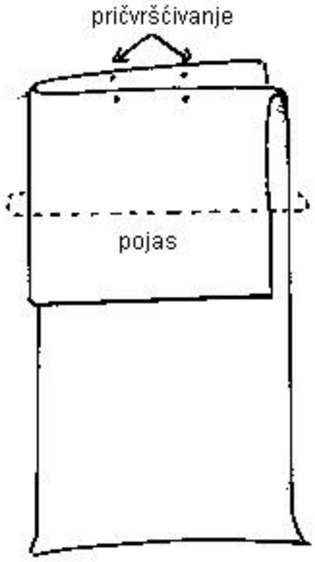

Figure 33.

Figure 34.

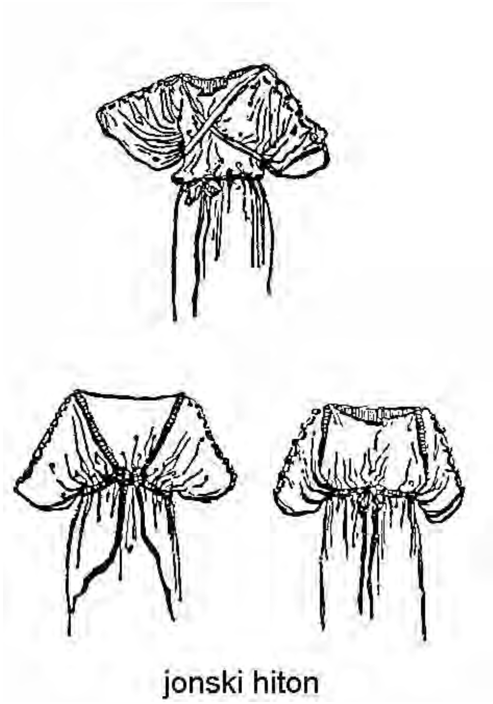

Figure 35.

Peplos

This dress was worn by women at the height of the classical period (4th and 5th Century BC). Essentially, this is the kind of dress, which is fancifully draped and folded, so you always leave a part that hangs in the upper body. It is in fact a kind of tunic and is made from wool and heavier materials. He moved to the foot (Fig. 36, 37, 38 and 39).

Figure 36.

Figure 37.

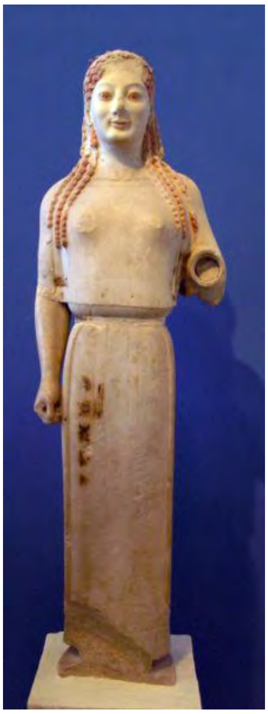

Figure 38.

Figure 39.

It is made of rectangular pieces of fabric and can be attached to buttons, pins, or pins on the various, imaginative ways, and depending on the style, combined with the tying and draping. (Figure 40 and 41).

Figure 40.

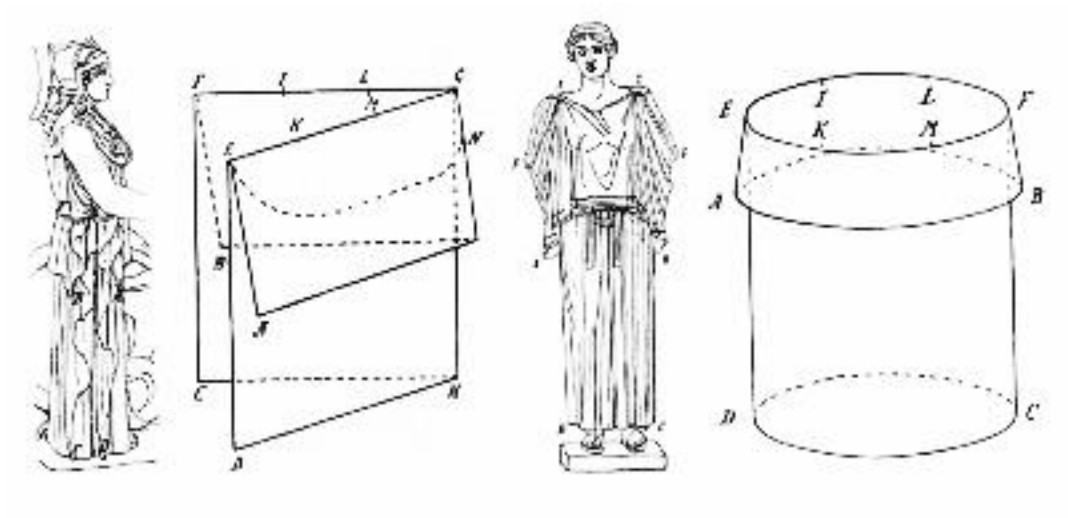

Figure 41.

3. Conclusion

Because of warm climate, clothing in the Greece is not complicated and layered. It is simplicity is a basic and immeasurable value of Greek ornaments and clothing.
The beauty of this simplified clothing lies precisely in the rich drapery, ligation and decoration fabric designs, which applies particularly to the edge of fabric.
Previously, long thought to be due to marble statues and temples to us other than that time, Greeks prefer to wear white clothes. In addition to rich colours, we have inherited from the Greeks also rich ornamentation, stylized to perfection, and often close today has geometric abstraction, uniting the miraculous way the ancient and modern, and deleting time limits.

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DETERMINATION OF GENERATED TEXTILE WASTE IN CLOTHING COMPANIES OF DIFFERENT TECHNOLOGICAL LEVEL

Silvana KRSTEVA & Goran DEMBOSKI

Abstract: *During the last decade, the clothing manufacturing companies have being exposed to high competition from the low labor countries and to constant increasing of production costs. This in turn, for the manufacturing companies aiming to increase competitiveness and profitability, imposes the issue of better utilization of the existing resources. The material costs in clothing manufacturing represent more than 50% of the price of the garment. The technique of processing cutting orders and planning economic cutting lays are of utmost importance for better utilization of materials and for increasing the efficiency of cutting process.*

In this paper, the influence of the level of applied technology on the percentage of generated textile waste has been analyzed in two representative clothing manufacturing companies. The aim of this work is to provide additional information regarding the planning of cutting orders, generated textile waste and existing condition of utilization of textile materials in Macedonian apparel industry.

Key words: clothing manufacturing companies, textile waste, cut order planning, CAD system, material costs and labor costs.

Introduction

In today's highly competitive global market, manufacturers are faced with a constant pressure to reduce costs, offer greater product selection, and faster product delivery. By maintaining lower labor cost and factory automation tools, many companies have successfully reduced operating costs.

The focus of efficiency in the apparel industry is to reduce the cost of raw materials (material costs), which often reach up to 75% of total production costs. In the recent years we witness continuous increasing of the price of textile materials, so any higher percentage of utilization of materials achieved directly affects the overall production costs (Jacobs - Blecha C. et al., 1998).

CAD/CAM systems for nesting/marking and CNC automated cutting equipment have proven effective in increasing the efficiency of the individual cutting operation. But the greatest opportunity for savings in overall time and material costs remains more effectively optimizing the overall cutting process – from order through cutting (Beazley A., et al., 2003). The cut order planning process, spreading and cutting process in the cutting department, determine the utilization of textile materials. Great importance in increasing the efficient use of materials is the planning the conversion work orders in cutting plans.

The purpose of this research is to investigate the influence on the level of applied technology on the percentage of generated textile waste in clothing manufacturing companies.

Theory

Cut order planning is an important linkage in the workflow control system. Cut order planning is the activity of planning the order for cutting, as an input into the marker making stage so that the cutting room receives complete spreading and cutting instructions (Wallace T. F. et al. 2003). The cut order planning process is a dynamic function that must respond to the ever - changing status of many critical factors such as sales, inventory levels, raw materials, and availability of labor and equipment. The variety of sizes, styles, fabrics and colors induces significant complexity into the problem. Adding to the complexity, and thus potentially increasing total production costs, are setup the changeover costs, the question of appropriate sizes, and the necessity to meet customers‘ demands competitively (Cooklin G. et al., 2006).

Current industry approaches for performing cut order planning range from manual ad hoc procedures to customized proprietary software. Many apparel manufacturing facilities are still using very unsophisticated methods, depending on the expertise of one individual who has the necessary data and decision making tools only in his or her memory. Profit margins in this industry severely limit capital investment, resulting in few resources for computing equipment. Commercial software for cut order planning has been developed, but effective application requires extensive customization and the necessary hardware for implementation (Hands C. et al., 1997).

The cutting room has a greater effect on excessive manufacturing costs than any other department concerned with the actual production of garments. The revolution in the garment industry took place as a result of the introduction of CAD/CAM techniques. CAD/CAM systems are becoming more affordable during the whole time (D. J. Tyler, 2008).

Today it is advisable to use CAD/CAM systems wherever it is economically justified (Knox A., 1994, Gradiar M. et al., 1997). Handmade markers are time consuming, and if you change your mind about the layout you have to start over from the beginning. Making patterns on a CAD system allows very precise drafting and measurements. But the real advantage is that each pattern is stored on the computer and adjustments can be made very quickly and easily. CAD systems allow the marker maker to play with the pieces until it gets a good layout that minimizes waste. Reduced labor costs and faster production are the benefits. The better the layout is, the less fabric we have to buy on the first place, and much less textile waste is generated (Tincher W. C. et al., 1993).

Experiment

In two representative clothing manufacturing companies, designated A and B, which differ in terms of organization, number of employers, production capacity, the level of applied technology in the cutting process etc., the function of processing work orders has been analyzed and the real percentage of generated textile waste has been identified.

Production company A is formed in 2007 and only offers CMT services to different foreign partners. It employs about 45 productive workers in two production lines. The main activity of this company is production of pants. Here it is very important to mention that, the production company A, still uses manual production of markers for the greatest part of the work orders, because it has not got a CAD system. The cutting department is fitted with 1 cutting table for spreading with a length of 8,5 m, 1 band knife and 2 straight knife cutting machines. The production capacity ranges between 240 - 250 product units daily, which depend on the style and model.

Production company B is a modern and dynamic company with main activity in the field of textile and logistic on the European and world level. The company founders are occupied with this work since 2001. Their production palette includes men, women and children's denim collections and they monthly export between 20000 and 30000 units. The production company B has got a computer design system CAD. The cutting department is fitted with 4 cutting tables for spreading with a length of 8,5 m, 1 spreading machine, 3 band knife and 5 straight knife cutting machines.

In each production company the function of cut order planning and processing of three variants of work orders, was analyzed. In table 1 and 2 the structure of analyzed work orders at both companies is presented. The tables clearly show that the work orders have different structure and differ in terms of the model, sizes, quantity etc. Besides the difference in the structure of the analyzed work orders, the difference in level of applied technology also affects on planning markers and economic cutting lays for analyzed work orders.

Table 1. Structure of the analyzed work orders in the production company A

Work order	Production company A								
1 (women's pants)	Size	**46**	**48**	**50**	**52**	**54**			**Total**
	quantity	85	25	230	25	65			430
2 (women's pants)	Size	**44**	**46**	**48**	**50**	**52**	**54**		**Total**
	quantity	110	132	204	183	110	96		835
3 (women's pants)	Size	**44**	**46**	**48**	**50**	**52**	**54**		**Total**
	quantity	63	85	136	103	93	85		565

Table 2. Structure of the analyzed work orders in the production company B

Work order	Production company B									
4 (children's pants)	Size	**4**	**6**	**8**	**10**	**11**	**12**	**14**	**16**	**Total**
	quantity	34	23	23	36	23	36	36	21	232
5 (men's pants)	Size	**38**	**40**	**42**	**44**	**46**	**48**	**48B**		**Total**
	quantity	23	54	62	60	53	18	4		274
6 (men's pants)	Size	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**38**	**Total**
	quantity	80	100	160	140	200	100	120	60	960

The analyses of work orders in production companies were performed in several steps and there are some differences in the investigation performed at both companies:

- monitoring of the development of cut order plan according to the structure of analyzed work order (company A and B);
- monitoring of manual preparation of necessary markers (company A);
- manually measuring the length and width of the markers, m (company A);
- monitoring of the computer marker making using Gerber Accumark system (company B);
- analysis of the basic data required for cut markers (company B);
- monitoring the process of spreading plies and forming cut layers (company A and B);
- following the order of spreading fabric rolls (company A and B);
- measuring lengths and mass of the remnants of used fabric rolls, (company A and B)
- determination of the actual percentage of textile waste generated in the cutting process from each cut layer, by manual measurement using technical scale, (company A);
- measurement areal weight of the textile material with dimensions (10 x 10) cm, using a laboratory scale, (company B);
- calculating the actual percentage of generated textile waste in the cutting process from each layer, m^2, and its expression in mass units (company B);
- determination of the total time required for processing of the work order and calculating the total labor costs, (company A and B)

Findings

Table 3 and 4 presents the summary of obtained results from a research conducted in clothing manufacturing companies A and B.

Table 3. Total production costs and quantities of generated textile waste in the production company A

Production company A	Work order 1	Work order 2	Work order 3
Number of clothing pieces	430	835	565
Total number of layers	212	425	284
Cutting clothing pieces	424	835	568
Total material costs, €	2887,60	5867,45	4784,42
Total labor costs, €	43,95	60,99	50,38
Total production costs, €	2931,55	5928,44	4834,80
Total quantity of textlie waste, kg	66,70	228,42	94,66
Total quantity of textile waste from cut layers, %	28,2	35,00	26,5
Total quantity of textile waste from remnants, %	2,2	0,6	2,5
Total quantity of textlie waste, %	30,4	35,6	29,0

Table 4. Total production costs and quantities of generated textile waste in the production company B

Production company B	Work order 4	Work order 5	Work order 6
Number of clothing pieces	232	274	960
Total number of layers	114	147	421
Cutting clothing pieces	232	277	963
Total material costs, €	932,09	1755,45	6893,48
Total labour costs, €	39,08	32,06	84,02
Total production costs, €	971,17	1787,51	6977,5
Total quanty of textile waste, kg	17,6	50,50	112,82
Total quanty of textile waste from cut layers, %	19,8	26,5	18
Total quantity of textile waste from remnants, %	1,2	1,1	1,7
Total quantity of textile waste, %	21	27,6	19,7

To evaluate the impact of the level of applied technology on total production costs, quantities of generated textile waste in the production companies A is compared with the quantities of generated waste in the company B.

The results from comparison of total quantities of textile waste and waste from remnants, % are shown as a diagram (Figure 1 and 2).

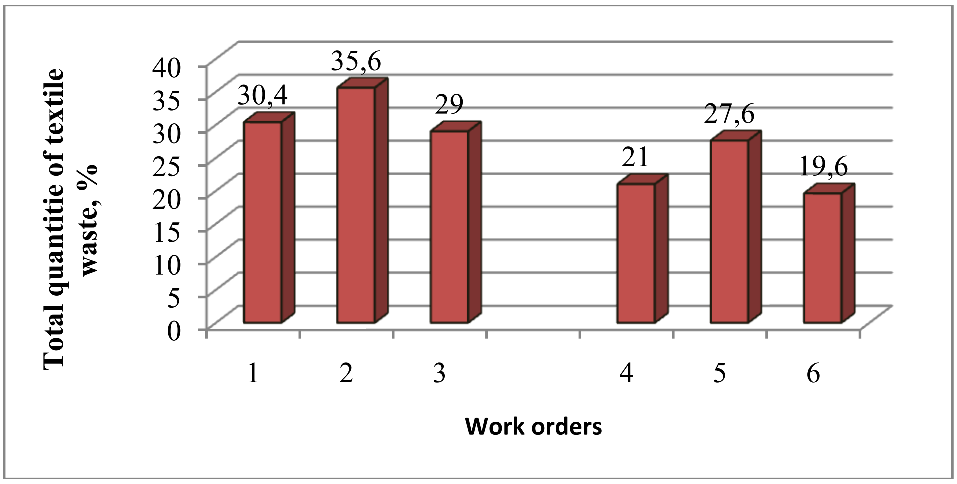

Figure 1. Total quantities of generated textlie waste in the production companies A and B, %

Figure 2. Total quantities of textile waste from remnants in production companies A and B, %

Discussion

Based on the analysis conducted in the representative companies (Figure 1 and 2), it can be concluded that the greatest quantities of textile waste (29 to 35,6)% created the production company A. One of the main reasons for this is certainly the difference in their technological capabilities. The production company A does not have a CAD system, and as a result of the inefficient planning and utilization of textile materials, a significant amount of textile waste is created and consequently the total production costs are increased. Despite the high percentage of waste as a result of the ply losses, in this production company there is a high percentage of waste due to fabric faults and remnants from fabrics rolls (0,6 to 2,5)%.

In the second production company B the quantities of generated textile waste are smaller and this is mostly due to the efficient interactive planning of cut markers using CAD system and its extensive experience in the manufacturing of pants.

The quantities of generated textile waste in the production company B ranges from (19,6 to 27,6)% and these differences are due to the difference in the structure of processed work orders and the effective width of the used textile materials. From Table 4 it is clear that the greatest amount of textile waste (27,6%) are generated with processing of work order 5. The higher percentage of waste is a result of the structure of the work order and the application of markers with low utilization.
In none of the analyzed production companies, planning the fabric rolls for spreading is not used, which contributes to the percentage of waste due to fabric faults and remnants from fabrics roll (figure 2) which move from (0,6 to 2,5)%.

Conclusion

The analyzed production companies produce different quantities of textile waste. One of the main reasons for variation in the percentage of generated waste, in companies that produce similar products, is the difference in the level of applied technological equipment.

In the production company A, as a result of inefficient planning and lack of a CAD system, the quantities of textile waste ranges from 29 to 35,6 %. On the contrary in the company B as a result of the extensive experience in the production of standard products and efficient interactive planning of marker using CAD system, the quantities of textile waste ranges from 19,6 to 27,6%.

In the analyzed companies, material costs dominate over labor costs, which clearly indicate that when planning cut orders the priority should be given to the material costs. An efficient utilization of textile materials will help to reduce the production costs and quantities of generated textile waste. Planning the order of spreading fabric rolls can further affect the utilization of textile materials and reduce the total quantities of generated textile waste.

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THE LEGAL PROTECTION OF THE SOFTWARE IN THE USA AND SERBIAN LAW

Nadežda LJUBOJEV & Stanislava SINĐELIĆ

Abstract: *The need for the appropriate legal norms of software is one of the imperatives not only for our, but also for the globally observed modern society. However, there are still many doubts in the United States, as the representative of the software industry, and in the European Union concerning the legal framework where the legal protection is possible. In the legal practice, at the moment, currently are accepted a copyright and a patent way of protection. The question arises whether in this ways created a legal uncertainty or unequal legal solutions which are the result of different conceptions of the patent ability or the authorship. Therefore, in this work the author has tried to define the concept of software, through the analysis of the relevant sources of our laws and stating the source from the United States of America laws, and highlight the current situation regarding the legal .*

Key words: software, legal protection, copyright law, patent law.

Introduction

Software companies, particularly in the United States of America as a cradle of software industry, gained a large profit even in the first years of the designing of software. As the legal protection of software was not provided, one of the main goals was to establish adequate legal framework for the exploitation of software whose market value was very high. It became a worldwide problem so the debate between the advocates of patent law and those of copyright law was lively in the realm of intellectual property law. Although numerous legal acts were passed nationally and internationally, there seemed to be no uniformity of legal protection.

The complexity of software issue caused the debate about the appropriate legal protection of this good to drag out for decades. Since the growing significance of electronic commerce and information technology on society based on the Internet indicates that the real expansion of software designing and use is to come, the problem of the adequate legal protection on European continent is still regarded as unsettled. Moreover, the economic impact of software industry of the United States of America and its considerable effort that software should have the legal protection as a patent have raised to some extents the doubts about the effectiveness of the concept of copyright protection.

Once source code (when it is written in a programming language) has been available to public, it can be used to design another software program in a simple way without copying it directly resulting in copyright infringement. Furthermore, in this field are technological constraints of intellectual creativity for there is no endless number of ways how to develop the same idea as it is the case in the other creative work. By that fact alone, it is extremely difficult in a certain case to tell apart whether the software is a plagiarism of the other one or the original creation of the author. Besides, thanks to developed computer technology, software program has become an easily accessible product whose copies are made at minimal costs.

On the other hand, the complex characteristics of software raise the question of patent protection. Source and object codes as forms of expressions are under copyright protection. However, software activation gives technical result, which not seldom has its industrial application. With the respect to this fact, legal theory and practice to some extent call into question the concept of copyright protection.

There are numerous works which seriously deal with the dilemma between copyright and patent protection both in our and foreign literature. (Howard, A. 2002) They all provide the starting point

for a comprehensive analysis of the problem but in our work we will present only the current normative acts in our law, noting what is the legal protection of software in the United States of America.

Regarding all aspects, we feel it necessary to depict our legislation as de lege lata and de lege ferenda. In the last part of the paper, we will briefly explain the relation between copyright and patent protection of software co-existing in our practice.

2. Legal Protection for Software

A The Term and Types of Software

There is a need for precise definition of the term of software as the object of legal protection . The term "software" denotes "computer program and procedures, associated documentation and data relating to the functioning of the computer system."(Standard Glossary of Software Engineering Terminology, 1983)

We have to distinguish this term from the other closely resembling term-computer program-since their meanings are not identical. We will indicate what it means since it is a narrower term. A computer program includes ―anarranged sequence of instructions that are attached to the material carrier and with the help of a computer performs a specific function or achieves a particular result."(Davidson, J. A. *et. al* 1986)

Otherwise, according to its implementation software is frequently divided into two groups: system and application software but in terms of legal protection, this division has no special significance. Existing differences between them may affect the certain issues in the legal transactions. For example, system software includes a translation program (from programming language into machine one) utility program (including services, help) as well as a protocol and managing program (drivers) (Tasić,B. 1998). An operating system is the part of system software and it consists of programs that are the basis of application software for it coordinates the work of different operating units: processors, printers, keyboards, and other related devices (Hoppen, N 2005). In fact, an operating system is a combination of hardware, on the one hand, and a user and application software, on the other hand.

On the market the most significant application software is intended for end users "to solve business, scientific and industrial problems,"(Tasic, B and Bauer I.,1998) and whose performance depends on the operating system and utility program. Yet, in legal literature the usage of both terms are equally justified for computer programs are often marketed in the form of software. In practice, however, the term software is prevailing, which has influenced us to choose this term in our work even though there are the cases of solely computer programs. Although we have opted for language consistency, we will necessarily use the term computer program as well in order not to reduce the credibility of an information source.

B Legal Protection for Software in United States of America

Digital technology has become an inevitable part of everyday life globally and in Serbia as well. This statement refers to the large economic importance of software and the key issue of determining its adequate legal protection.

In the United States computer software, at the beginning, was not protected as an intellectual property. In the absence of the strict legal norms, on the nature of the software, thus the form of the legal protection, a great contribution was given by jurisdistical practice. In the United States, in 60's and 70's of the last century, in the jurisdistical decisions it is pointed out that the source code is a form of expressing ideas, and therefore the software is considered as a work of the author.(Yang,G.C,2004-2005)

This jurisdistical praxis view is given by the amendments to the U.S. Copyright Act (1980). Later, also with the Computer Software Copyright Act (1980). By authors rights the form of invention is protected, respectively the literary software code, but not the idea that stands behind it. In this way, the jurisdistical praxis is applying the relevant regulations has moved the borders between the forms and ideas, with the time giving the possibility for the protection of the software patent. For example, *in Apple Computer, Inc. v. Franklin Computer Corp*.[2] In 1983, the court has extended the author's jurisdistical protection to the objective code, as a form of the expression of the ideas regardless the medium on which it was fixed.

In this way, law was increasingly erasing the differences between the software as an author's work and a patent inovation. In the American theory, it is emphasized that in some cases, such as in the *Allapat* case, the court had the opinion that the software can recognize the patent protection always when the conditions for patentability are present. (Brown, F.V.1988) However, despite the increasingly frequent practice of software patentability, we have to conclude that the legal system in the United States the primary form of protection is still the copyright, as well as in the EU law.

C Legal Protection for Software in Serbian Law

According to the provisions of the European Communities Council Directive on the legal protection of computer programs (Directive 91/250) which is the primary act regulating the issue of protection of computer programs in the EU, member states protect computer programs as literary works by copyright within the meaning of Berne Convention for the Protection of Literary and Artistic Works. Ideas and principles which underlie any element of a computer program, including ideas and principles which underlie its interfaces, are not subject of copyright protection.[3] (Todorović , B. 2000) In fact, the form of software includes source code (when expressed in some of the programming languages), objective code (in the form of binary numbers, i.e. In machine language) and executable code (electronic digital readout on the physical medium: magnetic tape, a chip, CD). (Standard Glossary of Software Engineering Terminology, 1983)

However, neither judicial nor administrative practice in EU member states and the European Patent Office ignores the current trends of American precedents when making decisions. It has been proven by the data which show that the national authorities in the European Patent Office has granted thousands of patents applicable to computer inventions.(Toeniskoetter, S. 2005-2006) In our legal system, the software was firstly recognized copyright protection by the Law on Amendments and Supplements to Copyright of 1990. Copyright and Related Rights Act of 1998 that followed took the same concept explicitly adding software to the list of works of authorship.[4]

In our legal system, the basic form of protection for software is copyright.

Act of 2004 did not make any substantial changes, but seeking to formally comply with international regulations, the software was classified as a written work.[5] It provides for the existing Law on Copyright and Related Rights. [6] However, given the specificity of software as intellectual property, consistent application of the provisions of the copyright in works of literature is not justified. Therefore, our law as well as international legislation has provided a number of provisions, which recognize the need for special regulation of the software, which we will deal with in particular.

According to the current Law on Copyright and Related Rights, the author of the computer program has the exclusive right to permit or prohibit the rental of copies of his work. The term ‗rental` means making a copy available for use to the other by a public institutions without direct or indirect

1Apple Computer, Inc. V. Franklin Computer Corp. 714F.2d 1240, 1249 (3d Cir. 1983.

[3] Art. 1(1) and Art.(2) Directive 91/250.

[4] Art. 2(2) (10). Copyright and Related Rights Act in1998, Official Journal n. 24/ 98.

[5]Art. 2(2) (1). Copyright and Related Rights Act in 2004 Official journal SCG, n. 61/ 2004

[6] Copyright and Related Rights Act in 2004 Official journal RS n. 104/09.

commercial advantage. [7]This legal provision was not the part of Law on Copyright and Related Rights of 1988. In accordance with Article 40 of existing Law on Copyright and Related Rights which has been taken along with the previous Article 24 of the Directive on rental and serve, in the case of the serve of copies of works of authorship by a person whose business is registered, the author has the right to claim compensation. (Directive 91/250) The different legal treatment in terms of this power stems from the highly technical characteristics of software, which makes its reproduction very simple procedure. Therefore, the legislator considered it necessary to provide the author with the exclusive authority to be able to achieve the higher degree of control over the use of his work.

The software copyright suspension is strictly regulated. The legislator has provided that a person who has lawfully obtained a copy of a computer program may, for their own use of the usual special-purpose programs: accommodate a program in computer memory and run it, remove bugs and make other necessary changes to it which are consistent with its purpose, unless otherwise agreed, make a backup copy of the program on a tangible carrier, made compilation of the program exclusively in order to obtain the necessary information to achieve interoperability of the program with other independently created software or specific hardware, if that information is not available in any other way and the decompilation of the program is done in only a portion of which is necessary to achieve interoperability.[8]

Program storage in computer memory and its running are, in fact, acts of reproduction which are exclusively within the power of the author.[9] However, these actions are necessary to the person who has legally obtained a copy of the software, to use it. Therefore, it was necessary to suspend the specified powers of the author.

The technical nature of software means that the design and use of software requires the use of machines (computers), so software bugs often occur. Any unauthorized intervention would represent a treatment of the work, and thus a violation of the exclusive non-proprietary rights to make changes. First of all, because of the undisturbed use of the program, the legislature has given the holder the legal authority to remove bugs and to make other necessary changes to the program. However, by the agreement between him and the right holder the application of this provision may be excluded. The similar purpose has legal authority of the holder of the copy of the software to make copies of the software on a durable physical medium, since the working copy during the use can be damaged or destroyed. (Standard Glossary of Software Engineering Terminology, 1983).

Given the extraordinary economic importance of software, the legislature has provided specific provisions in the Law of Treaties, and for the copyright work created in employment, which may be waived only if it is provided in the contract.

Finally, it must be emphasized that the employer is the permanent holder of all exclusive proprietary powers to the software employed. When it comes to the other works created in employment, the employer is the holder of the proprietary powers for a limited period of five years from the completion of the work.[10]

3. The coexistence of copyright and patent law

If we bear in mind that the basic form of the protection for software is copyright, we should not ignore the fact that copyright protection for software, which has already been widely accepted, includes any form of expression, that is, both source and object code. On the other hand, considering the cases of recognition of patents for software, one of the key issues which has been raised is whether

[7]Art. 24. Copyright and Related Rights Act.
[8] Art. 47 (1). Copyright and Related Rights Act.
7 Art. 20 (4). Copyright and Related Rights Act
[10] Art . 98. Copyright and Related Rights Act.

the copyright and patent protection coexist in a parallel way or complement each other. The answer to this question is the subject of the consideration in this section.

As stated above, according to Directive 91/250, TRIPS and the WIPO Copyright Treaty[11], software along with its source code and object code is protected as literary work in terms of the Berne Convention. [12] (Matthews, D. 2002) Given the legal significance of these acts, the legislation of European countries is, in this regard, largely harmonized. However, the field of the application of software in the information era spreads and covers those areas that are traditionally protected by industrial property rights, i.e. by patent law. This fact causes differences in software protection.

In this regard, and by the analysis of current legal practice, it can be concluded that the software under certain conditions, may be subject to patent protection. Interpreting the relevant provisions of the European Patent Convention, the standpoint of the European Patent Office is that software, when you start or store it in a computer, produces or has the ability to produce a further technical effect which goes beyond the normal physical interaction between software and computers (hardware) by which the program is run.

This means that the software can be patentable. The basic requirement for the patentability of software is to make a technical contribution. The similar determination of patentability exists in the legal system of the United States, because a patent can be assigned for the procedure, device or products that are new and useful. Patent protection can be given to the promotion of procedures, devices and products, provided that such promotion satisfies required conditions.

We can conclude that the uneven level of the protection for software, in those situations when it can be considered an invention in terms of patent law, brings a different view of patentability. Given the above facts that the United States recognizes inventions patent protection under somewhat different conditions than it is the case in the European Union and most national legislations in Europe, it is possible that certain software is protected under Patent Law in the United States, but under Copyright Law on European continent. In this way, however, it does not call the primacy of the worldwide concept of copyright law into question. In addition, it is necessary to emphasize that despite the increasingly common practice of patenting software, in the legal system of the United States the primary form of protection is copyright.

Doubtlessly, some legal and economic uncertainty on the market of software brings software in some cases, depending on the territory of a country, under the protection of both patented invention and the work of authorship. In this regard, it is not unlikely that in the same country, under certain conditions, software as a work of authorship may also meet the requirements of patentabilitz.

4. Conclusion

Digital technology has become an inevitable part of everyday life globally and in Serbia as well. This statement refers to the large economic importance of software and the key issue of determining its adequate legal protection.

In our legal system, the software was firstly recognized copyright protection by the Law on Amendments and Supplements to Copyright of 1990. Copyright and Related Rights Act of 1998. that followed took the same concept explicitly adding software to the list of works of authorship.

Act of 2004. did not make any substantial changes, but seeking to formally comply with international regulations, the software was classified as a written work. It provides for the existing Law on Copyright and Related Rights. However, given the specificity of software as intellectual property, consistent application of the provisions of the copyright in works of literature is not justified. Therefore, our law as well as international legislation has provided a number of provisions, which recognize the need for special regulation of the software.

[11] 4 WIPO Copyright Treaty.
[12] Art.1(1)i (2) Directive 91/ 250 i 10(1)TRIPS-a.

However, the field of the application of software in the information era spreads and covers those areas that are traditionally protected by industrial property rights, i.e. by patent law. This fact causes differences in software protection.

In this regard, and by the analysis of current legal practice, it can be concluded that the software under certain conditions, may be subject to patent protection. The basic requirement for the patentability of software is to make a technical contribution. The similar determination of patentability exists in the legal system of the United States of America, because a patent can be assigned for the procedure, device or product that are new and useful. Patent protection can be given to the promotion of procedures, devices and products, provided that such promotion satisfies required conditions.

We can conclude that the uneven level of the protection for software, in those situations when it can be considered an invention in terms of patent law, brings a different view of patentability. Given the above facts that the United States recognizes inventions patent protection under somewhat different conditions than it is the case in the European Union and most national legislations in Europe, it is possible that certain software is protected under Patent Law in the United States, but under Copyright Law on European continent. In this way, however, it does not call the primacy of the worldwide concept of copyright law into question. In this way, however, it does not call the primacy of the worldwide concept of copyright law into question. In addition, it is necessary to emphasize that despite the increasingly common practice of patenting software, in the legal system of the United States the primary form of protection is copyright.

Based on previous exposure it is evident that in practice copyright and patent protection of software co- exist. Given this fact, we will present briefly what is their relationship.

Based on this we can conclude that these two types of protection can complement each other so that copyright protects the **form** in which the software expresses, and the patent protects the **idea** on which it is based, provided it meets the requirements of patentability.

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ROLE OF CLOTHES IN CREATING VISUAL IDENTITY

Ana GRGUROVIĆ & Vasilije KOVAČEV

Abstract: _As Virginia Woolf suggests that clothing is far more important task than that warms us (which is essentially the first and main task of creation of clothing) It changes our world view and how the world looks at us.Attitude toward the garments is part of the overall behavior of people. Today we see a clear tendency that the clothing is increasingly becoming a key to understanding self-identity - that man constitutes itself through the presentation of clothes. Aesthetics and symbols are therefore in the center of the creation of identity. Identity is one of the most important concepts in the descriptions of the function mode, it is connected with the general by focusing on self-realization. In the postmodern system, baseline society has an open character and identity reflexive nature of the body. This implies that individuals increasingly have to construct identity through the means at their disposal. Clothing occupies a central place in our attempt to distinguish itself in its own historical situation , and as such influential phenomenon - it should be taken seriously as a subject of research._

Key words: Pirot kilim patterns, visual identity, the fashion market.

1. Introduction

The central ambition will be to establish a prudent attitude towards fashion and garments in the role of identity construction, changing the way in general - latantno, sometimes superficially treat it, and seeing the importance of the extent to which it shapes our lives. Using examples, we can realize as much as possible on the basis of some more general points of relevance on the issue of fashion and clothing to create identity, to build a stable identity-rooted in the tradition of the separate elements-symbols of tradition and personal identity that reflects a lifestyle.

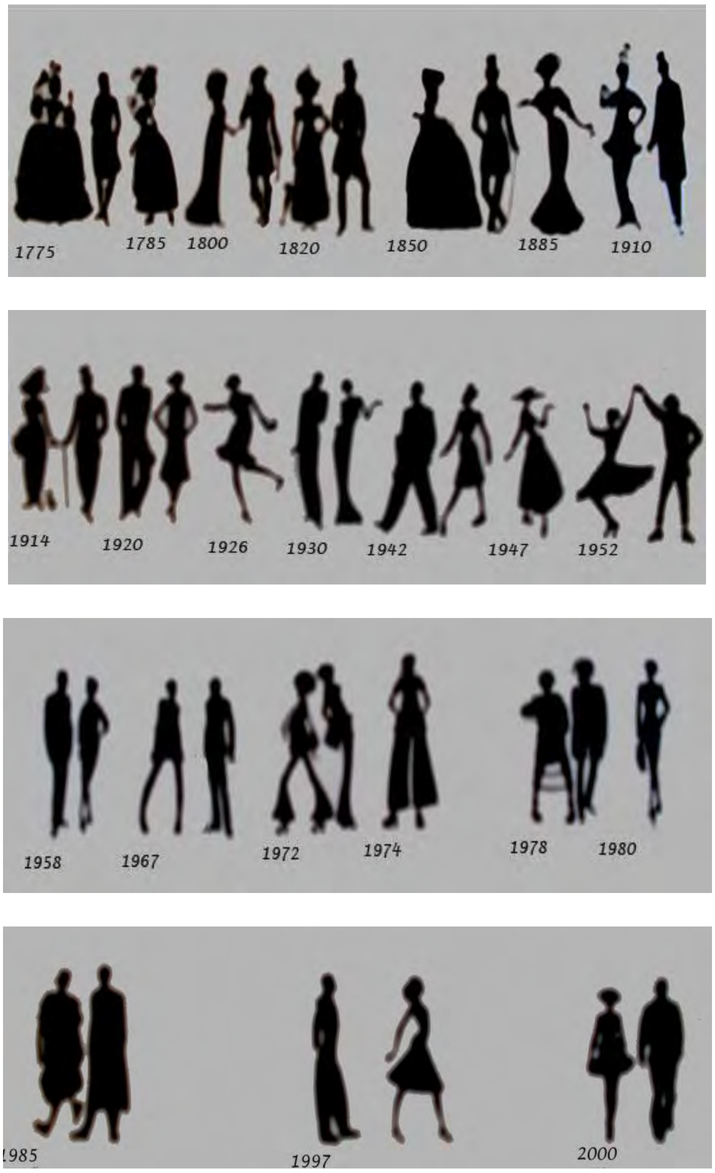
Having made a global plan of treatment issues, working with the set (main) hypothesis and the choice of methods of explorations, access to data collection. During data collection of identified data sources including: - the study of literature, historical and other documents, arranging with the principle of unity, diversity, analysis of general concepts to the individual, as well as the unification of the whole individual in the initial phase of data collection and data preparation for analysis and concrete, the classification in determining the correlation of quantitative and qualitative effects, linking theory and practice.

2. Historical overview of clothes, and acceptance of the development of modern design aesthetics

The impulse to decorate existed since before the modern age. Vikings with no doubt were interested for its appearance, it was customary to wear a comb attached to a belt that was a symbol of rank.
Fashion is made in one society is transformed and then a growing number of societies and social areas to follow its logic. Typically it is claimed that the mode of dress emerged in the late Middle Ages, possibly in the early Renaissance. In the late Middle Ages clothes began to resemble a modern way that was tailored to the individual.
From the eighteenth century the fashion industry Modena is increasingly democratized in the sense that it is no longer reserved for a small group of wealthy men-but also the middle class. Until the nineteenth century European clothing changed little since. Roman times when the next function to meet basic human need for protection and warmth, a desire for stronger realization. Mid-nineteenth century fashion with the courts (which occurs at the end of the eighteenth century) is replaced by middle class fashion. At first, the garments made in small batches and only for the privileged and wealthy classes of society. The development of class society and the industrial revolution, the ruling class became the driving force

of development mode, while the lower classes passively copied to be able to identify with a higher class. The middle class is the link that connects them. (See picture 1).

The development of mass-produced clothing more symbolic character gains consumption - clothes there that would help to identifier subject to what the object is eating. In other words, there are two principles of differentiation: in the class and classes above-imitation clothing.



Picture 1: Schematic view - the development of bones forms - silhouettes, from the eighteenth to the twentieth century.

3. Definition importance visual identity through construction clothes

In order to define the significance and meaning of clothing as a visual speech in a trance in the construction of visual identity, it should first define the meaning of the term and the words fashion and garment? The word fashion is derived from the Latin word modus objective measure of the manner, form and composition. The meaning of art can't be explain intentions of artists, because the work itself

has a meaning. It can be said to be a fashion designer who gives meaning but the meaning of clothing garment is reduced in those who use it. Then it will mean what I think as a user means. The meaning remains the only function when they reject.
The sense we try to reveal in the review and the study of patterns of diffusion of fashion, its logic and temporality, its relation to the body and language, its status as a commodity and art this perspective visual identity is something that must be created, and to create a place on the basis of interpretation: who we are and serious evaluation of what needs to be. In the clothing and appearance of the phenomenon, there is no problem of identity-loss assumption of a base belonging to a culture-region-Therefore you should try to understand the evaluation (of tradition as the basis of identity, and as a symbol of wholeness.

4. Use of clothes

Fashion clothing - as a social phenomenon, long beyond the basic needs for protection and warmth, it strengthens the desire for self-actualization. There are reasons to be skeptical about the difference between the clothes themselves and the use-value in use, and clothing. We can say that it is crucial to use what is a commodity.

The use of clothing in the exchange of information is called semiology. Theoretical clothing culture and analysts have focused primarily on four practical functions-meaning the use of clothing: the utility-bearing capacity, modesty, immodesty, ornament-fashion details.

5. Meaning of clothes - fashion and language

Cultural theorists and analysts of clothing focused primarily on the use of the four meanings of clothing: the utility-bearing capacity, modesty, immodesty, ornament-fashion details. The word fashion is derived from the Latin word modus objective measure of the manner, form and composition. To understand mode, this code, we must understand the language that is constituted as a mode - if you do not know the code we are unable to position in the system.

I joined the technique of data collection method of content analysis of the different characteristics of clothing: symbolic forms and social communication (visual speech in a dialogue with fashion) clothing does not send messages & quot; just like that. Distinguish: the signifier and the signified, the significator and the significator. In this sense there is messaging tool, the creator or recipient-users, and content of the message-wear. Interpretation of the clothing depends on the perceptual habits, perception, perception-image: what we see when we look at something depends on what we have seen.
There is a set of common rules that bind the signifier and the signified. Speech-like clothing is an important signal to others on the social stratum from which it originates on a social class which aspires There proportional relationship between the amount of clothes that a man has and how one can express visually. Always introduce your selves, your appearance was to promote an idea, product, service - and whether we competent on the basis of their appearance to present. A man and his appearance celokuna today in quick time, quick message that is sent to its appearance. The overall impression of a message is formed by the 7% of the content, 38% of the vote dynamics of color rhythm, 55% of our body part, body, hair color, appearance, clothing, fashion accessories and ..- to 10% detected and 90% of the closed area. The appearance of the composition of color and shape-every individual reacts differently to the shape of hair, clothes and elements appear.

6. Impact level clothing in creating visual identity

Glimpse the effects of clothing on creating a visual identity, (the observation point are given forms of identity-references) distinguish the following forms of visual identity: class, social, cultural - tradition-sourcing, consumer and personal identity (taste, ethics, aesthetics).

One of the main points of the Gadamer hermeneutics is that any attempt to understand something, any scientific or unscientific research is necessary for the historically conditioned contingent hermeneutical situation. Modern design aesthetic of fashion is constantly moving towards the level of development of human society and the degree of development of human consciousness under the new intellectual scientific achievements.

Fashion clothing culture is an inevitable result of cultural development in 19om century. Goods, science and technology are becoming dominant in relation to man. Of course, getting all the clothes and the cultural component. Culture is at the end of the 20th century became one of the main engines of the economy, such as a car or at the beginning of the 20th century railways in the second half of the century 19og in vogue today can distinguish three main categories: luxury, industrial and street. Luxury fashion is at the top of the pyramid and the price is woven by the measure. Expensive part of this mode is high fashion haute couture

Industrial fashion is mass produced but there is a range of expensive designer clothes to cheaper clothing store chain. Through the aesthetic and functional characteristics of the clothes, in dialogue with fashion, the subject demonstrates loyalty. Thus external factors within a society and as a personal individual (habitus, self) through the origin shape the garment as the main and supporting details, hair makeup fashion ... as supporting services, which completes the whole. Appropriate clothing can grant us success in the right places with the right people

Messages that transmit traditional western clothing of the twentieth century: Masculinity: pants, tie, wide straps, rough and heavy fabrics. Femininity: skirts, cleavage-defined waist, delicate fabrics. Sexual maturity: Tight clothing, transparent or shiny materials, high heels. Immaturity: lack of shape, tight clothes, jeans, childish or application patterns, bright colors, flat shoes. Dominance: Uniforms, uncomfortable fabrics, huge shoulder pads, dark brown leather, metal buttons, big hats and accessories. Subordination: impractical and superfluous details of fabrics, pale colors, decorative shoes. Intelligence: reading glasses, blue or dark socks, dark colors, briefcase. Compliance: designer clothing, clear cuts and soft colors. Rebellion: Extreme clothing and hairstyles, tattoos, piercing or absence of unusual shoes shoes. Employment: uniforms, classic suits, carrying tools and equipment for work-work uniform. Origin: clothes typical of a particular city or region. Wealth: gold jewelry, precious stones, clean and new clothes, perfect cut, mandatory labels, dramatic color, fur, perfume. Recreation: casual or sports wear with a logo, a cut that reveals the body, slim figure, shoes. Maturity: fidelity styles from the past.

7. Effects of environmental factors to defferentiate visual identity

To understand the differentiation of a clothing company it is necessary to consider the impact - the intensity of environmental factors on the occurrence of this phenomenon. George Sproles suggested factors that affect the decisions we make when buying clothes: cultural (climatic conditions), encouraging self-psychological, social, personal (life stay).

Following factors influencing the purchase decision are: symbolic differentiation, social status, modernity, convenience and operation, convenience, price, quality and comfort, the look-how our clothing is;fit; relevantvost, economic ethics, and global context mode . Thus, we distinguish between: class, social, cultural - tradition-sourcing, consumer and personal identity (taste, ethics, aesthetics).

Psychological factors: Clothing has its function as the socialize; and differentiating force. They are very important and emerging economies in which fashion products are purchased as a way to recent statements success. Because of that, the class differences are still important despite the suppression of social difference through education and job changes. Material and symbolic resources necessary to make it self treated yourself. Social roles and statuses define the place of individuals in each group was that this is a family club and the prevailing tendency for the values of achieving success and enrichment of concern for the environment can affect the types of consumers that will accept product. Accepting a certain mode is generally understood and seen as a manifestation of group behavior. Distribution and branding are spread globally, the production is rapidly changing every society needs producers and customers Clothes can be selected to reflect the personal status but to demonstrate membership in a particular group. Consumption of clothing: should be explained on the basis of class differentiation. It also considered that the consumption of clothing to feel motivated and well-being of bliss, in addition to our ambitions to become a socially recognized Today's consumption is not so much focused on class identity as personal. It offers great opportunities for the creation of the self in interaction between consumers and clothing. When a man as a consumer to obtain products with money, the higher the symbolic effort to integrate the facility into the self. (Philosophy money, Simmel 1900) Modernism: Modernist clothing-clothing that is fashionable intellectual level corresponds to historical time, the environment and evolution of society, our acceptance of modernity, whether they are designers or models serve consumers as an indicator of our creativity, flexibility and preparedness for the future. The credibility and value for money right now are the major issues to deal with every designer and fashion consumers are better informed today than ever.

8. Use of symbols in dress key to creating identity

All energy consumption of symbolic signs. All goods are just a sign when it is free from all functions. In developing the design aesthetics of textiles through the ages in all the nations of the world there is a fret-pattern-like symbol that has the aesthetic and symbolic importance in the culture of a civilization. In our climate we have in various areas of our ornaments in medieval frescoes as well as folk handicrafts. The original ornamentation presents a spiritual wealth as possible substrates basis or inspiration for new modern tendencies People want to be special objects from consuming certain symbolic value.

Seek their identity in what we currently surrounds the symbolic values that are available to us. And to accept that symbols need to express something about who we are. Based on observations over the case, certain laws are derived factors and consequences -visual styles identity. Examination. the content, form and dimensions of the ways in which the wear occurs between people and communicate-marks, images form the shape, color. I joined the technique of collecting built on various characteristics of clothing: symbolic forms and social communication (visual speech in a dialogue with fashion, see picture 2). In this sense there is a transmitter messages, or significator creator, recipient of a message - signifikant users, and content of the message-wear. Clothing is seen as the content - its basic meanings are expressed through the thoughts and ideas (categories and subcategories of dressing).

Picture 2: Revial presentation model pattern symbol-inkorporiraje Pirot rugs in contemporary costume

9. Scientific and social justification of research

We analyzed the identity of a new approach to designing clothes, which is applied to the Serbian-European contemporary style of dress, with a tradition retained the basic identity as the basis for further upgrades, and without which the latter element was modern and impersonal. The choice of documents for the theoretical content analysis-a cross-section of reviews in this field Experts clothing - provides the best insight into the heart of the meaningfulness of clothing. Symbols from our tradition of folklore - are an important part of that whole - the key to preservation of identity.

The practical importance of explorations and use justification of the research is reflected in contributions to science (such as its mission to identify, describe and explain) Contribution methodology in terms of new knowledge consists in the fact that the results identified a new form of access point to the contribution of dressing application design and development bones of today and the social level contributes to-wear and fashion as a social phenomenon, this approach can contribute to the preservation of fashion (visual) identity of the nation. Processing of data sources and theoretical and scientific experiment-physical models materializing in the material plane through practice. Cognitive role of hypothesis: theoretical and real research) The absolute: individual-specific characteristics of individual occurrences. The hypothesis of ideal types: the behavior of people towards a particular type of case-clothes. (The ratio of men to garments is part of the overall behavior of people.). Interpretation of the results, drawing conclusions on the implementation of hypothesis was carried out on the basis of test methods (market) and the opinions of experts in the field) and evaluate the results based on scientific data collection and observed data from the model results, through direct sensory perception and interpretation of research results and draw conclusions of scientific assumptions. In this sense approach to the analysis of the data - the research results. The essence of this analysis is the decomposition of the data in the form of statements of fact: an evaluation of the data, sorts the contents of the collected data, the assessment in relation to the theoretical part, and estimates of experts in this field of fashion critics, the creators).

10. Visual symbolism of Pirot rug- historical significance and review of data

In developing the design aesthetics of textiles - over the centuries in all the nations of the world there is a fret-pattern that has aesthetic and symbolic importance in the culture of a civilization. Illustrations in Serbian medieval frescoes and folk arts and crafts is the entire spiritual wealth of the original surface as a possible basis or inspiration for a new modern tendencies. Pirot rugs are important for its high artistic, and technological quality. The richness of colors and variety of motifs are an expression of refined artistic feeling permeated religious beliefs. The ornamentation on the patterns of the Pirot kilim is always geometric: stylized story, flowers, item on display from the immediate environment. It contains Chinese and Greek and Turkish elements. The study of ornamentation on the Pirot kilim work requires experts in various fields, because of the richness and the large number of variations.

11. Conclusion

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In the future vision of fashion and art to create the identity of modern man (and therefore the identity of a civilization, society and individuals ...) may be threatened market economy that focuses only on price. The way we buy fashion may in the future to impose a change in the production and consumption. This is one of the biggest challenges facing the fashion today.

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MECHANICS OF COMPOSITE MATERIALS AND FIBER STIFFNESS INFLUENCE ON THEIR STRUCTURE

V. R. GLIGORIJEVIC, J. STEPANOVIC, V. PETROVIC, L. KOSTADINOVIĆ & N. ĆIRKOVIĆ

Abstract: *This paper outlines the basic ideas about the application of mechanical stress on the part of the matrix and fiber. Take a simple case of a composite material containing aligned, continuous fibers. This can be represented using the "plate model". For loading parallel to the fiber axis, as a condition imposed by the same strain, which leads to the rules of research "mixtures" of Jung's module. This is followed by cases of continuous fiber transverse loads, axial loads and intermittent with fiber.*
Control of stiffness and strength is one way that is applied to divide the load between the fiber and matrix.

Key words: mechanical stress, the matrix, stiffness, model, load.

1. Introduction

Composite structures of knitted fabrics were produced using a unique knitting and warp stitch linking technique combined with a material part with the opposite characteristics to create a single membrane that is much better than its components are manufactured separately and then combined procedures with different bonding,
soldering or stitch technique the latest warp knitting. Raschell, ABC stitch machine, a simple composite fabrics products with high production. .

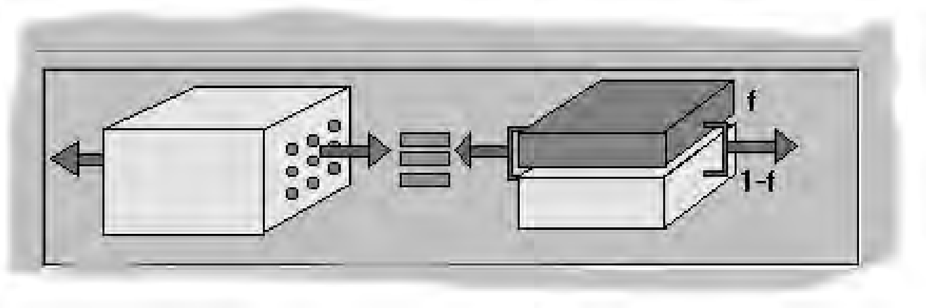
The most popular composite fabrics are two-axial, known as "enhanced non-woven materials." Most com positive materials are strong, hard fibers in a matrix that is weaker and less stiff . The goal is usually to a component, which is strong and firm, is of ten low density. Commercial materials are usually glass or carbon fibers in polymer matrices based on thermal resistance, such as polyester or epoxy resin. Sometimes, thermo plastic polymers can have an advantage because they adapt after the start of production. There are other classes $\bar{\sigma}_m$, $\bar{\sigma}_f$ of composite materials whose matrix of metal or ceramic (a ceramic). For the most part, this is still under development, with the problems of high costs of production that has yet to be resolved or reduced. In addition, in these composites the reasons for adding fiber (or, in some cases, particles) are often quite complex, for example, improvements can be traced to creep, wear, susceptibility to fracture, thermal stability, and so on. This software package includes simple mechanical stiffness and strength, which, when applied to all composite, it is often more relevant to the increased fiber (reinforced) polymers.

2. Removable load

The concept of load between the matrix and the strengthening of the composition (fiber) is the primary (central) for understanding the mechanical behavior of composite materials. External load (force) applied to the composite material partially borne by the matrix and the reinforcement part. The load carried by the matrix of the composite material over the productives the average load in the matrix and the intersection. Removable increased load is determined in a similar manner. By equating the external load imposed on the result of the sum, and dividing by the total area of cross section, provides an important and basic equation of the theory of composite materials is sometimes called the "average rule":

$$f\bar{\sigma}_m + (1-f)\bar{\sigma}_f = \sigma_A \qquad (1)$$

related capacity-matrix and the average pressure (tension) fibers ($\bar{\sigma}_m$, $\bar{\sigma}_f$) in the composite containing a volume (or area average) share of f- ups applied tostrain with. So a certain amount of stress will be carried out of the fibers, and the rest of the matrix. If the elastic response of composite materials, this ratio will be independent and represent important characteristics of the material. It depends on the volume proportion, shape and orientation of reinforcements and elastic properties of the two sums. The gain can be considered to act effectively when carrying out a relatively high proportion of the applied load. This can lead to greater strength and rigidity, as reinforcement is usually stronger and harder, than the matrix.



Fifure1. The stress of composite materials

3. The stress of composite materials

Let the stress of the composite material parallel to the fibers. Since they are connected together, and fiber and matrix will be stretched in the same amount in that direction, that will have the same strength E (Figure 1). This means that, since the fibers are stiffer (have a higher Jung module E), she submitted more stress. This illustrates the concept of load transfer and load sharing between the matrix and fiber, which is desirable because the fiber is better suited to carry high stresses. Let the sum of contributions from each phase equal to the total load, then we can find Jung's composite module (diagram). It can be seen to be applied "mixture rule". This is sometimes called "equal pressure" or "Voigt" case. Equations over the axial stiffness of the composite materials come to influence the stiffness fiber composite / relationship matrix stiffness and volume share of fibers that must be investigated on the basis of selected values.

4. Transverse stiffness

Also of importance is the response of composite materials to applied loads of fiber in the transverse direction. It is expected that the stiffness and strain of the composite material to be much less, because the (weak) matrix is not protected by the mounting tension (pressure) to the same extent as for the axial load.

Predicting or forecasting the transverse stiffness of composite materials composed of elastic properties is much harder than the axial value. The conventional approach is to assume that the system can again be repere sented by "plate model". The lower limit of stiffness is obtained from the "equal load" (Figure 2). This value is not acceptable, because in practice the matrix components are more effective "in parallel" with fiber(as in models with equal pressure) rather than "in" as is assumed. Empirical expressions are available to give a much better approximation, such as Tsai-help.

Help-Tsai expression for transverse stiffness (which is not given in the module, and if available in the dictionary) is:

$$E_2 = \frac{E_m(1+\xi\eta f)}{(1-\eta f)}, \qquad (2)$$

where,

$$\eta = \frac{\left(\frac{E_f}{E_m} - 1\right)}{\left(\frac{E_f}{E_m} + \xi\right)}.$$

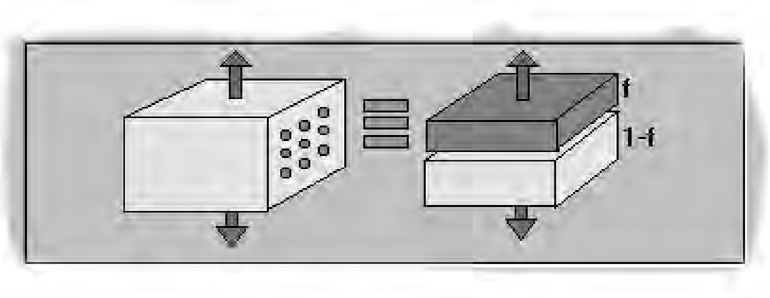


Figure 2. Equal loading

The value of x can be taken as an adjustable parameter, but its size is usually a single row. The expression gives expression gives the correct values in the limits f = 0 and f = 1, and generally gives a good consis tency with experimental over the full range of fiber content. The general conclusion that the transferse stiffness (and stress) of the aligned composite materials is poor.

5. Determination of strength

There are several possible approaches to the prediction strength of composite materials. If the voltage in two components like and these cord case of fibers of the axial load, then these values can be compared with the corresponding forces (forces) to determine whether it will succeedor not. The treatment is a logical development from the analysis of axialstiffness, with additional input variable power ratio of fiber and matrix.

6. The economic advantage of short fiber

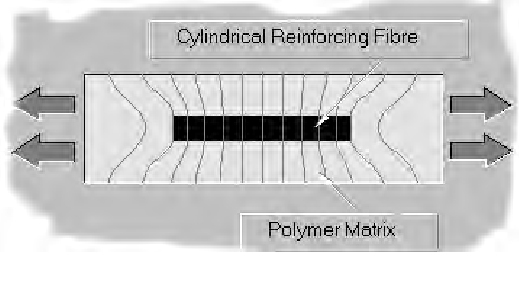


Figure 3. Tension in the matrix

Short fibers have an economic advantage and easy processing. When the fibers are long, the same voltage is no longer a requirement to maintain the axial load, since the voltage in the fiber has tendency come off according to their areas (see Figure 3). This means that the average voltage in the matrixmust be greater than that of other fibers.

This reduces the voltage to the fiber, and thus a higher average voltage in the matrix (in comparison with the case of long fiber) will reduce thestiffness of the composite voltage, since the matrix is weaker and less rigid than fiber. So there is interest in quantifying the changes of distribution of stresses such as short fibers. Several models are in common use, rangingfrom fairly simple analytical methods to complex numerical packages. The simplest model is the so-called "backward shear".
This is based on the assumption that all load is transferred from matrix to fibers formed by a pronounced shear acting on a cylindrical surface between the two squads. The accumulation of stress in the fibers in relation to this shear stressed the use of force balance in part the increased fiber. This leads to an expression that refers to the rate of change in voltage on the fiber surface at that point and fiber radius, r

$$\frac{d\sigma_f}{dx} = -\frac{2\tau_i}{r}. \quad (3)$$

Which may be regarded as a basic attitude backward shear. Distribution of stresses in the fiber is determined by relating the shear stress in the matrixaround the fibers on the composite macroscopic voltage. Some maths atical formulations lead to solutions for the distribution of power at a distance from the middle point of the fibers means hyperbolic trigonometric functions:

$$\sigma_f = E_f \varepsilon_1 [1 - \cosh(nx/r)\operatorname{sech}(ns)], \quad (4)$$

where E1-strain composite, S-fiber ratio (length / diameter) and ann-bezdimenzi it constant:

$$n = \left(\frac{2E_m}{E_f(1+\nu_m)\ln(1/f)}\right)^{1/2}, \quad (5)$$

where nm Poasonov relationship matrix. Variations in the surface she are stress along the fiber length are derived according to equation (3), by the difference of these equations:

$$\tau_i = \frac{n\varepsilon_1}{2} E_f \sinh\left(\frac{nx}{r}\right) \operatorname{sech}(ns), \quad (6)$$

The equation for the stress (pressure) in the fiber, together with the assumption of average pressure in the matrix, which was imposed on the composite material can be used to evaluate the complex stiffness. This leads to:

$$\sigma_1 = \varepsilon_1 \left[fE_f \left(1 - \frac{\tanh(ns)}{ns}\right) + (1-f)E_m \right]. \quad (7)$$

The term in square brackets is the composite stiffness. There is a possibility to examine the stiffness provided for in the function of the relationship of fiber, fiber / matrix stiffness and relations of volume share of fibers. Other observed points around the model residual shear can be used to examine the inelastic behavior. For example, interfacial sliding (interfacialfriction when reaches the critical value), it can be anticipated. As the pres sure imposed on the composite material increases, the slip is spread along the fibers with interfacial and is able to rise above some critical value, s, can be identified, below which can not be subjected to fiber fracture. This corresponds to the top (central) fiber where only the fiber strain reaches its ultimate strain. Sf, so, by integrating equation (3) along half the length of fiber we get:

$$s_* = \frac{\sigma_{f*}}{2\tau_{i*}}. \qquad (8)$$

From the above it follows that the distribution relationship between S* and S* / 2 is expected when the composite material subjected to great stress. S* values range from more than 100, the composite polymer with poor surf a eattachment, for about 2-3 for strong metal-matrix. Corresponding to different parameters under investigation can influence the distribution of surf ace shear, the strain in the fibers and to predict whether the relationship given enough fiber can affect their fracture.

Conclusion

* The key question in this study is to control the stiffness and strength, it is a way that is applied to divide the load between the fiber and matrix;
* To understand how the "plate model" used to obtain axial and lateral stiffness of fiber;
* That the term for the model plate (equal power) and not sufficiently precise to obtain more precise estimates of benefits Halpin-Tsai equation.
* To understand why the width of the axial stiffness is less when the fibers are broken and the general nature of field strength from the load in this case;
* To be able to communicate, to use the model to predict shear and axial stiffness to determine whether a given ratio of fibers can be broken by the applied load;
* The treatment of employees is negligible thermal residual stress, which in practice can be significant in some cases;

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MODELING AND SIMULATION OF THREE-DIMENSIONAL KNITTED PATTERNS COMPUTER GRAPHICS

V. R. GLIGORIJEVIC, J. STEPANOVIC, V. PETROVIC, L. KOSTADINOVIĆ & N. ĆIRKOVIĆ

Abstract: *This paper introduces a system with three-dimensional computer graphics in the design of knitted garment.*
Quick physically correct visualization of macro-structures of clothing is of crucial importance in the textile industry because it allows rapid and less expensive product development. For a real look of virtual textiles may be used by computer graphics as part of the rapid production of flat knitting machines. The paper pays particular attention to the process of knitting and not exceed the visualization as it is done in [4].
Other authors [8] presented a new approach thatis able to produce a sample of simulated data produced by the original designer, and knitter must intrepetira this data and to produce the final sample, which is quite time consuming and expensive. Simulation of knitting as a system to fully simulate the entire process of knitting, and as a result, images of samples of knitted products can be generated without using the actual knitting machines. This is not just a new step for the industry, but also the demanding process that must include the physical. mechanical properties of materials and yarns.
To understand the model and basic data about the structure of knitted fabrics are given a basic knitting pa tterns that contain only simple loops, but the authors [9] think that it is necessary to take twists and structures that are experiencing other than ordinary loops and snare (not processed lock loop) , long loop, yarn and other flotation, which would enable the production of clothing items of interest to the world market (see figure 3 right in (c) and (d) and figure 4 right.
Key words: physical modeling, modeling of textiles, computer graphics, simulation, 3D- models

1. Introduction

After looking at the history of mankind, we have evidence that there are textiles for thousands of years. We have many different ways to produce garments made of one row or a series of loops and braids, knots, weaving, knitting, etc..However, two main methods, in relation to the amount of building materials, the weaving and knitting. While the simple weaving and crossing weft warp yarn, knitting has interlacing loops.
Four centuries ago, the first knitting machine was invented William Lee, in 1589, from the village of Calverton near Nottingham. Since then, knitting has advanced in the areas of products that require flexibility, comfort and insulation. In fact woven garments have found their way into daily wear-time, even in high fashion. A large number of fabrics produced on flat knitting machines for knitting that are very diverse in the production of almost arbitrary kind of knitted patterns. At the same time there are advantages and disadvantages produced yarn. There are countless ways to combine inter-knit net working.
There are both advantages and disadvantages of knitwear. There are countless ways to combine the abstraction of each loop and each year, designers have come up with four different collection of new fashion models. This work needs to be faster and more intense at lower costs. Access via computer graphics must exist as part of the rapid production of virtual and real appearance textiles. So expensive knitting machines available to produce various patterns designed to cut costs and simulation of production. Visualization textiles have already made their place in the history of computer graphics. Draping textiles was thoroughly investigated by several authors. One of the first

was J. Weil [7]. He used a purely geometric approach catenary (curve, which idealizes a higher range) surfaces. Researchers Group N. Thalmann [2] had thrown cloth-modeling to high elongation.
Moreover, Dr. D. Breen and others. [1] proposed a particle system approach with the power minimized process to simulate the draping of fabrics. All these works are sophisticated and together participate in a simulation to calculate the trajectory of particles. In addition, collision detection algorithms were developed and are suitable for screen-modeling.
A good survey of cloth modeling technique can be found in [5]. Visualization of micro-structure of textiles, fabrics, has not caught a lot of attention within the computer graphics community. But it is a micro structure which is of vital importance for the textile industry.
In this paper, attention is paid to the process of knitting, not to exceed that visualization is presented for example in [4].Here we want to present an application that allows almost instant visualization of the newly designed knitting patterns.So time visualization techniques, such as light-modeling in [4] does not apply. But we want to calculate the natural impression of specimens based on knitting data and physical properties of the twisted yarns.
To achieve this, the authors [8] took the knitting machine with all the technical data of the tables of the Company, with the generated data structure to represent it, and apply a system of particles to simulate the natural behavior patterns. For visualization purposes, used the simple technique of drawing routine s'open GL library.

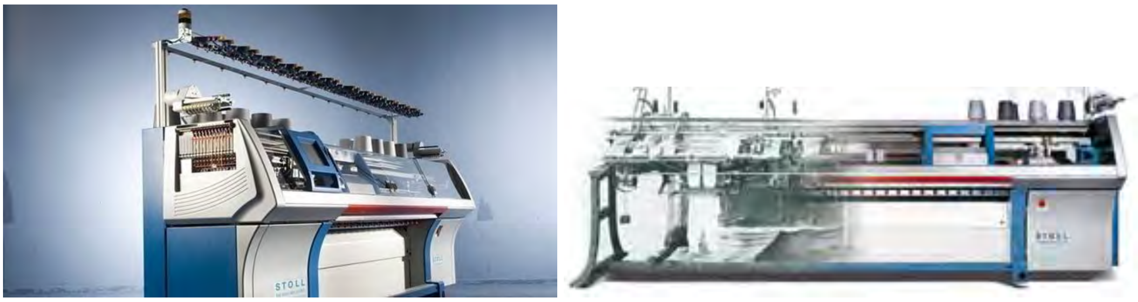


Figure 1. Knitting machine Stoll, the latest model at ITMA2011th Barcelona

2. Simulation of knitting

The authors [8] presented a new approach that is able to produce a sample of simulated data produced by the original designers. Usually, the knitter must intrepretira this data and to produce the final sample, which is quite time consuming and expensive. Simulation of knitting is a system that fully simulates the whole process of knitting. As a result, images of samples of knitted products can be generated without using the actual knitting machines. This is not just a very innovative step for the industry, but still very demanding process that must include the physical mechanical properties of materials, or yarn.
Input data for the system are the same as the data will besent to the right machine for knitting. In our case it is a form of data table of the Company, which is the largest machine manufacturer in Europe. Figure 1 shows the knitting machine table.
Simulation of knitting has been implemented in an objective-oriented framework using C + +. The system is equipped with an intuitive graphical user interface (GKI).It was developed using a fast turn and open App invent or (display) for viewing to enable three-dimensional overview of the knitwear and interactive handling. GKI system is shown in figure 2.

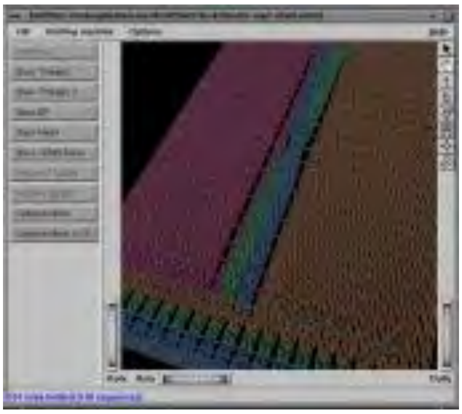


Figure 2. Graphical user interface system for simulating knitting [8]

Global parameters of knitting machines and needles for a number of English-Cola, or the number of needles in the bar, the number of yarn, and so on, are considered for simulation. The physical advantage on the basis of simulations is the fact that knitting can be replaced or introduced into any knitting yarn from those that are available. In contrast, the system allows easy replacement of yarn and simulation can be restarted. As of machine knitting, knitting simulation has two bar that can be equipped with any number of needles. In addition, virtual knitting machine is equipped with several facilities needed for the simulation process.

3. Data structure

Representation of knitted samples to the appropriate data structure requires a very flexible approach.

Today, there are almost no limits to design patterns, using modern machines for knitting, and every day a new and highly complex patterns generated. This is very important, knowing that the machine can knit a few operations, although in recent years appeared more sophisticated machines. A data structure that can store all necessary information about the specifics of knitted samples must meet a huge number of unstable conditions.
We'll mention some of the most important: Information regarding the composition of the raw yarn;

Wind yarn into 3D space; Intreraction points yarn.
In addition, all information required for physical modeling must be available, or is exposed to the forces of knitting and must be stretched. The authors [8] developed a model that can play all kinds of knitted patterns in the manner described above. To understand this model and basic data structures, it is necessary first to take a closer look at some examples of knitted patterns. Figure 3 (a) and (b) shows a simple knitted samples conta ining only a knitted loop. Some more sampled samples are shownin figure 4. How to move 3D curve effect? Is it really necessary to keep the whole curve in explicit function or parametric representation? It would be very expensive, and happiness is easier solution to this problem is viewed from an abstract point of view only in terms of power, yarn can be seen or viewed as a polygonal line. In places where the yarn is subjceted to deformations or forces, given bending. In the context of knitted patterns, such pointsare called deformation bonding points (DVT), they are linked together and cross the interactive, ie, pushing each other.

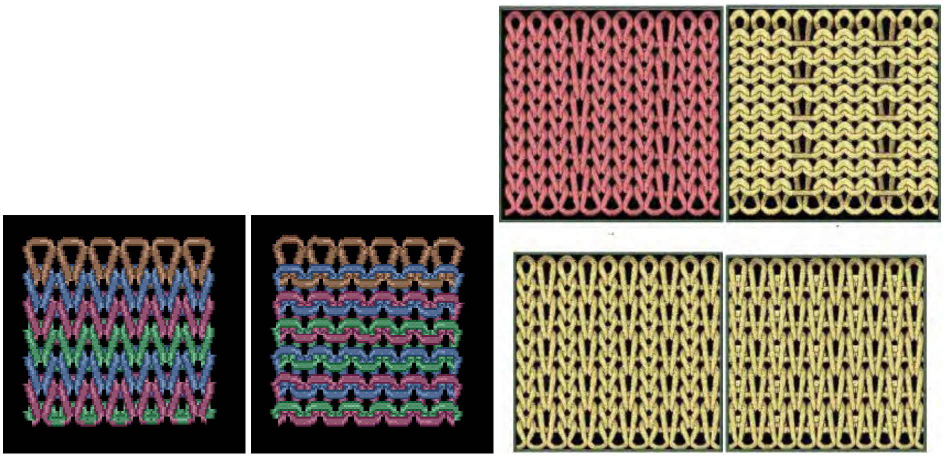


Figure 3. An example of knitted samples: (a) view of the front-right side and (b) rear-left side., The right-sampled image-derived fabrics (c) and (d)

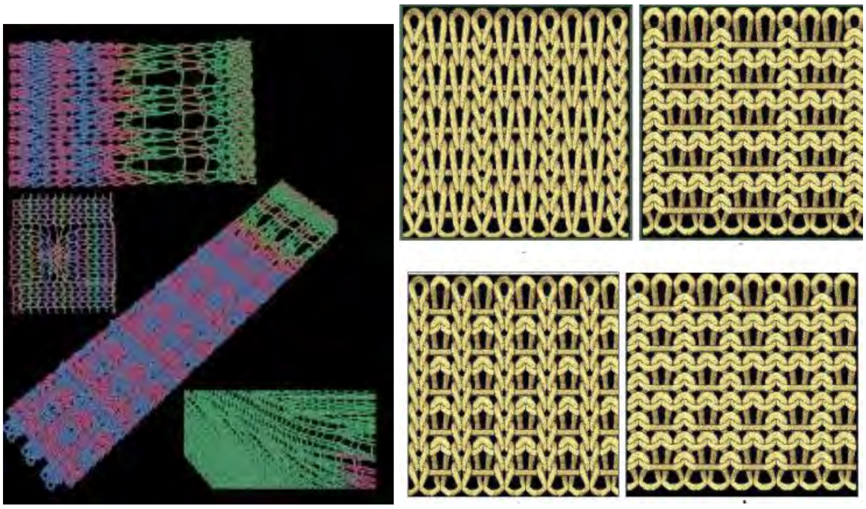


Figure 4. Typical specimens sampled knitwear

DVT DVT of the yarn is not exposed to any other forces except gravity. Gravity does not cause cross to hang and get lost in the framework of the braided pattern due to the following reasons:
Yarns are light-weighted; Distance between DVT is low.
As we all know from everyday experience, the yarn can be drawn from the fabric and hang loosely. Fortunately, this does not happen during the creation of the sample and the same should not be included in the simulation.

The model is simple, but close to reality. In reality knitwear mesh, cross slip is only observed between the two loops. So can not ignore the yarn friction yarn. So we can only consider the touch points in the binding loop. However, the lines we distribute free amount of yarn around the neighboring yarn loops. Yarn can be viewed as a chain of connected points (LPT). From an abstract way of seeing, the basic structure of the knitted sample is primarily independent of the actual location of individual points in space. There is a strong dependence on distant points when it comes to physical modeling to look at the forces within the knitted sample. But especially for mid level based on the structure of the curves cross depends on the binding of abstract points. Binder yarn from different points share the same coordinate space, but it is stored only once and shared by the different binding points.This is an override duplicate information on the structure of data. The total representation of knitwear patterns in mech structure is composed of connective points and edges formed between the

binder yarn counts. Figure 5, shows a braided pattern, that is the binding point, and the resulting mesh structure knitwear pattern. It is obvious that the yarn it self can draw by simply connecting the bonding points. More polygon segments need to be better approximated curve linking the points that can also be seen in figure 5, a. In addition, the true direction of yarn will not go through the bonding point, but the movement around them forming a loop. However, the polygonal method is used to simulate the physical interaction as a valid pass.
How samples should be kept in a flexible way of using linked list structure, we have implemented our list template class C and C list container. For example C provides a list of doubly linked list entity-list with a number of methods allowing quick access to the head and the last element of a list of lists as well as further necessary search methods.
This is a pretty small part of the knitwear pattern, just two loops, but it is enough to demonstrate the basic structure.

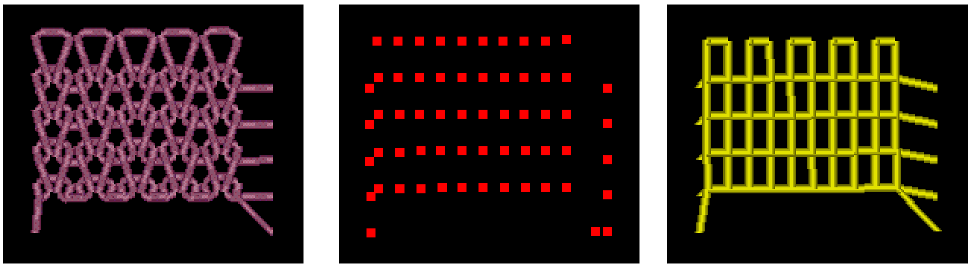
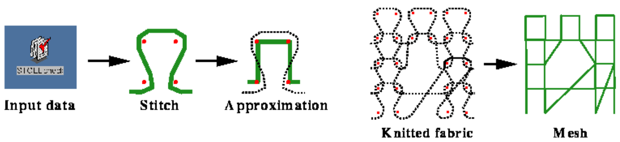


Figure 5 The data structure of knitted samples: (a) knitwearpattern, (b) the corresponding binding points, and (c) the corresponding mesh structure.



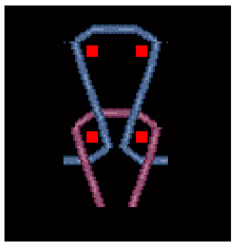


Figure 6. Approximation of the direction switch to the network Figure7. Knitted pattern which contains two knitted loop- half loop

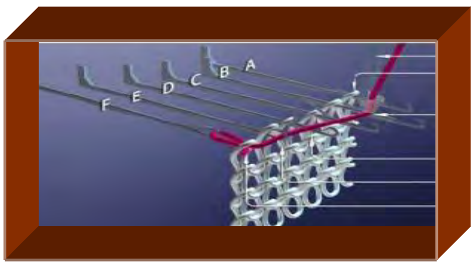


Figure 8. Generation-making loop

The two loops in this example are dull spots in the the connective structure that contains a list of two yarn (binder course points). Each of the directional bonding points is just a list of binding points. The first line of binding points to two, and one of the four directions of binding points. As mentioned earlier, each binding point is an abstract object of providing information and history from the creation of bonding points, for example: Is the point made binding on the front or back of the bar machines, whether up, down, right and left connective point. This information is necessary for the schematic view of yarn on the basis of the data structure. Each item has a connective point to their spatial coordinates. These coordinates are stored in the connec tive points of tables that are essentially sorted linked list of binding points standings. Each entry has the spatial coordinates of binding points. As noted earlier, there are bonding points are divided along the lines connec ting points of the same coordinates.

Thus, they point to the same table binding points entered in the table of binding points by passing unnecessary storage mentioned earlier. In this case, the bonding points table consists of four inputs. To speed up search opera tions, we keep a table of binding points for each class. Storage knitted sample is an approximation. Instead of saving for every wrong move in 3D, we store the edges of a network linking all the neighboring points that represent the simplified structure of knitted patterns.

Figure 7 shows the repetition of the inputs to the final structure of the network for a simple pattern. As mentioned earlier, we must be able to present sample is based on data structures. This requires some additi onal information that we have not mentioned so far. For example, each item gets its binding information in its creation, indicating that it was created on the front or rear bar machine, whether the loop on the left or right side, and soon. This allows us to show the direction of yarn in a quick and easy way.

4. Topology creation

Generation of the previously described data structure from the given data input format is very demanding format is very demanding process. Topology is the relationship between yarn that has to be generated. To better understand this process we will describe a machine for knitting and possible surgery. Yarns from the device to add and move out of the zone to the zone where the knitting is interwoven into the loop. Depending on the machine model and its construction machine can perform three operations basics: knitting, transfer loops from one barto another or from one needle to another bar and turn.

Knitting. In order to create knitting needles must be from their needle channels run up to create a loop, a snare, flotation, elongated loop and more. The process of creating the loop is described in detail in the book Professor Gligorijevic "Knitting technology with theoretical and experimental analysis" . Figure 8 is given a flat pattern for knitting machine son which to knit not only the most basic knitting, but alsoleft - mesh left and right-right cross-interlock knit that until recently could only get the interlock machines and circular left- Mesh left the flat left-left-machines. Each new row is inserted knitwear into the data structure. Consequently, each new order we create a new binding orientation points which are inserted in the inventory list-a list of targeted binding points.
Related 3D coordinates are stored in a table of binding points in it self further linked list of tables of binding points.
Note, we must first check whether the registered binding points in the table already exist in order to prevent exc ess.

This operation is fast even for large samples that contain a lot of points because the connective inventory list is keep sorted and sequenced. Adding a new loop order can be entered only overlap the binding point in the table that arise during the process of knitting a new row. So, we have only to compare the binding points entered in the table with the Y coordinate if they are greater or equal to the previous row. In the event that there is no equivalent of a new insertion.Binding point simply share that entered the binding point in the table with one or more other binding points of the targeted binding points.

Transfer. Elements of the transmission loop transmit the same needle in the opposite bar. Two situations are possible: The opposite is empty needle or needles, but contrary to contain some elements of the-loop traps. In the first case, we simply modify the coordinates entered in the table of binding points in connection with bonding spots to be found in the other needle bar. This essentially leads to the addition or deletion of remote needle entered the bar at the binding point coordinates from a table. In the second case, we really have to get across any point from the previous bonding pins at the other pins, but retained the same binding point or other yarns. As a result, we get a reduction of binding points table of the four entered the merger in two.

Turning bar. This operation does not affect the individual pins, but the entire rear bar. Turning bar can be executed to turn the device left or right for one or more of needle-step process. In any case, I is added or subtracted out of the binding set of all points entered in the table are affected by this operation.

Grid orientation of our approach introduces a stretching or distortion that can be seen in figure 7. This is mainly due to the association coordinates in each row. When we create a new line, loop more on inacative nee dles and comes to stretching. Stretch loops or, more precisely, the corresponding element in the mesh data structure does not affect the topology in any way.
In the finishing stage topology, the loop stretching equalized by appropriate physical forces. This is possible because we store the actual amount distributed passes over each loop. Therefore, stretching the loop (the upper two-point binding) results in a strong driving force of binding points that correspond to the following formula:

$$F_i xyz \sum_{k=0}^{ni} V_k xyz \,,$$

where i- index of network points;
Fi - force vector of i-th point;
ni - the number of neighbors of the i-point network;
Vk - k-vector of force and of the adjacent network point-and that is just super-ranking powers that occur.

Vk force vector can be determined by empirical data yarns (used in our system), or approximated to:

Vk (x y z)=Ck distance between k-default distanceα.

where Ck is again a material (yarn), always dependent on size, and an integer 1, 3, 5.

Indeed, the topology change may also affect the operation of the turning bar and a transmission loop. A very simple example of a sample containing two loops inside the front bar. Transfer one loop to another loop in the back bar, is detrimental to the other side of the second loop, and transfer back, there is a collision because of the crossing yarns that are in the same plane. This has to be protected during the turn and transfer operations. For these operations we have included a test segment exceeds the crash and was bending corresponding to a collision is resolved, or to introduce new binding points.

Conclusion

• For faster production and real appearance of virtual textiles require access by using computer graphics as part of the production;
• To gather the available knitting machines to produce different patterns designed to reduce production costs;
• Visualization and simulation of textile has found its place in the history of computer graphics;
• J. Weil [7] is one of the first to use a purely geometric approach catenary surfaces;
• The authors of [1] proposed a particle system approach with the power minimized process to simulate the draping of textile;
• Visualization of micro-textile structure within the computer graphics community is of vital importance for the textile industry;
• Simulation of twists as a system to fully simulate the entire process of knitting patterns and knitted products images can be generated without using the actual knitting machines;
• This is not only innovative steps for the industry, but also in an extremely demanding process that must include the physical mechanical properties of materials, and yarn;
• All the information needed for physical modeling must be a last resort because it is exposed to the forces of knitting and must be stretched;
• In terms of power, yarn can be seen or viewed as a polygonal line. In places where the yarn is subjected to deformations or forces, given bending, such points are called deformation bonding points (DVT), they are linked together and cross the interactive and pushing each other.

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FASHION DESIGN PLAN OF ACTION AND TENDENCIES IN FUTURE

Serena LANJI – KRSTIĆ

Abstract: *Climate change affects the development trends of the textile industry related to the creation of clothing and the development and application of new technologies in the textile industry as well as the emergence of new types of services. The ecological approach to cultivation of raw materials, the application of nanotechnology innovations, the principles of recycling of used textiles will significantly affect the trends of development of this industry.*

Key words: climate changes, smart textiles, organic cotton, new technologies in textile.

Introduction

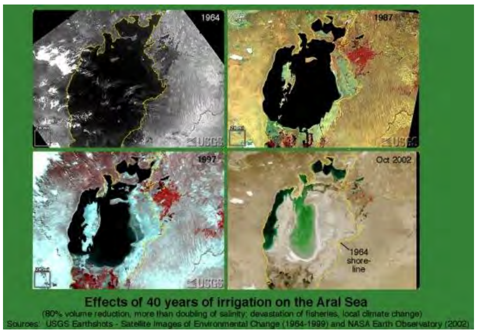
Climate change will condition the tendency of a different concept of seasonality. Nobody will focus on seasonal items. The orientation of fashion design is no longer seasonal, but with a clear and continual philosophy of layered and the universal way of clothing. Fashion designers will need to think comprehensively and to create design solutions that will be applicable in all seasons. Layered clothing will be more present. The tendency is that clothing can easily suit sudden changes of temperature. Of course the existence of winter jackets and swimsuits do not vanish, but usual clothing elements will easily be combined in any season.

The textile industry from the environmental point of view

The textile industry has contributed to the pollution of nature, because what has led to climate change is the human factor. In laundry detergents phosphate content is a serious problem for the environment. The content of phosphates in detergents ranges up to 30%, in liquid detergents phosphate content is lower while in the washing tablets its concentration is the highest. Due phosphate in waste water, stimulates the growth of green algae. They significantly influence the processes of eutrophication. It is recommended to use detergents that contain less than 5% phosphates as well as those who are completely free of phosphates and are 100% biodegradable. Reduction processes, chemical treatment of textiles in terms of maintenance is imperative. But, unfortunately, reducing the number of washing or chemical treatment is not a long term solution. Tendencies of choosing the way to reduce the chemical treatment of textiles, for now are: light disinfection, mechanical treatment, the use of "smart materials". As a result, fashion designers are increasingly seeking the implementation of durable materials that are less polluting, easier to maintain and require less maintenance attention.

Picture no. 1 Washing of laundry without chemicals ***[5]***

A natural disaster, pollution caused by textile industry waste water, which in the future must not happen, is an example of the Aral Sea. Once it was one to four largest lakes in the world. The process of destruction began during the 1940s when the policy of the then Soviet Union furthered the cultivation of cotton in the region. River Amu Darya in today‘s Uzbekistan and the Syr Darya in today‘s Kazakhstan have been turned into channels for irrigation of cotton fields. Water from the Aral Sea is diverted for irrigation purposes. Today it it is reduced to a quarter of its former size, increased salinity and polluted with pesticides and fertilizers. Nearly 20 million people has been depending on agriculture in the region. There is a high unemployment rate; respiratory diseases, cancer, and climatic conditions have changed completely. Summers are much warmer and very dry, winters are colder and longer, there are dust storms. A project has been initiated attempting to revitalize the former Aral Sea, a new dam has been built that will enable the inflow of 29 cubic kilometers of water into the little sea and help to restore the river delta and the former ecosystem . [10]



Picture no. 2 Disaster of Aral Sea caused by cotton growing ***[6]***

Because of disasters like the Aral Sea, in the future, we must rely on "responsible customers". The poor conditions in manufacturing in the eastern countries, cheap labor, employment of children, are very disturbing factors present in today's textile industry and customers are becoming more aware and become concerned about these facts.

Table 2. People Living on Less than

	$1 a Day	$2 a Day
Bangladesh	36.0%	82.8%
Cambodia	34.1%	77.7%
China	16.6%	46.7%
Costa Rica	20.1%	94.5%
Dominican Republic	20.0%	20.0%
El Salvador	31.1%	58.0%
Honduras	23.8%	44.4%
Indonesia	7.5%	52.4%
Nicaragua	45.1%	79.9%
Vietnam	17.7%	63.7%

Source: World Bank, *World Development Indicators*
Data for the most recent year available were used for each country. Currency conversions by PPP.

Picture no. 3 Child labor ***[7]*** *and people living on less than 1 and 2$ per day in countries the export of which is based mainly on textile industry*

Social awareness is evolving and customers are increasingly considering about what they buy and about what conditions the low-paid people who produce the goods live and work in. Retailers and leading fashion companies require their suppliers to apply the rules of good practice in labor standards, but there are difficulties in enforcing this mission in the supply chain, leading to concerns about working hours, safety and child labor exploitation. The changes will be guided by the decision of future customer. Reducing the adverse impact on environment and promoting social equality will happen, based on decisions that will be made by the buyer. Future customer behavior will be characterized by the following factors:

-buying of second hand clothes where it is possible
-buying less number of items but more long lasting items
-when deciding on buying, crucial point will be how much energy is spent during the production of article, how much toxic materials is emitted during the production, how good the workers are paid and how good the working conditions and the rights of workers are
-renting of clothes which will not be often worn
-extending the item life cycle through its repairs and alterations
-giving used items to resell, recycle, for a yarn and fiber
Education of customers is of vital importance in the future. Priority will be long lasting, in exchange for short-lived fashion.

Organic cotton

Due to the alarming social factors, the impact on the environment, there is a new type of cotton called organic cotton. Organic cotton is cotton that is grown without using synthetic fertilizers and pesticides. There is growing interest for organic cotton due to increasing awareness about the high soil pollution problems, harmful effects on workers in the manufacturing process, adverse effects during the use by end users, all under the influence of conventional pesticides and fertilizers in the production process. Until a few years ago, production of organic cotton was less than 1% of world cotton production, but that percentage increases every year. Currently organic cotton is more expensive than conventional, but this difference will decrease over time. Fashion design is very narrow, as regards the application of creativity, because of more expensive raw materials and the end-product of organic cotton, will be more expensive. The risk and experimentation are not allowed because of higher prices. In this case, the raw material is conditional for fashion design, which is reduced to the simplicity of style, to the classic design that is acceptable for most customers. Details are usually reduced to a minimum. So far, organic cotton is most applicable for underwear and baby clothes. [11]

Picture no.4 Organic cotton and products made of it **[2; 3; 1; 4]**

Leasing of textile products

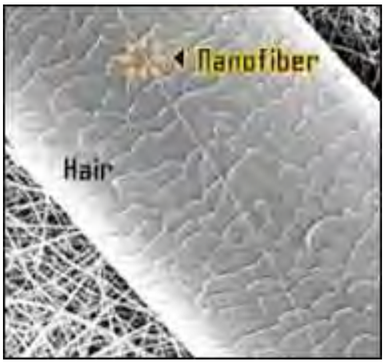
One of the future new trends is the leasing of textile products. If you decide to use leasing rather than buying, you can have a greater range of models that are available and less space it will take for the items and their storage at home. In Serbia, it has become possible to use leasing for the hotel and

restaurant linens including maintenance and transportation to the user of leasing. In this way, the lessee can make great savings in time and in funds required for maintenance.
Potential attractive factors to lease:
- Cost per product is reduced,
- Maintenance is simple – items are returned after use ,
- Textiles can be rented for various purposes, functions, special occasions or for different environment,
- Allows cheaper access to special garments which are used for a short time or follow rapid changes in fashion,
- Helps to follow a cultural or social changes as needed for different occasions, for example business clothing.

Almost everywhere in the world leasing a beautiful wedding dress has become usual. Lease sustainability requires an acceptable fashion design that will long be attractive. The cuts must be as universal as possible in order to be attractive to many people.

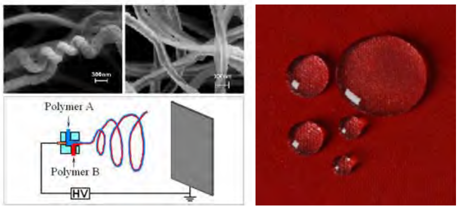
New technologies

Fashion design is increasingly turning to implementation of new technologies and it will be the major factor and role of clothing in the future. The role of clothing will no longer be just to cover and protects the body. The basic function of clothing has no longer been the primary one. In the future meeting special needs will become every day routine, for example mobile phone charging, basic information about the state of the organism, special feeling of comfort, especially fiber and built-in substances that deodorize the body, heated or cooled, and the like. Nanotechnology application will play the major role in future. Even today there are various products that contain nano-sized fibers with special properties and functions.



Picture no.5 Use of nanotechnology in textile **_[8]_**

In addition to new technology, "Green Era" is proposed in textiles, too. "Green Era” is here to encourage the possibility of recycling textiles and making new garments by use of old clothes as raw materials respectively. This new technology is also applicable in the manufacturing process in which robotics replace workers. One such example is the application of laser sewing machine. In 2005 the ―Prolas ―GmbH, “Pfaff” and ―TWI― manufacturers won the Techtextil award for innovation in the sewing machine mentioned. Application of new technologies in production has its primacy. One of the novelties is a production of seamless underwear; it is woven by pre-defined design, which must be extremely simple. In this case, a simple design compensates for outstanding comfort. The tendency is to create clothing that will require no or minimum maintenance manually, to avoid ironing, must be resistant to liquids and stains while at the same time must be comfortable and airtight.



Picture no. 6 Performances of nano-textile ***[8;9]***

Once, to be a fashion designer you had to be a great drawer but today that skill is not needed any more thanks to new technologies. For a fashion designer it is enough to have only basic knowledge of form, color matching and cut, because all other data can be obtained in the form of software on line or by qualified people. Stages of fashion design are increasingly being separated, specialized, for more and better satisfaction of customers‘ needs. IT technology has enabled high precision of cut, quick changes in the model, precision in size, great possibilities of combining aimed at encouraging creativity.

Conclusion

The impact of climate change, increasing awareness of costumers in the field of responsible and corporate business, high performance standards set, smart materials in the field of nanotechnology, the introduction of IT technology innovations in the production and creation in the textile industry will crucially orient and change the structure, development and the necessary knowledge in this industry. Emergence of new services, mitigating the impact of seasonality, the emergence of extraordinary materials that satisfy various needs of consumers at the same time as performing several functions, the increasing environmental orientation, prohibition of child labor, increasing costs of raw materials are to be expected. Textile industry will experience a "new revolution" in all its areas. This is a signal to all the businesses to join the new processes as soon as possible if they want to survive.

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THE INCORPORATION OF TRADITIONAL VALUES INCONTEMPORARY SERBIAN COSTUMES CLOTHING TRENDS

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Abstract: _Today fashion is very defined and has lost some of their spirit and perhaps elitism.In the future vision of fashion and creativity and the identity of modern man (therefore the identity of a civilization, society and individuals..) can be endanger a market economy that focuses only on price._
I do not suspect the impact of techniques and technologies may lead policy makers in a position to make them redundant or impose greater challenges ahead. Changes in the market are faster and require a huge effort of producers and designers to make the model at the right time were in the right place on the market. Innovation in traditional values are likely to be the dominant feature of this concept in the future. The way we buy fashion may in the future to impose a change in the production and consumption. This is one of the biggest challenges of fashion today. The loss of the aura does not imply that aesthetic experience disappears to change the essence and leaves nice. Industrial fashion does not allow individuals to view what they are already showing as members of a group cultural traditions and habits-that every nation has, individuals can identity self-extract-symbol -significators of traditional clothing, with the personal touch of style and sensibility of the individual (this can achieve individual and social significance) - creating the potential for preservation of identity.
Stylization of folk costumes in a recognizable contemporary modern-costume, option is to use not only in gaming folklore but also the development of specific details in the fashion industry-which will be the subject of project activities in this work. In the discussion of the concept of tradition will serve an example of the Serbian traditional costumes, incorporation of visual elements in contemporary costume, which can be applied to the study and application of costume traditions of other nations.

Key words: folk costumes, traditions, textiles. design, contemporary clothing.

1. Introduction

Contemporary clothing allows an individual to express their identity and to show how the individual relates to others - both in the group and outside. Giving his own style of character-we can still expressed only as an aesthetic phenomenon. The quality of people is expressed through the ability to appropriate the quality of an object - the symbolic qualities. Today, the national costume as a term generally related to the museum collection and processing of relevant professional ethnologists and cultural anthropologists, folklorists, but with fashion designers can contribute to better understanding of individual cultural values of an entity.
Through separate elements of clothing styles, patterns, color and form with the application can be implemented in a contemporary form of fashion creations.

2. Basic principles of clothing

Fashion is a complex process that takes place on many levels - it is a phenomenon that macro-social stimulating effect on people and on individual behavior. The clothing is a visual language in a trance-who we are, where we came from and what lifestyle we aspire to. The clothing is elevated language to convey the message that you want others to perceive you. Many psychological factors that help explain the motives of people that are in line with fashion trends are behaving: comfort, the pursuit of change, personal creativity, sex appeal fashion products are aesthetic objects and their origin is usually in the

field of art or history. The inspiration for the design often comes from art. The future is planned fashion industrial perhaps more than at any historical time. The influence of demographic environment, mans concern about the environment and the acceptance of new technologies are inevitable and could stifle their creators or more complex challenges imposed by the current.
The role of clothing in addition to primary-practical to heat the building is to protect identity. Symbols are crucial in creating identity. The competitive ethos of the fashion industry revolves around the phenomenon of season - fashion cycle. Factors influencing the difference in clothing other than geography and demographics are cultural social personal and psychological.

Fashion is a phenomenon that should occupy a central place in our attempt to understand themselves in their own historical situation and, as such an influential phenomenon must be taken seriously as a subject of research. Fostering identity through traditional value-clothing items on a person acquires the status of.

3. Insight into the history of Serbian folk costumes

3.1 The study of traditional cultural heritage of folk costumes and Serbia- recognizable elements in clothing

The study of the Serbian traditional costumes in time and space through various media of communication-through folk art, textiles, costume-carpets, multimedia as well as a precise literary historical data from many forms and styles-see nature Serbian costumes. The impressive collection of national costumes show the richness, diversity and nuanced to name a wide variety of popular clothing that features our traditional culture.
We can conclude that-cultural traditions and habits-that every nation has, the individual can be identity self-extract-symbol or insignia significators traditional clothes, with a personal touch to the individual taste and style (this can be achieved by individual and social significance) - creating the potential for conservation identity.

What would be typical and full of popular culture including national costume - is that it is only in fragments which are mixed under the influence of traffic, mass migration and continuous mixing with other civilizations, as well as under the influence of the media and the increasing globalization of culture modern cosmopolitan lifestyle.

The dominant aspect of a culture people tend to express itself through the design of various garments. Observes the influence of tradition which is reflected through the clothes and linked to identity. Systematization costume is made a several combination (see Figure 1 and Figure 2).

Figure 1. Women civil costume oriental type, Serbian, nineteenth century image; Srpska civil costume mid-nineteenth century

Do the right answer, which are typical features of Serbian traditional costumes that could have come a long and systematic research, because every part of Serbia well known for their typical costumes from the end-influenced by the particular historical and economic conditions and time. The museum collection of folk costumes include a period of two hundred years, the oldest article of clothing dating from the late eighteenth century, and the newer costumes from the seventies. Costumes are divided on the collection of rural and urban collection of costumes.

Serbian costume occupies a prominent place in the culture and traditions of the Serbian people. Its role in history is very important as a symbol of ethnic identity. It is emphasized by the visual and aesthetic values with all its varied forms and decorations. Each region was inhabited by the Serbs through history - had its own special costume.

Serbian costume is characterized by the influence of the culture of the people who were passing through our country to be with their traditional values drowned in the general features of the costumes of the people connected to spiritual experience. The process of liberation from the oriental influence and acceptance of European mode was a gradual, even a little before the middle of the nineteenth century in the liberated part of Serbia (Serbian Principality) there was a symbiosis of elements Balkan and European fashion clothing costume in the so-called Serbian dress, which became typical pattern of dressing women in the Serbian cities.

People want to be consuming specific objects with a certain symbolic value. Seek their identity in what we currently surrounds the symbolic values that are available to us. And it should accept the symbols to express something about who we are. Symbols resulting from our tradition of folklore - are an important part of the whole - the key to preservation of identity- skills, knowledge and imagination- looked at in contemporary formats.
This ornament is the original spiritual wealth as a possible basis or inspiration for new modern trends. Following the history of clothing in Serbia-horizontally through time and events and vertically through various social activities and creative achievements, we can clearly confirm the symbolic

importance of Pirot rug patterns for visual identification of the local population and the Serbian people, because it carries a powerful symbolic patterns Pirot rug transcends local, regional and national Thus Pirot rug pattern confirms its strong potential as a symbolic symbols survive only real time and materials in which they occur (see Figure 3) symbols should represent meaningful and to contribute something to say about the one who wears them.


Figure 2. Collection: & quot; WOMEN-SRPKINJA & quot;, incorporation of visual elements in contemporary ethnic costumes

3.2 Summarizing and concretize basic theories and research findings of Serbian tradicional folk costumes

New research by contemporary methodology, can give a picture of decline typical features costumes Serbia-that can be said of the use and replaced by modern dressing and can be seen only on special occasions and museum exhibits. Many changes over the centuries have influenced the shaping of the bones of Serbian tradition: a cosmopolitan and modern course of globalization, the industrial revolution - the first affected properties and characteristics of other countries and the dictates of fashion.
It is assumed that tradition as the basis of identity significantly depress the construction of stable visual identity based on tradition. Fact-finding is carried out sensory perception and experimental practice through physical materialization.
The merging of traditional and modern styles creates new possibilities for experimenting with new styles.

4. Creation of new finished model

4.1 Incorporating visual elements of folk costumes of Serbia and the European fashion

Today fashion is subject to change and development and data on traditional Serbian costumes have the cognitive value to be checked through the new knowledge-bones aesthetic design study of Logic and temporaliteta dress costumes and development of our region: the tradition of broadcasting and

temporaliteta, its status as a commodity and the Arts but also as an ideal for the construction of the self.
Successful creation of new collections of clothes and models for a theory has a creative and innovation expert profile-designers. It is necessary for the success of this process of creation is good
cooperation between designers and constructors hood, then select the type of materials, auxiliary materials and opreljenosti machine park.
When creating a clothing should take into account the following principles:
Purpose garment that will be produced (based on the determined identity and product design)

- create a garment that must match the destination (the material to suit its purpose, which is a product designed for the target age-group)
- type materials that will be used for the clothing use
- case cost of the product
- the conditions and resources available for work.

When creating a new final model, during the creative process, it is necessary to consider the following principles: collection of ideas and information, assessment of feasibility and acceptability of ideas, idea selection, acceptance of ideas, new product development and technical and technological preparation.
Creation is defined by the designers and constructors in consultation tailor, and because errors are costly, this is a long process that requires hard work.
Since it is a pret a porter collection first analyze the target-group market, the assessment of trends in quality fashion fabrics. Influence through trade fairs, the Internet magazine preferably consults and home fashion fabrics and products that follow fashion forecast. Thus we meet with a catalog of patterns fabric patterns and color weaving. A key direction in the domain of choice is a mixture of fabrics and natural fibers stretch the effects of fashion and comfort in the new forms and applications-as the main spheres of interest.

5. New product development

The production process is characterized by technical clothing and technological factors such as the type of technical equipment and means of work, the structure of technological processes and so on. For the process of sewing in addition to unrivaled selection methods, technology plan, the funds for one of the essential factors of the process of making a proper planning, setting up and coordinating the operating parameters that will ensure the continuity of the process of making clothes.
The objective analysis of the product is to provide the best way of organizing work, that is the best method and adequate resources to work for the selected method. Time breaks perceived complexity of products and core-provides the best quality design and optimization of development time.
It is necessary to have as many ideas. The selection of ideas that provide a way to select the best ideas (if less damage is a bad idea to accept than reject the goods). During this process it is important to identify key values constantly finding new creative solutions that present more carefully to build and nurture. Given the fact that the achieved level of culture as a folk costume dress given constant must be changed and developed, and following the course of industrial development. fashion.
When a sample of the finished model follows the adoption of the model in which participate the creator, designer, sewing. If the product conforms to the required conditions and sketch ideas and ultimately the creators, the model is adopted and moves to the next operation.
Market-you for a moment that should predict the customers wants and needs - the moment when the product appears on the market to-moment when it adopted the idea of developing a new product market - the length of the product development process.
Suppose that ti-adopted the idea of developing a new product and that it is based on scientific knowledge amount that is less than the total amount of scientific and technological knowledge that could potentially be used in the formation of ideas and in its implementation. Point - the item design

variables with different types of project, but generally speaking generally applicable criteria are as follows: - the ability research creativity and application of knowledge.
Independence of thought and action, - the ability to analyze and communication - creative and intellectual curiosity - the ability to take risk - skills-originality of imagination (emotionality, energy and intellect) - the ability of synthesis of their ideas with their own chosen fashion way - direction, (and interpretation) - professional understanding of industry rules and methods - the ability to work individually as well as individuals and as a team member - the practice and presentation skills – management - only evolution - the full meaning and creativity, their creative and intellectual potential and resolution of their interests and design aspirations with parameters of courage and experience.

6. Process implementation ideas

6.1 The process requires the realization of the idea:

Ability of a methodological approach that is research-point grading system and programming-technological culture that is suitable. Theoretical knowledge and practical experience in the field of technological knowledge of a discipline-economic conditions-the designer must be an independent organ of integration that is to develop awareness sense and ability to understand that clothing unity and integrity of the initiated-designer has the ability to communicate their solutions to a verbal and visual reports via illustrations and sketches.

Good planning and scheduling the timing of the time products are sold in the chain is essential - a traditional time of sale of natural seasonal cycle. The production line is planned so that production costs are as low as possible to minimize the cost of risk. The essence of risk-taking are the ability to control risks (such as procurement of materials and savings on great...).

7. Design collections >Serbian-women<

7.1 The tradition and openness to new values -in the correlation

All forms of beauty, like any phenomenon, contain something eternal and ephemeral, and something absolutely special. Absolute and eternal beauty does not exist it is only an abstraction. A special element in the beauty comes from passion and therefore we have a special passion we have a special beauty.
Unification of tradition and modern creates new opportunities for experimentation is the basis of style, tradition-base visual identity, and returning the same - the modern trends, we can affect the resolution of problems and create and maintain the visual identity-established personality.
Collection >Serb woman< exudes style-fusing-traditional and cosmopolitan spirit of modern women. " Ethno-Chic " is a new style of clothing that exudes a collection, a mix of modernity and the past, retro-futuristic, the personification of tradition, modernity and femininity-spirit and pride of the Serbian women who wear through the ages, (a feeling of pride is not enough but it is necessary to preserve indentity) new style of dress that celebrates the Serbian ultra-feminine woman today from head to toe.
Spirituality and honesty costume is based on a clear conception of what it means when a man was acquitted of the human limitation-that only the human hand and a keen eye for detail designers can inspire the construction. When designing the collection I kept my style, concept art with a touch of tradition and contemporary expression of market demands. The proposed solutions represent a new direction-modern moment that leads to timeless themes of classical costume. Which lies in the

interpretation of classics and well thought out effort to revive the tradition and make it modern without over-emphasizing one or the other.
Clear silhouette and complexity of style, feminine styles with pronounced shoulders hips, waist prominent, pronounced contours of the body, fine details in the finish, and hand work - through tradition. The choice of color and the absence of over crowding detail their relationship with the radical concept of full costume in the form of freedom built on the bones (deep knowledge of tradition). The collection is made of light weight summer material satin silk linen, cotton, pleasant textures, lace, ruffle and flounce.

Figure 3. Drawings and models of the finished product

8. Summary and analysis of research results

8.1 Fashion reviews

Interpretation of the results and draw conclusions about the implementation of set-ideas was carried out based on methods (market) and the opinions of fashion critics survey of visitors and customers, as well as examination by direct sensory perception. Based on this interpretation of the results was carried out research and draw conclusions, and scientific assumptions.

Analyzed a new approach to designing clothes, where he applied modern Serbian-European style of dress, with the retained elements of tradition-identity as a basis for further upgrades, and without which the latter element was modern and impersonal.
Experimental research conducted on the construction of the visual identity of clothing - which takes place on the basis of interpretation: who we are, and serious evaluation of what needs to be, according to the results of the market: advantages and validity of these hypotheses, a new approach to dressing in the technological process of making clothes.

Market research performed after the Review highlighted the growing consumer need and desire for recognition; of the original - and traditional in our country and abroad. In this sense approach to the analysis of the data - the research results. The essence of this analysis is the decomposition of the data in the form of statements of fact: an evaluation of the data, sorts the contents of the collected data, the assessment in relation to the theoretical part, and estimates of experts in this field of fashion critics, the creators).


Kolekcija Laguna, prva modna revija pisa organizovana u Srbiji, dobila je nagrac u kategoriji Najbolji vizuelni identitet modne revije. Statuetu je u ime Lagu primio PR Delfi knjižara i idejni tvorac re vije Ivan Golušin, a prisutne su pozdravi književnica Natalija Dević i njene „junaki Milica Milša, Jelena Petković i Bojana Kesić čiji je nastup na reviji bio najzapažen Na reviji *Kolekcije Laguna*, održanoj velikoj sali SKC-a 22. aprila, uoči Sv skog dana knjige, poznate lične su oživele junake šesnaest najčitanijih knjiga dom ćih autora
U ulozi glavnih junaka pojavile su se Suzana Mančić Jelena Tomašević Aleksandra Jeftan vić, Mirka Vasilje- vić, Anabela, Srđ Karanović i mnog drugi, a najveći ap uz pobrale su Milic Milša, Jelena Petkov Bojana Kesić i Marina Kotev- ski, koje su se, u maniru *Seks i grada*, pojavile u ulogama junakinja hit romana Natalije Dević *Igra zavođenja plus Upu stvo za upotrebu muškaraca*. U glamuroznim kreacijama Suza Perić i cipelama koje je specijal za njih dizajnirao Krisbo, junaki nje i autorka ispraćene su burni aplauzom.

Figure 4. Press statement

The unit of analysis is the revelation which is taken to mean a whole clearly bounded by the media in the form of newspaper genres. Basis for preparation of the assessment and description of each publication on the following criteria: date, media, media types, authorship.
The polling was conducted market research to assess Fashion show presentation and performance reviews. With the introduction of the fair in Düsseldorf as well as Fashion show appearance on Belgrade Fashion Week, according to marketing research (Tiger Trade's) printed media (media press clipping) and experts in the field: collection was met with the acceptance of chain stores from around the world.
This assumption is confirmed the main hypothesis: a close and understandable to our climate, the recognition of traditional values and the applicability and capacity in practice - developing his own style and taste, using symbols as well as designer clothing handmade (non-industrial mass). On the basis of quantitative data quality analysis Fashion-selection and the analysis included 481 reports about a fashion event (according to research).
Doo clippings for analysis of the media, Belgrade. based on continuous coverage during the months: March, April, May and June 2010 god. The dominant form of the analyzed publications in print media and internet portals are photo reportage and photo news, articles and illustrations accompanied by the publication show. All analyzed a fashion event Fashion are reported neutrally valued publication or publication of negative evaluation.

11. Conclusion

Practical importance - the development of use-the justification given clothing, reflected in contributions to science and society: the determined results of new forms of access points to the contribution of dressing application and development of bone forming today, and contributes to the societal level-such as access to the clothing and fashion as a social phenomenon may contribute to the preservation of (visual) identity of the nation.

Adaptation to new processes, aesthetic design and implementation of analytical and experimental procedure of the field research (market assessment)-this example the application of traditional circuit-modern costume can be made using the traditional costumes of each nation-nationality with their insignia (Hungary, Macedonia, China, India ...).

Traditional Serbian costume evolved-as a way of dressing a new philosophy - that continues every day to communicate with us, in primary forms or stylish, updated and woven into new content and features occupying the territory of the spirit and beauty that transcends national boundarie.

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MONTENEGRO'S FASHION SCENE

Anastazija MIRANOVIĆ

Introduction

While recently staying in Montenegro, The European Commission President Mr Barroso has stated that he believes in the creative potential of this country people, which is the greatest guarantee that all requirements are going to be fulfilled and all obstacles overcome on the road to the European Union. Actually, we do not know whether Mr Barroso has stated that only in a diplomatic-courtesy manner, but after all it‘s not so important. What is much more important is the continuously expressed and demonstrated creative potential of our people, whether they work in Montenegro or abroad. The people of Montenegro always tend to reach the greatest achievements in all creativity areas. That creative ego is the expression of their history and tradition, strength of mind and, above all, the spirit who is not satisfied with an average achievement, but tends to keep up with the best. The modern Montenegrin fashion designers, drawing inspiration from its own traditions, all achieved noticeable results, so that, after a period of stagnation, we can speak about the increasing revival of the fashion scene.

Tradition as a base of fashion design

Montenegro has a lot of things that could "enter" into the European Union. Above all, it is its multi-ethnicity and multiculturalism as the most beautiful combination of influences that come from the Central Europe, the Orient and of course the old Mediterranean. The richness and diversity of folklore, different climatic and geographical zones and inter-connection between all of that in a relatively small space are the factors that were a prerequisite for the creation of the ethnic art, many arts and handcrafts. However, the excellent achievements have been realized in terms of costumes, especially the female Montenegrin folk costume, which still serves as an inspiration to the designers. In the seventies of the last century, the first runner-up for Miss World from former Yugoslavia was Nikica Marinovic from Dubrovnik. That was the competition held in London. A curiosity was that she was dressed in a Montenegrin folk costume during the solemn presentation of the participating countries.

The Montenegrin folk costume, it seems, largely reflects the spirit of the people, and has long been an inexhaustible source of inspiration for the designers. The folk costume expresses the dignity, nobility, sense of beauty and belonging to the Montenegrin people. It is, no doubt, expression of national pride - that strong fluid which connects the people with their own country. In the old Montenegro, a possession of that folk costume, which was very expensive, was a matter of the utmost prestige. The people in everyday speech called it "golden suit, or golden goods".

In accordance with all this, a significant number of fashion creators benefit Montenegrin folk costume, folklore and the other ethnic elements for their creations. That is particularly evident in the women's formal dresses, usually made from the best materials, modernly designed, with a subtle sense of form, proportion and ornament. Also, there are the filigree embroidery and decorative details that indicate the designer's talent, but also the skill and the "golden hands" of their collaborators and artistic artisans. Generally speaking, the traditional clothing, such as women's dress or blouse with creative ideas of contemporary designers has a modern design shape, in accordance with the spirit of the time and the important, solemn and beautiful moments in the life of a woman of the twenty-first century. These models are characterized by its elegance, sophistication and extravagance, designed for a modern, self-conscious and decisive woman, who knows what she wants, what she can and how to achieve her own goals. Some collections are inspired by the era of the Petrovic dynasty and by the clothing worn at the Royal court of Cetinje. The clothing models are made of the velvet, brocade, silk, silk and golden threads, etc. The handiwork is represented by the knitted and crocheted models, as well as the modern hand-painted details on velvet. By an imaginative combination of velvet and brocade with the golden and silver thread, the stylish and elegant dresses are designed for the beautiful Montenegrin women who nobly keep their traditions, but they look and dress fashionably.

The newest events on the fashion scene

About a revival of the fashion scene in Montenegro could be spoken only after 2000th year. Then, in Bar was held the first Fashion Connection organized by the fashion agency - Mondain Models . Confidently, at that fashion event, besides the foreign (Svetlana Horvat and Vladanka Celic – from Serbia) have appeared the local fashion "power", "Bella Vista" from Podgorica and Anastazija Miranovic from Bar. Since then, three times a year in April, August and November, the Fashion Connection is being held and organized by the Mondain Models agency. In parallel with this agency, there is another - Cosmopolitan, which also has organized several times a year fashion event called Fashion-Royal. At these events presents the fashion author's, creator's work and fashion brands represented in Montenegro. Of course, quality varies from event to event. It is not uncommon for designers, dissatisfied with the event organizations, to take part in the organizational activities of the fashion event, which is far more difficult, but a better solution. Absence of a coherent and adequate Models Association of Montenegro or agency that would deal with organized labor and education of models, for which there is a great potential in Montenegro, makes more difficult the achievement and realization of the professional work at all levels of the Montenegrin fashion scene. In recent months the progress in this direction could be noticed. Some former models established their own agencies that deal with the modeling.

In order that scene could exist, it should exist a system. However, the basic criteria for its professional existence are not established yet. It is only at the beginning. There are two agencies, which in the absence of adequate competition, dictate the dynamics and quality of the fashion events, with the exception of sporadic occurrences of the independent authors fashion events. There are no professional associations, neither the association of creators and designers, nor the models association. Also, there are no the fashion critics, but the creators themselves are engaged in certain media to comment on the fashion scene. Since recently (three years), there are the annual awards for the best designer, the best collection, the best fashion event, the best hair stylist, the best makeup artist, the best model, etc., in organization of the Cosmopolitan Agency. The members of the jury are often the awards winners and it shows about its credibility and relevance even to a laic. So, no matter how you would analyze the fashion scene of Montenegro - vertically or horizontally, "cracks" exist because it isn‘t based on a professional foundation from the very beginning.

However, in order that this paper would not become entirely negative still there is a hope. A need to write about the fashion scene, which is as it is, shows that something happens with the local fashion scene, what gives some hope, that by the natural progression, if not otherwise, it would begin to crystallize and define the specific phenomena and the growth of competition / competitiveness at all levels that would make its quality.

We can now talk of the existence of three generations of the authors (creators, designers) - an older, middle and younger generation. In particular, the appearance of a significant number of young designers in 2010/2011th, that some of them finished the textile prestigious design schools abroad - Belgrade, Milan and so on, tells us that things are moving in the right direction.

Also, very important thing, if not decisive, a maker of the initiation of fashion events in Montenegro, although not directly, is the existence and lasting for a 13 years of the International Fashion Festival in Kotor, organized by the modeling agency Fabrica from Belgrade. This fashion event is still going on at the end of July in Kotor in front of The Cathedral of Saint Tryphon and over years represents the most prestigious and the highest quality fashion festival, not only in Montenegro, but even wider. The Fashion Festival in Kotor reached an international reputation, for what is undoubtedly meritorious famous Italian designer Renato Balestra, who made the remarkable contribution to this event. The

arrival of foreign, mainly Italian medias that follow fashion, to this event has affirmed it international character as well as the famous fashion houses that participated in previous festivals in Kotor - we would mention just some of them - Dior, Rocco Baroko, Ungaro, Murat and the others.
One may say that the long-term existence of this kind of festival has been a core point, but still isolated and separate from the other Montenegrin fashion stories, especially because of the International Fashion Festival in Kotor, as the name says, it emphasizes concentrating primarily on the international fashion scene, not domestic. However, on all these events domestic authors appear, for example, several times the Montenegrin creator Marina Banovic has appeared. We hope that the agency Fabrika, in organizational terms, will be more flexible for local authors, because in the best interest of all participants is strengthening the domestic power and the potential development in this regard. There is certainly the significant support of the Town Kotor and its administration, which participates in the event financing.

Conclusion

The well known events in the Balkans - the collapse of former Yugoslavia, in particular has hit the complete domestic textile and clothing industry, and almost completely paralyzed the fashion scene. The same scenario happened in Montenegro. But fortunately, the neighborhood of Italy and its fashion scene, gave an insight into contemporary fashion events, more than it was possible in the other regions. In the past ten years, a fashion scene revives. The talented, young designers and fashion events became more frequent. Many models were created based on the motifs of folk costumes, folklore and the other ethnic elements. Also, designs are characterized by the emphasized aesthetics, elegance and grace. All above mentioned, gives a brief overview of the fashion scene situation in Montenegro, in order to point out that there is a "material" and the potential for its valid development. Until now, there is neither its proper channeling and management, nor the development strategies.

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DO YOU COMPETE?

Bojana KRSMANOVIC

Introduction

Although a number of apparel firms from Serbia are competing successfully in the global market, many firms from the sector still believe that good products will sell itself regardless of their sales approach. They do not invest enough into the sales process; they are often lacking a clear marketing and sales strategy and are lacking to invest into new knowledge and skills of their employees.
This article provides you with inputs on two out of many important aspects that will help you stay competitive in the apparel sector – *visual retail merchandising* and *closing of the skills gap of your employees*. I believe it will inspire you to rethink about your own business strategy.

Visual retail merchandising – an important aspect for apparel retailers

If you have ever stood outside a shop admiring the artistry of the window display, or being distracted by a sale item while passing through a department store, or paused to take in information from a store guide, then you have been sidetracked by visual merchandising.

If you purchased as a result of stopping in your progress along the pavement or through the store, then you have succumbed to its supremacy. [13]

What is Visual retail merchandising **?**

It is the display of products which makes them appealing, attractive, accessible, engaging, and enticing to shoppers in a retail store. Visual merchandising utilizes displays, color, lighting, smells, sounds, digital technology and interactive elements to catch customers' attention and persuade them to make purchases. Visual merchandising helps convey the image of the brand and reflects the personality of the target markets that the retail store wants to attract.[14]
Visual merchandising is creating visual displays and arranging merchandise assortments within a store to improve the layout and presentation and to increase traffic and sales. It is the art of displaying merchandise in a manner that is appealing to the eyes of the customer.[15]

Why is Visual retail merchandising **important?**

"Shopper found dead in local store; cause of death – boredom"
- Stanley Marcus, Chairman-Emeritus, Neiman Marcus –

In considering the importance of visual merchandising on retail businesses the **single and most important reason is to engage and inspire shoppers**, to encourage them to buy more of the products

13 (Tony Morgan, Visual Merchandising)
14 (By Barbara Farfan, About.com Guide)
15 (Wikipedia.com)

you want them to, increasing your sales, margin and return on space – after all, you are running a business! That engagement process of course starts even before they have set foot in your store…

The exterior of your premises should be instantly appealing with clear, consistent branding applied to your signage. The entrance reflects the personality of your store and must entice the passer by to enter.

Creative and inventive window display…
is an excellent opportunity to bring more custom to your store. Your customers have only a few seconds to view and be attracted by your displays so keep them simple, bold and uncluttered. Cluttered, stale, or badly organized displays are liable to do the exact opposite and turn those potential customers away.

Ensure any special offers are clearly readable and not too big / small, bearing in mind the demographic of your target audience. If your window space is limited try using bright colors and lighting to draw the eye, maybe even motion. Change the displays frequently based on how often your customers visit the store. A fantastic but dated display could do more harm than good.

3 key areas to be aware of in your visual merchandising approach[16]:

1. *Avoid overwhelming / confusing the customer*

It is very easy to be attracted to new product opportunities and be constantly adding to the range / choice you offer. The issue is that what can happen is that the sales you are achieving are simply shared between more SKUs, making your business more complex and putting you at risk of carrying excess stock.

Range proliferation can strangle a business from a cash flow perspective, so getting the balance right is critical. Too little choice will put customers off, too much will confuse them.

Ideally you should analyze your retail space to understand what the maximum number of products you can present at any given time is. Then be ruthless. Every product is costing you money both to stock and also it occupies your high cost retail real estate – if it hasn‘t earned the right to be there, and it isn‘t a product typically connected to the purchase of a high margin line (therefore earning it‘s right by virtue of a related sale) then get rid of it – make way for a product that will earn you some money! Remember – focus on your return on space…

It‘s important your store is inviting and uncluttered. There‘s nothing worse than walking into a messy store and feeling totally lost and overwhelmed with the amount of stuff in your line of sight! It will make potential customers walk out, trust me, I‘ve done this myself.

Try to reference the layout by color within a product category to ease the shopper‘s identification of products they need or matching products. Take a leaf out of the online/e-commerce store design and display products with other products that they work well/look good with.

[16] (From the article written by Clare Rayner, ―The Retail Champion" and Kelly Molson, Founder and Managing Director of Rubber Cheese.)

2. *Make sure your ideal customers can feel at ease, to linger longer:*

Once you've got the potential customer in the store and have presented a beautiful, profitable range, you need to retain them for as long as possible – typically the longer they stay, the more they will spend…

If you make your customers feel at ease, they will linger longer. Music, lighting, colours etc can all have a huge effect on the stress levels of the shopper. How many times have you left a store because it was too bright or the music too loud?

Try appealing to all 5 senses sympathetically and be aware that the demographic of your target market will feel different in different atmospheres.

For example:

- **Sight**: Use lighting to change the mood of the store and to highlight products on offer.
- **Hearing**: Music in stores has a huge effect on our stress levels. You may assume a toy store would play children's songs or nursery rhymes? In fact the parents will feel a lot less stressed if the music is something softer, possibly classical.
- **Touch**: Allow clients to handle or test the products. This encourages conversation and rapport with your clients.
- **Smell**: Certain fragrances are calming such as Vanilla or Lavender or Citrus to uplift. Try using seasonal fragrances to evoke a sense of magic, cinnamon around Christmas time.
- **Taste**: Not always possible but if you can offer free tasters they are a sure fire way of selling more product. Last Christmas Eve I queued up for our turkey in the local farm shop. They had a plateful of sausages for us to try while we waited. Guess what else I bought before I left?

3. *Make sure customers can find products in store, and that they have the information they need to buy with confidence*

Your in store signage must be clear and concise. Too many signs will act like a hundred shouting voices, not enough and your customer won't know where to go.

Keep it simple and in line with your existing store branding. Use fonts and colours that are easily readable from a distance, avoid script or fussy, ornate styles.

Products need to be presented in a way that the customer can understand exactly what they do and how they help them. This is where good Point of Sale and freestanding merchandise displays really come in to play.

Point of sale (POS) or checkout is the location where a transaction occurs. Use this area to display new products, special offers or ―nobrainer" purchases, for example lip balms, pens, small handbag sized items.

You can be really creative with these displays. Keep them simple and bold. There are hundreds of off the shelf display products you can purchase usually in plastic or cardboard.

Be creative with the products themselves. For example, if you were selling say paper napkins, create origami animals from them – instantly more appealing.

If you have own brand products invest in working with a design agency that specializes in packaging design so that your product appeals exactly to your target customer. The right packaging design can make or break a product, especially if it‘s new to the market or has huge competition. A good brand and packaging designer will draw out the brand story and encapsulate that into the design, giving your product maximum shelf appeal.

So, what can you do to make a difference, for little investment and maximum impact?
There are a number of things you can do to make significant impact for little cost:

1. Make the interior (and exterior) of your store as inviting as you can…
- A tidy store is a must. De-clutter! Remove anything that isn‘t adding to your brand.

- Keep the decor, floors and windows clean. Ensure the flooring is suitable for you target customers. Try out different fragrances to keep the store smelling fresh.

- Make the most of the space you have but allow plenty of room for movement, remember your customers may have large trolleys or buggies with them. Don‘t make them feel claustrophobic – sometimes there is commercial benefit to having empty space!

- Ensure you have good lighting that helps the customers navigate the store and highlights key promotions. Use lighting to draw them into the store, don‘t have any dark corners!

- Use music to enhance the atmosphere – unless you are running a library a little background noise makes customers more comfortable to have conversations as they feel they are less easily overheard. Ensure your choice of music is relevant to your target customer AND make sure you‘re not in breach of any public performance rights!

2. Present your products clearly, full shelves, clearly and correctly labeled.
- Products must be clearly and correctly labeled, with more product information available as required. Pricing and offers must be understandable

- Shelves should be well stocked but not over full and cramped as this will not only look bad but detract from the product itself. The last thing you need is for a customer to attempt to take a product off the shelf and cause an avalanche – they will be embarrassed and your product may well get damaged!

- Allow the customer more information about a product but not too much that the offer and pricing is misunderstood.

- Packaging should be not only informative but ideally part of the overall merchandising appeal

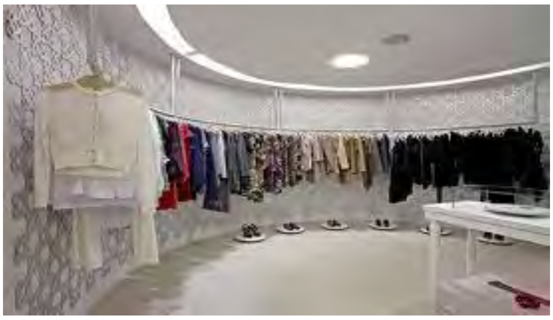
- Some products can be purchased pre-merchandised within an attractive free standing display unit – but beware – too many of these can over crowd the store!

3. Analyze everything… know the commercial basis for every decision you make – because after all, you are running a business…

- Know the cash margins every product contributes, the volumes you sell and determine what value each product has in your range. Don't forget to consider the value-add of certain products e.g. tend to be purchased with other key items…

- Define the maximum SKU count your store(s) can accommodate and stick to that. If you want to list a new item ask yourself what it replaces… consider the impact on your profitability as well as your aesthetics and product presentation when making a range

- Trial changes to find out what impact they have – try different layouts, new products and different promotions. Ask customers what they think and also measure the sales and margin impact. You'll only know if a change improves things if you try it – and keep an eye on your KPIs (_Key Performance Indicators)_!



Summing up – Why you need to really focus on your visual merchandising…
Visual merchandising can make a good retail outlet great. Investing a little time and effort in giving your store a facelift can make a world of difference. Engaging some professional services to help with your branding, your window displays or your in store signage can make you really stand out from the crowd. Ruthlessly looking at your products profitability in the context of what presence on the display space you give them could give you competitive advantage… in a crowded market you need to pull out all the stops to give your customer the shopping experience they really want – but you can expect to reap the rewards when you get it right**.**

Here are some of the companies (well known in the local market) that use VRM services. Now you probably know why you like spending time in their shops!
http://www.extremeintimo.com/home/index.php
http://www.ivko-knits.com/en/
If you are unsure how to do this on your own, contact a VRM consultant* that will help you look and sell good!
***What to expect from a VRM consultant**
A needs assessment which would be an overview of your store right now into which the consultant would incorporate any concerns, struggles, goals you have. The consultant would take extensive photographs of your location as a baseline in addition to engaging in extensive discussions about your current store problems, long range goals and opportunities.
The next step would then be to analyze all this information and develop a prioritized plan to meet these goals. VRM needs assessments phase often includes a competitor analysis as well.

The VRM process includes the following phases and it is up to you to decide what the steps YOU would like to pursue are:

I. Visual and/or written details that provide a ‗snapshot' of your store as it is today with a sales analyses
II. Report on the findings
III. Recommendation for a direction that will help you meet your goal and drive traffic
IV. Program implementation strategy
V. A strategy for reviewing the success of visual merchandising plans
VI. Visual (photographic) overview of the ‗after'

Apparel sector skills gap analysis[17]

In 2008 Xaosolutions surveyed the most competitive apparel firms in Serbia, that employ a total of 914 employees in 29 general and industry-specific occupations aiming to identify skills gaps in the industry and to evaluate prospects and barriers to growth in apparel sector. Although it the analyses are done in 2008, findings are still applicable for the situation in Serbia apparel industry in many ways.
Skills Gaps Analysis examined the following:
- **Labor and skills availabilities** in the Apparel sector
- Existing education in the apparel industry in Serbia, **main constraints developments and trends**
- To what extent existing academic programs match **the business needs**
- Involvement of the **private sector in support** to education needs
- Availability of trainers and administrators of various **certification programs** critical to export
- Obstacles in the institutional and regulatory environments, and other considerations **relevant to bridging the current skills gaps**

The key findings were :
- Lack of workers mobility, and differences from urban and rural areas in finding experienced labor

- Apparel sector in Serbia on average has a lower wages in compare to jobs with similar qualifications therefore it is challenging to find workers in urban areas or close to bigger cities. The wages are too low to motivate workers for work mobility and only place where it is possible to find enough workers are rural areas where these jobs are in addition to income from the agriculture Concerns with lack of technical skills and interest of young people for work in this industry (marketing and sales managers, financial managers)

- Lack of soft skills, industry expertise, market orientation and knowledge on global apparel industry

- Local apparel firms are predominantly family businesses. It is a challenge with employing managers outside family. Family members are not always the best choice, nor have enough expertise in apparel sector.

- Firms have reported that outputs of education are not in accordance to the needs of the industry. (lack of market orientation, lack of practice) curricula are improving but the process is very slow

[17] Report on Skills Gap Analyses by Xaosolutions DOO

- Companies are not investing (enough) in trainings
- Cooperation between education sector and apparel firms is very weak. Although there are examples of cooperation this is results of individual efforts on both sides – no established framework

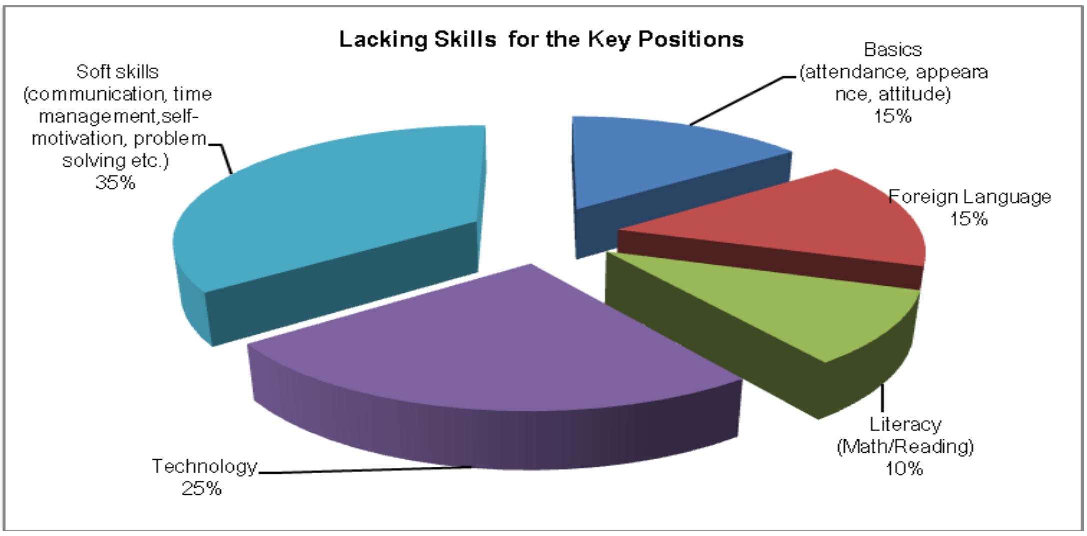
Table: % of currently employed in identified occupations within selected firms

General Manager	0,9%
Operations Manager	0,3%
Marketing & Sales Manager	0,4%
IT Manager	0,1%
Finance Manager	0,7%
HR Manager	0,1%
Production Manager	0,5%
Purchasing Manager/Buyer/Agent	0,0%
Market research analysts	0,1%
Quality Managers	0,2%
Retail Salesperson	21,0%
Sales Reps (wholesale and manufacturing)	1,9%
Computer support specialists / systems administrators	0,4%
Bill and account collectors	0,3%
Secretaries and administrative assistants	0,8%
Bookkeeping, accounting clerks	2,2%
Customer service representatives	0,2%
Cargo and freight agents	0,5%
Production, planning, and expediting clerks	0,5%
Shipping, receiving, and traffic clerks	0,7%
Stock clerks and order fillers	1,8%
Weighers, measurers, checkers, and samplers, recordkeeping	3,8%
Fashion designers	1,6%
Tailors, dressmakers, custom sewers	1,5%
Patternmakers	1,9%
Cutters and Trimmers	3,4%
Sewing machine operators	46,7%

Textile Knitting and Weaving Machine Setters, Operators, and Tenders	6,3%
Engineers	1,0%

- A total of 67.7% of employees in the selected firms are sewing machine operators and retail sales persons. Only 3,4% are in management positions.
- Only 50% companies have job descriptions. Some reported they have job descriptions but they are not using them in practice.

Important skills missing for the current occupations identified by companies are:



The following skills needs are identified by surveyed companies **for current** workers: 35% are soft skills, 25% technology skills, and 15% of basic skills such as attitude, appearance etc., 15 % foreign language skills, and 10% literacy.

Companies identified the following training priorities:

• **Teamwork skills** • **Problem solving skills** • **Foreign Language Skills**	• **Leadership** • **Technical job performance skills** • **Communication skills** • **Change management skills**

High Impact Jobs

High impact jobs identified by companies **as the most important for growth and competitiveness** of the industry:

Apparel Specific Occupations	Cross Cutting Occupations
Fabric and apparel pattern makers	Marketing managers
Fashion Designers	Sales managers
Quality Control	Production managers
Weighers, measurers, checkers, and samplers, recordkeeping (in Serbian: normirci)	Operations managers
	Buyers

Recommendations
Sector level interventions

- Support the establishment of an apparel skills center example: http://www.skillfast-uk.org/)
- Improve access to information about global industry developments in the Serbian language (articles, books, news, case studies)
- Work with schools and universities to introduce marketing in apparel in their curricula and train teachers
- Support universities with up-to-date technologies to be used in teaching (e.g. software for fashion design)

Firm level interventions

- Soft skills trainings (Communications, Leadership, Teamwork, Problem Solving and Change Management)
- Foundational business skills
- Marketing and sales in apparel - trainings and TA (marketing strategy, wholesale and retail sales)
- Retail sales training
- Management trainings for staff in management positions
- Pattern making trainings
- Technical assistance
- Finance training for managers (profitability, cost calculations, budgeting, projections)
- Technical Assistance to develop outsourcing and subcontracting plans for companies in need of production capacity increases
- Improve communication between companies and schools by establishing internships
- Business English Courses for employees in management positions
- Technical Assistance for companies to develop on-the-job training programs for current and new workers (customer support, retail store management and sales)

For more information please visit:
http://www.compete.rs/files/Skills_Gap_Analysis_2008_FINAL.pdf

ABOUT XAOSOLUTIONS DOO -

XAOSOLUTIONS (www.xaosolutions.com) is a management consulting and entrepreneurship development firm from Belgrade, Serbia. Aiming to support strategic growth of the private sector and local and regional socio-economic development in Serbia and the Balkans XAOSolutions provides consulting and training in the areas of: (i) Management consulting; (ii) Entrepreneurship development; (iii) Project management, and (iv) Gender and Economics.

Our clients are SMEs, public sector, civil society organizations, international and local organizations and consulting firms active in the field of local and regional socio-economic and private sector development. We cooperate on a long term and on a project basis with local and international consulting firms, and organizations, research and academic institutes and with individual consultants across private, public and civil society sector.

MATERIALS FOR THE WINTER COLLECTION 2012/2013

Mirjana RISTIĆ

Introduction

What would be the syntethic of new proposal of fabrics for Fall Winter collection 2012-13 just presented on fairs of Milano and Paris?

Seems that this season will be a balance between luxury and sobriety,two contradicory poles.It could be described like continual search for elegance and simplicity .Sophisticated colours, fine compact yarns, light muslins and silk, bright silk fabrics, the warm and comfortable look and substance of flannels are the essential requirements of the next winter collection.It could be noted that melange is present in all sections.
Colours – always protagonists – create magic atmospheres; warm and cold, soft and pale, lively or bright, they are mixed and melted together obtaining fairy and surreal combinations. The colour palette anyway presents simplicity and rigorous tones taken from nature and chemistry,with a touch of klein blue. This is a very deep ultramarine blue created by the French artist.
The main directions are classic,sportswar and contemporary where conciliating of rigor and development is the wish that arrives from economic world.

Classic

The classic world shows itself through plain colours with wavy backgrounds, minimal and micro-designs,making the surfaces lively.
Polished and matt colours alternate. Dobby effects seem small jewel decorations, they are fine,precious and noble and show a fine luxury taste.
Blue-grey and dusty colours are shown with glamour.
Melange and moulinè yarns dominate the sophisticated classic contest.
Evident herringbones are softened by the multi-tone mixtures of fancy yarns.
The 140 twinspun yarn is very important: it is used in twill, saia, popeline constructions ,
it gives prominence to the all-over soft structures.
Well-defined lines with delicate chromatism renew the classic and its image.
Finishing processes partially influence thin, basic, sometimes monochromatic, stripes.
Essentiality defines glam and severity.

Sportswear

Street art and urban life inspired Sportswear style of Winter collection 2012/2013.
A dynamic concept of active sport, an expression of beauty, practicality,
comfort and essentiality characterize every design, structure and detail.
Micro and midi checks with strong, strange and refined combinations create a frame of this segment.Everything is concentrated on blurs and complicated fades, vaporousness and delicacy.
Chromatisms are soft and water-coloured for a fine and creative chaos; they are delicate in a light and shadow contrast.On the one side we have warm and soft colours, which make the mono and bi-brushed flannels softer,on the other the bright ones, combined with grey, mastix and with lightless of zephyr and popeline.They create suggestive atmospheres and pleasant sensations.
Designs reduce, they become small artworks. Rich decorations underline contrasts.
Nothing is normal, everything is enriched with details, yarns, materials, aspects and new finishing processes.

Especially double-face becomes the protagonist but also mono – face structures have effect similar to fur, long filaments hide precise lines of bold stripes and overchecks.

Contemporary
This section develops in an actual and modern contest.
Cotton jacquards, velvet cotton, "liquid" satin, antique muslins,dobby all-over enriched with mélange and moulinè have a strong evidence here.The fabrics are created by thick cotton fibers mixed together with thin silk and compact cotton yarns.Raising in wool mixture suit and cachemire have a felting look.Light, soft fabrics balance woolly, compact and voluminous ones. Overdye on double-face creates a fusion look.Flowers, dots and stripes, also together, and micro-patterns are reproduced on corduroy velvet and muslins together with small fine romantic prints.

Highlights:

- Wool blends for smooth and neat ,slubby and grainy aspects.Washed silk.Velvetty cotton
- Feathery surfaces feature angora,kid mohar,baby alpaca hairs
- Hi-tech membrane for bonding or sandwich padding
- Lightweight,airy,vaporous fabrics teamed with wooly , compact, felted types
- Similar motifs for different weights and structures: from georgette to velvet, to satin,quilting,lace
- Combinations of geometrics, graphic play,blotches of color fon inlay,appliqués,raised prints

There is an interesting intiative noted on fairs Milano Unica and Premiere Vision –the linen which takes part of winter collection, though it's traditionally a key player of the summer.
Its natural characteristics of breathability, high power due to moisture absorption
structure of the fiber make it actually ideal material for a summer, cool and comfortable.
Perhaps for this, automatic association is idea of summer fiber but it's rarely considered for winter clothing. This natural fiber, making full use of its versatility for both neat and in blends. Linen blended with other fibersr, such as wool and cashmere or silk offer the possibility of unusual hands, giving more "power" structure and soft tissues of itself sagging, the other increases the wearability and comfort features.
For those who prefer to face the winter in a "layered", is the choice of fabrics in pure linen for leaders in direct contact with the skin. A linen shirt worn under a Wool Sweater brings all the benefits of acupuncture Meridian massage the skin and its antistatic flax, sending the body heat of winter and ensuring the now proverbial breathability.
Here is the meaning - to bring the best European producers of flax grown, spun and woven in the EU, for use in winter clothing, becauese that provides comfort and thermal insulation 100% natural.

Literature:

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FINISHING EFFECT ANALYSIS ON DIFFERENT JEANS MATERIAL TYPES

Slavisa DJURDJEVIC, Marija STANKOVIC & Vasilije PETROVIC

Abstract: _In purpose of getting better definitive look, jeans garment needs to get trough all finishing treatments. Jeans finishing treatment contains process of grinding, stone wash, acid treatment, softening and dyeing. In each of this phases jeans garment attain extra characteristics like flexibility, softness, comfort and many different aesthetic characteristics. During accomplishing all of this finishes, jeans garments are treating with different chemicals, acids and enzymes. Researching the react of this treatments on seven different types of jeans materials we got different effects._

Key words: jeans, grinding, stone wash, dyeing, softening, finishing.

1. Introduction

Nowadays, textile industry produces clothes which are esthetic, functional, good looking and comfort with a nice and adaptable form and material. Because of that, textile industry has to complete rigorous requests. Clothing industry has to satisfy conditions related to fashion moving, product design, variety and quality, but also about market time request.[1]

The purpose of this article is to show importance of finishing process of the jeans clothes production. Without finishing process, jeans clothes are rugged and inflexible for wearing. Extra softness, flexibility and comfort can be attain trough all phases of jeans finishing. Jeans garment, especially jeans pants, represent very important part of fashion and theirs finish look depend of grinding, stone wash, acid treatment, softening and dyeing process. All of these finishing phases are explained in this article.

In this article we can see how different types of jeans material react on grinding, stone wash, acid treatment, softening and dyeing process. It is shown a stone wash effect on jeans look and the difference which is made in the case when the grinding and dyeing are involved.

2. Raw material for jeans production

Cotton is main raw material for jeans production. Because of requires in fashion trends, there are in use different types of fibers beside cotton. Today jeans material is produce from:

- 100% cotton fibers,
- Blended of cotton and chemical fibers (polyester, elastane fiber, polyamide fiber and chemical cellulose fiber),
- Wool fiber
- Hemp fiber[2]

Woolen jeans are ideal for colder times. Hemp is used rarely because of their properties and specificity in production and the primacy assume chemical cellulose fibers. [2]

3. Grinding jeans

Denim is a textile that we use nearly every day because of its comfort, versatility and durability. We use denim in jeans, jackets, purses, skirts, and in a variety of the other garments and fashion accessories. Denim is made out of cotton, and often is blended with other fibers such as polyester and spandex to help creating the movement and flexibility in the garment. Most garments made of denim have been chemically treated or "finished". There are many ways to finish denim, including stone washing, grinding, enzyme washing, dyeing and softening…[3]

A sanded finishing for denim is achieved through a combination of pumice stones, enzymes and sand; used to create the illusion of aged denim jeans. Although the purpose of this is generally for aesthetics, this process also loosens the fibers in the denim, making the denim fit more comfortably and move more easily. Grinding jeans creates an uneven, worn look, which is ideal for daily casual wear, and also for pairing with solid colors or denim jackets. However, it is a very intensive labor needed for the sand finishing of denim, therefore a pair of jeans that has been sand finished will usually be slightly more expensive than one that has not. It is a necessity to finish denim in order to get a final soft touch.

4. Stone finishing

The Stone wash is a process that is used to give denim a worn out look. It also increases the denim's softness and flexibility. The stone washed jeans have been popular for quite some time everywhere in the world. In order to stone wash jeans, in an original way, they will be washed with pumice stones. Since the pumice stones have a rough surface they will scrap off a layer on the denim so that some of the white threads from the cloth will become more visible. This process is very difficult because it is hard to control the amount of wear and the fabric tear. However, more importantly, there is a problem with disposing of environmental waste and grit caused by this process. [4]
There are two types of the stone wash jeans:

- Stone wash in warm water.
- Stone wash in cold water.

4.1 Stone wash in warm water

The Stone wash in warm water contains eight phases:

I phase – material desizing with agents RUCOLASE[18] SML 1-2 % and RUCOGEN[19] 1-2 % where newly water has to be 1:10, temperature 45^{o} C and time duration is 15 minutes.
II phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.
III phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.
IV phase – Stone wash – with agents RUCOGEN EA 3%, Enzymes 0.5-1 %, pumice stone 0.5-1 kilogram per kilogram jeans. Newly water has to be 1:10, temperature 40-60^{o} C, time duration is 30-60 minutes depending of jeans types. Small doses of chlorine should be added (liter by liter which depend of jeans type and his blanching possibility) before ending stone wash process and this process continue until we achieve wanted nuance.

[18] Rucolase - enzyme for the catalytic decomposition of hydrogen peroxide into water and oxygen after peroxide bleaching.
[19] Rucogen – washing agent especially for jeans clothes. It is used to prevent stains or discolorations in the other finishing processes of jeans.

V phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.
VI phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.
VII phase – Neutralization – with agents METABISULFAT 2%, BELSOL 1%, newly water has to be 1:10, temperature 20^{o} C, time duration is 3 minutes.
VIII phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.

4.2 Stone wash in cold water

I phase – desizing material with agents RUCOLASE SML 3 % and RUCOGEN 3 % where newly water has to be 1:10, temperature 45^{o} C and time duration is 15 minutes.
II phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.
III phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.
IV phase – Stone wash – with agents BIOSUPER 33 COLD 1-2%, RUCOGEN 1-2 %, pumice stone 0.5-1 kilogram per kilogram jeans. Newly water has to be 1:10, temperature 20 ^{o} C, time duration is 30-60 minutes depending of jeans types. Small doses of chlorine should be added (liter by liter which depend of jeans type and his blanching possibility) before ending stone wash process and this process continue until achieving wanted nuance.
V phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.
VI phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.
VII phase – Neutralization – with agents METABISULFAT 2%, BELSOL 1%, newly water has to be 1:10, temperature 20^{o} C, time duration is 3 minutes.
VIII phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.

5. Hipermangan finishing

A finishing treatment with hipermangan creates significant contrasts in the color of the denim material. Hipermangan is applied using brush on places where we want to achieve extra blanching, in purpose to obtain bigger contrast. The blanching intensity depends of hipermangan quantity. This treatment contains five phases:

Picture 5.1. Hypermangan neutralization in washing cylinder

I phase – drying jeans after stone washing
II phase – hipermangan application on jeans model
III phase – cleaning – with agents METABISULFAT 2%, BELSOL 1%. Newly water has to be 1:10, temperature 30-40^{o} C, time duration is 15 minutes.
IV phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.
V phase – Rinsing – where newly water has to be 1:15, water temperature 20^{o} C, time duration is 3 minutes.

6. Softening jeans

After grinding, stone washing and hipermangan phases, the last phase is softening. Softening attains with agents PERUSOL IPS 1-2%, RUCOGEN GWS 0.5-1%, RUCOGEN EA 0.5%. Newly water has to be 1:15, temperature 40^{o} C and time duration is 20 minutes.

7. Dyeing jeans

If we decide for dye jeans, a color will be put in the last 5 minutes in softening phase. An average quantity is five grams per liter of water.

The grinding, stone wash, acid treatment and dyeing effects on different types of jeans materials

In this part we can see how different types of jeans material react on grinding, stone wash, acid treatment, softening and dyeing process. It is shown a stone wash effect on jeans look, and the difference which is made in the case when the grinding and dyeing are involved.

1. Pictures 8.1 and 8.2 demonstrate ―walo cam easy” jeans (373 gr/m^2) after finishing processes.

Picture 8.1. Appearances of rugged, grinded and stone washed jeans

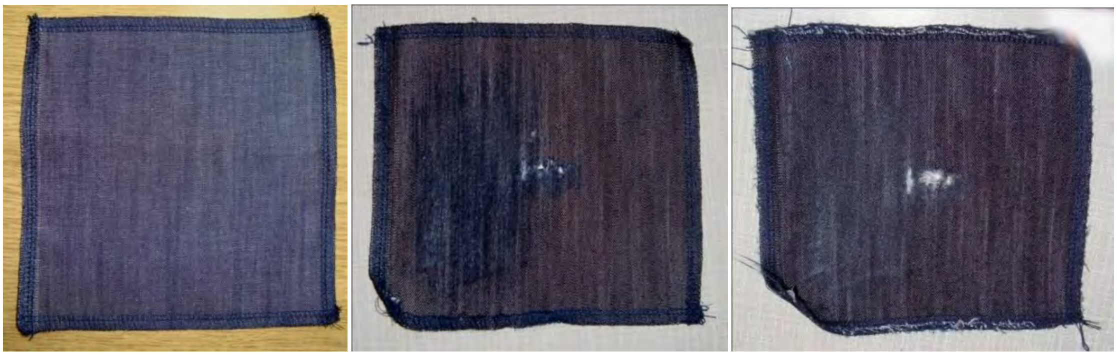
Picture 8.1. Appearances of jeans after hipermangan, softening and dyeing treatment

1. Pictures 8.3 and 8.4 demonstrate —rend 202” jeans (406 gr/m^2) after finishing processes.

Picture 8.3. Appearances of rugged, grinded and stone washed jeans

Picture 8.4. Appearances of jeans after hypermangan, softening and dyeing treatment

2. Pictures 8.5 and 8.6 demonstrate —M200A” jeans (283 gr/m^2) after finishing processes.



Picture 8.5. Appearances of rugged, grinded and stone washed jeans

Picture 8.6. Appearances of jeans after hypermangan, softening and dyeing treatment

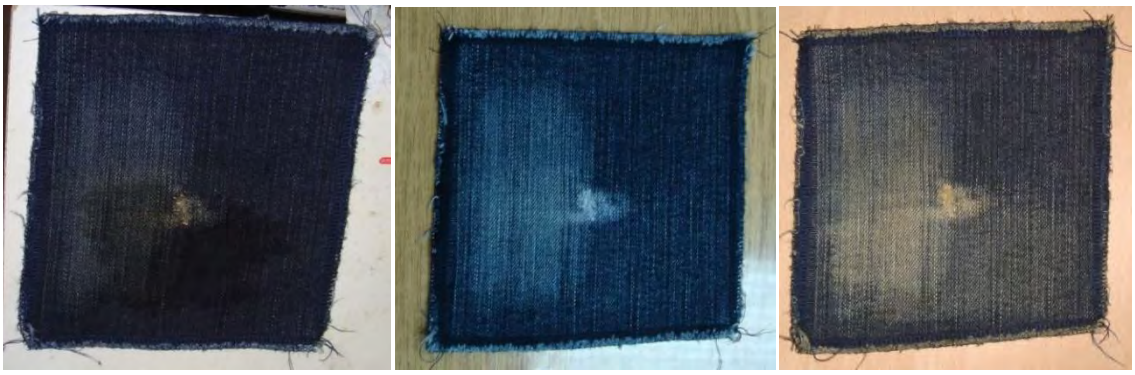
3. Pictures 8.7 and 8.8 demonstrate ―Newtrebeca” jeans (373 gr/m^2) after finishing processes.

Picture 8.7. Appearances of rugged, grinded and stone washed jeans

Picture 8.8. Appearances of jeans after hypermangan, softening and dyeing treatment

4. Pictures 8.9 and 8.10 demonstrate ―ScbBlue Rusty 9504” jeans (390 gr/m^2) after finishing processes

Picture 8.9. Appearances of rugged, grinded and stone washed jeans



Picture 8.10. Appearances of jeans after hypermangan, softening and dyeing treatment

5. Pictures 8.11 and 8.12 demonstrate —Elis Najt” jeans (272 gr/m^2) after finishing processes

Picture 8.11. Appearances of rugged, grinded and stone washed jeans

Picture 8.12. Appearances of jeans after hypermangan, softening and dyeing treatment

6. Pictures 8.13 and 8.14 demonstrate —Elis Najt” jeans (272 gr/m^2) after finishing processes

Picture 8.13 Appearances of rugged, grinded and stone washed jeans

Picture 8.12. Appearances of jeans after hipermangan, softening and dyeing treatment

8. Analysis of the operations used during finishing process

Table 1.Finishing process operations list

Operation list of finishing process for jeans			
Number of workers: 4			
Daily size: 174			
Ordinal number	Operation name	Work resources	Time production (min)
1	Grinding	HW	10,00
2	Stone wash	WC	60,00
3	Drying	DM	30,00
4	Hipermangan treatment	HW	11,00
5	Softening	WC	10,00
6	Drying	HW	30,00
Sum:			151,00

Table 2. Legend of work resouces

HW	Hand work
WC	Wash cylindre
DM	Drying machine

To create a plan for the technological process of finishing children‘s jeans, it was given a dally capacity (Cd), which amounts to 174 pieces a day and time (Tr), which is 435 min.

Since it is required a lot of time for finishing process of jeans production, it is separately specified the number of workers and machines involved in this process.

The required number of workers for the grinding operation is calculated using the formula:

$$R = \frac{Cd \cdot T(grinding)}{Tr} = \frac{174 \cdot 10}{435} = 4\, workers$$

Washing cylinder is used for stone wash finishing process. Capacity of cylinder depend of its size and it vary in range 200-1000 products. Therefore, it is required one washing cylinder for daily capacity of 174 products. The same washing cylinder is also used for softening process. Drying system has the same capacity like washing cylinder so there is need only for one system.

The required number of workers for applying hipermangan is calculated using the formula:

$$R = \frac{Cd \cdot T(hiper.)}{Tr} = \frac{174 \cdot 11}{435} = 4{,}4 \approx 4\, workers$$

9. Conclusion

The different width and colors of jeans have different reaction on finishing processes. It can be seen in chapter 8. It can be seen that black jeans has a tendency to change color to blue after the process of stone washing and the hipermangan treatment. It is also observed that all samples of jeans material are grinding on the right side, so we can see color differences on that side after stone washing. Grinding part is much brighter. The upper side of samples is treated with hipermangan. In this case, the upper-left corner of jeans samples has been grinded and treated with hipermangan and upper-right side of jeans samples has been only hipermangan treated. After hipermangan neutralization and softening it can be seen that the grinded part of the sample is drastic brighter then the only stone washed part of jeans sample. The grinded place of sample also has better tied of color.

The finishing treatments, grinding, stone washing, hipermangan treatment, softening and dyeing are used only for a jeans material. These finishes demand a lot of time, which can be seen in table 1, where for the grinding it is needed 10 minutes, 60 minutes for the stone washing, 60 minutes for the drying, 11 minutes for the hipermangan treatments and 10 minutes for the softening. Finally, for all these operations the required time is 151 minutes.

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APPLICATION OF ICT IN FASHION DESIGN

Ivan TASIC, Dajana TUBIC & Jelena TASIC

Abstract: *Textile industry is very suitable for applications to adapt computer graphics because of their familiarity with the aesthetic values. Today there are many different manufacturers of specialized software for 2-D and 3-D design of clothes, and also works with machinery design and tailoring of the computer. The information relating to the design and collection of clothing can unite in one place appropriate programs. In addition to the preservation and protection of important data base relating to design a collection of clothing, these programs allow the user to adjust the command according to their needs.*
This paper presents the work of a professional software for designers. The authors show the application of new solutions in manufacturing, using new information technologies, management techniques and modern design

Key words: fashion, design, clothing, computer, software.

1. Introduction

Fashion is a phenomenon that has never been as topical as at the time you just pass through. The penetration of the consumer society, encouraging spending, increasing exposure to advertising messages, frequent changes of trends in production was caused by repeated attempts at rational explanation, or the legality of the search terms of fashion trends. The new fashion era has brought new standards, and no seller, brand or designer did not have a monopoly in the creation of new styles and trends. There has never been so intense interest in fashion as in the era of electronic media, advertising and consumer society in which we live. Fashion is committed to a "nice", the aesthetic factor in the industrial design. General feature model is that these are short-lived and transitory understanding, and not always reach the artistic and aesthetic level. And if not fleeting social phenomenon is used as a tool for successful placement. In the field of fashion clothing industry requirements are the dominant factor. As we know, today in many industries, and is represented by the fashion-intensive application of ICT.

2. The concept of design and appearance

The design is three-dimensional or two-dimensional appearance of the entire product or part thereof, which is determined by its visual characteristics, in particular the lines, contours, colors, shape, texture and materials of the product itself or its ornamentation, and their combination(*www.pks.rs).*
When it comes to design we can say that the design includes design of an object to satisfy the functional and aesthetic requirements. In free translation design means: drawing, sketch, design, pattern, first draft (the first idea that occurs to be a work of art). In a more general sense when it comes to designing industrial products - industrial design computer products - computer design. What used to be called formatting, now gets a new name - design. Industrial design is a creative activity whose aim is to determine the formal qualities of manufactured industrial quality subjects. This off and the external form, but primarily on the structural and functional elements and one system of relationship that turned into a coherent whole from the standpoint of the consumer. Today we share the design of graphic design (labels, logos, posters ...), industrial design (machines, cars, home appliances ...) and textile design (materials and cuts)
The actual design is considered the beginning of the 19th century, as the life industry. Design is in the true sense of the word and developed with the development of industry and mass consumption and

production... Design work is increasing and the success of designers is measured by the number of copies of his work are realized. Design has taken the theory of functionalism, in which objects should primarily serve a purpose, to respect the simple geometric shapes without decorative elements, made the final standards applicable to many kinds of products because they get so cheap, quickly made and functional products. The design follows social trends, has been associated with fashion whims, so rapidly changing and developing new styles.

3. Fashion and clothing

Fashion is a significant social phenomenon of time, but also the most sensitive indicators with a "taste of the epoch" (Dorfles, 1990:8) which is the basis of every aesthetic and critical evaluation of a particular period. (Adorno, Horkheimer, 1980:91). Textile and Fashion Design is an area where the merging technology and creativity creates a good collection of clothes. Textile designer is able to understand the production process, and to give their contribution at any time of manufacture, research, textiles, printing on fabric design, creation of a collection of clothing, to marketing strategy.
Fashion Clothing in its emerging postal clothing from the need for change, innovation, differentiation, distancing, and individualization. The beginnings of such phenomena had to be possible that the change arose in the life of any group or individual. Be removed and the age-old idea that a change of clothes in the new century dictated a final purpose, for example: aesthetic improvement of the human figure, greater functionality, adaptation to time, the expression of the spirit "of time" and so on.
Clothes can be defined as a set of "covering" the body of a man who protects him from the unwelcome influence of the surrounding environment: cold, rain, wind, mechanical injury, etc.. Contemporary understanding of clothing includes garments that man just put on your body: various pieces of clothing, shoes, caps, hats, etc.. The primary function of the protective clothing (physical and moral protection), and usable and practical, as is any clothing associated with a human activity, has some intended, helping him to adjust the surrounding environment. Each item of clothing is a matter that is used to perform one or more functions. At the same clothes and a cosmetic - it decorates the man in it are inextricably linked and uses the concept of beauty. (www.cet.rs)
Clothing product is a complex set of benefits for consumers, whose valuable on a scale determined by product capabilities to meet the appropriate requirements. For apparel products to the customer can be complex and multi-purpose meeting: functional, aesthetic, ergonomic, economic, emotional, sociološko.Za development of a new apparel product is necessary to know what consumers want because they are active recipients and providers of information in the system of communication and active participants in decision decisions that are important to adapt the business of the production system (PPS). Due to rapid technological development of the human dynamics of business generation manufacturing systems are forced to engage in the learning process and accumulation ability to develop innovative products and processes. Modern production and clothes sales is based on QRS and JIT strategy, developing tailor-made clothing (Made-to-Measure), with selling and buying clothes from virtual factory. Computer integrated manufacturing CIM, which includes clothing, CAD, CAM, CAPP and CAQ, connecting all the vital functions of business and production systems, storage of raw materials through to the warehouse and technical prepare and readymade garments. Optimizing the Construction of preparation, all next steps in the technological process of production of clothing will allow for continuous quality and profitable operation.
Costume is a system of objects and elements of clothing, a single unified concept and purpose, reflecting the social, national, regional origin of man, his sex, age, profession etc.. Costume is closely connected with the life, traditions, customs and mentality characterizing a particular region, a particular historical period, nation or ethnic group, and also with social position, behavior and lifestyle specific person (or social groups) expressing his individuality. Costume and protective clothing behind-the practical and useful function. But more important is its presentation of functions, i.e. costume is a special form of communication, it communicates information about the surroundings of man, his social status, political sympathies, religious affiliation, aesthetic taste and culture.

In the circles of scientists, engineers and designers believes that the next mega trend in the clothing industry will be the next generation. It is not the new and unusual design clothing that sets fashion trends, but it has a variety of clothing options - from automatic changing its looks, the collection of biometric data, to regulate body temperature. These, and many other features are achieved thanks to a new generation of textile materials, installation of semiconductor elements, sensors, Bluetooth modules, and sometimes processors - all based on the purpose and use of clothing.
Science and fashion are becoming closer, and the question is whether the future fashion designers have to be programmers and electronics to create clothes. Over the next few years these clothes will be more pronounced, with lower prices, and we now look at some of the models that already offer or are developing. The design and clothing design for the future now, there are two approaches: the design and manufacture a new generation of fabrics that have a variety of intelligent features and installation of various electronic elements in clothing. Creating new types of materials that will make this clothing is the only area that will in future have a lot to offer, and here are often mentioned: polymers, fiber optics, nanotechnology, biochemistry and so on.

4. Application of ict in fashion design

In the textile industry, computers are used in the design process, preparation of production and the production itself. The use of computers aimed at overcoming the technological limitations of traditional manufacturing, as well as enabling new, creative techniques in the design process. The software and hardware being developed for these applications must comply with specific requirements arising from the implementation in the textile industry, as well as existing technologies.
Continuous increase in computer performance, the growing involvement of computers in computer networks, with the stock price, make use of computers in an increasing number of areas of human endeavor. All are powerful multimedia capabilities of computers. There are various forms of presentation graphics: display on a monitor, record on computer disk, various types of printing (black and white, color, print multiple resolutions, different sizes of prints, various types of material on which is printed), so switching to film. Graphics are handled on your computer faster and more comfortable, it is possible to cultivate more and more graphic information. The increase in power that have microprocessor-based computers and the development of specialized graphics chip provides more complicated processing and graphics. Therefore, the price paid is decreasing.
These properties qualify for the application of computers in almost all sectors in which it works with graphics. Especially if it relates to the industrial environment, in which the computer is becoming an indispensable tool design where the design process may involve the production and preparation.
Connecting computers in a network of computers to physical dislocation applied at various stages of production, resource sharing, communication, various network services. Of course, even here the use of computers is limited to the design. Computers can be used in all stages of production, from design, through the preparation, monitoring and production management to building documentation.

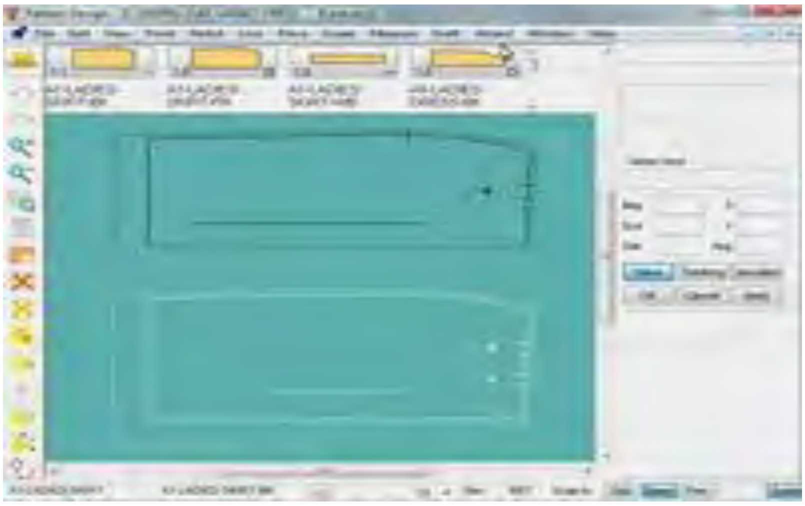
5. Applications for the working professional designers

Create a new fashion collection or individual garment requires a relatively long period of time. It includes: manually browsing magazines and catalogs, go to shows, fairs and other events, the long drawing and painting a large number of drawings, material selection, making the collection and testing it, itd.Za efficiently perform these tasks on the market today offers a number of program packages which save time and give more efficient results.
Software packages for the textile and clothing design have the following options:
1. set of options that give the designer the possibility of drawing creation of monochrome or color lines with different color depths.
2. set of options that are used to manipulate the samples surface of textile materials.

3. set of options that enable you to work with a wide range of colors.
4. set of options that are used to create horizontal, vertical or slanted patterns on the textile material, the principle character in the mirror or on the principle of report.
5. set of options that are used for moving and copying parts of reports pictures or sketches.
6. set of options that are used to store and reference images, contours, or pallets.
7. set of options that are used to display text when necessary

Some of the software to design are:

- *Gerbe Techology* is a leader in this area is from 1969. year when it started producing the first system for tailoring. Since then, the corporation has contributed its technology solutions rapidly developing industry of furniture, clothing and leather goods.

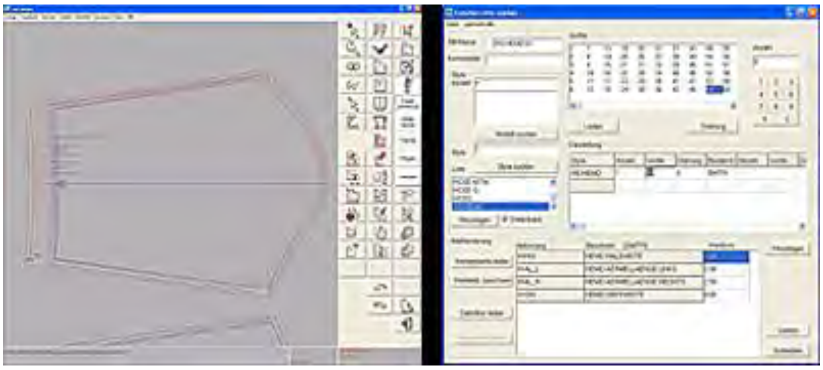


Source: www.4shared.com

-*Gerber Designer Artworks Studio*- Top software for professional designers who work for complete formation of the basic model (color, hue, etc.).. In addition to designing, this software allows visualization and optimization.
-*Gerber Designer Silhuette 2000* - Professional system for making basic cuts to meet all professional requirements and flexibility for the application of individual techniques that are used in making designers basic models.
-*Gerber Designer Digitizer*- Top digitizer that enables you to enter basic template using a special mouse to the computer in digital form, which can be further processed using software for grading, cutting pictures, and so fitting.
-*Gerber Designer AccuMark i Marker*- The software for making basic cuts, grading, blending cutting files and so on.
-*Lectra Systemes*,

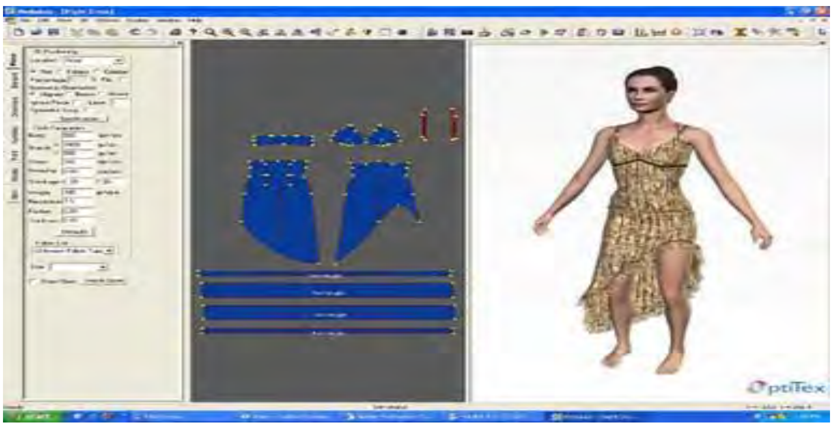
Source: www.walterwilhelmassoc.com

- *Apparel Assyst* - is the name for Assyst CAD software packet based on the Windows platform, which has been specially developed for the textile industry. The range of applications that this package includes the use of the concept and design to the garment tailoring. The data flow is organized so that it can meet the production at the global level because the data available over the Internet



Source: www.assyst.de

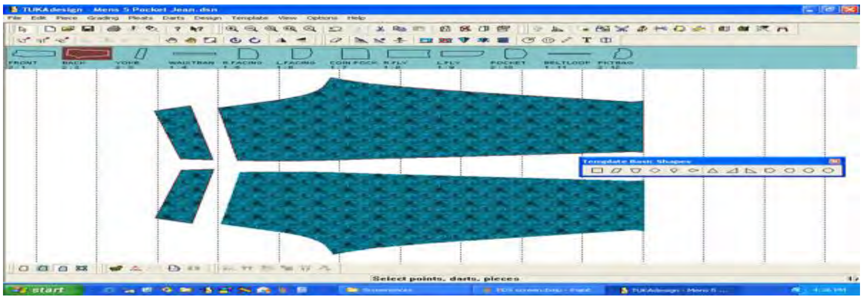
- *OptiTex* (3D visualization software for the fashion industry)



Source: www.telechargertout.com

Source: www.gulnazahmad.hubpages.com

-TukaCAD



Source: www.vip-software.com

-Virtual Fashion Basic 1.0

-Virtual Fashion Basic Vista

Source: www.programas.com

6. Conclusion

Clothing industry in the world, but we do not bring results if it does not pursue the necessary improvements that will lead to increased productivity, more rational use of productive resources and lower costs, and does not see necessity to change management, capacity planning. It involves the use of new solutions in the production, application of new information systems, management techniques and contemporary designs.
Apparel with a variety of digital accessories is increasingly occurring in the future we will see more and more different products. This phenomenon carries with it several issues. Not yet clear how close daily contact with various devices affect health, as well as the impact of different fabrics that are made from any stranger and stranger material. It takes years to investigate these impacts, and the industry predicts that within ten years every piece of clothing have something digitally embedded in its structure.
New product design becomes his most important trait, a commodity aesthetics of one of the most powerful drivers for product placement.
It's hard to imagine a modern design process without a PC. Connecting computers in a network of computers to physical dislocation applied at various stages of production, resource sharing, communication, various network services. Of course, even here the use of computers is limited to the design. Computers can be used in all stages of production, from design, through the preparation, monitoring and production management to building documentation.

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INFLUENCE OF FASHION ON CONSUMPTION

Ljubomir MAŠIREVIĆ

Abstract: *The aim of this paper is to present the development of the consumer society between the late 19th century and today and demonstrate the influence fashion has on this entire process. The first part of the paper deals with offering definitions and arguments concerning the very concept of consumer society. The second part of the paper demonstrates how the development of the bourgeois society triggered the need for excessive consumption and all other accompanying social changes in the behaviour of consumers brought on by the new age. This part discusses the early bourgeois rise of department stores and clothes shops in city centres and shows how we have come to have enormous shopping malls – a world of their own today and physically detached from cities. These are now places where both consumer and cultural lives are led. The conclusions of the paper involve an argument casting aside the viewpoint that it was actually consumerism that has brought on the democratisation of societies, as well as rejecting the idea that we make free choices when purchasing goods available on the market, while it proves we are under an enormous influence from the environments we originate from and that our decisions are far from being spontaneous.*

Key words: Fashion, Consumption, Identity, Purchase, Culture.

Consumer society

The everyday supply of a wide range of goods makes our lives more complex as we are ever more frequently forced to choose what we are buying and thus fulfil our own needs the best we can. However, it always remains unclear what our true needs are and what has been imposed on us as a purchase target. The concept of consumer society helps us if not offer an answer to this question, then at least to comprehend the complexity of the issue being debated. Once all of the societies used to be deemed as manufacturing societies. Still, in the Western world a decreasing number of people are involved in production for at least two reasons. Firstly, the technology has advanced and requires less and less human labour and, secondly, China is fast becoming the world‘s factory floor and an increasing number of companies are relocating their manufacturing to this nation. Classical consumerism theories suggest a fulfilment of the existing needs, while this is nowadays proving to be the explanation satisfying for a decreasing stake in the overall consumption. People are spending more and more in order to entertain themselves or establish their identity, and this is how consumption becomes a symbolic activity designed for us to send out a message rather than meet our needs.

Consumption and fashion are being identified as one of the most significant sociological issues of today and ones which are frequently addressed simultaneously. These phenomena are intertwined as consumption is under enormous influence of fashion. If the aforementioned is true, the direction in which societies develop is characterised by purchase as a symbolic activity during which faceless goods acquire tremendous social significance. Roland Barthes over-emphasised the symbolic aspect of clothes, claiming they have but one function – to have meaning. Dick Hebdige wrote the famous book *Subculture: The Meaning of Style (1980)*, arguing in it that subcultural symbols are used as bridges to like-minded people, and walls separating them from the rest of the population. The goods which is used is not neutral, but rather imbued with meaning. For example, the use of Apple computers, a choice of certain make of suit or choice of colours with fans of sports clubs is connected with certain mental connotations which can be dramatic, and if someone wearing certain colours should stray into the wrong area they could be in trouble.

It is a generally accepted notion in sociology that today in the Western world we live in a consumer society or that our living culture has become consumption-oriented as a result of consumption bearing an almost exclusively symbolic meaning. In his book *Lifestyles* (2003), David Chaney writes that people‘s social status does not depend on the vocation of a group‘s member, but rather the way they use the available material resources and privileges. Based on this conclusion, Chaney adopts a presumption that lifestyles are typically based on social organisation of consumption. In social sciences, it is believed one is entitled to talk of consumer society when the use of available resources in order to meet basic needs is reduced to a fraction of total consumption. Lars Svendsen (2005) argues the existence of consumption is not the sole characteristic of a consumer society, nor the fact this consumption is on the increase, but that the key aspect is that it is largely detached from what is called needs satisfaction. This underlies a modern-day feature that a symbolic, rather than material or use-value, is increasingly the one being purchased.
On the other hand, consumption incorporates almost every human – both adults and children, the employed, unemployed and pensioners, while a minority of a population is involved in production. Moreover, sociologists Castells (2000) and Giddens (2003) observe another trend which justifies the use of phrase ―consumer society", and one which is reflected in the fact that what we call *working life* takes up an ever decreasing proportion of a man‘s life. In some countries of the West life expectancy has reached the age of 80, while an average working life is around 30 years. This leads to a conclusion that the phenomena of idleness, boredom and popular entertainment are intrinsically linked with consumption. It is obvious consumption now occupies the focal point of social lives and justified to delve into reflecting on the contemporary times and put a perspective on the modern society through an analysis of consumerism and fashion.

Consumption and fashion from the 19th century until today

During the 19th century a turn of events took place in the Western societies and the concern regarding production was replaced by an obsession with purchase. Huge amounts of products that piled up as a result of a sudden technological advance brought about a state where manufacturers could not rely on what the desires and imagination of the people could encourage them to purchase. Strategies to manipulate the desires and needs had proved to be necessary so that the public could be encouraged to an act of purchase, which they were beginning to see as pleasure. Exterior visual fascination with purchase objects was becoming more important than use-value and needs satisfaction. The methods of fabricating need relied on skilful visual product presentations and manipulations which were acquired with various effects. At first vendors would take over the methodology from show business, subsequently standardising their approach to advertising. Special attention was given to the place and manner of showcasing goods, while advertising was being professionalised, giving birth to the advertising industry and the institution of advertising agency with a sole aim – to probe the market on behalf of certain manufacturers. The key role was played by the expansion of capital cities of the Western countries, as they were growing into consumption and entertainment centres. Big centres, well connected with provincial areas which had always mimicked city living, were places of wealth and power and growing into tourist destinations offering modern and up-to-date content. Describing the trends in showcasing and advertising goods in European capital cities, Gundle and Castelli write the following in their book *The Glamour System*:

> The ultimate purpose of such grandiose efforts was to endow commodities with an aura, a mystery or an appeal that went beyond their use-value. Although many goods, including clothes, household items and foodstuffs, continued to be sold on the basis of their practical utility (no store missed an opportunity to claim that it offered good value), others relied heavily on the ideas that were associated with them, in particular the promise of magical transformation or instant escape from the constraints of everyday life (Gundle and Castelli, 2007: 17)

It was particularly important to place the goods in such a selling environment where it would lose its original purpose and emanate splendour and pleasure. In order for people to purchase the goods, manufacturers need to create an image of their product as if it possessed an aura and that possessing one would improve the buyer‘s social status and simultaneously acquire a certain kind of lifestyle. Goods have been drawn into the process of fetishisation, as advertising blurs its roots, while idealisation is introduced by stimulating a man‘s imagination into fantasising about an unreal world of pleasure this latest product offers.

It has been mentioned the development of major cities such as London or Paris in the 19th century was one of the key preconditions for the birth of consumer society. The famous urban reconstructions of London and Paris had brought on squares, expansive parks and broad and straight boulevards. Cities were increasingly built in the ethos of bourgeoisie rationality in place of the preceding medieval chaos. However, the key aspect from the perspective of this essay is the fact the reconstructed capital cities were increasingly becoming places of modern consumption and entertainment. Spending money on luxury, latest trends in fashion and material goods not strictly belonging to the category of basic existential necessities requires conditions such as urban backdrop, higher standard of living and latest possibilities of social mobility in the capitalist society. The nineteenth century was a time when the cultural life left courts and poured out into the cities. While the new bourgeoisie class which arose after the French Revolution demanded a new visual dimension of urban centres, these cities, in turn, were forced to change due to increased volume of trade and in order to ensure the development of an improved urban infrastructure the new age demanded. Moreover, well-lit cities facilitated for products of a new industry to be offered in an appealing and, until then, unfamiliar way. Commercial urban centres were springing up where there was wealth, but also people‘s desire to display their riches in the best possible light.

Apart from new production technologies and development of capital cities, there was another compelling phenomenon crucial for the institution of the commercial society – the emergence of expansive shops or department stores. The first department stores signalled the beginning of today‘s mode of sale and encouragement to purchase, now seen in hypermarkets in all developed capitalist countries. Through its practice of showcasing goods, the bourgeois society created the world of consumer culture inundated with deceptive images and spectacles. Department stores appeared in the most developed countries of the West, serving as temples amid cities of gracefulness and material wealth in which they were located. After their emergence small corner shops had become obsolete, as trade was acquiring traits of megalomania.

… Ralph Hower, the historian of Macy‘s of New York suggests that the first approach to the department store in Europe was London firm of W. Hitchcock and Co., which was already organized into twelve departments in 1839. He also suggests that although general trading and barter were still much more common in North America, there was increasing specialization of shopping in the cities there as well, and that the department store emerged in both the United States and Europe at about the same time and probably independently (Wilson, 2003: 146).

As Gundle and Castelli argued in 2007, the consumer was like a member of the audience in a theatre – a spectator whose imagination was being excited. Department stores had spread a new showcasing culture and thus had appeased the spirit of the times in which everything was becoming transparent and subject to public critique. The most significant change brought on by department stores, when it comes to the development of the consumer society, was the sale, however not at highest prices, but rather as massive as possible. Similar to the mechanisms of modern societies, the idea had become to sell enormous quantities of goods to as many people possible at incredibly low prices. Department stores manipulated with the dreams and fantasies of the ordinary man, very much like today‘s mega markets, succeeded in concealing the fact the very goods had been manufactured by means of exploiting both people and natural resources. During this period two more changes in behaviour when purchasing and selling goods took place. Goods were being sold at lowest possible prices which only made clearing sales virtually impossible. Secondly, customers were invited to freely roam around shopping areas looking at goods on offer, without any pressure of having to actually buy anything (Wilson, 2003). Moreover, changes emblematic of this period are the professionalization of salesmen. The act of selling had taken on a bureaucratic edge, while salesmen were ever more narrowly specialised for the sale of particular type of goods.

Ultimately, the modern forms of consumption that began developing in the 19th century were partially influenced by old aristocratic practices. Prior to the emergence of the bourgeois society the aristocracy were the key consumer class. Social changes had introduced the change of epochs, as aristocracy was losing its privileges in a wide-reaching process of democratisation, conceding its perch of key consumer to the bourgeoisie. The newly-formed bourgeoisie was not merely taking over the practices of the aristocracy, but the shift took place in a more complex way, accompanied by a clash of practices and affinities. As theorist Campbell noticed (Svendsen, 2005), the key characteristic of the aristocratic hedonism manifested in special pleasures, while the main feature of the bourgeois hedonism was an insatiability in a never-ending expression of desires. Modern hedonism had instilled imagination about a certain product in individual needs, which created the situation where the tendency towards desire satisfaction had become enjoyment in itself. People create mental images in order to achieve individual satisfaction, while the entire process could be described as a creation of an imaginary world in which the desire for a goods or brand becomes an obsession. However, the flooding of market with diverse goods could not simply rely on the demands of the incontinent hedonistic consumers, and so strategies for manipulating the human desires and needs were being devised simultaneously. Products lacked spirit, because mass industrial production had taken away the uniqueness the handmade product crafted in workshops had once had. Through the means of advertising, design and other methods of manipulation, faceless goods were intended to have their spirit reinstated and be sold to consumers driven by an imaginary world of dreams. If possible, a product was to be presented and fetishised as being glamorous, and accordingly a more desirable item to possess.

One could argue about whether glamour filled the modern world of dreams with material content. It was borne out of instilling very irrational impulses, romantic notions and illusions into the heart of the modern culture based on abstraction, rationality and money. It was an organised form of magic and illusion, added to the commercial imperative and camouflaging it. It corresponded with the feeling of ideal self of the modern individual and the tendencies toward social mobility and an escape from boredom (Gandl i Kasteli, 2007: 57).

Together with exhibition halls and museums, the 19th century department stores, complete with the concept of purchase as an act of entertainment and pleasure instead of meeting realistic needs, bore witness to the development of what we today call the capitalist society with a consumer culture. Once small corner shops were removed from European and North American metropolises, shiny glass windows of department stores glittered, luring people into an endless spending spree. A further development of consumption underwent insignificant changes between the two world wars. During this period fashion cycles changed, as the shops had become more modernised and compartmentalised for selling certain items in certain departments. The most considerable novelty in the development of consumer culture was the emergence of chain stores of a single owner, such as Marks & Spencer. All chain stores showed a growth tendency that would eventually turn them into global concerns. The period between the two wars radiated a modernistic spirit of optimism and the belief science and technology should keep ceaselessly improving the quality of life and enable the satisfaction of basic needs, as well as the growing number of people‘s insatiable desires.

During 1950s department stores were becoming out-of-date, as younger generations were beginning to opt for alternative means of purchase, such as home delivery or phone order, which would eventually evolve into today‘s Internet sale. Such methods of sale reduced the prices of products as they required no vast, centrally-located, storage areas to be rented where the goods would be exhibited. Young people of higher living standards were looking for well-fitting and comfortable clothes at lowest possible prices, which eventually brought to the introduction of first clothes shops. Department stores were suffering blows from latest trends in purchase methods and were beginning to go bust or adapt to survive, embracing the idea of boutiques and introducing them in their premises. Apart from clothes shops springing across chains of department stores, fashion departments aimed at younger consumers also emerged. During the 1960s clothes shops had become a common sight in Western Europe, and differentiated into those targeting more affluent customers and those targeting people with more humble incomes, as well as boutiques specialising in selling underwear, sports apparel, etc. Every provincial town soon boasted clothes shops in its streets, while, at the same time, branded store chains and expansive shops resembling department stores where most diverse goods could be purchased.

In the 1970s a recession in world economy set in and prices began to soar, as clothes shops, pursuing the sale of their goods, were accelerating fashion trends as their latest releases were being launched in quicker succession and would keep the status of current fashion for ever shorter time cycles. ―There was a kind of overkill of style, and ultimately this generation of boutiques failed, as the young developed dissident fashions so extreme that only a new generation of designers could respond to or develop them commercially...” (Wilson, 2003: 153). Together with these tendencies there was a rise of luxurious clothes meant for successful women and men. Clothes shops were either going out of business or adapting to the latest class of customer – one with more lavish demands. Regardless of these tendencies, a certain number of clothes shops and chain stores meant for those with more humble incomes stayed afloat and survived the race with the latest sale trends. In essence, the fashion tradition of the 1970s – defined by frequent changes – had begun to change and we saw the emergence of the postmodern formula of adding detail with virtually identical styles which are ceaselessly recycled in the shape of retro-fashion with minor, effectively insignificant, changes.

The aforementioned trends put an end to the rise of department stores in centres of major urban metropolises from the period of the bourgeois society‘s prosperity. Latest social trends are characterised by the fact the importance of major city centres is diminishing, wide car roads are fast spreading, while the development of other means of city transport – which, such as metro, have provided an easier mobility for the urban population – have contributed to the emergence of suburban sales points. In North America this trend was most pronounced and had given birth to what we could call regional shopping centres outside big cities. These are places which postmodern theorists have branded simulacrums of reality and consumerist dream worlds. Unlike the trends of the 19th century, here we have the introduction of a new urban form which is accompanied by a change in consumption practices. Instead of a centralised city, its decentralised equivalent emerged, and with it a consumer zone – a new autarkic space, completely detached both from the city and the real world. Within these new centres the consumer‘s dream was fulfilled, while the early-19th century capitalism now had a novel form of hyper-consumption amid an unreal and simulated realm. New sales points in a decentralised city had become the temples of the early 19th century lifestyle culture. They not only succeeded in incorporating purchase as one of the most important modern phenomena, but also other aspects of life were now taking place in enormous shopping centres. The modern man of the West, but also of our own Serbia here, are frequenting shopping centres where they have lunches, drink coffee, meet up with friends, spend their afternoons with family, walking and gazing at windows of a wide range of shops, and even watch movies in a shopping centre‘s own cinema theatre. Belgrade is an excellent example of an Eastern European where cinemas have relocated to shopping malls and where its most sophisticated and largest movie theatres are now found in its biggest shopping centres. Shopping centres have become places where people earn or spend money, spend free time and enjoy in the culture of their time in an isolated and simulated surroundings with less and less contact with the city‘s reality and the real world outside in general.

There remains a question how all these aforementioned changes affect fashion and its replacement cycles. Fashion has always made a radical distinction between city living and the province. Extravagance, glamour, elegance and style in the way we dress and the way we live have always been integral parts of metropolises, unlike the province, which has seen the outflow of its exceptional and ambitious individuals. It appears that fashion is nowadays less associated with specific city trends, but more with individual choices. However, these individual choices are not spontaneous and do not reflect an individual‘s freedom to purchase what they want. Purchase is still socially conditioned, and essentially, we can notice a weakened influence urban fashion centres have on choices. However, this is not a process of liberation, but rather an symptom of an increased level of detachment. Clothes are less and less a statement of belonging to a group of people (subculture), but even more noticeably, the basic togetherness which has characterised urban attiring in a major city is disappearing. Nevertheless, through purchase we do not become radically free, but regardless of all this, our consumption sends out messages to other people. The desire not to purchase something trendy, to be remarkable and unique is also a message we are sending out. Moreover, goods such as cars, ridiculously expensive personal computers, cutting edge mobile phones, sports bicycles and designer clothes are not used for their original purposes of meeting basic needs of transport or surfing the Net, but are possessed so that one could demonstrate his or her independence and individuality in their purchase decisions, while they actually have neither. It appears we are purchasing our own lifestyle. With the act of purchase we acquire symbols which demonstrate who we are in our efforts to establish our identity. In essence this amounts to alienated existences within a metropolis surroundings. Modern-day populations of major cities are slowly abandoning the practices of collective, subcultural way of dressing in an attempt to express independence and distance themselves from everyone else. Therefore, contemporary fashion, aided by excessive consumerism, has provided for a fake feeling of radical individualism. We are in fact still overly concerned with a product‘s brand name and its mode of sale, trying to create our own lifestyle.

A collective way of dressing in a subcultural spirit once analysed by Dick Hebdige can be seen today in small provincial communities. In these places an individual embraces a subcultural way of dressing and expressing themselves in order to establish a feeling of unity with the group of like-minded individuals and relieve the feeling of boredom and a no-way-out situation of a small-town community. Collective subcultural way of dressing is an attempt to lock horns with the phenomenon of boredom. A certain clothing item or accessory, which is in itself virtually insignificant (like a pin badge or a torn piece of clothing), is there to help overcome the uneventfulness of an environment and make sense out of the emptiness of the dominant culture which surrounds the local individuals. Fashion can never be one‘s way of finding the meaning of life, but such reasoning could have a negative effect. It offers nothing of the essence to our lives and the individual who begins establishing their identity through fashion is met with a counter-effect which shatters their identity. An attempt of utmost individualisation leads to its own antithesis in estrangement, with one‘s identity threatened and destabilised. Lars Svendsen concludes his book dedicated to the phenomenon of fashion with these words:

… that fashion is capable of expressing profound and current cultural interests and that, this way, it is the way towards „inconvenient truths about the world―.But what truths are these? To celebrate superficiality, to live in an ever more functionalised reality, to have increasingly inconsistent identities and so on? In that case, fashion tells us truths to which perhaps it contributed the most (Svendsen, 2005: 157).

Conclusion

If we follow Barthes‘s theory that clothes have but one function – to have meaning instead of protect the body – then the idea advocated by certain authors according to which there has been an overall process of democratisation in clothing in the 20th century appears virtually inacceptable. In his conclusion in *Histoire du Costume*, Grau writes that in the present moment of social development clothes have lost their social value to have symbolic meaning. These viewpoints are a direct opposite to those adopted in this paper. Clothes, according to Grau, still holds significance to the people in the Western societies, but has largely lost its ability to convey social class and status. ―The democratisation of the society, the closing of gaps in standards of living and the internationalisation of culture have all contributed to the homogenisation of clothes" (Grau, 2008: 117).

Actually, as old structures gradually weaken, the individual is confirmed as an entity around which society and fashion are structured. And therefore, refuting Tocqueville, the West is not moving towards hordes of ―similar and identical individuals" where ―one‘s distinctive look will soon blend in a common physiognomy", but rather towards a powerfully democratic society which appreciates differences, for which the development of clothing is the best testimony (Grau, 2008: 118).

However, these conclusions seem harsh and unsociological. Especially the one which argues that an individual becomes an entity around which a society is structured. Just as Pierre Bourdieu demonstrated in his 1984 book *Distinction*, people make various choices based on what they have been taught and what is known as social-cultural capital. The underlying point is that we do not independently decide to engage in purchase, but we are rather imposed the framework by the norms of the environment we originate from. Men in Serbia, as much as they might think they are free, still decide not to buy skirts in clothes shops. Generally speaking, the concept that we visit shops in order to buy trousers is so internalised and widely and readily accepted that one may believe this is a natural act, without noticing anything externally imposed. Although the disparities are not as gross as in the previous eras and people do wear seemingly similar clothes, anyone versed in pop culture of their time or trying to break from the everyday routine and challenge purchase decisions will come to a conclusion that although we seemingly wear the same clothes, they still have a strong symbolic meaning. If you are unable to tell whether an individual is wealthy or not judging by their outfit, this is simply not the only meaning clothes carry. We gain a multitude of diverse mental notions from judging people based on what they are wearing. Today‘s Westerners are free to choose, but they still fail to do it due to at least two reasons. To begin with, some clothes are just beyond to financial reach of the lower strata of the society, while we make our choices in a highly complex way and under the influence of the environment from which we originate and more often than not we have previously formed viewpoints regarding what we deem necessary. Most people‘s first association to buying trousers are denim jeans, while they are oblivious to the fact denim jeans have gone through markedly different phases of use and have not always been as widespread a clothing item.

By giving an account of the development of the consumer society, the emphasis was intended to be placed in this paper on the fact that fashion pluralism of the late 20th century makes us no freer. Grau and Lipovetsky are theorists and historians of fashion for whom fashion dynamics represents freedom and democratisation, while these are positions disputed in this paper. Fashion, with its ever shortening cycles, has become an integral part of the consumer society, while the correlation between fashion and consumption began in the early bourgeois world of the 19th century. It is responsible for the creation of the compulsion to purchase as much as possible. It is true the number of brand names is on a perpetual increase and that differences between clothes have become more subtle. There is a growing variety of denim jeans on offer and it is now being sold as dark, pale, washed out and even torn and it is beyond any doubt that purchasing such items is a kind of freedom, as argued by Michel de Certeau and John Fiske (2001). People are free to attribute meaning to brand names on their own. However, a question remains whether these details truly constitute a fundamental difference and whether we are really free if we have an opportunity to choose from a variety of denim jeans trousers. To what extent do people truly create their own meanings, and to what extent do they conform to existing symbolic values of goods in a society? In any case, the account of the development of the consumer society enables us to see the path which has taken us to a stage when we believe consumption in modern-day, urban, decentralized, shopping centres convinces us we are truly free and that we are free to choose from an offer of diverse products. We have created our own mental images that owning a personal computer with an apple logo brings pleasure, distinction and uniqueness within the consumer society. Actually, a choice of such a personal computer is a social matter and a testimony we are spending with certain limitations and ideas of what this product offers in a symbolic sense. Svendsen (2005) says the modern-day man of the Western world is free from all, but wonders whether this freedom could be devoid of content. Making choices in contemporary shopping malls, we try to achieve themselves, but without having any idea of what the aim is and what they are striving for in their personal achievement. The situation is such that we can make a distinction and show how free we are when we choose our favourite brand name, but it is also the case that we do it without any knowledge of where we want to go and what we are striving for.

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THE USAGE OF MTM SYSTEM IN DEFINING WORK METHOD IN TECHNOLOGICAL OPERATIONS FOR KNITWEAR GARMENT PRODUCTION

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Abstract: *MTM system of predetermined time enables defining more appropriate work method and normative prior real work place definition. Increasing demands for productivity improvements encourage researches in the field of work survey in order to find work methods, which would ensure required effect without additional investments. This paper deals with defining work method by using MTM system in technological process of knitwear garment sewing at working place that carries out sewing of women's shirt hem. Analyzed operation, which is carried out on sewing machine, is timely divided into 4 technological processes. According to researches, these processes have been proved to have ability to carry out harmonized movements. On the basis of different researches, normal time needed for carrying out operation have been defined 348.1 TMU. This time gives the hourly production 288 of women's shirts.*

Key words: MTM systems, work operation decomposition, work rationalization.

1. Introduction

Demands for increasing productivity urge surveys in the field of work research in order to define actions and methods of work that would, without additional investments, secure requested performance and output.

The work itself includes performing technological operations by interactive work of workers, machines and subjects of labor. Industrial production the work is divided into smaller work phases, technological work operations, technological procedures within these operations, i.e. actions and movements.

The operation is the unit of work phase. It is also a part of technological process that is often researched, monitored and analyzed.

Division of work operations into actions is a minimum requirement for modern approach to work rationalization. There are 20 standardized actions, but, due to its characteristics, it is not possible to use all of them in ready-made clothing industry.

The movement is the part of the action that makes a unity. There are movements of arms, legs and body. The movements are as follows:

- preoperational in relation to work,
- finishing, after the work has been done,
- Movements during the working process, i.e. handling work subjects.

Division technological operation into basic movements gives the opportunity to find better work methods, eliminate unnecessary movements, make training for workers much easier and precise definition of time normative. The movements are very short-lived, so they cannot be measured by conventional methods. Thus, for definition of time normative related to handheld technological actions and movements, we use method of predefined time (MTM method).

2. Methods of predefined time

There are several systems for predefined time that are used for definition of time normative:

MTM Methods Time Measurement, WF Work Factor System, BMT Basic Motion Timestudy, MTA Motion Time Analysis etc. All these systems are similar and are based on the fact that, using basic movements, we can define time normative for each technological operation according to basic movements. Times for these movements are arranged in tables, so by combining and addition all these times we can obtain the time of total action (which has been divided into movements). Obtained time is normal time (t_n),, because the values are given for an average worker, and that time should be increased for additional time (k_n, k_a i k_d coefficients) i order to determine real normative [8].
The advantages of this method are:

- Production times are very accurate.
- Recording time is eliminated and subjective factor of determination of assessment efforts is eliminated, too.
- Obtained results are related to an average man and are obtained by observing a lot of people. That is why these results are more objective than other methods.
- By dividing actions into basic movements we create a cornerstone for obtaining better working mode, defining more economical working process and stabilization of work place and working conditions.
- Choice of appropriate equipment, appliances and tools for work.
- We can define time needed for handy works.

2.1. Mtm system

One of the main goals of this system is to enable short, clear and understandable description of working method with defined time needed for work performance. This goal has been achieved through special label system related to basic movements and special tehnique for description of working method using symbols. Basic movements, as well as the symbols of these movements in MTM system are working movemets of: hands-grabbing (R), catching (G), carrying (M), assembling (P), disassembling (D), pressing (AP), dropping (RL), arm swing (T), circular rotation (C), eyes-transmission (ET), eye concentration (EF), feet-(FM), legs-(LM) and body-step aside (SS), walking (W), body rotation (TB), bending (B), stooping (S), tottering (K), sitting (SIT) and getting up (STD). All these simple movements in MTM system require very short performance time. Because of that, special time unit ,TMU(Time – Mesaurement – Unit (sec = TMU $\cdot 3.6 \cdot 10^{-2}$) [8], has been introduced on order to define time normative.
Prior to definition of working method, it is neccessary to define which basic movements can be carried out combined or at the same time and which one is timely more crucial. The set of basic movements that can be carried out at the same time with the same body part is the set of combined movements. Simultaneous movements are caried out by different parts of the body simultaneously. As for the combined movements, we can analyse left hand, right hand, left leg, right leg, body and head as individual functional body parts while simultaneous movements are carried out by both hands, legs or arms or, if you are very skillful, with both hands and foot.
This system can be applied in: appropriate planning of technological processes of garment production, defining optimal methods f work performance, rationalization of present work actions, defining of production normative, budget performance and real production costs [13].

3. Eksperimental

This survey has defined the method of technological operation of hem sewing on women`s T-shirt at working place. Delivery and dispatch of work items is carried out by technological wheels. Tested operation is being carried out in sewing machine UNION SPECIAL KS122 K01-2548UT4A CD. Mono right hem on T-shirt was sewed with stitch type 600 (covered chain stitch), sewing length 92 mm. The sewing process is carried out in one segment A (Figure 1). This operation is divided into four technological procedures.

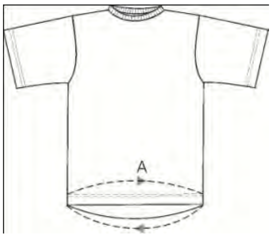

Figure 1. Sewing segments of hems on women`s T-shirt on sewing machine.

Table 1 shows work cycle of an executor with appropriate movements related to technological operation of sewing hems. It includes the description of working operations of left and right hands, body and feet movements with appropriate symbols and performance times according to MTM system [8].

Table 1 MTM analysis of the technological operation of sewing hems on women`s T-shirt

Ordinal number	Description of the left hand work	symbol	TMU	symbol	Description of the right hand work
1	taking the T-shirt and carrying to the machine				
1.1	grabs the T-shirt	R67B	23.2		
1.2	turning the body	TB1	18.6		
1.3	step aside	SS24C1	17.0		
1.4	catches the T-shirt	G1B	3.5		
1.5	takes the T-shirt to the machine	$M45B_{BA}$	17.0		
1.6	drops the T-shirt	RL1	2.0		
2	putting the hem under the pedal				
2.1	grabs the T-shirt	$R54B_{BA}$	19.5	(R44B)	grabs the T-shirt
2.2	catches the T-shirt	(G1B)	3.5	G1B	catches the T-shirt
2.3	carries to the hem channel	M49C	21.6	(M28C)	carries to the hem channel
2.4	drops the T-shirt	(RL1)	2.0	RL1	drops the T-shirt
2.5	arranges the hem	(P2 NSE)	21.0	P2 NSE	arranges the hem
2.6			13.0	R40A	reaches the switcher

2.7			3.4	AF	turns on the switcher
2.8			3.0	RLF	breakage of the contact force
3	automatic hem sewing of segment A				
	hem sewing		203.5		t_m= 7.33 sec
4	storage of T-shirt				
4.1	grabs the T-shirt	(R30B)	12.8	R30B	grabs the T-shirt
4.2	cathes the T-shirt	(G1B)	3.5	G1B	cathes the T-shirt
4.3	drops the T-shirt	(RL1)	16.8 18.0	$M45B_{BA}$ SS35C1	carries to technological wheels step aside
4.4			2.0	RL1	drops tthe T-shirt

Work cycle of an executor on the work place sewing hems on T-shirt includes 4 actions, and the technological procedure (1) should be covered additional one and should be carried out simultaneously with sewing machine. Waiting time (wt) is related to the time after covered additional action had been done, and till the finishing of automatic hem sewing process.

(1) taking the T-shirt and inter-storage		(1)			
2.putting the T-shirt under the pedal	2				
3.automatic hem sewing on the machine		3			
wt.waiting time			wt		
4. storage on the wheels				4	
Time normative - TMU	88.5	205		54.6	
400	0 40 80 120 160 200 240 280 320 360				

Figure 2. Work cycle of hem sewing on women`s T-shirt on sewing machine

On the basis of defined work method, using MTM system, we have determined normal times of carrying out technological actions increased by fatigue coefficient (k_n = 0.15) and environment coefficient (k_a= 1.4). In that way, we obtained real performance times of appropriate technological actions. According to the values in the figure 2, we have shown the graphics of the work cycle (348.1 TMU (12.52 sec). Technical equipment of the sewing machine enables switching off accessory machinery-handy actions and the introduction of handy-covered technological actions, which leads to much shorter performance time (in this case the time is shorter for 82.8 TMU). This method enables the production of 288 women`s T-shirts per hour.

4. Conclusion

MTM system can be applied in many different ways in the field of serial production. MTM analysis makes it possible that basic parts can be made instantly without time construction (as it was the case with conventional method). The system of predefined times enables definition of more appropriate work method as well as the opportunity for normative definition before the definition of real work place. Demands for increasing productivity urge research in the field of work performance in order to find procedures and work methods that would, without additional investments, ensure requested output and lower production costs. This paper deals with the definition of work method using MTM analysis in technological process of knitted fabrics sewing at work place sewing hems for women`s T-shirt. On the basis of presented work method and MTM analysis, it is determined that there was an increase in production per hour (44%) in relation to the analysis and time of conventional method [9]. Definition of work method in this way contributes the organization of more economical work process if we have in mind the frequency of appliance of this work method in the fiels of knitted wear production.

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TESTING OF FABRIC DRAPE

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Abstract: *Fabric drape can be define as a complex deformation of fabric in three dimensions under its own weight, while hangs over some object. Drape is a term which complexity is not easy to present in quantity, becouse drape is depend of more parameters which effect can not be always defined and predicted. The most important parameter for describing fabric drape is drape coefficient. However, it is proved later that drape coefficient is not suficient for describing complexity of drape phenomenon, so as important parametars are added number of nodes, node distribution, and minimal and maximal amplitude which present greatest and at least distance from centre of the circle to the curve of draped semple.*

Key words: drape, drape coefficient, fabric.

1. Introduction

Fabric drape can be define as a complex deformation of fabric in three dimensions under its own weight, while hangs over some object. The study of fabric drape started in 30s last century when Pierce established fabric bending theory using cantilever method [7]. However, this procedure refered to twodimensional fabric testing. Threedimensional studies of fabric drape begun at the sixties last century [1, 2].

The major contribution in developing instruments and methods for study fabric drape, was by Cusick, when he constructed Cusick Drape Meter. Although, after Cusick, with progress of science and technology, it was developed more devices this type and purpose, Cusicks Drape Meter is still in use. Cusick, also, as most important parameter of fabric drape, established dape coefficient which can be defined as a ratio of ring area of fabric sample before draping and projected area of draped part of the fabric. Drape coefficient is expressed in percentage and has value from 0 to 100 %.

First of all, the drape coefficient was calculated, by the copying shadow of draped sample on the paper, and then was, with paper mass of projection of draped part of the fabric and paper mass of undraped fabric ring, obtained percentage ratio. Nowadays, the shadow of draped sample is captured with digital camera, imported in computer, and by the diferent softweres is obtained drape coefficient [4, 5].

However, later is proved that drape coefficient is insufficient parameter for describing complexity of drape phenomenon, so, as a significant parameters, are added number of nodes, node distribution, and minimal and maximal amplitude which presents greatest and at least distance from centre of the circle to the curve of draped semple [2, 3].

The greatest influence on drape coefficient has fabric rigidity. The more figid fabric is, the less it will drape, and its drape coefficient value wil be closer to 100% and vice versa. Loose and flexible fabrics will have drape coefficient value closer to 0 %. It is, also found that drape coefficient depends on mechanical fabric properties, first of all on bending rigidity, bending hysteresis, shear hysteresis etc [8, 9].

In this paper it is presented study of determination fabric drape coefficient for different types of fabrics, then determination of number of nodes and minimal and maximal amplitude. Then it was investigated dependance of drape coefficient and time of fabric drape.

2. Metodology

For this purpose, it is built special non-standard device which is shown in Figure 1. This device consist of upper and bottom glass plate. Between them is placed circle pedestal with 18 cm diameter,

on which is placed sample with 30 cm diameter [10, 11]. Below bottom plate are placed 4 light bulbs arranged in
4 cornes, which illuminate bottom plate on which is glued mate paper to give diffuse light, on whole area, to eliminate perspective effect on sample shadow. The sample is illuminated from below, becouse the edges of the sample are more visible. On the upper plate are drawn circles with 18 cm and 30 cm diameters becouse of easier and more precise computer processing. Above device is placed digital camera which captures configuration of the draped sample. The samples are subsequently tansferred in computer, and pictures are further processed in software Adobe Photoshop.

Figure 1: *Drape meter*

Procedure of picture processing in Adobe Photoshop is shown in Figure 2. First is carried out picture cuting and calibrating, then is used tool „threshold―for adjusment threshold between black and white. The colour picture becomes black and white where the areas is easy to mark and calculate areas in numbers of pixels. Then the drape coefficient is obtained with division area of draped part with area of non draped part and multiplying with 100. Before that, it is necessary to perform picture cleanig, where on the white area black pixels are removed, and on the black white.

a b c

Figure 2: *Procedure of picture processing in Adobe Photoshop: a) raw fotography, b) processing with tool threshold, c) picture cleanig.*

3. Experimental

For testing are used 17 fabrics from comercial production. In table 1 are shown characteristics of tested fabrics: fiber composition (%), weave, warp yarn count (Tt_o), weft yarn count (Tt_p), warp density (G_o), weft density (G_p), fabric thickness (d), fabric weight (Q).

From each fabric is taken ten circle samples with 30 cm diameter. Before testing all samples were ironed. Then, each simple of each fabric is placed on the Drape meter pedestal and it was captured a picture of draped simple first on the face then on the back. At the end for each simple is calculated drape coefficient on fabric face and fabric back, and then is calculated total drape coefficient for fabric face and back. Also are determinated number of nodes and minimal and maximal amplitudes. The result are shown in table 2.

Sample	Fiber composition (%)	Weave	Fabric weight Q (g/m²)	Warp yarn count Tt_o (tex)	Weft yarn count Tt_p (tex)	Warp density G_o (threads/cm)	Weft density G_p (threads/cm)	Fabric thickness d (mm)
T_1	Cotton 100 %	$K\frac{4}{4}Z$	302,21	30 x 2	30 x 2	27	19	1.05
T_2	Cotton 100 %	$K\frac{2}{2}S$	182,20	20 x 2	16 x 2	21	19	0.69
T_3	Cotton 100 %	Diamond weave	140,47	20	14	40	30	0.41
T_4	Cotton 100 %	Broken twill	187	20 x 2	20 x 2	20	21	0.68
T_5	Cotton 100 %	Plain	310,85	30 x 2	30 x 2	25	20	0.55
T_6	Cotton 100 %	Plain	82,65	8,4	8,4	50	29	0.22
T_7	Cotton 100 %	Plain	160,85	23	20	44	23	0.31
T_8	Cotton 100 %	Plain	399,85	68x2	48 x 2	18	9	0.92
T_9	Cotton 100 %	Plain	389,02	23x2	28 x2	35	32	0.91
T_{10}	Cotton 100 %	$K\frac{2}{1}S$	216,28	24	30	52	28	0.46
T_{11}	Cotton 100 %	Plain	139,75	15	16	47	29	0.25
T_{12}	Synthetics	$K\frac{1}{2}Z$	343,4	28 x 2	28 x 2	29	21	0.68
T_{13}	Synthetics	$K\frac{2}{2}S$	300,6	92	96	14	14	1.18
T_{14}	Synthetics	$K\frac{2}{2}S$	297,13	28 x 2	28 x 2	25	24	0.72
T_{15}	Synthetics	$K\frac{1}{2}S$	166,7	5	28	70	39	0.33
T_{16}	Synthetics	$K\frac{2}{1}S$	84,98	8,4	14	44	27	0.28
T_{17}	Synthetics	Plain	123,12	8,8	25		22	0.22

Table 1: *Characteristics of tested samples*

Sample	DC* (%) Total	DC (%) Face	DC (%) Back	Number of nodes NN							Minimal amplitude (cm)	Maximal amplitude (cm)
				0	3	4	5	6	7	8		
T_1	**42.6**	**40.75**	**44.42**				**5**	**3**		**2**	**10.14**	**14.18**
T_2	**34.35**	**32.95**	**35.74**					**3**	**6**	**1**	**9.02**	**14.12**
T_3	**29.5**	**29.73**	**29.29**						**7**	**3**	**9.00**	**13.49**
T_4	**28.36**	**28.96**	**27.76**					**7**	**3**		**9.00**	**13.85**
T_5	**70.68**	**71.87**	**69.48**	**4**	**2**		**4**				**11.76**	**14.71**
T_6	**37.72**	**40.24**	**35.19**					**5**	**5**		**9.00**	**13.76**
T_7	**55.56**	**53.78**	**57.43**			**1**	**1**	**8**			**10.11**	**14.53**
T_8	**61.41**	**61.96**	**60.85**				**4**	**6**			**10.37**	**14.77**
T_9	**82.63**	**84.65**	**80.62**	**10**							**12.34**	**14.61**
T_{10}	**62.29**	**60.48**	**64.1**			**1**	**7**	**2**			**10.36**	**14.61**
T_{11}	**39.53**	**41.07**	**37.99**				**1**	**4**	**4**	**1**	**9.00**	**14.61**
T_{12}	**57.48**	**58.15**	**56.85**				**5**	**4**	**1**		**10.15**	**14.97**
T_{13}	**45.08**	**44.36**	**45.8**				**1**	**5**	**4**		**9.03**	**14.61**
T_{14}	**36.3**	**35.1**	**37.49**			**1**	**3**	**3**	**2**	**1**	**9.27**	**14.81**
T_{15}	**51.35**	**46.29**	**56.41**			**1**	**3**	**3**	**3**		**9.14**	**14.36**
T_{16}	**25.48**	**21.5**	**29.49**				**3**	**7**			**9.00**	**12.99**
T_{17}	**51.24**	**51.17**	**51.24**			**1**	**3**	**6**			**9.00**	**14.35**

* DC – Drape coefficient

***Table 2:** Draped parameters for analyzed fabrics*

Testing drape parametes after certain time period

For testing changes in drape coefficient and number of nodes after certain time period, three fabrics are tested which are chosen based on total drape coefficient shown in table 2; fabric T_{16} with smallest drape coefficient DC = 25,48%, fabric T_9 with greatest drape coefficient DC = 82, 63% and fabric T_7 with average value of drape coefficient DC = 55,56%. The fabrics are tested at several time periods, e.g., drape coefficient is measured at 0, 4, 6, and 24 hours after setting sample on the Drape meter pedestal. Results obtained are shown in table 3.

Sample	Drape parameters	Time (h)				
		0	2	4	6	24
T_7	**Drape coefficient, DC (%)**	**49.71**	**44.73**	**42.89**	**42.24**	**40.49**
	Number of nodes	**7**	**7**	**7**	**7**	**7**
T_9	**Drape coefficient, DC (%)**	**76.04**	**74.64**	**73.49**	**72.68**	**71.24**
	Number of nodes	**4**	**4**	**4**	**4**	**4**
T_{16}	**Drape coefficient, DC (%)**	**19.02**	**14.17**	**13.49**	**12.87**	**12.27**
	Number of nodes	**6**	**6**	**6**	**6**	**6**

***Table 3:** Results obtained for drape parameters in diferent time periods for 3 tested fabrics*

4. Results and discussion

This research is directed to consideration and clarification the complexity of fabric drape phenomenon. Undrestanding the term drape is important for evaluation of finite garment look in real life circumstances, and also for computer simulation advancement. Thus, drape parameters are investigated from following aspects: comparison of drape coefficient in fabrics with different structure, testing the influence of time on drape coefficient and subjective assesment of drape.

In Figure 3 is shown graphical representation of drape coefficient for seventeen fabrics, on fabric face, fabric back, and total value of drape coefficient. From Figure 7 and from Table 2, can be concluded that values of drape coefficients are in range from DC = 25.48 % for fabric T_{16} to DC = 82, 63% for fabric T_9. The fabric T_{16} is made of synthetic yarn in twill weave with low fabric weight Q = 84.98 g/m^2, and low fabric thickness d = 0.28 mm. The fabric T_9 is made of 100 % cotton yarn in plain weave with fabric weight Q = 389.02 g/m^2, and fabric thickness is d = 0.91 mm. Fabric T_{16} has very loose structure expressed shear characteristics, while fabric T_9 is very stiff with dense construction.

Small values of drape coefficient, also, have fabrics: : T_3, DC = 29.5%; T_4, DC = 28, 36%; T_6, DC = 37,72% and T_{14}, DC = 36, 3%. From table 1, one can see that fiber composition does not have big influence on drape coefficient values, but construction properties does. High drape coefficient have fabrics; T_5, DC = 70.68 %; T_8, DC = 61.41% and T_{10}, DC = 62.29%. This fabrics are all woven in plain weave and they have high fabric weight values, as well as a very strong structure.

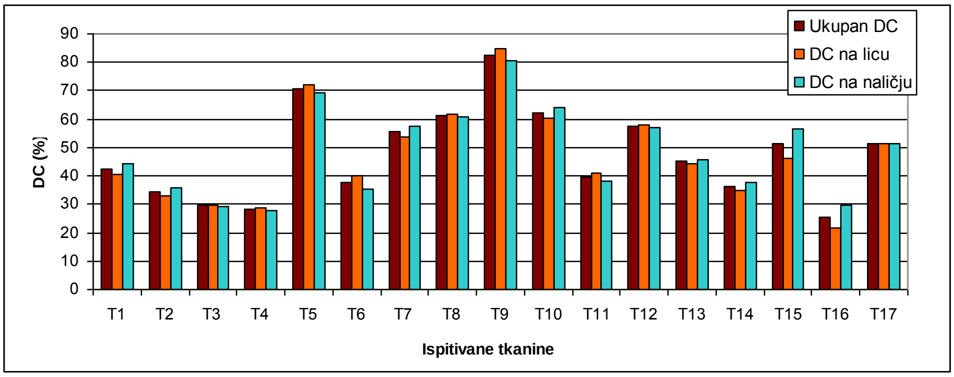
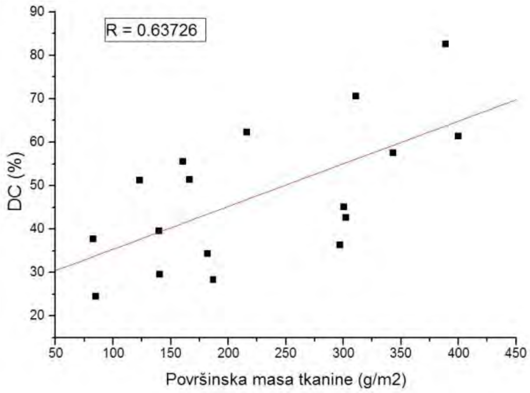


***Figure 3**: Graphical representation of drape coefficient values*

In this paper are also shown values of drape coefficient on fabric`s face and back. In all cases, e.g., on each tested fabrics, values of drape coefficient are different on face and back. On eight tested fabrics, drape coefficient value were higher on face, while on eleven tested fabrics, drape coefficient values were higher on back.

Of structure parameters for tested fabrics, shown in table1, only fabric weight has direct influence on drape coefficient becouse drape represents bending of fabric under the influence of gravity, and that bending depends of mass of draped fabric part. In Figure 4 is shown graph of linear dependence of drape coefficient and fabric weight of tested fabrics. Correlation coefficient 0.63726, which is not satisfying.



Picture 4*: Dependence of drape coefficient of fabric weight*

In table 2 are shown number of nodes for ten samples after setting on the drape meter pedestal. The fabrics had 0, 3, 4, 5, 6, 7 or 8 nodes. One can see that very stiff fabrics with high drape coefficient value (T_5 and T_9) do not nodes or form just few of them. Most samples have 6 nodes. Differences in number of nodes and change of draped profile indicate that fabric change its configuration every time when it drapes.

In this paper are determinated minimal and maximal amplitude for tested samples. In table 2 are shown average values of minimal and maximal amplitude for each tested sample. The minimum amplitude is the smallest distance from the center of the circle to the edge of draped sample, and the maximum amplitude is the maximum distance from the center of the circle to the edge of draped sample, and thus the smallest value of the minimum amplitude must be 9 cm (because it is the radius of a base on which the fabric is draped) and the maximum value of the maximum amplitude should be 15 cm (because it is the radius of the sample on which fabric is draped). The values for the minimum amplitude ranged from 9.00 – 12.34 cm, and maximum amplitude values ranged from 13.76 - 14.77 cm.

For the three tested fabrics (T_7, T_9 and T_{16}) it was performed analysis of drape parameters change over time. Draping parameters were measured after 0, 2, 4, 6 and 24 hours after placing fabric on a drape meter pedestal. The results are shown in Table 3 and Figure 5.

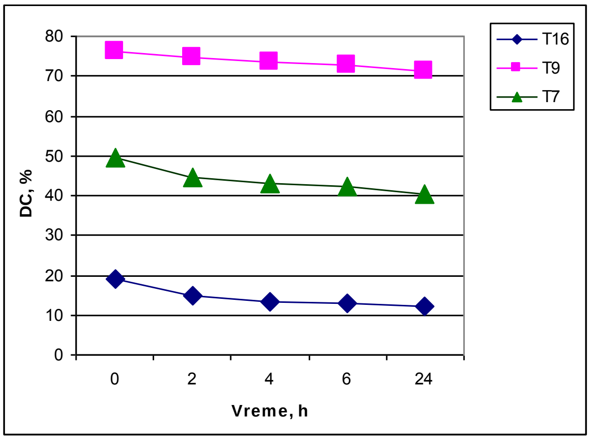


Figure 5: *Dependence of the drape coefficient from the time of draping.*

The results were as expected. In all samples is observed the decrease in drape coefficient over time. At the sample T_7 biggest change was recorded from 0 - 2 hours of draping, and the smallest change in draping coefficient was observed from 4 - 6 hours of draping. At samples T_9 and T_{16} biggest change in drape coefficient was observed, also, after first two hours, and the smallest change in drape coefficient was observed in a time interval of 6 - 24 h.

5. Conclusion

In order to clarify the phenomenon of fabric drape, one must take into account many parameters that affect the draping of fabric, especially fabric constructional parameters, mechanical properties, as well as the composition and processing of materials.

This work may represent the beginning of a future study of fabric drape. The conclusions reached in this paper can not be considered as conclusive, but they can create a database and indicate the direction in which the research of fabric drape might go.

The results can be drawn the following conclusions:
- The drape coefficient depends of fabric structural parameters,
- That the fabrics woven in a twill weave have smaller drape coeeficient of fabrics in linen interlacing,
- That the fabric always has a different configuration or profile when it drapes,
- That fabric do not always has the same number of folds,
- That drape coefficient decreases with time and that decrease is greatest durig first two hours of draping, and smallest after 24 hours of draping.

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THE INFLUENCE OF PHYSICAL-MECHANICAL CHARACTERISTICS OF FABRICS FOR GARMENT THAT IS USED FOR SPECIAL USAGE ON THE VALUES OF RESSISTANCE TO WATER VAPOUR

Mirjana RELJIĆ, Dragan ĐORĐIĆ & Vasilije PETROVIĆ

Abstract: *The influence of the garment on the human body is very big and it can be seen through heat exchange between the body and environment. Because of that, the philosophy of the garment can be included in interdisciplinary science. The surveys in this field have been conducted for the last several decades. At first, the demand for these surveys originated from the army. As military uniform has special usage, soldier should be comfortable in it, and it must fulfill certain functional requirements, there was the need for researching thermo-physical characteristics of the fabrics. These were first demands for systematic and quality researches related to the influence of the garment on human body in the way of heat exchange between body and environment. Garment physiology has its biggest contribution in the production of fabrics for special usage.*
Thermo-physiological comfort includes good physical-heat balance at minimum body efforts in different climate conditions as well as during different physical activities. Garment comfort i.e.wearing comfort is one of the main conditions for defining garment quality during wearing.

Key words: ISO 11092, Ret, Heat resistance

1.Introduction

Wearing comfort of the garment is one of the most important characteristics of apparel products, especially ones that are in direct contact with the skin. There are two kinds of comfort: contact comfort and physiological comfort. Contact comfort is usually defined by surface characteristics of textile material, while physiological comfort is usually defined by capability of heat and moisture transmission through textile surface.
Textile materials form special microclimate on the surface of the human body and, in that way, ensure heat comfort during wearing. Microclimate of the human body is generally defined through water permeability, water vapour and air, as well as with insulating characteristics. Interactions between garment and human body have been researched for a long time and these characteristics are defined as bio-physiological characteristics.
Modern textile materials used for making garment products are projected in such a way that they at the same time prevent water penetration from the fabric face to back, while, on the other hand, enables flow of the water vapour from the back to face of textile material providing appropriate heat permeability depending on the purpose of the garment product. In literature, these materials are often marked as bio-functional textile materials.

2. Human body as complex thermo-regulative mechanizam

The balance between produced heat of human body and its exchange with the environment is carried out by conduction, convection, radiation and vaporing. Body-garment-environment system must be stable, because only stable system gives feeling of comfort or discomfort with a person who wears that garment product. Thus, the energetic balance is maintained in very small limits of tolerance, i.e. small limits of inner temperature of the body.

Every human body is individual and is different from other bodies in the way of weight, height and structure, i.e.proportional mass distribution. Furthermore, very important researches of human body include physiological, bio-chemical and physical surveys and t they can be observed through following

characteristics: metabolism, evaporation, surface skin temperature, rectal temperature, ear temperature, heart rate and specific skin surfaces.

Garment can be defined through three common characteristics: total insulation, i.e. resistance to heat penetration, resistance to moisture penetration and resistance to wind penetration and through three structural characteristics: distance from the skin to outer surface of the garment (environment), mass and porosity.

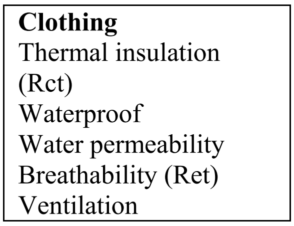
The environment is defined by: temperature, relative moisture and radiative sun heat as well other heat sources.
During human movement body and garment have special relationship, and some changes occur: reduction of air film thickness on the outer garment surface, in and between garment layers there is stronger airflow, outer garment surface becomes wet with sweat, contacts produce occasional effects: feeling of warmth and cold, and inertial effects related to sweat evaporation. Comfort, i.e.thermo-physiological influence of the garment is related to garment heat resistance (R_{ct}) and the resistance to the water vapour flow (R_{et}).

3. Devices and methods for measuring thermo-physiological comfort

Many devices and research methods simulating thermo-regulation of human skin have been developed for measuring thermo-physiological comfort of textile materials during wearing.
One kind of these devices is heat doll, or segments of doll‘s body such are arm and leg. The doll is a complex measuring device made in the shape of human body that simulate heat exchange between human body and environment. It is made according to fundamental principles that are the same for hot plates. The dolls are divided into many segments, which are individually regulated, and it enables monitoring values both for the whole body and for individual body parts. There are many standards that can be applied on this device such are: ASTM F 1291 (Standard Test Method for Measuring the Thermal Insulation of Clothing Using a Heated Manikin), ASTM F 2370 (Standard Test Method for Measuring the Evaporative Resistance of Clothing Using a Sweating Manikin), ASTM F 2371 (Standard Test Method for Measuring the Heat Removal Rate of Personal Cooling Systems Using a Sweating Heated Manikin), ASTM F 1720 (Standard Test Method for Measuring Thermal Insulation of Sleeping Bags Using a Heated Manikin)
The other kind of devices is hot plate used for testing resistance to heat penetration and water vapour of textile surfaces, which simulates processes that are related to human skin (Umbach, 1984; McCullough, 1990; ISO 11092,1993). Standards that are used for this kind of devices are ASTM F 1868 (Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate) and ISO 11092:1993 (Textiles - Physiological effects - Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test)).

During the hotplate testings, the sample is positioned on the square plate and the plate is heated until it reaches constant temperature that is similar to human skin temperature.
Furthermore, while testing water vapour flow through textile surface, the water is added to the surface and the plate is covered by barrier (microporous membrane and film) that prevents the contact between water and textile product, and enables water vapour penetration. The parameters that can be calculated on the basis of conducted testings on hotplate are heat resistance and resistance to water vapour penetration. On the basis of mentioned parameters, it is possible to define water vapour permeability and water vapour permeability index.

ISO 11092:1993 standard is used for defining method for measuring heat resistance and resistance to water vapour in the conditions of thermodynamic balance of fabrics, films, coats, foamy materials and



leather that are used for garment production and production of fillings, sleeping bags and similar textile products.
According to this method, the tested sample is positioned on the electircal heating plate with conditioned air that flows over the upper surface. During the definition of heat resistance R_{ct}, the heat flux that flows through the tested sample in the conditions after restoring thermodynamic balance is measured. The method that is described in this international standard enables measuring heat resistance of R_{ct} material and that is defined by subtraction of heat resistance at air border layer over the surface of the measuring device from air border layer of tested sample, both were measured under the same conditions.
For defining water vapour resistance R_{et}, electric the membrane that is water vapour permeable covers porous heat plate, bit it is not permeable for water in liquid state. The water supplies heat plate with vapour and runs through membrane in the shape of steam. So there are no contact between liquid water and tested sample. When the tested sample is positioned on the membrane, the heat flux that is needed for maintaining heat plate temperature is the measure of the quantity of water vapour and it is used for defining resistance of water vapour of R_{et} material, by subtraction of resistance of water vapour of air border layer over the surface of testing device from air border layer of tested sample, both were measured under the same conditions.

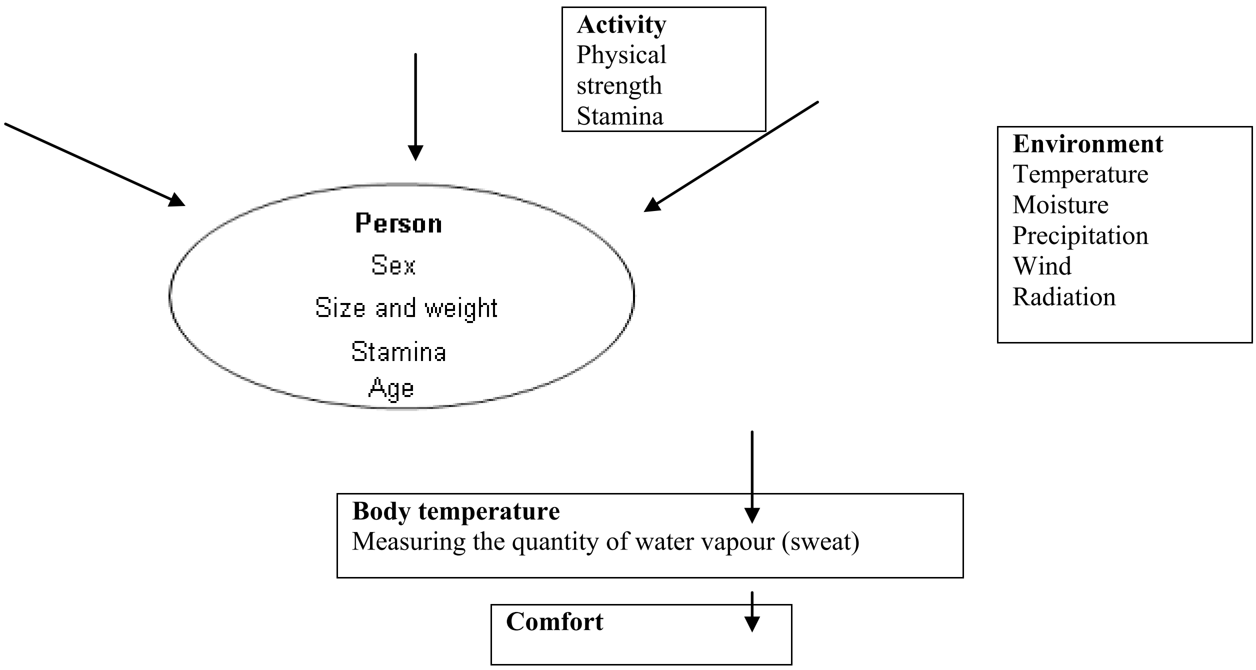


Figure 1. Schematic presentation of heat balance

Heat resistance R_{ct} is the difference between temperatures of two material faces that are divided by the resultant of heat flux per unit area in the direction of gradient. Dry heat flux can be consisted of one or two conductive, convective components and radiation component. Heat resistance R_{ct}, is expressed in m^2K/W units and is specific value of textile materials or the component that defines dry heat flux transversal to given surface, as a reaction to stable applied heat gradient. The temperature of measuring unit T_m is 35°C, air temperature T_a 20°C, relative humidity R.H. 65% and air velocity v_a is 1mph.
The heat resistance is calculated according to:

$$R_{ct} = \frac{(T_m - T_a)\cdot A}{H - \Delta H_c} - R_{ct0}$$

Where:
R_{ct}-heat resistance expressed in m^2K/W
T_a-air temperature in tested area expressed in [C°]
T_m – measuring unit temperature expressed in [C°]
H – the heating force of measuring unit expressed in [W]
ΔH_c – the correction of heating force for measuring heat resistance R_{ct}
R_{ct0} – is the constant of the device, expressed in m^2K/W, for measuring heat resistance R_{ct}
A – the surface of measuring unit, expressed in m^2

Water vapour resistance, R_{et}: the difference of water vapour pressure between two material faces divided by resultant of evaporation heat flux per area unit in the direction of gradient. Evaporation heat flux can consist of diffuse and convective component. Water vapour resistance R_{et}, expressed in m^2Pa/W, is a specific size of textile materials or components that defines `latent` evaporation heat flux transversal to given surface, as a reaction to applied stable temperature gradient.
Measuring unit temperature T_m and air temperature T_a is 35°C; air velocity is 1 mph, and relative air humidity R.H. is maintained by the constant at 40%.

Water vapour resistance R_{et} is calculated according to:

$$R_{et} = \frac{(p_m - p_a)\cdot A}{H - \Delta H_e} - R_{et0}$$

Where
R_{et} – water vapour resistance, expressed in m^2Pa/W
p_a – partial water vapour pressure, expressed in Pascals [Pa], in the air of the area that is being tested on temperatures T_a
p_m – partial pressure of saturated water vapour, expressed in Pascals [Pa], on the surface of measuring unit at the temperature T_m.
ΔH_e – correction of heating force for measuring water vapour resistance R_{et}
R_{et0} – the constant of the device, expressed in m^2Pa/W, for measuring water vapour resistance R_{et0}
:
Water vapour permeability index, i_{mt}: relation between heat resistance and water vapour resistance according to the equation:

$$i_{mt} = S\cdot \frac{R_{ct}}{R_{et}}$$

Where: S = 60 Pa/K

i_{mt} is a dimensionless unit and its values are between 0 and 1. 0 value includes materials that do not leak water vapour, these materials have great water vapour resistance, while materials with 1 value have both heat and water vapour resistance.

Water vapour resistance, W_d: the characteristic of textile or composite material, that depends on water vapour resistance and temperature, according to the equation:

$$W_d = \frac{1}{R_{et} \cdot \phi_{T_m}}$$

Where: Φ_{Tm} latent heat of water evaporation at temperature T_m of measured unit, equal to, for example to 0.672 Wxh/g at T_m=35°C. Water vapour permeability is expressed in g/m^{2}hPa.

4. Experimental

Five fabrics with the same raw material content and different surface mass and wire density per weft and warp have been tested (Table 1).

Table 1. Physical-mechanical and chemical characteristics of five fabrics for special usage garment

	1	2	3	4	5
Raw material content ISO 1833-11 ISO 1833-24	50% Co 50% Pes	50% Co 50% Pes	50% Co 50% Pes	50% Co 50% Pes	50% Co 50% Pes
Surface mass [g/m^2] ISO 3801	267,1	211	191,3	161,5	277,6
Wire density [ț/10 cm] ISO 7211/2 -warp -weft	310 172	358 223	362 196	277 196	307 220
Air permeability [mm/s] ISO 9237	31,0	64,6	71,7	336,8	15,5
Yarn count ISO 2060 [tex] -warp -weft	26,2x2 26,1x2	15,8x2 18x2	15,3x2 15,2x2	14,9x2 16,4x2	26,5x2 21,5x2
Weave SRPS F.CO.012	Rip-stop	Rip-stop	Rip-stop	Rip-stop	Rip-stop

Testing Ret values is conducted on the device with hotplate, according to ISO 11090:1993 (Figure 2).

Figure 2. Device for measuring resistance of water vapour flow (Ret)

During testing, the constant temperature of measuring unit was maintained, Tm, and air temperature at 35C°, air velocity at 1 mph, relative air humidity RH=40%, which is equal to partial water vapour pressure p_a at 2250 Pa. partial water vapour pressure p_m that is directly applied to the surface of measuring unit is equal to the saturated vapour pressure at surface temperature, i.e.5620 Pa.

Table 2. Results from 15 measurings of Ret values [m^2Pa/W] on the sample 1.

Number of measuring.	Ta	Tm	Ts	Ts1	Va	R.H	H	Ret
1	35.3	35.00	34.85	34.45	0.84	40.5	18.16	2.22
2	35.3	35.00	34.85	34.45	0.84	40.5	18.12	2.23
3	35.3	35.00	34.85	34.45	0.84	40.5	18.08	2.25
4	35.3	35.00	34.85	34.45	0.84	40.4	18.04	2.27
5	35.3	35.00	34.86	34.45	0.84	40.5	17.89	2.33
6	35.0	35.00	34.97	34.56	1.09	40.0	18.27	2.17
7	35.0	35.00	34.97	34.56	1.09	40.0	18.38	1.13
8	35.0	35.00	34.97	34.56	1.09	40.0	18.60	2.04
9	35.0	35.00	34.97	34.56	1.09	40.0	18.71	2.00
10	35.0	35.00	34.97	34.56	1.09	39.9	19.04	1.87
11	35.1	35.00	34.97	34.57	1.09	39.5	17.53	2.48
12	35.1	35.00	34.97	34.56	1.09	39.5	17.60	2.45
13	35.1	35.00	34.97	34.56	1.09	39.5	17.69	2.42
14	35.1	35.00	34.97	34.56	1.09	39.5	17.72	2.39
15	35.1	35.00	34.97	34.57	1.09	39.4	17.93	2.31
								2.24

Table 3. Results of 10 measurements of Ret values [m^2Pa/W] on the sample 2

Number of measuring.	Ta	Tm	Ts	Ts1	Va	R.H	H	Ret
1	35.2	35.00	34.99	34.64	1.06	39.1	18.67	2.02
2	35.2	35.00	34.99	34.64	1.06	39.1	18.69	2.01
3	35.2	35.00	34.99	34.64	1.06	39.1	18.69	2.01
4	35.2	35.00	34.99	34.64	1.06	39.1	18.70	2.00
5	35.2	35.00	34.99	34.64	1.06	39.1	18.85	1.95
6	35.3	35.00	34.99	34.62	1.07	38.3	19.01	1.89
7	35.3	35.00	34.99	34.62	1.07	38.3	18.96	1.90
8	35.3	35.00	34.99	34.62	1.07	38.3	18.93	1.93
9	35.3	35.00	34.99	34.62	1.07	38.3	18.85	1.95
10	35.3	35.00	34.99	34.62	1.07	38.3	18.76	1.98
								1.96

Table 4. Results of 10 measurements of Ret values [m^2Pa/W] on the sample 3

Number of measuring	Ta	Tm	Ts	Ts1	Va	R.H	H	Ret
1	35.1	35.00	34.98	34.69	1.07	41.6	20.11	1.50
2	35.1	35.00	34.98	34.69	1.07	41.5	19.92	1.56
3	35.1	35.00	34.98	34.69	1.07	41.5	19.54	1.69
4	35.1	35.00	34.98	34.69	1.07	41.5	19.35	1.76
5	35.1	35.00	34.98	34.69	1.07	41.5	18.98	1.90
6	35.2	35.00	34.99	34.70	1.07	39.7	20.27	1.45
7	35.2	35.00	34.99	34.70	1.08	39.7	20.18	1.47
8	35.2	35.00	34.99	34.70	1.08	39.7	20.09	1.50
9	35.2	35.00	34.99	34.70	1.08	39.7	19.99	1.54
10	35.2	35.00	34.99	34.70	1.08	39.6	19.79	1.61
								1.60

Table 5. Results of 10 measurements of Ret values [m^2Pa/W] on the sample 4

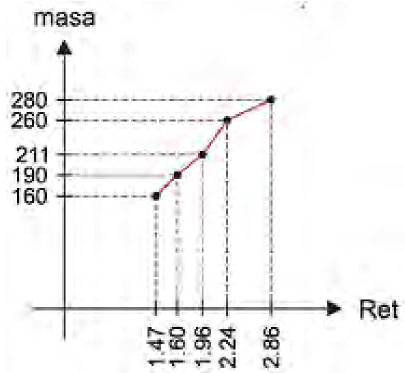
Number of measuring.	Ta	Tm	Ts	Ts1	Va	R.H	H	Ret
1	35.1	35.00	35.03	34.69	1.10	40.4	21.34	1.11
2	35.1	35.00	35.02	34.69	1.10	40.4	20.80	1.28
3	35.1	35.00	35.02	34.69	1.10	40.3	20.45	1.39
4	35.1	35.00	35.02	34.69	1.10	40.3	20.33	1.43
5	35.1	35.00	35.02	34.69	1.10	40.3	19.98	1.54
6	35.0	35.00	34.92	34.69	1.10	38.0	20.63	1.33
7	35.1	35.00	34.91	34.69	1.10	38.0	20.06	1.51
8	35.1	35.01	34.91	34.69	1.10	38.0	19.87	1.58
9	35.1	35.01	34.91	34.69	1.10	38.0	19.52	1.70
10	35.1	35.01	34.91	34.69	1.10	38.0	19.05	1.87
								1.47

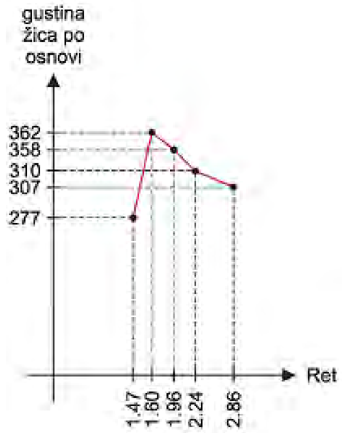
Table 6. Results of 10 measurements of Ret values [m^2Pa/W] on the sample 5

Number of measuring..	Ta	Tm	Ts	Ts1	Va	R.H	H	Ret
1	35.1	35.00	35.00	34.56	1.04	40.7	16.87	2.79
2	35.1	35.00	35.00	34.56	1.04	40.7	16.76	2.84
3	35.1	35.00	35.00	34.56	1.04	40.7	16.67	2.88
4	35.1	35.00	35.00	34.56	1.04	40.7	16.51	2.96
5	35.1	35.00	35.00	34.56	1.04	40.7	16.36	3.03
6	35.2	35.00	35.00	34.55	0.93	40.2	16.92	2.76
7	35.2	35.00	35.00	34.55	0.93	40.2	16.85	2.80
8	35.3	35.00	35.00	34.56	0.93	40.2	16.78	2.83
9	35.3	35.00	35.00	34.56	0.93	40.2	16.72	2.86
10	35.2	35.00	35.00	34.56	0.93	40.1	16.66	2.89
								2.86

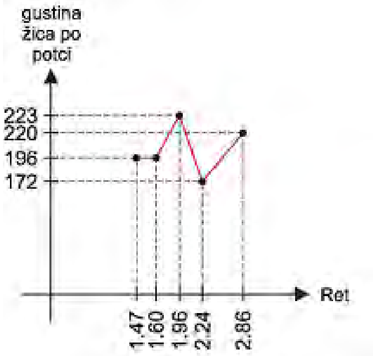
Table 7. Mean values of Ret [m^2Pa/W] measured on five samples

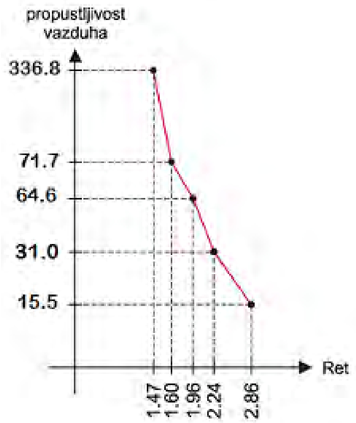
	1	2	3	4	5
Ret (T=35 C°, RH=40%) [m^2Pa/W] ISO 11092	2,24	1,96	1,60	1,47	2,86





Histogram 1.Contrasted values of surface mass and Ret values   Histogram 2.Contrasted values of wire density of warp and Ret values



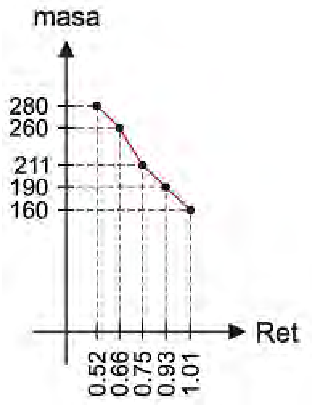


Histogram 3.Contrasted values of wire density of weft and Ret values   Histogram 4.Contrasted values of air permeability and Ret values

Analyzing histogram 1, we can notice that, with the increase of surface mass, the Ret value increases linearly. Furthermore, the increase of air permeability leads to decrease of Ret values (histogram 4). Histograms 2 and 3 show that increase of wire density increases Ret values, and, at the same time, water vapour resistance at thermodynamic balance conditions decreases.

Table 8. The values of water vapour permeability for five fabrics

	1	2	3	4	5
Wd [g/m^{2}hPa]	0,6644	0,759	0,930	1,013	0,520



Histogram 5. Compared values of water vapour permeability Wd and surface mass on five samples.

According to histogram 5, it can be noticed that water vapour permeability value Wd decreases with the increase of surface mass.

5. Conclusion

The feeling of comfort is a very important thermo-physical characteristic of garment product. Nowadays, there is a great demand for comfortable clothes, especially in the field of army equipment, but also in sports and daily clothes.
The Ret value, i.e.water vapour resistance in thermodynamic balance is one of the very important values for textile materials. This value defines comfort. Five fabrics have been analyzed. These fabrics will be used for the special usage garment. Their physical-mechanical characteristics (surface mass, wire density for warp and weft and air permeability) were contrasted with Ret values.
After measuring, it was concluded that with the increase of surface mass Ret values also increase, and with the increase of air permeability, Ret value decreases. Decrease of wire density leads to increase of Ret value.

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THE ANALYSIS OF USAGE CHARACTERISTICS OF COTTON SOCKS

Dragan ĐORĐIĆ, Vasilije PETROVIĆ & Mirjana RELJIĆ

Abstract: *Men's cotton socks are the basic part of men's clothing. The quality of socks plays an important role in usage characteristics. The usage characteristics of socks can bee seen through the following: yarn count, abrasion, punching toes or heels, knitting density, water vapour permeability. This paper compares research results obtained from the yarn with package and yarn decomposed from the sock. The results of the research show the decreas of the quality during waring,i.e.abrasion that affects the lifetime of cotton sock.*

Key words: abrasion, socks, cotton, yarn strength

1. Introduction

Men's socks are essential clothing product. The function of a sock is to protect the foot from weather conditions (cold), as well as from mechanical impacts of shoes. The socks can be made in different raw material contents, but the most common yarn is cotton, either in 100% raw material content or in a mixture with PA, PES and other fibres. The weave is very important for aesthetic appearance of the sock. The sock that is being tested is weft single weave sock. The raw material content and wave have a considerably big influence on the wearing comfort and usage characteristics of socks.

2.usage characteristics of men's socks

Socks are one of the most common knit goods that are made by knitting staple of filament yarns with different raw material content (cotton, wool, polyamide, polyacryl). Cotton socks are soft, have good sweat and water vapour absorption, easy to maintain even if they are prone to loop cleaving. Men's socks are usually knitted from the yarn made of polyamid staple fibres. Those socks are very soft, resistant to abrasion, long-term, washable and they do not shrink. The drawback of these socks is that they cause feet sweating. Furthermore, a very important production aspect is production of compression elastic socks used in medicine. They are used for preventing thrombosis in internal veins. Raw materials that are used in production of these socks are polyamid, cotton, viscous and elastane fibres, or their mixtures. This type of socks used in medicine is made of weft right-right knitted fabric 1:1. Stretching and elasticity of these socks depend on the number of elastane threads.
Socks can be produced on machines with flat or round needle bed. The type of weave used in sock production has great influence on their appearance, durability and elasticity. Weft Glat and warp-knitted weaves are used for socks knitting. These socks have soft surface, are stretchable in both directions and have very good count (women's socks). The drawback of this weave is that it is prone to rip the loops in case of damaging. Mesh weave is usually used for production of women's socks. These socks are not as soft as socks in glat weave, but they are more durable. They are less prone to ripping loops and some of them do not rip loops at all, so the hole is created when they are damaged. The main drawback of this weave is lower elasticity. Thus, if a sock is not adjusted to the foot , it causes tension in some of its parts, which causes lower wearing comfort and shorter durbility. Sock abrasion is an inevitable problem, which is often noticable on heels, toes and foot.
The abrasion can mostly be noticed during wearing and walking. The washing also affects the durability of socks.

he results of abrasion are creation of nubs, spacing in density and finally the hole in the sock. If the sock is consisted of natural and synthetic yarns, first to be removed will be natural one, which gives the sock required characteristics. The sock will be left only with synthetic yarn, which gives the sock undesirable appearance and lowers the thickness of the sock (Table 1).

	Cotton socks
Aesthetic appearance	Changable
Durability	Long
Resistance to abrasion	Moderate
Breaking force	Moderate to strong
Elongation	Small
Comfort	High
Absorption	Excellent
Thermal protection	low
Appearance cosistency	Excellent
Elasticityt	Low
Dimensional stability	Moderate
Elastic recovery	Moderate
Maintaining	Machine washing and drying

Table 1. Usage characteristics of cotton socks

3. Single-cylinder automatic stocking knitter for production of men's socks

According to the type of socks they produce, these automats can be divided in:
- Single-cylinder automatic for production of women, men and children‘s stocking,
- Double-system stocking knitter for production of men and women‘s stocking, and
- Single-cylinder automatic stocking knitter for production of women‘s stocking.

Men‘s socks that have been tested were made on single-cylinder automatic, with 17 needles per 1 inch (machine count). Figure 1 shows the automatic stocking knitter made by Lonati (462 3 3/4").

Figure 1. Automatic stocking knitter Lonati 462 3 3/4" used for production of men, women and children's stockings.

3.1 Mechanisms for creating loops

The basic elements used for creating loops are latch needles and sinkers. Latch needles are placed in needle cylinder, and the sinkers are in sinker mechanism. Besides needles and sinkers, this mechanism is consisted of: needle cylinder, needle pushers, sinker ring, sinker crown, needle and sinker locks, elements used for creating loops and fingers, thread positioners and the device for changing knitting density.
During loop creation, the needles move vertically in channels of needle cylinder. Locks through needle butt move the needles. The sinkers move horizontally in radial channels of sinker ring and crown towards the center of cylinder and vice versa. Sinker locks run sinkers with sinker butts.
All automatic stocking knitters usually produce seamless stocks by creating loops. The locks are very important for creating loops because they run needles. The locks are positioned around the cylinder and they are the system of steel parts of particular shape that affects needle butts and needle pushers. This action enables the work of some needles. Automatic stocking knitters usually have double acting locks that are positioned in basic knitting system and are used for production of heels and fingers. The one exeption is the machine with one-sided spinning cylinder used for production of pipe stockings. Nowadays, there are many different shapes of heels at produced stockings. Some of them have conventional, Y-shape, wedge shape, etc. The methods of heel production are different in relation to needle arrangement that is included or not in the working process. The specificity of heel and finger production is necessity for spherical shape. The procedure in these processes is usually consisted of turning off needles with high butts, gradual subtraction of needles with short butts and turning on needles with high butts.

4.experimental

4.1Testing cotton yarn (100% Co) from package before knitting process and the yarn decomposed from finished and treated sock.

All testings have been conducted according to SRPS and ISO standards. Table 2 shows the usage table of physical and chemical yarn characterstics (Table 2)

SRPS EN ISO 2060:1994 – Defining linear density of yarn
SRPS EN ISO 2062 : 2002 – Defining breaking force and breaking elongation
EN ISO 2061: 1994 – Defining twists in yarn
SRPS F.S2.013 :1986 – Defining wire density,i.e. rows and wales
SRPS F.S2.022 : 1958 – Defining resistance of fabric to sprinkling
SRPS F.S2.023:1958 – Defining resistance to abrasion
ASTM E-96 :2000 – Testing water vapour permeability
ISO 1833-11: 2006 - Defining raw material content of cotton

	YARN FROM THE PACKAGE	YARN DECOMPOSED FROM FINAL PRODUCT
RAW MATERIAL CONTENT (ISO 1833-11)	100% Co	100% Co
COUNT (SRPS EN ISO 2060)	20X1 tex	20X1 tex
	50/1 Nm	50/1 Nm
BREAKING FORCE (SRPS EN ISO 2062) -mean value -coefficient of strength variation	12,65 cN/tex 252,9 cN 9,6 %	9,57 cN/tex 191,5 cN 9,9 %
BREAKING ELONGATION (SRPS EN ISO 2062)	2,2 %	1,8 %
TWISTING OF SINGLE YARN (EN ISO 2061)	Z 798	Z 815

Table 2. The results of testing cotton yarns

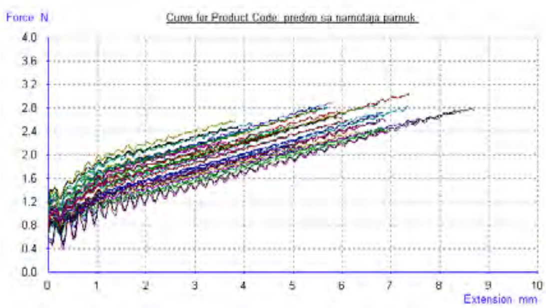


Diagram 1. Cotton yarn from package, treated breaking force and elongation

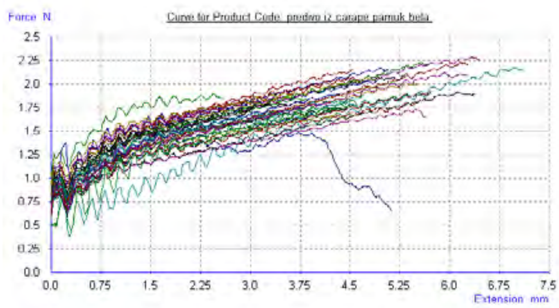
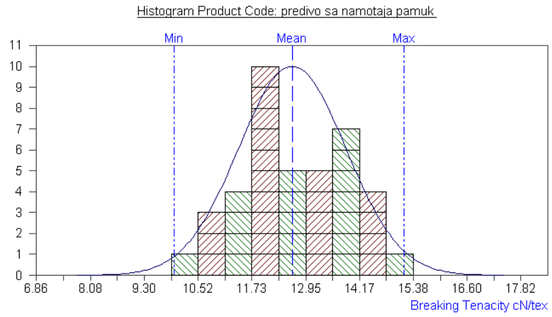
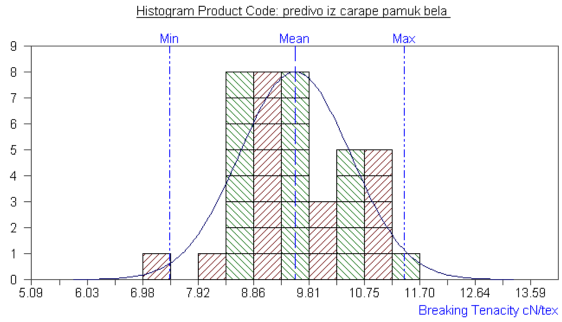


Diagram 2. Cotton yarn decomposed from sock, breaking force and elongation

In diagram 1, we compare breaking force of the yarn from package to the yarn decomposed from the sock.
In diagram 2, we compare breaking forces of cotton yarn from package and yarn decomposed from the sock.



Histogram 1. Cotton yarn from package,
from treated
breaking force in cN/tex



Histogram 2. Cotton yarn decomposed
sock, breaking force in
cN/tex

4.1Testing usage characteristics of finished stocking

Raw material content (ISO 1833-11:2006):	Pamuk
Calf/foot	100 %
Heel /toes	100 %
Knitting density(SRPS F.S2.013:1986): -number of rows per length -number of loops per width	 107 r/10 cm 100 p/10 cm
Penetration force(SRPS F.S2.022:1958): - Heel /toes	 36,6 daN
Resistance to abrasion (SRPS F.S2.023:1958) -Number of rotations until the first hole appears -Mass loss Mass at the beginning of abrasion Mass at the end of abrasion Total loss of mass at the end of abrasion	 46000 1,0765 gr 1,0065 gr 0,07 gr (7 %)
Water vapour permeability (ASTM E-96:2000)	1899,5 $g/m^2/24^h$

Table 1.Results of testing on cotton sock

Testing of socks whose chemical and physical characteristics are shown in table 3. The value of breaking force can be digitaly read in diagram 3.
Figures 2,3,4,5,6,7,8 show the abrasion process after different number of rotations and the changes were photographed from different angles.

Diagram 3. Heel and toe penetration on cotton sock abrasion

Figure 2. The appearance of cotton sock before

Figure 2. The appearance of cotton sock before abrasion

Figure 3. Photo of cotton sock after 10000 rotations rotations in the in the direction of rows.

Figure 4. Photo of cotton sock after 10000 direction of loops.

Figure 5. Photo of cotton sock after 4000 rotations rotations in the in the direction of rows

Figure 6. Photo of cotton sock after 4000 direction of loops

Figure 7. Photo of cotton sock after 46000 rotations in the direction of rows

Figure 8. Photo of cotton sock after 46000 rotations in the direction of loops.

5. Conclusion

Comparing obtained results from chemical and physical testings we can conclude that, asfar as yarn count is concerned, there were no changes. The difference in twist at single yarn is very small. The main change can be noticed in breaking force and elongation, i.e.breaking force of the yarn from package is bigger than breaking force of the yarn decomposed from the sock (for more than 24,3%). Breaking elongation is also bigger at the yarn from package than the yarn decomposed from cotton sock (for more than 18,2%).
Obtained results of breaking force show that technological procedure during production process caused weaking of breaking force.
By measuring test tube from finished sock prior and after the abrasion, we can notice mass loss (for 7%). Given percent of mass loss indicates to worse usage characteristic of the sock, i.e.durability will be shorter in relation to the sock made from PA fibres or from Co+PA fibres.

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FASHION AS INSPIRATION

Snežana MILOŠEVIĆ

Abstract: *This paper explores two complex themes, actually two aspirations of the fashion designers. Eternal striving for new innovative inspirations, discovering new forms, completely perfect creations that represent something entirely new. Another aspiration is a recognition that fashion designers are artists. Their connection with the art has been created by studying various periods and movements of the art history as a main source of their inspiration.*

Key words: Soybean fiber, natural dyeing, madder, drooping brome, buckthorn, gallnut.

1. Introduction

The fashion in the civilization is one of the most influential phenomena, from the Renaissance to now. It has subjugated to itself more areas of the world of modern man and almost became his second nature. Understanding of the fashion therefore should contribute to the understanding of ourselves and our actions in life. The fashion affects most people's relation towards themselves and towards others, even though many deny it, but the denial is often in conflict with their consumer habits, so therefore the fashion is a phenomenon that takes an important place in our attempts to understand ourselves in our own historical situation.
The fashion development as a historical phenomenon shows us the essential features of modernity by constant trend towards 'new'.

German philosopher Walter Benjamin wrote: 'fashion is an eternal return of new '.

2. New as a fashion principle

When the fashion came into being, it was one of the most important events in world history, because it indicates the direction of modernity. It is commonly claimed that fashion was created in the late middle age, possibly in the early Renaissance. At that time Europe experienced a strong economic development, and economic changes have created rapid cultural changes. The changes of clothing began to be noticeable and were not accidental or rare. These changes were to be pursued for its own sake. The clothing was changing its basic forms rapidly, and the changes of the accompanying details were faster and more varied. During this period occur the creative clothing, designs, new colors, textures, also appear the variations in the width and length of clothing and the variations in the forms of the hats and shoes. This tendency increased as time goes by. The change of clothing evoked the joy. The changes in styles of dressing for centuries were available only to a class of rich people, but as the middle class began to grow, they gradually included the ever-expanding number of people because they also wanted to be dressed up 'by fashion'.

In the eighteen century the first editions of the fashion magazines appeared, such as English Lady's Magazine (1770) and German Jurnal des Luxus und der Moden (1786).These magazines accelerated the changes of fashion, thus the information what's **in** and what **out** disseminated far more quickly and coming to much more people than before.

The concept of 'new' is relatively new. Of course, that people were always aware that some things are newer than the others. There are examples of using the Latin term 'modernus' which means a new or newer and is the origin of the term 'modernity', even from the sixth century. However, much later the distinction between 'old' and 'new' received wide application, and during the eighteen-century the notion of a 'new' has spread widely. The Italian Philosopher Gianni Vattimo indicates that the epoch of modernity claims that to be modern is a worthy effort, or more specify the 'modern' means to be 'new'. Practically all fashion theoreticians point out 'new' and constant series of the 'new' objects which replace the objects that were 'new' but have become 'old' as the baseline of fashion. Kant is one of the most important theoreticians of fashion that emphasizes 'new' as the basic line mode: 'The novelty is what makes fashion beloved'. Erlier, the fashion theoreticians have connected the beauty and the fashion. Kant says that it does not have to deal with beauty, it can be 'degenerated into something adventurous, kinky and disgusting'. Thus it deals with 'competition' more than it deals with an approach of 'good taste'. In this, Kant also shows the more modern fashion views than the other theorists who associated the fashion with the pursuit of beauty.

The beauty in fashion is not even in the pursuit of eternity. Sometimes, there is no beauty in functionality. As to modern aesthetics, the beauty is in the pass rate of short-lived items and it is absolutely modern.

The request for the originality is eternally present and through the history observed in the artistic avant-garde. The worship of the new at the Avantgarde was conducted with the aim of creating a final, which can not be overcome by something more new. When an artist or a creator of fashion designs something new, the elements from the history of art and fashion could be seen, 'a copy has always been present as a basic precondition of the original'. This all suggests to us that fashion has never had an illusion of eternity, and it is always supposed that everything would soon be outdated by something newer.

Lash Fr. H. Svensen says that the fashion lives in the game between forgetting and remembering and always remembers its past and turns to it in cycles, but also forgets that the past is just a past; the fashion in its essence must be absolutely modern.

The essence of fashion is reflected in a constant search for the originality and innovation, which moves in cycles, where one cycle is the time that passes from when a fashion is introduced until replaced. The fashion cycles have accelerated since the nineteenth century and especially in the last 50 years, which leads to that everyone fails to create the radically new styles. This contributed to the recirculation rate of the previous styles, as an inspiration for many collections. When we say the recirculation that does not mean that these are direct copies of earlier garments, but finding inspiration in different elements of earlier styles of fashion, or less extreme collections of specific styles.

Many creators, besides that they have previously recirculated fashion trends and were inspired by them, have also did the same thing with their own previous collections and turned them into new collections. Diane von Furstenberg explicitly pointed out that in her collection of the 2001th made a reproduction of a dress that launched the 1972nd, relaunching it with the completely same advertising that had been used before. Dolce & Gabbana, Prada and the other creators have opened outlets where you can find models from the previous collections. By order are being produced the earlier models of shoes from Manolo Blanik Collection, as Fendi does with handbags.

Fashion and art

Often present question are the fashion designers artists or is it just their desire?

Fashion and art are connected more often than we are usually able to notice it. Relatively often we could encounter with notions that tie them to specific artistic periods, such as Renaissance and Baroque style, minimalistic or retro.. During the eighteen century there was a separation of art from trades, tailors remained within the trades and clothing was placed in the inartistic sphere. Around 1860 when was introduced haute couture (high fashion), fashion has had the ambition to be recognized as a full-fledged art. Charles Frederick Worth and Paul Poiret have had this ambition. Worth has taken the initiative to release a fashion designer from the role of tradesman, who is fully subordinated to the wishes of customers, to free designer who, in accordance with romantic art view creates the inspiring subjective works. In Paris, the 1857th opened his own fashion house and was the first true 'King of Fashion'. He used his creativity in selecting materials, design development, clothing production and has began to do the same thing that artists do - to sign the clothes and to put marks on. Worth led the fight of fashion designers for their full recognition as the artists. It was noticeable that his clothing style was inspired by art, he was collecting the paintings and antiques and has begun including the photographers. A strong desire for the acquisition of artistic recognition he had and therefore organized the art exhibitions and related events. He categorically said in 1913 " I am an artist, not a tailor", also to his creations he has began to give names instead of numbers, which has given a symbolic dimension. Paul Poiret was the first one who had shown the fashion like a luxurious social event. At his time the art was used to enhance the cultural capital of a designer. Such an example was followed by Coco Chanel, who had spent a lot of time on making contacts with famous artists, supported the artistic events, dance performances, had arranged sumptuous feasts with the artists in order to increase her cultural capital.

During the 1980s and the 1990s, there has been a rapid convergence of fashion and art. Many fashion designers have been inspired to use the recognized artists for their campaigns, such as Cindy Serman who made fashion photography for Comme des Garson and Tracey Emin who made the advertising campaign for Vivienne Westwood. Also, many fashion companies sponsor artists, museums of contemporary art, Calvin Klein has sponsored several exhibitions, while Gucci has sponsored the sculptor Richard Seru and Vanessa Beecroft performance artist. During this period, the Metropolitan Museum of Art had set out an exhibition of Yves Saint-Laurent and from then a series of exhibitions of art and fashion have begun.

Designing clothes was inspiring for visual artists: Henri Matisse, Salvador Dali, Gustav Klimt who was married to fashion designer Emilie Flog and designed clothes. The famous designer Yves Saint-Laurent made a collection inspired by Mondrian paintings with characteristic rectangulars in bright colors, black lines, he also designed interesting shirt models inspired by Andy Warhol's and Roy Lichtenstein's paintings, unusual skirt forms inspired by Picasso.

After all this we can come to a conclusion that the art is a rich treasury for the fashion studying and for getting new ideas and inspiration to create a new fashion. The fashion designers are constantly engaged in researching untapped possibilities of form, texture, color and ornamentation, to express their inspiration by good creation. Weather this creation will be good in functional and aesthetic sense, depends on its inventivity, sense for fashion trends and constant readiness for a art playing. In order to come up to new fashion solutions, it is also extremely important a skill of fitting and combining the highly stylized ethno motifs with contemporary and even futuristic shapes that are also derived from some former shapes.

4. Model

By studying this topic, an inspiration to create a model that would be a combination of various elements of the artistic periods and movements certainly has appeared. A model originated from the study of futurism, the search for balance between speed, movement, elements of architecture. A dress reminds of a sculpture, that could be seen in its form as well as an influence of urban city life. It consists of two parts a playful skirt and a corset.

The upper part consists of the corset - styled plisse with the pleats as futuristic architectural elements that is enriched with the detail on one shoulder, that gives a dose of refinement and femininity.

The lower part of the dress is in 'bubble' form. By this constructor‘s solution a volume is achieved that emphasis a feeling of glamour but also stylistic precision.

5. Conclusion

By studying this topic a more philosophical reflection about fashion may prevail and it should be like this as long as we look at fashion as a way to shape and inspire our life and appearance, without the tendency to change our essence. After all these studies the conclusion is that the fashion is a multiple phenomenon which has a certain meaning, but in reality depends on an acceptance extend.

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DESIGN OF EDUCATIONAL SOFTWARE FOR HAND WEAVING LEARNING

Ljubica KAZI & Vera ĐEKIĆ

Abstract : *This paper presents design of educational software that could be used in the process of hand weaving teaching and learning. This software is presented by business process diagram (presenting user and software activities) and user interface design in aim to enable further design and implementation, as well as using in educational process in the field of hand weaving.*

Key words: Hand weaving, educational software, software design.

Introduction

Hand weaving is one of courses that are taught as a subject within textile area formal education at education secondary schools, high schools, colleges and universities. There are also many informal courses in hand weaving that are offered by private and public organizations. Informally, people enjoy working handcraft work, like hand weaving and join hand weaving courses.

Computer aided education bring educational software (Nadrljanski, 2000) as variety of tools that could help students and teachers in the educational process. Educational software was primarily developed as stand-alone executive software that could be deployed at single computer workstations. Introducing Internet in all different areas enabled access to diversity of knowledge and skills resources, so people do not need to attend formal or informal courses. They can just access learning resources or get tutoring on-line.

There are many tools developed as a professional aid in hand waving and weave design. Some of them could be easily used as a part of an automated industry fabrication of these weaves. This paper aim is to present current state of available hand weaving software in the context of education. It will be considered the need for specialized educational software support in this area. We propose design of educational software that could support teaching and learning process in the field of hand weaving. We present our software design in the aspect of student‘s and software activities, i.e. software functions (presented by business process model) and user interface design. This way, we give specification for software development that could lead to implementation of such software. After implementation, this software could be used in hand weaving teaching and learning.

Hand weaving software

There are many software tools created for the purpose of weaving design. Most of them are created in aim to enable professionals create their weave designs with many features enabled in user friendly interface. We explored some of them, such as Pointcarre (PointCarre) and Fiberworks (Fiberworks) PCW Bronze 4.2.

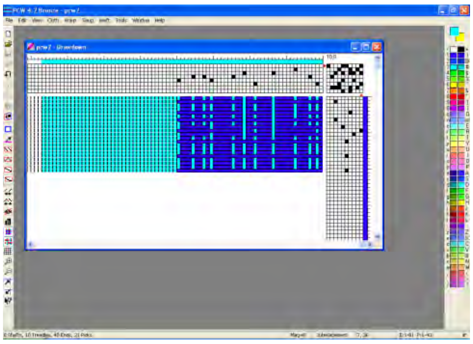

Figure 1: Weaving design software Fiberworks PCW Bronze 4.2

Many of these tools have functionalities, such as those presented for PCW Bronze 4.2 (Table 1). These features enable easy manipulation of threads, warp and weft, as well as cloth as a whole. During the process of using these software, we define warp and weft colors and shema, as well as tieup and cloth preview is presented immediately during setting these elements. This way a user can see effects of his work and change elements as needed.

Table 1: Functional features of Fiberworks PCW Bronze 4.2

ASPECT	***DETAIL***
Color	Choose color from pallete
	Adjust fine color diversity
Drawing	Line, dot, free hand
Zoom	Magnify, Zoom-out
File management	Save, print, load
Cloth	Position
Thread	Add thread, remove thread
Warp and Weft	Fill, Color, Repeat, Thickness …

Educational needs

Thomson and Barton point out that education and professional practice often are in the great difference (specially regarding in textile industry) and there is need for including professional environment knowledge and skills requirements in educational contents (Thomson and Barton 2004). Students often complain that there is no enough tutoring material regarding using professional software, so they use manuals and helps that are provided, or simply use video tutorials that some user put at YouTube, as displayed at Figure 2 (Video for Fiberworks).

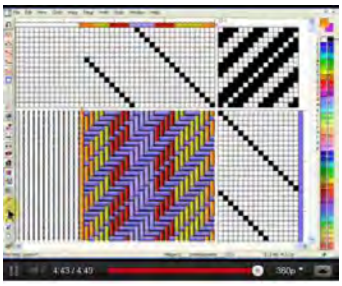

*Figure 2: Weaving design software Fiberworks tutorial from Youtube (*Fiberworks video tutorial*)*

The need for educational software in this field is obvious for several reasons:

1. Students could know how to use specific professional software, but could not know basic principles that rely under these automatisms
2. Students could know how to use specific professional software, but other kind of software that could be available in future professional environment is still to be taught again
3. Students should be able to design cloth, and then to know how to put warp, weft and tieup aspects, i.e. they should be able to go backwards – from the ―whole cloth” to pieces that make them be like that.

Proposed design for educational software in hand weaving

We propose hand weaving educational software (named HWES) that could be working in several working modes:

- Automated mode – students do their design of cloth part, and start automated warp and weft interlacement and whole cloth preview
- Learning mode – students do their design of cloth part and manually do warp and weft interlacement and whole cloth preview, with possible using automated warp and weft interlacement and whole cloth preview for checking their work
- Test mode - students do their design of cloth part and manually do warp and weft interlacement and whole cloth preview, while teachers start automated warp and weft interlacement and whole cloth preview for evaluation of students work

Proposed software working modes with student activities and functional features of software is presented by business process diagram (Figure 3).

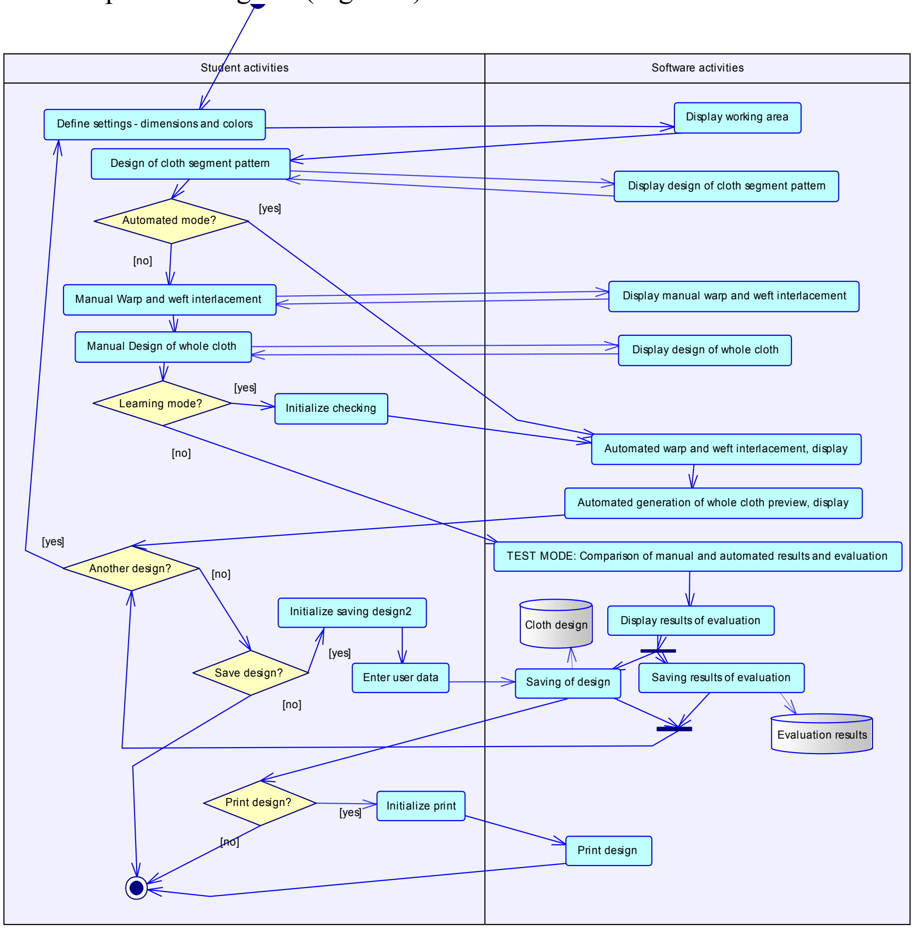

Figure 3: Business process model for automated, learning and test using mode

Software user interface design is created according to needed functional characteristics, defined at business process model (Figure 3). Software is designed so all functionality is organized by software tabs.

First tab (Figure 4) belongs to settings for work mode, cloth segment dimensions (number of rows and columns for cells at design tab) and thread colors.

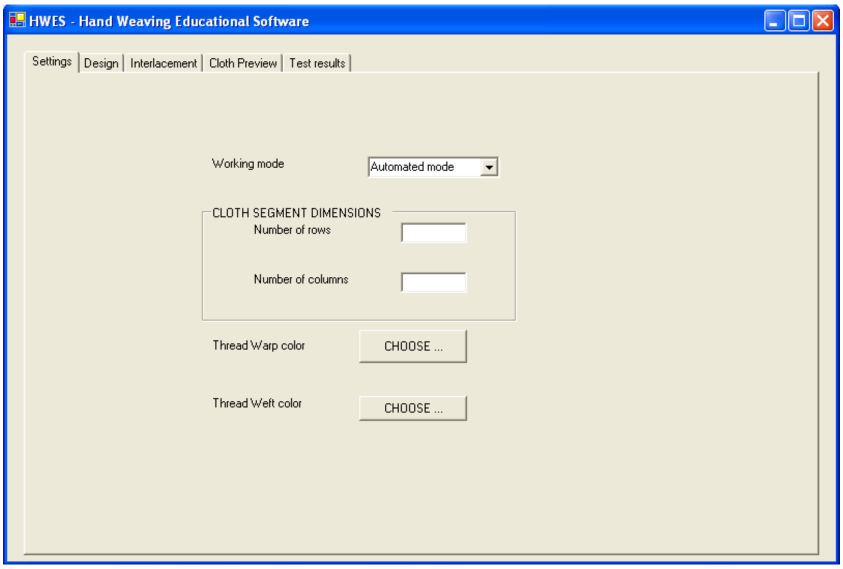

Figure 4. User interface design of SETTINGS tab for HWES software

Second tab (Figure 5) belongs to design where student for each thread of warp and weft choose color and mark by clicking at each cell in cloth segment so cloth segment design appears.

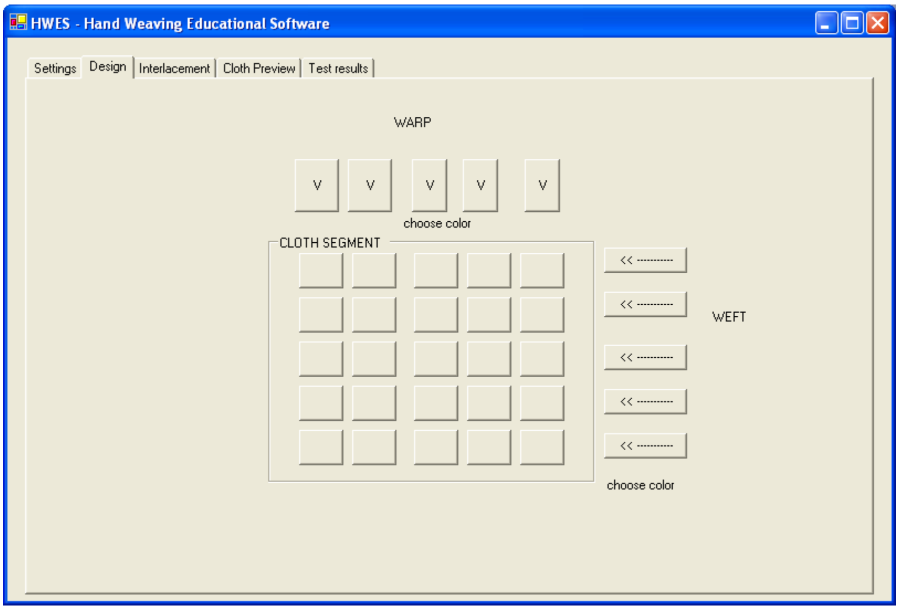

Figure 5. User interface design of DESIGN tab for HWES software

Next tab (Figure 6) is INTERLACEMENT, where student should show (or automated mode will display) interlacement for each warp and weft thread, as well as tieup.

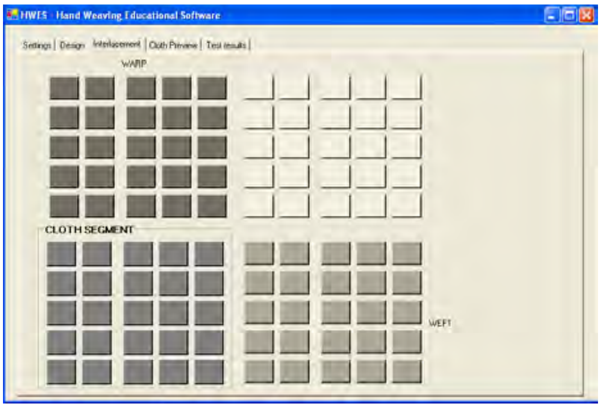

Figure 6. User interface design of INTERLACEMENT tab for HWES software

Figure 7. shows whole cloth preview, made manually by students or automatically by software in automated mode. At this tab it is possible to save design and print it.

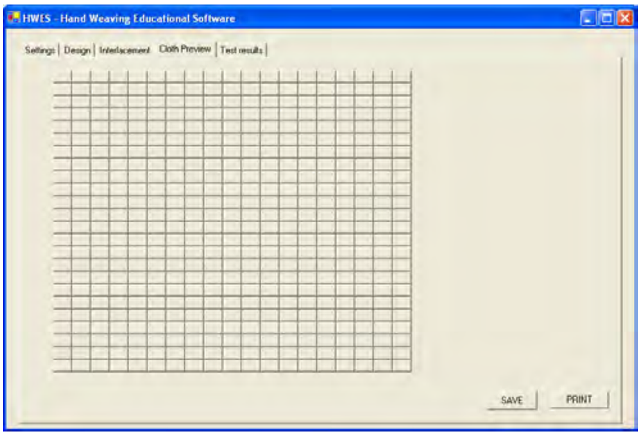

Figure 7. User interface design of CLOTH PREVIEW tab for HWES software

Finally, when testing mode is activated, at last tab (Figure 8.) there are test results for each testing segment- interlacement and whole cloth preview.

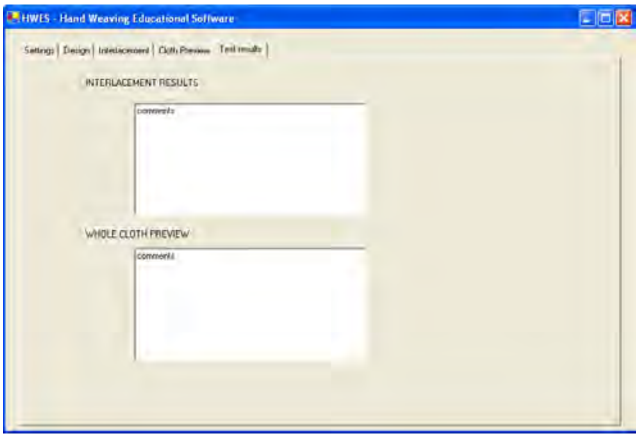

Figure 8. User interface design of TEST RESULTS tab for HWES software

Conclusion

This paper presents research results in the area of educational software for textile industry. Specially, it concerns hand weaving professional software functionality and presents needs for educational software that supports learning of hand weaving. Since that existing professional software for hand weaving support is not sufficient for hand weaving education, we propose design of an educational software that would help students learn elements of hand weaving.

We proposed educational software for hand weaving, named HWES. Business process model that presents student activities and software functionality that is supporting those activities presents software using in three working modes – automated, learning and testing modes. We also presented design of user interface, followed by explanations how these software screens would be used. Presented business process model and user interface design are good basis for implementation of HWES software. Future directions would lead to implementation of this software and using it in textile education at secondary/high schools and universities.

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IMPORTANCE OF QUALITY IN TEXTILE AND CLOTHING INDUSTRY

Mirjana RISTIĆ, Vasilije PETROVIĆ & Momčilo BJELICA

Abstract: *In Europe, the companies were forced to implement the system of quality management in order to improve the products and to prolong the lifetime of products. Therefore, the complexity of new textile and clothing products has caused the development of new - stricter standards Today, this has resulted in the including of the quality assurance into development of the highly innovative products during their entire life-cycles. starting with the design, development, production, distribution, use, maintenance, to its recycling or disposal. This requires the development of new solutions for the better management and recycling of the waste materials as well as the control mechanisms which will ensure controlling in the entire textile chain. For a typical textile product, there are 7 characteristic stages of life which passes through. This paper shows the importance of quality in the example of the clothing production of the knits.The dependency of the five factors influence on quality of the knits is presented. The five factors are: materials, production methods, machine park, labor force and operating modes.*

1. Introduction

In comparison of clothing and textile products and many other consumer products, it is clear how specific they are so it requires uniqueness of understanding of their quality. In fact, the users of the textile and clothing products require the fulfillment of various needs from those basic needs of life-sustaining until the cultural and social. Therefore, the quality of clothing products must always adapt to the costumer and his demands which are related to the purpose of the product. This makes that the quality of clothing products is a very complex category.
Clothing industry of the developed and medium developed countries in the world is going through many crises and permanent decline in production, loss of market, laying off workers, closing factories, and relocation of production in undeveloped countries with cheap labor force. Therefore, developed countries have intensified their research with the goal of developing innovative products, leading to the development in the field of the new textile materials. For making these materials are created: numerous possibilities of choices of raw materials, processes of the technological development, refining processes, resulting in production of garments and textile products of specific purposes as well as making intelligent textiles and clothing. All these facts make the notion of quality even more complex from the technical, subjective and marketing standpoints.

Buying apparel and textile products is determined by its aesthetic properties, shape, style, color, design, touch and suitability. Europe as a place of diverse cultural heritage is a strong driving force of fashion and design. However, the fact is that the textile and clothing industry in Europe can no longer rely on the cheap labor force as well as privileged access to raw materials. Therefore, the capacity of design and product development are seen as the most important factors of competitiveness of these industries which have to follow the rapid changes of market demands. In doing so, success will require not only the creativity and the scientific - technical elements based on knowledge but also in applying concepts, methods and technologies needed to realize their own creative ideas into usable industrial ideas. Therefore, the quality, design and product development are crucial for all producers in the chain from the manufacturers to manufacturers of the final products: household textiles and technical textiles.
A specific characteristic of the clothing product quality is a great influence of fashion trends on the requirements for quality. This causes a very large dynamic changes in requirements for the quality characteristics that is need to be aligned with changes in fashion trends. While, fashion trends influence at the overall characteristics of products from the design, style, type of material up to the production technology.

2. The quality of clothing production

The rapid technological changes and customer‘s expectations require of the manufacturers to constantly improve the quality of fashion products in order to survive in the market by quality. Therefore, the quality of each garment manufacture requires:

1. the product quality,
2. the material quality,
3. the process quality:
   - the market research quality
   - the design quality
   - the quality of materials supply
   - the quality of production and
   - the quality of seling..

The quality of the clothing and materials production is defined by the appropriate standards and agreements of the purchase.

Schematic diagram in Figure 2.1. presents the dependence of the five factors influence on the quality of clothing from the knits. The five factors are: materials, production methods, machine park, labor, and operating modes.

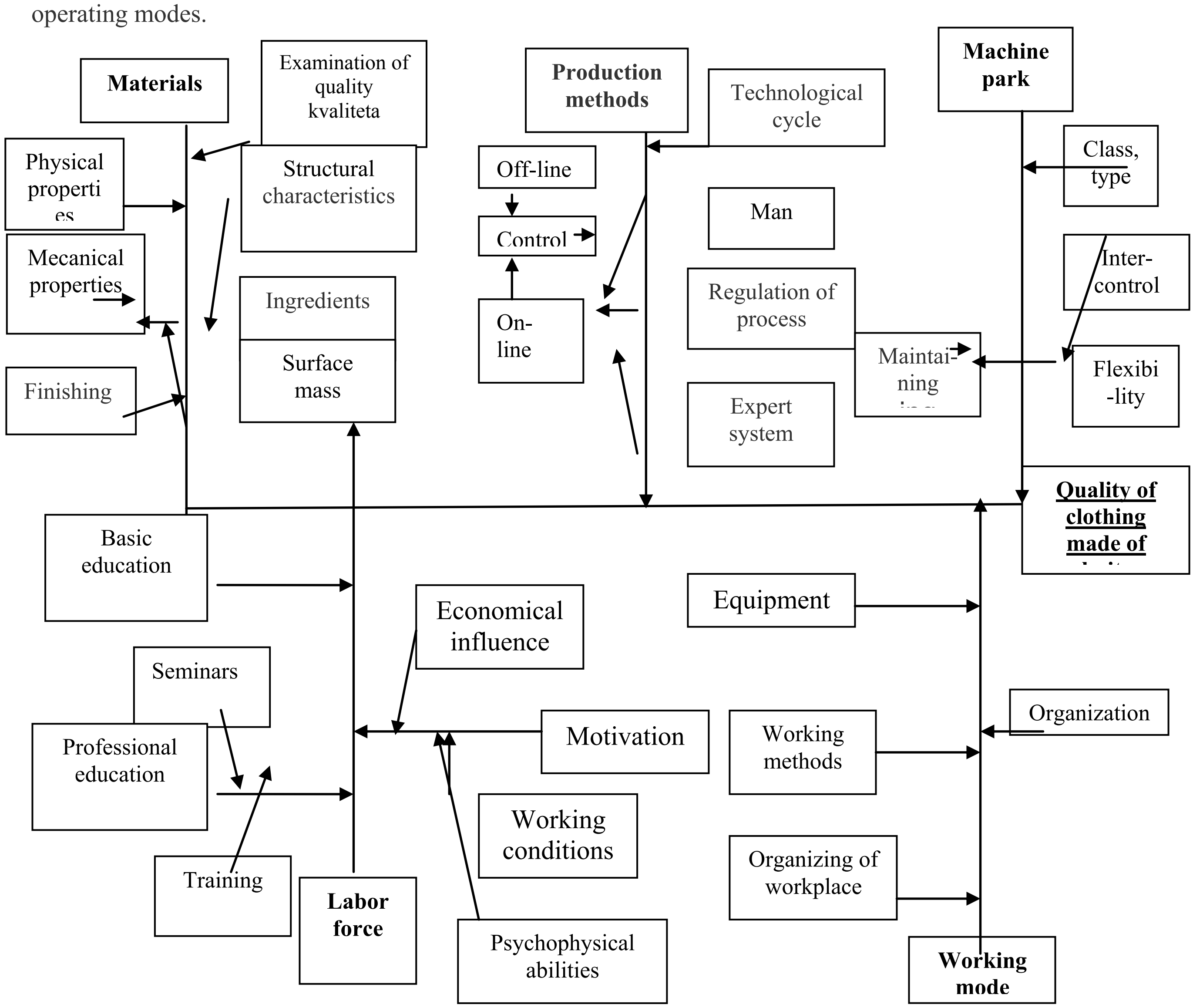

Figure 2.1: Schematic diagram of the causal influence on the clothing quality made of knits

2.1 The quality of the knits

The quality of knits or knitted products is understood as a degree to which knits or knitted products meet the specific human needs. So the quality of knitted products is meant to be a product made of certain number of loops and the appropriate surface mass as well as certain properties in the direction of rows and the lines of loops. Certainly, this product should have an appropriate look which greatly depends on the quality of the used yarn and entanglings of knits. The quality consists of a set of specific properties of knitted products which have more or less the impact on the usability value. The factors which affect the formation of the quality of knits can be divided into the following groups:

- properties of raw materials, auxiliary materials and semi-products,
- design and construction of products,
- technological processing of raw materials and semi-products and
- suitability of the manipulation‘s conditions to the product‘s characteristics.

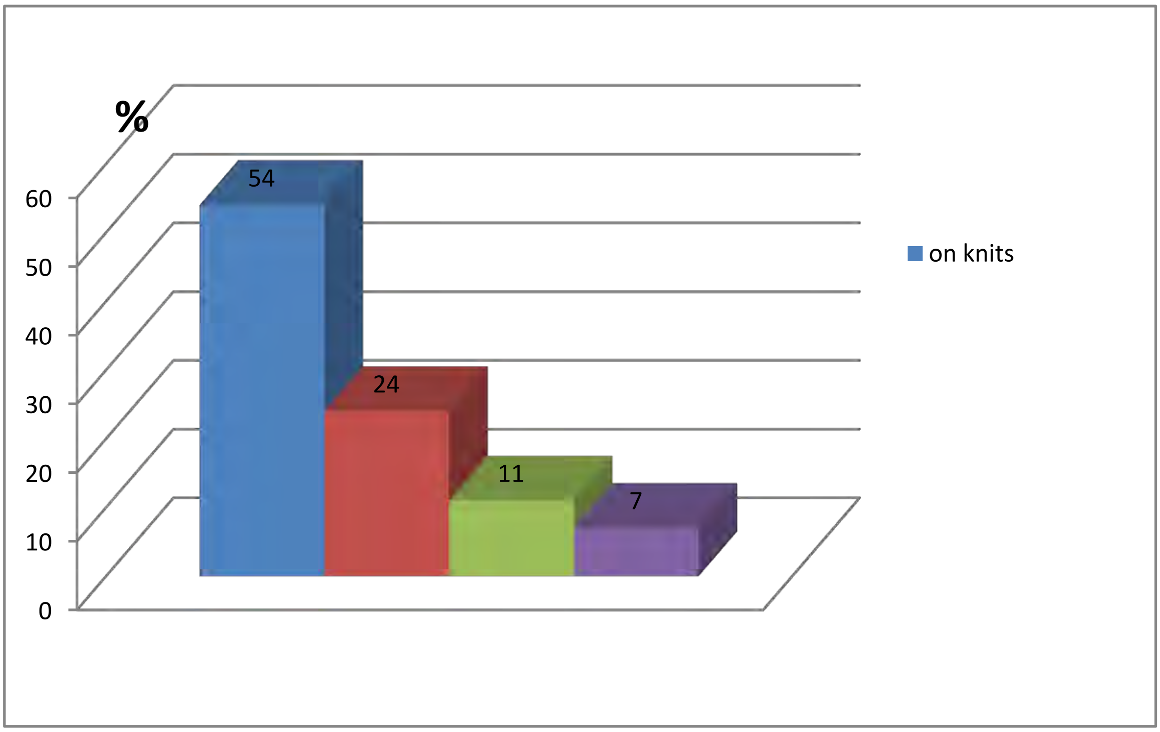

Figure 2.2: The value of percentage share of errors on clothing made of knits

According to some studies the highest number of errors of clothing are created in the process of knitting. Figure 2.2 shows the percentage share of mistakes of different origin on the garments made of the cotton knits of the inadequate quality. Figure (1) shows that the value of percentage share of: errors on knits - 54%, errors of yarn - 24%, errors occurred in processing 15%, errors made in the confection - 7%.

The components of the quality are the basic service properties of knitted products that determine their quality. The quality of these products is determined by a set of specific components, that each has a quantitative value which is called the quality indicator. By the measurement and evaluation of quality indicators, as well as observing the behavior of knitted products in use, determines the quality of goods.

When evaluating the quality of knitwear all properties that are considered can be divided into several groups:

- technical characteristics,
- organoleptic properties,
- exploitation properties and
- aesthetic characteristics.

3. The concept of managment of the lifecycle and overall quality

In order to increase the competitiveness of European products, an initiative of the textile and clothing industry in 2004 has been launched in Brussels by the European Technology Platform for the future of textile and clothing industry in Europe. The initial proposal was that the "textile and clothing industry in cooperation with institutes and universities need to improve coordination of existing structures in order to improve production while avoiding fragmentation, and by the new technologies to realize the research ventures in order to develop new products." The activities has been taken to get around this initial proposal come together representatives of the textile and clothing industry, research centers, academia and government institutions of all profiles at the European level.
The purpose of this gathering was setting the vision for development over a longer time period of the textile and clothing industry in which this industry should be innovative by the knowledge about the application of new technologies. These activities have led to the document of strategic research development created in 2006, that provides a vision of development of the textile and clothing industry in Europe by 2020. This document was done under the direction of EURATEX (The european Apparel and Textile Organisation) in cooperation with organizations TEXTRANET (The European Network of Textile Research Organisations) and AUTEX (The Association of Universities for Textiles). The European Technology Platform contains the activity that is divided into three main long-term industry trends. Each of these trends has within itself another three additional groups (sections). This is shown in Table 1.

Table 1: The priorities of Research & Development (Research & Development / R&D) of The European Technology Platform (ETP) for the future of the textile and clothing industry in Europe

From commercial to specialized products	**New textile applications**	**From mass production to the tailormade production**
Section 1 New special fibers and composites	Section 4 New textile products with improved properties	Section 7 Mass production of clothing / fashion
Section 2 Functionality of textiles	Section 5 New textile products for technical use	Section 8 A new concept of product design and technology
Section 3 Biomaterials and biotechnology, the ecology in production	Section 6 Intelligent textiles and clothing	Section 9 The concept of lifecycle management and the overall quality

According to the European technology platform for future development, the key elements of the economy in Europe will be innovation and new developed technologies. A turning point in the development of clothing and textile industry will be the creative work with its creativity and inventivity in seeking new or better product solutions. The goal of these activities is to unify a multitude of standards that are in use today into a unique standardization that would be used to support innovations. In particular, will be insisting on the standardization in the field of technical textiles, the environment protection, the health care and in the area of the relationship among standards and intellectual property.

In Europe, the companies had been forced to implement a quality management system in order to improve the products itself and to extend the lifetime of the products. Therefore, the complexity of new textile and clothing products has caused the development of new - stricter standards. This has resulted that in the development of highly innovative products today is included the quality assurance the during his whole lifecycle starting from design, development, production, distribution, use, maintenance, up to its recycling or disposal. This requires the development of new solutions for the better recycling or management of the waste materials as well as the control mechanisms which will ensure control in the entire textile chain. For a typical textile product, the seven stages of lifecycle through which it passes are characteristic. Within these seven life stages 20 key research themes are identified and the two transversal themes included in:

- **phases of concept and design making:** quality parameters of raw materials, use and maintenance parameters of the final product, prediction and simulation of its features, comfort and fulfillment of the standards and law regulations,

- **engineering phases:** includes innovative tools for optimizing quality and ecology in the production, distribution, implementation, use, service industries, recycling or disposal, and while the prototyping. This phase is based on the experience of the use of existing products,

- **phases of production:** include the specification of materials in production, quality management, management of system errors / defects in material, optimization of production systems, on-line quality control and environmental parameters,

- **phases of distribution and application:** predict an improvement in the standardization of the product quality and of the data management quality,

- **phases of use and service activities (dry cleaning and laundry):** predicts the development of methods and processes of retaining and restoring the functional properties of textile materials, durability of properties during the use phase, the development of new products that affect the improvement of product quality during the phase of the use and maintenance, the instructions and training for proper global use and maintenance of products, the analysis of problems arising during the implementation of the complaint, more accurate methods of determining the possible errors, the development of nondestructive methods for quality evaluation, modeling / simulation of the aging process in various conditions of use or maintenance,

- **the other lifecycle (reuse):** predicts the development of new procedures which help that the existing textiles could be reused,

- **the end of lifecycle (recycling or disposal):** predicts researches in the last cycle which must be focused to the development of the new recycling methods.

The transversal themes that permeate the entire textile chain are: the knowledge management and the management of information system.

4. Conclusion

In comparison of clothing and textile products and many other consumer products, it is clear how specific they are so it requires uniqueness of understanding of their quality.
In fact, the users of the textile and clothing products require the fulfillment of various needs from those basic needs of life-sustaining until the cultural and social. Therefore, the quality of clothing products must always adapt to the costumer and his demands which are related to the purpose of the product. This makes that the quality of clothing products is a very complex category.

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APPLICATIONS IN REHABILITATION MULTIAXIAL FABRIC WASTE LANDFILL AND SECONDARY PRODUCTION OF BIOGAS LANDFILL

Predrag PETROVIĆ, Nebojša MARTINOVIĆ & Marija PETROVIĆ

Abstract: *Application of multiaxial fabrics is very wide and allows multiple applications in the field of prevention in the construction of sections of roads and railway lines, tunnels, dams, irrigation canals and drainage systems, sports fields, landslides, dump recyclables, then in making filters for wastewater treatment gas and water, protective clothing fabric for intervention teams in emergencies and many other applications. In addition to these, multiaxial fabrics can be applied in the following areas: military and civil aviation, automotive industry and motorcycle, river and sea shipping industry, the production of alternative energy sources, etc. accessories production.*
By applying modern production technology multiracial fabric, reduce production costs, which directly affects the competitiveness of new products in domestic and foreign markets, and conquering the market and increase profits on the export of products with better characteristics than existing in the world.
This paper presents a short overview of the characteristics of applications, production, type of testing, environmental requirements and other parameters geotextile multiaxial fabrics in different applications, with emphasis on applications in the landfill lining secondary waste, as the opening of new and rehabilitation of old and above all in possible production of biogas from organic waste secondary or landfill gas.

Key words: Multiracial fabrics, Landfill, Remediation, Bio-gas, Sustainable, Development, Ecology.

1. Introduction

The overall objective of the implementation of development multiaxial fabric development, production and use of a brand new program for the protection of the environment, settlement, health, prevention of soil erosion prevention in the field of road and rail transport, agriculture, water resources, forestry, and in medicine, textile, automotive, aviation industry and other economic areas.

In developed countries of Europe, more than 70 of the last century, there was a gradual deterioration of the environment, above all, contamination of soil, water and air, with the impact of man, is not related only to the immediate place of pollution, but uncontrolled spread in ecosystems. In poorer countries, this trend is more pronounced, because of the apparent lack of necessary financial resources and appropriate technical management of project implementation in the preparation of communications traffic, tunnels, irrigation canals and drainage systems, dams, landfills and other recyclable materials in the areas in need of prevention of environmental land, water and air.

In Serbia there is no national strategy for the management of flood protection, municipal and other waste, road and rail network, the use of agricultural land, but even so, we see many consequences that are manifested by numerous floods, road accidents, under-utilization of agricultural land, environmental pollution and working environment of people and so on. The very fact that supporting these findings is that the Serbian government has defined and adopted a strategy for building needs and regioalnih landfills, but unfortunately the implementation of this strategic goal is not reached even 10% of the planned number of landfills.

2. Implementation of intention multiaxial fabric

The implementation of new manufacturing multiaxial fabrics for lining landfills to achieve the following objectives: Development of new products with improved physical, chemical and biological characteristics in relation to the existing bonded fabrics, the world's best possible use of technology in production, achieving a minimum impact on the working and living environment, with the necessary resistance to UV-radiation and radiological safety, the conquest of the product to be more competitive than the existing fabric, the ability of different applications, with extended periods of useful life, getting products to be competitive in domestic and foreign markets, achieve increased employment and profit from the sale of new products, reducing imports and the gradual substitution of similar materials for different applications and needs environmental protection, encourage domestic production and export growth, the possibility of a new business cooperation with companies of similar programs, and other goals.

The development of modern technologies, materials and systems provide an adequate answer to solving the growing problems in these application areas. The use of geotextiles multiaxial an important link in completing the process, be it hard or soft ground, in the plains or the mountains, the ocean or rivers, waste or wastewater. [1].

3. Application and primary function fabric geosintetics multiaxial

Waste materials are among the high-risk substances that pollute every day and threaten the environment, and to be a systematic approach to potential disasters, and environmental consequences if they continue to neglect curricula in the framework of strategies and legal provisions.

The use of geotextiles multiaxial an important link in completing the process in favor of prevention was to prevent any consequences. For example, the use of fabrics in multiaxial waste disposal, is very topical because of its features that provide decades of isolation and re-use for energy production (California landfills connected pipes that are underground accumulate methane and other gases by implementing them directly in thermal power plants). Showing some possible applications geotextile multiaxial fabric is given in Fig. 1

Fig.1. Areas of possible applications multiaxial fabric [7]

Response to the demands of European technical norms and standards for specific applications, in order to protect the environment from pollution and decomposition processes of waste at landfill sites modern, provides a complete isolation of the body controlled landfills and the waste streams, resulting in the degradation process. Isolation of bottom and troughs formed landfill slope shall be done in order to prevent penetration procednog landfill gases and leachate into the soil or ground and leave their uncontrolled locations, which would result in contamination of soil, air, groundwater and surface water, as well as possible occurrence of gas in explosive concentrations in undefined places.

It can be seen that the use of multilayered fabrics geotekstilnih multiaxial, and when it comes to requirements regarding the stability of the terrain in different geographic areas and fields, they satisfy the following:

Separation - geosynthetics used to separate two layers of earth that have different granularity. For example, geotextile is used to prevent the material in road to penetrate soft sublayer times and thus to maintain the projected thickness of road separator also prevents the top layer of fine particles in the main road lift pass granular layer of road.

Filtration - geosynthetic prevents the migration of fine particles of earth into the drainage layer. It is also used under the stone embankment of the river banks to prevent erosion of the country.

Drainage-geosynthetic acts as a drain that carried water flow through less permeable soil. She, for example, used to announce the water pressure on the embankment roadway. If water flow is stronger, it is recommended to switch to geocomposite. Prefabricated drainage pipes PVD (prefabricated vertical drains) are used to accelerate consolidation of soft cohesive foundation soil below the embankment.

Reinforcement-geosynthetics used as a reinforcing layer in the soil, which improves strength and deformability of the land. Geotextiles and geogrids are used to improve soil tensile strength to form the reinforced soil wall. Strengthening of land to be built over embankments and supporting soft and weak base or to build the embankment slopes steep angle that it can not be done in non-reinforced land. Geogrids can be used to bridge the holes that may appear below the base course for roads and railways kaso and the cover layer in landfills.

Barriers to liquid/gas-geosynthetics are used as impermeable barriers for fluids and gases. Clay geosynthetic clay material (GCL) is used as a barrier to the penetration of a liquid or gas into the ground, and the top layer of asphalt to prevent swelling of the land that could damage the top layer asphalt.

Erosion-geosynthetic prevents soil erosion caused by the influence of precipitation and runoff of surface waters. Biomat and geomat placed over the upper layer of soil on slopes.
In Fig.3, a schematic of the primary functions are shown geosynthetics multiaxial fabric.

Other features-geogrid reinforcement of the upper layer of asphalt, waterproofing and protection of geomembrane penetration, foundation waterproofing membranes, concrete structures based on bentonite.
Geosynthetics is also a solution for a number of concrete problems faced by experts in the fields of engineering, ecology, spatial planning and the like.

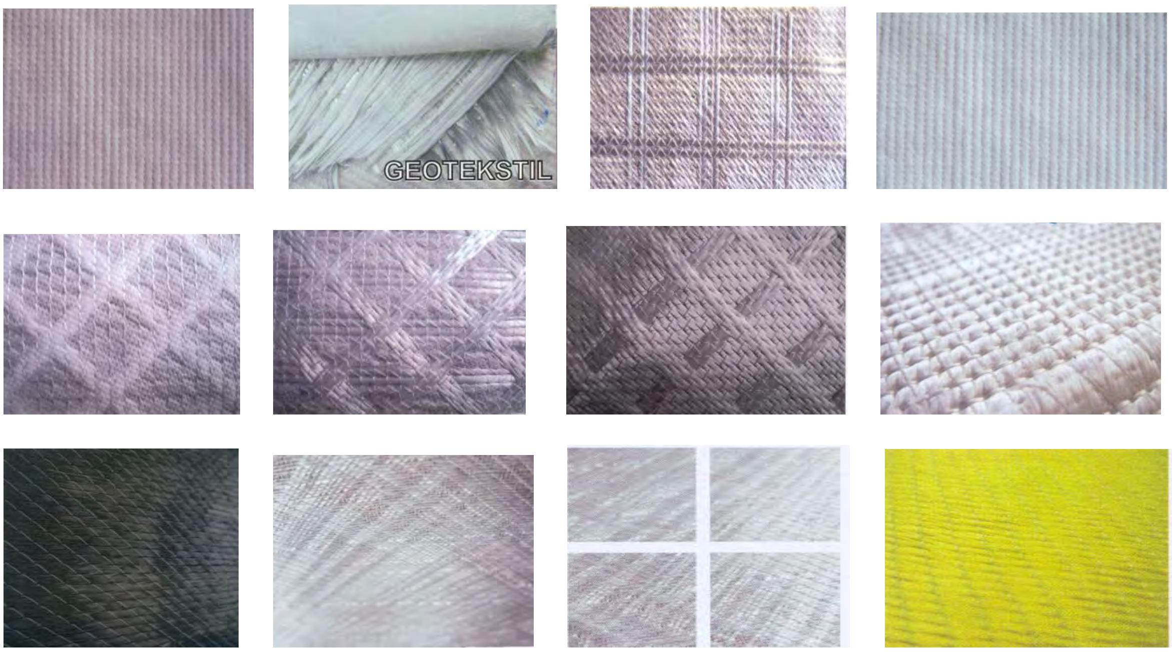
4. Feature overview multiaxial fabrics

Multiaxial fabrics, which have been developed in the company VM Protect **(Martin M-A-T-aramid, UHMWPE Martin-M-A-T, MAT-carbon Martin, Martin M-A-T-glass, basalt Martin M-A-T),** have excellent mechanical and physical properties and long life. Specificity multiaxial fabrics is that they consist of two or more layers, slow at different angles. That kind of production, there has been less distortion, easy shaping and manipulating fabric.

The specificity of the technological line is that it allows the layer after each multiaxial "retracted" another layer of a material, whether it is a foil, viles, felt or other material, depending on the purpose fabric. In this way, practically, can be obtained fabric with 7 or 8 different layers.

This geotextile has a way of making a completely new approach to solving the problem of drainage, filtarcije, separation, reinforcement, etc.[6].

In Fig.2, shows the general appearance, two of many possible combinations multiaxial slow fibers, and a schematic sectional view of fabric.



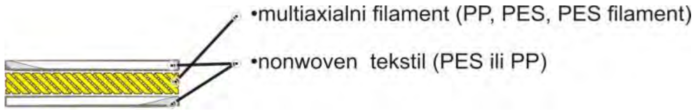


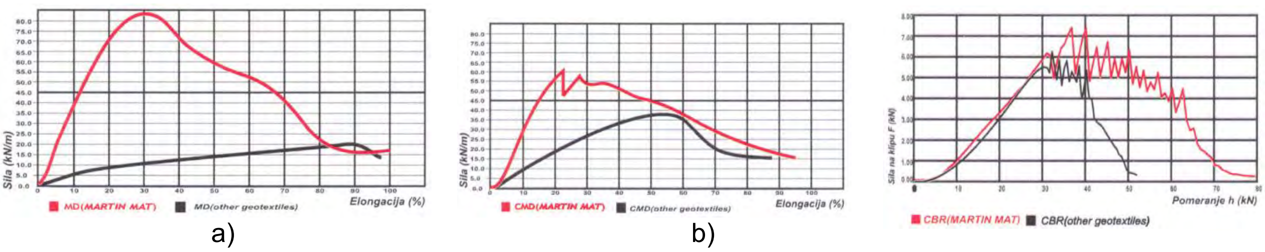
Fig. 2. General and graphic multiaxial fabrics, made from a combination of non-woven fabrics and multiaxial layer.

Multiaxial geotextile is a multi-dimensional-layered drainage system, composed of multiaxial layer and at least one layer of nonwoven fliza. Multiaxial "sandwiches" MARTIN M-A-T, is made of two layers of nonwoven geotextile Viles-a-150, with different core layer, with a combination of fiber glass, polyester, polypropylene, fibers, resins and other processed.

Comparative characteristics of multiaxial fabrics geotextile Martin M-A-T with the characteristics of other types and manufacturers of similar fabric, are shown in Table 1, and elongation characteristics and shifts depending on the force are shown in Fig. 3 (a, b, c).

Table 1. Comparison of basic characteristics of multiaxial fabrics geotextile Martin M-A-T

*with other fabrics of similar purpose***R. No.**	**Characteristics**	**Standards**	**Martin M-A-T**	**Other nonwovens**
1.	Weight	EN ISO 9864	750 g/m^2	1.200 g/m^2
2.	Breaking force (base)	EN ISO 10319	80 kN/m	40 kN/m
3.	Tensile strength (weft)	EN ISO 10319	60 kN/m	21,5 kN/m
4.	Elongation at break (%)	EN ISO 10319	< 20 < 100%	90/60 %
5.	Puncture resistance	EN ISO 12236	7000 N	5.500 N
6.	Thickness (mm)	EN ISO 9863	3 mm	9,5 mm
7.	Roll Width		255 cm ± 2%	-
8.	Roll length		50 m	



a) b) c)

Fig. 3 Comparative characteristics of elongation and displacement of multiaxial fabrics and Martin M-A-T other geotextile [7]

Multiaxial fabric is made by taking (at angles ranging from (-22.5° to +22.5°) these yarns, so that the aforementioned fabric samples can be endlessly combined, starting from various combinations of yarn types and refinement, with or without viles or thermoviles so, practically, given the applicable range of products in various industries.

Such fabrics, due to its particular structure, have better mechanical properties than the existing geotextile for different applications. Examination of test samples manufactured fabric, it was found that the so obtained materials lighter and thinner than fabric currently used for lining landfills as well as for other applications.

5. Technological multiaxial fabric production process

On standard weaving looms to produce fabrics of cotton and polyester in the mix and combined with conductive fibers, while the production line based on multiaxial composite materials and environmental protection of people and in combination with different types of yarn, depending on the application of these materials .

Technological line to that after each layer multiaxial "retracted" another layer of a material, whether it is a foil, viles, felt or other material, depending on the purpose fabric. In this way, practically, can be obtained fabric with 7 or 8 different layers.

For the production of geotextiles using a combination of the following yarn: PPPES/viles, PP/viles, PES/viles, PP/PES/Glass, PP/glass; PES/glass, 100% glass, 100% PP, 100% PES, 100 % PP with viles, 100% PES with viles, 100% glass with viles; combination of fibers with resin processed viles.

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Special requirements multiaxial fabric production are the basis for adjustments to the Company's existing technological line VM Protect COP MAX 3CNC S5 M13, brand Liba, a third generation with an installed computer program for tracking production. Line has five a moving robot that also can take five different layers and five different angles depending on the application fabric.

Fig. 4. Possible angles geotextile weaving looms and appearance [7]

The machine allows you to set the number of layers, angles (0°, ± 45°, 90°, ± 22.5°, ± 30°, ± 60°), the type of yarn (Polyethylene, Polypropylene, Polyamide, Polyester), then the yarn fineness (tex), the number of layers of fabric, yarn type and fineness of yarn in each layer, then the number of cycles per hour, a living area and so on. During operation, the possible correction of surface mass layers and each layer individually.

Basic raw materials used for production of geotextiles mulatiaxial are: polypropylene (PP), polyester (PES), polyethylene of high molecular density (UHMWPE), polyamide (PA), glass fiber, combined with the non-woven needleloom viles (chemical composition: PP or PES , which does not lose favorable characteristics influence biological and chemical processes, which makes them very useful in coating landfill or without fliza.

6. Quality inspection of raw materials

The quality of the finished product-multiaxial geotextile has a decisive effect the quality of raw materials. Every raw material that arrives in the warehouse, but passes a predetermined reception control:

a) evaluation of sample material (supplier data sheet, certificate of quality, visual controls, internal analysis, authorized laboratories);

b) following an internal control, the yarn is determined by an accredited laboratory: yarn fineness (tex), breaking force (daN), elongation (%), composition (%).

The primary characteristics of geotextiles depends on the purpose and functions, which are mainly based on: filtration, separation, reinforcement (reinforcement) and protection. On this basis, determined by the following characteristics: tensile strength, elongation at maximum load, the static penetration test (CBR test), elongation at break, check the characteristic size of the hole, permeability, durability, water flow capacity (for use in water and liquid waste from landfills), the effectiveness of protection.

7. Testing of mechanical and hydraulic characteristics multiaxial fabric

Testing of mechanical properties of fabrics made according to the following standards:

- Tensile strength (longitudinal), (min 40 kN/m), [EN ISO 10319];
- Tensile strength (transverse), (min 40 kN/m), [EN ISO 10319];
- Elongation at maximum force (longitudinal), (min 30%), [EN ISO 10319];
- Elongation at maximum force (transverse), (min 30%), [EN ISO 10319];
- Resistance to static penetration (CDR-test) - 7000 N min, [EN ISO 12236]
- Thickness (according to EN ISO 9863 (min 3 mm).

A test hydraulic characteristics of textiles to these standards:

- Vertical permeability of the fabric (h=50 mm), (l/m^2s) [EN ISO 11058];
- Size of the opening 090 (μ), [ISO 12956];
- Thickness of fabric (mm) [EN 964-1];
- Mass per unit area (specific weight, g/m^2), [EN 965]
- Water permeability (normal to the plane) - ds=50 mm (EN ISO 11058)
- Velocity of water flow in the plane (EN ISO 12958)

The Declaration contains the basic information about the product: the names of manufacturers and products, surface fabric weight, width and length of the roll, date of manufacture. [6].

8. Example of forming fabric overlaying multiaxial landfill

To form a watertight closing cover, using a layer-geotextile, relevant characteristics, as a buffer zone between this layer and clay, and above the layer of foil as a protective layer against damage from the next layer of gravel.

The most important requirements to be met by the multiaxial sheet:

-Chemical resistance (undiluted liquid substance at high concentrations, the dissolved liquid substances at different concentrations of precipitated sludge, the waste gases that are released, the ultraviolet radiation, and aging).

-Biological resistance (in a variety of microorganisms, weeds and plant secretion of plant substances on animals).

-Physical resistance (for high mechanical shocks of solid substances and disposal of waste materials, the pressure and the dynamic impact of large machines that bring in waste, throw away, deploy, or push into that flow, in rodents and other animals).

Multilayer insulation consists of the following elements:

1. Clay layer of 50cm (sheet and waterproof to protect insulation for leachate filtrate).
2. The first layer of geotextile, min. grammages 1.200g/m^2 and minimum thickness of 7.5mm (the protection foil from any damage);
3. Layers of foil min. 2mm (waterproof insulation for leachate filtrate);
4. The second layer of geotextile, the minimum specific weight and 1.200g/m^2 min. 7.5mm thick, to protect the foil from the abrasive effects of sand and machinery. [1].

Example execution of a final multilayered landfill drapes, can form the following components:

1. **A layer of gravel (or similar porous material) to drain gas,** 30cm thick, which is applied through the layers of everyday drapes inert material.
2. **A layer of geotextile**, the specific weight of 800g/m^2, as a buffer zone between the gas drainage layer and clay.
3. **A layer of clay,** 30cm thick and kf $\geq 1x10^{-5}$, which is placed over the drainage layer of gas. Watertight layer film thickness of less than 2.0mm.
4. **Geotextiles**, specific weight 800g/m^2, who serves as protection from damage gravel foil material.
5. **A layer of gravel for drainage of rainfall**, 40cm thick, which is placed on the foil. [7].
6. **A layer of earth for technical recultivation**, 50cm thick, which is placed over the geotextile layer.

9. Options production biogas- landfill gas

Due to the limited use of fossil fuels and increasing environmental pollution, renewable energy sources has become increasingly common, and one of the most efficient energy sources is biogas.

Biogas is a mixture of methane and carbon dioxide with traces of ammonia, hydrogen, nitrogen, hydrogen sulfide, carbon monoxide and water vapor. The percentage content of some components: Methane (CH_4) 50-70%, Carbon dioxide (CO_2) 30-40%, Hydrogen (H) 5-10%, Nitrogen (N_2) 1-2%, Water vapor (H_2O) 0.3%, Hydrogen sulfide (H_2S) 0 to 0.5% and dr.Biogas is about 20% lighter than air, and ignition temperature it is in the range of 650 to 750 ºC, with no strong odor and no color. When burning, clean burning blue flame, like natural gas. Thermal power is imeĊu20-30 MJ/Nm^3.

Biogas is obtained by fermenting or decaying organic matter, or green power plants and waste organic matter. Anaerobic bacteria convert C.+ H-> into methane and carbon dioxide (CO_2). Combustion of biogas is neutral, with no CO_2, so that does not contribute to increasing greenhouse gases in the atmosphere. This process occurs in nature in ponds, in swamps, in the digestive tract of ruminants, or the devices controlled fermentation facility to produce biogas in the absence of air, heat and light supply to the humidity > 50%.

Biogas can be obtained from: **Fertilizers** (pork, beef, sheep, goat, rabbit, chicken ...), **Energy plants** (corn, grass and corn silage, beet leaves, beet sugar...), **Agro-industrial residues** (waste from fruit, vegetables, oil crops residues, residues from the manufacture of wine, beer, juice, rotten vegetable oils, slaughter waste, residues and animal food products, fresh grass clippings...), **Municipal waste** (household waste, sewage, animal by-instrumentation.), **Municipal waste**, **Industrial waste** (it is enough to contain dry matter) and so on. [8].

In Fig.5, shows the appearance of storage of raw materials for biogas production, with a visible application of multiaxial fabrics possibility coating to protect the soil contamination. In Fig.6, presents a facility for production of biogas.

Fig.5. Show a storage dump

Fig.6. The general appearance of a plant to produce biogas

A more detailed view of a simple biogas plant is given in Fig. 7

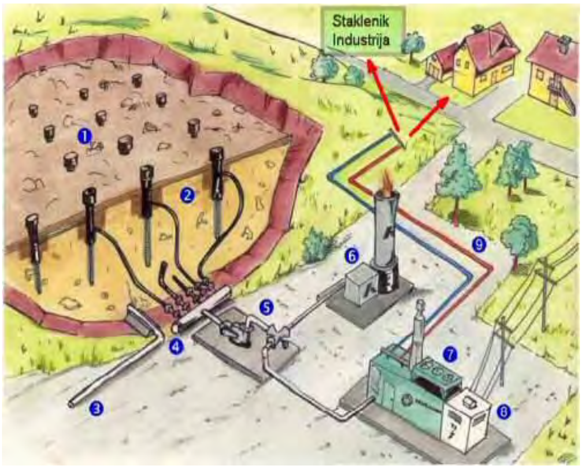

Fig. 7. Schematic layout of a plant to produce biogas [8]

1-Depot,
2-Gas probes (pins),
3-Barrel to collect water ocedne,
4-Gas collector,
5-Compressor suction gas,
6-High temperature torch,
7-Cogeneration engine,
8-Power stations,
9-Heating

Conclusions

Applying multiaxial geotextile made combination of different types of yarn (Polyethylene, Polypropylene, Polyester, Glass) and achieved a satisfactory basic level of quality and sustainable development, where we can leave future generations a reliable infrastructure, resources and preserved a healthy environment. The manufacture of the said materials, he would be an entirely new domestic product of excellent physical and mechanical properties, which would boost domestic production and thus reduce the need for imports.

The new product can be used in numerous industries, and one of the important items is the construction of new and rehabilitation of old landfill recyclable materials, particularly in the preparation of landfill facilities, which require the maintenance of the required characteristics of waste while protecting the land, water and air in the production of landfill biogas.

Starting from the fact that Serbia needs to build many large infrastructure facilities, the conclusion that the domestic market should be as fast as the realization of production of these fabrics, with the application of technological installations for the production of biogas.

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