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Contact and Editors' Address:
Liliana INDRIE,
UNIVERSITATEA DIN ORADEA,
FACULTATEA DE INGINERIE ENERGETICĂ ŞI MANAGEMENT INDUSTRIAL
DEPARTAMENTUL: TEXTILE- PIELĂRIE ŞI MANAGEMENT INDUSTRIAL
Str. B.St.Delavrancea nr. 4,
Oradea, 410058, Romania,
Tel.: 00-40-259-408448
E-mail : lindrie@uoradea.ro

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ANNALS OF THE UNIVERSITY OF ORADEA
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REMOVAL OF REACTIVE DYES FROM WASTEWATER OF TEXTILE INDUSTRIES BY USING ENVIRONMENTAL FRIENDLY ADSORBENTS

ALAM Md Shamim[1], SIDDIQUEE Md Abu Bakar[2], ROKNUZZAMAN Md [3]

[1]South East University, Lecturer, Department of Textile Engineering, 251/A & 252 Tejgaon I/A, 1208 Dhaka, Bangladesh, E-Mail: shamim100486@gmail.com

[2]Mawlana Bhashani Science and Technology University, Associate Professor, Department of Textile Engineering, Santosh, 1902 Tangail, Bangladesh, E-Mail: bakarsiddiquee_69@yahoo.com

[3]Mawlana Bhashani Science and Technology University, Assistant Professor, Department of Textile Engineering, Santosh, 1902 Tangail, Bangladesh, E-Mail: rokonuzzamanmd@yahoo.com

Corresponding author: Alam, Md Shamim, E-mail: shamim100486@gmail.com

Abstract: *This paper is aimed at developing a method to treat wastewater by using inexpensive adsorbents. Textile industries produce wastewater, otherwise known as effluent, as a bi-product of their production. The effluent contains several pollutants. Among the various stages of textile production, the operations in the dyeing plant, which include pre-treatments, dyeing, printing and finishing, produce the most pollution. The textile dyeing wastes contain unused or partially used organic compounds, and high level of different pollutants. They are often of strong color and may also be of high temperature. When disposed into water bodies or onto land these effluents will result in the deterioration of ecology and damage to aquatic life. Furthermore they may cause damage to fisheries and economic loss to fishermen and farmer, there may be impacts on human health which can be removed with the help of an effluent treatment plant (ETP). The "clean" water can then be safely discharged into the environment and ultimately save our environment from pollution. In this study, rice husk and cotton dust were used as an adsorbent. In this research work waste water was characterized with this useless adsorbents. The parameters which were tested in this study are DO, BOD, COD, TS, TDS and TSS. The results showed that the selected bio adsorbents have good potential for removal of reactive dyes from textile effluent.*

Key words: *Treatment, Environment, Effluent, DO, BOD.*

1. INTRODUCTION

Among all the manufacturing industries textile industry is cosidered one of the most complicated industries. Wastewater treatment is one of the major problems faced by textile manufacturers [2]. The presence of very small amounts of dyes in water (less than 1 ppm for some dyes) is highly visible and affects the aesthetic merit, water transparency and gas solubility in lakes, rivers and other water bodies. Dyes, however, are more difficult to treat because of their synthetic origin and mainly complex aromatic molecular structures [3]. The presence of dyeing effluent in a watercourse has a serious environmental impact. Dyeing effluent has high amount of color and other chemicals, which are very harmful for aquatic live [4].

Many studies have been undertaken to find low-cost sorbents, which include peat, bentonite, steel-plant slag, fly ash, maize cob, wood shavings and silica.[5] However, these low-cost sorbents generally have low uptake, which means that large amounts of sorbents are needed. Although good sorption capacities for dyes are found for such materials as cellulose, sugarcane bagasse, and coconut husk, successful regeneration has not been reported. Therefore, new, economical, easily available and highly effective sorbents still need to be found [6]. For my study I used two new and renewable biomaterials i.e micro dust and rice husk for wastewater treatment. The main purpose of this study was the removal of Color, TS, TDS, TSS and increase the DO of wastewater. From this experiment very good results were obtained in this regards.

2. EXPERIMENTAL METHODOLOGY

2.1 Materials and Reagents.

In addition to common laboratory glassware, apparatus and instruments used are UV-Vis spectrophotometer, portable multi-parameter, electronic balance, vacuum oven, magnetic stirrer, incubator and refrigerator.

2.2. Adsorbent preparation

After collecting grain size of rice husk were separated. Then dried husk was stirred in acetic acid solution at 60°C for 90 minutes. After that filtered husk was dried at 105 °C for 24 hours. [7]
Another biomaterial cotton dust was washed with distilled water for two times and then dust was stirred in water with sodium hydroxide, sodium silicate and hydrogen peroxide at 90°C for 90 minutes. Filtered dust was dried at 105°C for 24 hours.

2.3. Analytical Procedures:

Equal amount of biomaterials i.e cotton dust 1.5g, rice husk 1.5g and combined 1.5g (0.75g+0.75g) were added to the beaker. The adsorption experiments were carried out in beakers. Adsorption factors including the amount of adsorbents (1.5 g), initial sample concentration for waste water and dye solutions 100 mL and 10 mg/L respectively, contact time 120 minutes and pH 8 were evaluated. After the adjustment of pH to the desired value with 0.01 M HCL and 0.01 M NaOH solutions, the sample solution was stirred using a magnetic stirrer. The adsorption from the aqueous solution was studied. After the desired contact period for each batch experiment, the aqueous phases were separated from the materials, and the dye concentration of dye was measured using a UV-Vis Spectrophotometer.
Then optimization of different factors carried out like as adsorbents, pH and equilibrium time. The different amounts of adsorbents (1-4 g) were added to 100 mL dye solution in the bathes for 210 minutes for optimizing amount of adsorbent. Initial pH of solution was adjusted to 4, 5,6,7,8,9,11 and 12 using 0.01 M HCL and 0.01 M NaOH solutions at optimum condition adsorbent amount and dye solution concentration. To determine the equilibrium time for the maximum uptake of dye solution, the adsorption of two biomaterials were studied for the above optimized condition as a function of time(30,40,60,80,100,120,140,160,180,200 & 210 minutes).

2.4. Determination of physical and chemical characteristics of wastewater:

At first Calibration curve were obtained by measuring the absorbance of standard dye solution of known five concentrations (5, 10, 15,20,20,25 mg/L). The amounts of dye onto the adsorbents were determined by measuring the absorbance of dye after batch experiment by UV-Vis Spectrophotometer. The sample were analyzed against a calibration curve prepare by standard solution of dye. Finally Different physical and chemical characteristics of wastewater like as Total

Solids, Total Dissolved Solids, Total Suspended Solids, Dissolved Oxygen, pH, Biological Oxygen Demand and Chemical Oxygen Demand were measured with help of respective method and machine.

3. RESULTS AND DISCUSSION

3.1. Calibration Curve For Novacron red dye:

Calibrations were obtained by determining the concentrations of Novacron Red dye solution by UV-vis Spectrophotometer at wavelength of 570 nm where maximum absorbance was observed. The Absorbance vs. Concentration of Novacron Red dye solution is presented in **Fig.1.** From this figure, it is seen that the absorbance vs. concentration curve is a straight line passing through the origin. The correlation coefficient (R^2) of the line is 0.9998.

3.2. Observation of effect of contact time:

The effects of contact time for the adsorption of novacron red was studied for a period of 210 min and the results are shown in the **Fig.2**. It showed that the dye removal was rapid at a certain time then the rate was decreased after saturation. In this experiment the cotton dust, rice husk and combined adsorbent showed highest absorptive capacity at 120 mins, 140 mins and 130 mins respectively. . So that, after a certain period of time, the adsorbent reached to its equilibrium condition and we find out the optimum contact time.

3.3. Observation of effect of pH variation:

Change of pH also affects the adsorptive process through dissociation of functional groups on the adsorbent surface active sites. Consequently, this leads to a shift in reaction kinetics and adsorption equilibrium. The effect of pH of Novacron red on the adsorbents was shown in the **Fig 3**.

3.4. Observation of effect of adsorbent dosage:

The effects of adsorbents dosage on the removal of novacron red were shown in **Fig.4**. Interactions were carried out between dye solutions and adsorbents by adding different amounts of adsorbents (2-25 g/L) to 100 mL of 10 mg/L of dye solution taken in a beaker for 120 mins, 140 mins and 130 mins for cotton dust, rice husk and combined respectively. Removal efficiency was calculated by measuring absorbance of dye solutions after adsorption.

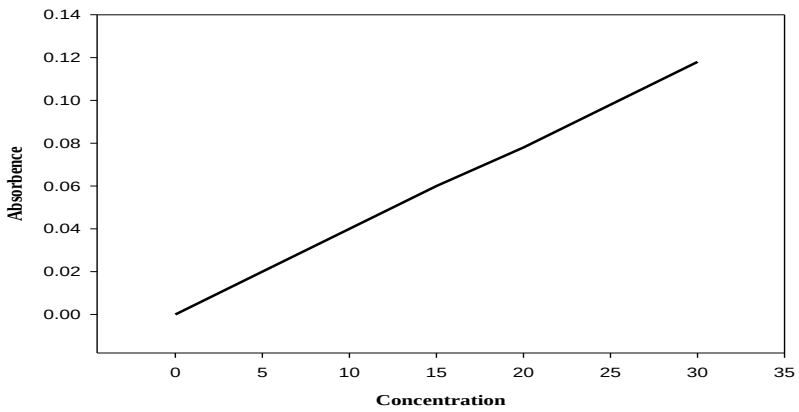

***Fig. 1**: Calibration Curve of Novacron red dye*

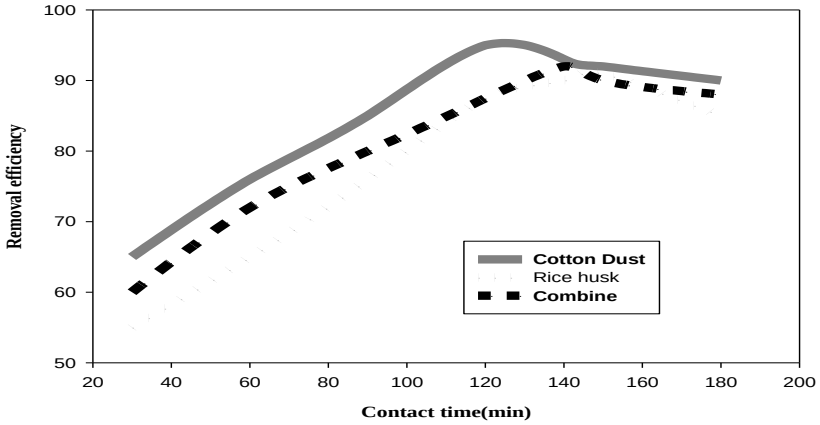

***Fig. 2**: Observation of effect of contact time*

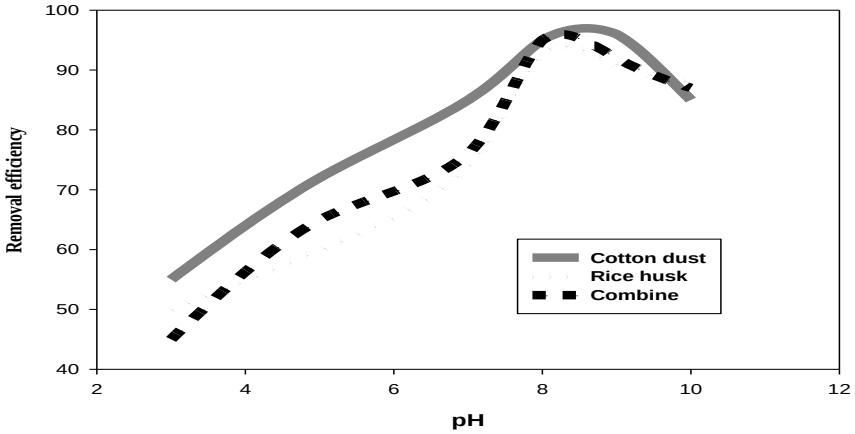

***Fig. 3**: Observation of effect of pH variation*

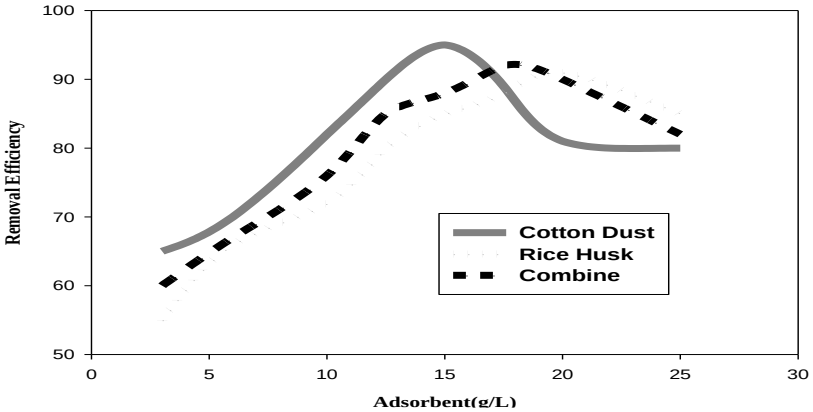

***Fig. 4**: Observation of effect of adsorbent dosage*

3.5. Physical and chemical characteristics of the textile waste water

Table1: *Physical and chemical characteristics of the textile waste water*

Parameters	Before Treatment	After Treatment With Cotton Dust	After Treatment With rice husk	After Treatment With combined
pH	11	8	7	7.5
DO(mg/L)	6.8	7.2	7	7.4
BOD(mg/L)	98	44	48	47
COD(mg/L)	992	315.5	389	330
TS(mg/L)	3444	2155	2214	2190
TDS(mg/L)	3224	2014	2090	2050
TSS(mg/L)	220	141	124	116

It is seen from visual and machine observation that after treating with the adsorbents, deep colored non-transparent wastewater became colorless and transparent indicating that both the adsorbents studied in this work are capable to remove reactive dyes from wastewater generated from textile industries.

5. CONCLUSIONS

Two new biomaterials namely cotton dust and rice husk were found to be very effective in removing reactive dyes from wastewater. Initially although one reactive dye, Novacron red was used, it is found that these adsorbents are able to remove all three reactive (Novacron red, Novacron yellow and Novacron blue) dyes present in collected wastewater sample.

Adsorptions on both biomaterials are found to be affected by pH of dye solution, contact time and adsorbent/dye ratio. Both the adsorbents are found able to decrease pH, COD materials, and BOD materials, TS, TDS and TSS significantly. They are also found to increase DO level in wastewater.

Comparable adsorptive ability of dyes from wastewater was found by cotton dust and rice husk regarding removal efficiency, however, regarding adsorbent/dye ratio and contact time, cotton dust seems to be a better adsorbent compared to rice husk. Rice hulls are economically cheap and so regeneration is not necessary [8]. The factors which favors the selection of cotton dust and rice husk are its low cost, widespread presence and organic composition which shows strong affinity for some selected dyes.

As Sorption is an effective process for decolorization of textile dyes so this is one of the effective techniques for color removal. Although cotton dust was the most effective sorbent due to the high surface area, another low cost sorbent rice hust could also be used for color removal.

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EFFECT OF DIVIDED CORE ON THE BENDING PERFORMANCES OF TEXTILE REINFORCED FOAM CORE SANDWICH COMPOSITES

ALPYILDIZ Tuba[1], ICTEN Bulent Murat[2], YALKIN Huseyin Erdem[3]

[1] Dokuz Eylul University, Engineering Faculty, Department of Textile Engineering, 35397, İzmir, Turkey,
E-Mail: tuba.alpyildiz@deu.edu.tr

[2] Dokuz Eylul University, Engineering Faculty, Department of Mechanical Engineering, 35397, İzmir, Turkey,
E-Mail: bulent.icten@deu.edu.tr

[3]Celal Bayar University, Applied Science Research Center, Manisa, Turkey,
E-Mail: huseyinerdem.yalkin@cbu.edu.tr

Corresponding author: ALPYILDIZ, Tuba, E-mail: tuba.alpyildiz@deu.edu.tr

Abstract: *Sandwich composites are generally used in marine applications, wind turbines, space and aircraft vehicles due to their high bending rigidities in addition to their lighter weights. The objective of this study is to investigate the effect of divided foam core and interlayer sheet of glass fabric on the bending performances of sandwich composites which are manufactured with glass fabrics as the facesheets/interlayer sheets and PVC foam as the core material. Sandwich composites with single and divided core are manufactured and compared in terms of flexural behavious via three point bending tests. It is found that the bending performance is enhanced with the use of divided core and using divided core does not affect the behaviour of the sandwich composite against bending deformations. In the case of the plain core sandwich composite, dividing the core is advised for certain applications rather than perforating the core to increase the bending stiffness and strength of the textile reinforced sandwich composites because it is possible to purchase core with any thickness and there is no need for additional process such as perforation. The proposed application could enhance the bending performances without altering the weight and cost of the sandwich composites, which are preferred due to their higher bending rigidities in relation to their lighter weights.*

Key words: *sandwich composite, glass, fabric, flexural, PVC foam*

1. INTRODUCTION

Sandwich composites are manufactured by using facesheets and core material in-between the facesheets. Facesheets are expected to be rigid and stronger; textile reinforcements are popularly preferred. Core materials are expected to be lighter but thicker and with lower strength than the facesheets; foam cores are popularly preferred. Sandwich composites are generally used in marine applications, wind turbines, space and aircraft vehicles due to their high bending rigidities in addition to their lighter weights. The properties of the facesheet, stiffness and strength properties of the core and the strength of core-to-facesheet bonding determine the characteristics of the sandwich composites.

Enhancement studies on the flexural stiffness and strength of sandwich composites have been achieved with the use of z-pinned cores [1], perforated core [2], stitched foam core [3], pin reinforced foam core [4], and foam cores with different design parameters [5]. Thus studies on the improvement of such properties of the sandwich composites have been and are still being done.

In this study the effect of "dividing the core materal" and "addition of an interlayer facesheet of textile reinforcement" on the bending performances of sandwich composites composed of glass fabrics as the facesheet and foam core are investigated. With this aim; 3 point bending tests are performed, plain, perforated and divided core specimens with interlayer sheet are compared.

2. EXPERIMENTAL

2.1 Materials

The sandwich composites were manufactured using unidirectional 300 g/m^2 E - glass fabrics as the sheet material, 0.06 g/cm^3 PVC foam as the core and epoxy resin.

As the first type of specimen standard sandwich composite was manufactured as reference specimen and coded as R20 with the stacking sequence of $[+45/-45/(0/90)_2/C_{20}/(90/0)_2/-45/+45]$. For the second type of specimen (P20), core material was perforated to have holes and during vacuum infusion these holes were filled with epoxy resin, which behave as a column and these specimens have the same stacking sequence with the reference specimens. As the next two types of specimen, core material was divided for both the reference (coded as R10/10) and perforated specimen (coded as P10/10) with the aim to examine the effect of dividing the core; both types of these specimen have the stacking sequence of $[+45/-45/0/90/C_{10}/(90/0)_s/\ C_{10}/90/0/-45/+45]$. Perforated core panels were drilled (prior to composite manufacture) with areal density of 0.5 hole/cm^2 by CNC milling machine with 2.5 mm diameter holes. For single core specimens the core thickness is 20 mm and for divided core specimens the core thickness is 10 mm.

Sandwich composites were manufactured by vacuum-assisted resin infusion process as given schematically in Fig. 1. Specimens were cured initially at room temperature for 24 hours, and then all of them were post-cured at 80 ºC for 15 hours. The nominal thicknesses of all of the samples are 23 mm. The reference specimen and specimen with perforated divided core can be seen in Fig. 2.

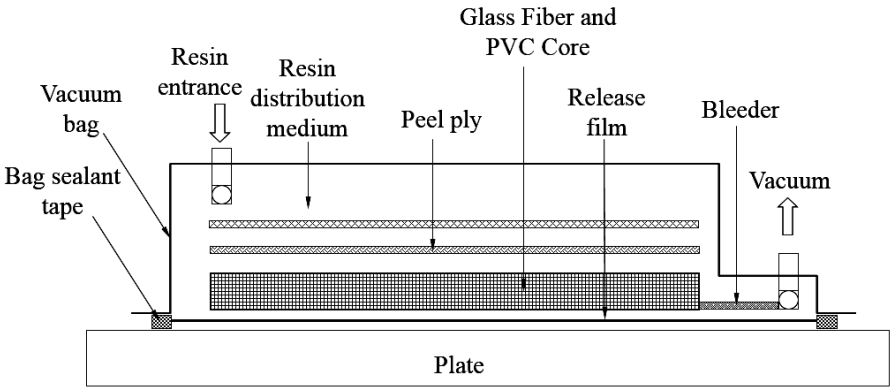


Fig.1: *Vacuum-assisted resin infusion process*

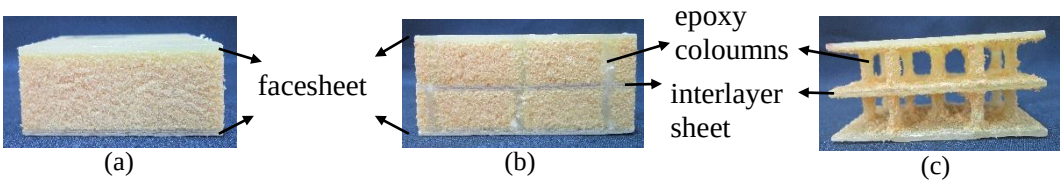


Fig. 2: *Images of the specimens (a) Reference specimen (R20) with nonperforated single core, (b) perforated specimen with divided core (P10/10), (c) columns in perforated specimen with divided core (P10/10) after the core is removed mechanically for presentation purpose*

2.2 Bending Tests

Three point bending tests were performed to determine flexural performance of the sandwich composites. The dimensions of the specimens were selected according to the recommendations of the ASTM C393/393M standard [6]. The span length, total length and width were 150 mm, 200 mm and 50 mm, respectively. The thickness of the specimen was 23 mm. Bending test apparatus (Fig. 3) was connected to Shimazdu AG-X 100kN testing machine. All of the tests were performed at constant crosshead displacement of 4 mm/min.

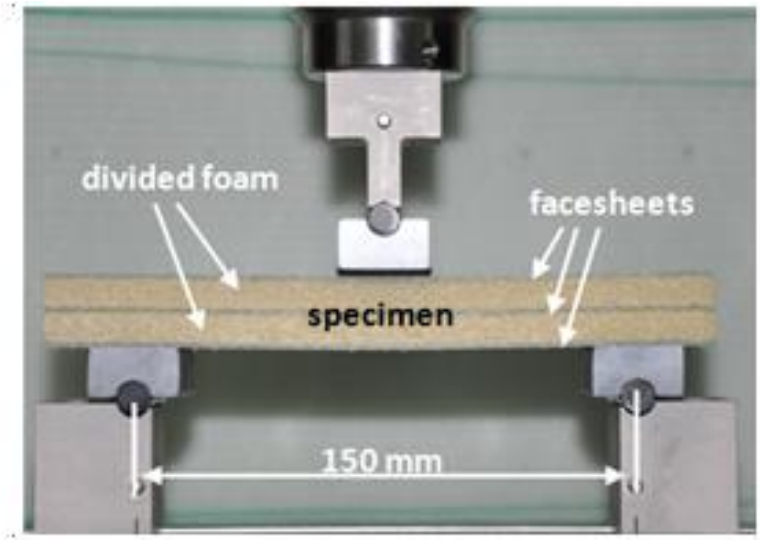


Fig. 3: *Three point bending test setup*

3. RESULTS AND DISCUSSION

Force-deflection behaviors of the specimens are given in Fig. 4; linear ascending trend between force and deflection values can be observed for all types of specimen. A distinction difference can be observed between the nonperforated and perforated specimens after the maximum force values are reached by the specimens and specimens with divided core behave similiarly with their single core counterparts.

As the nonperforated specimen R20 and its divided core counterpart R10/10 have reached its maximum, applied force is observed to descend and damage is seen after relatively higher deflection (Fig. 5a&b). In the meantime for the perforated specimens P20 and P10/10, damage can be observed right after the specimens have reached its maximum force without further deflection (Fig. 5c&d).

This difference can be explained with the damage mechanism taking place during the bending of the non-perforated specimens; specimens act as a "one-piece system" with the start of the bending but after the maximum force values the core has crushed and the top facesheet has cracked while there is no damage in the bottom facesheet of the sandwich composite. For the perforated specimens the sandwich composite also starts as a "one-piece system" and continues to maintain its integrity better than the non-perforated specimens because the applied force is transferred to the bottom sheet via the holes (filled with epoxy for perforated) in the core by acting like bonding columns between the facesheets. And as a result for all of the perforated specimens the damage is observed in only the core and no visual damage is observed in the top or bottom facesheets.

It can be clearly indicated that maximum force values of perforated specimens are significantly higher with a weight increase of 9% for undivided core and 12% for divided core sandwich specimen (Table 1) in comparison to their unperforated counterparts. Perforated specimens are found to be stiffer than the non-perforated specimen. For divided core specimens, the maximum force values and bending stiffness values are higher than their undivided core counterparts with a weight increase of 5% for nonperforated and 7% for perforated core sandwich specimen (Table 1).

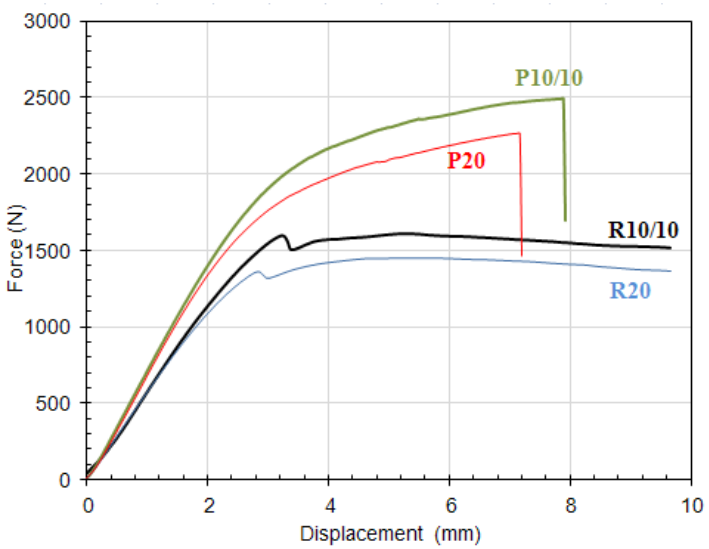
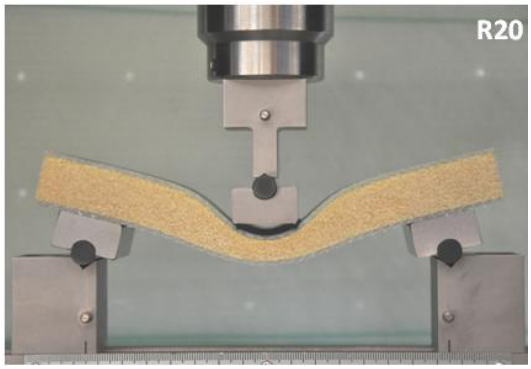
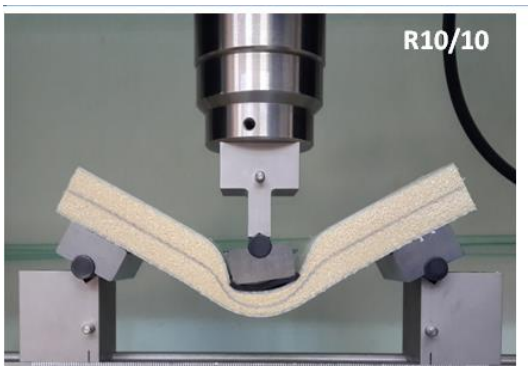


***Fig. 4**: Force-deflection behaviors of the specimens against bending*





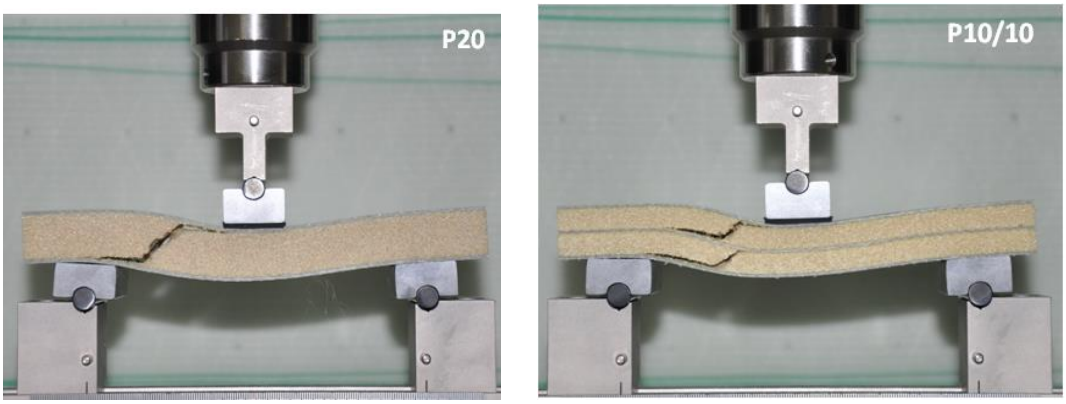


Fig. 5: *Bending failure of the specimens*

Table 1: *Sandwich composite specimens in terms of weight, bending stiffness and maximum force values*

Specimens	Bending Stiffness (N/mm)	Maximum force (N)	Weight (g/m^2)
R20	560	1359	7261
P20	699	2260	7911
R10/10	605	1591	7597
P10/10	747	2502	8481

4. CONCLUSION

The comparisons were performed between reference (R20), perforated (P20), reference divided core (R10/10) and perforated divided core (P10/10) sandwich composites in terms of three point bending performances.

It is seen that perforating the foam core highly affects the bending strength and stiffness of the sandwich composites. It can be indicated that perforation determines the damage mode in bending; causing higher stiffness. It is possible to obtain enhanced bending performance with the use of divided core and using divided core does not affect the behaviour of the sandwich composite against bending deformations.

In the case of the plain core sandwich composite, dividing the core can be advised for certain applications rather than perforating the core as it does not add on to the cost as an additional process (as perforating might) besides being less laborious (it is possible to purchase core material with any thickness) using divided core shall be preferred to increase the bending stiffness and strength of the textile reinforced sandwich composites.

As the future work, it is planned to continue investigating the shear, impact and compression after impact properties of the sandwich composites with such cores.

ACKNOWLEDGEMENT

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THE EFFECT OF 1, 2, 3, 4 BUTANETETRACARBOXYLIC ACID AND TIO_2 TREATMENT COTTON ON UV PROTECTION

BOU Eva[1], BONET Marilés[1], MONTAVA Ignacio[1], DIAZ Pablo[1], GISBERT Jaime[1]

[1]Universitat Politècnica de València, Textile and Paper Department, Plaza Ferrándiz y Carbonell s/n, 03801, Alcoy, Spain.

Corresponding author: Bonet, Marilés, E-mail: maboar@txp.upv.es

Abstract: *Cotton fabrics are modified chemically to add durable press properties. For that, the textile material is treated with crosslinking agents in combination with an appropriate catalyst. Polycarboxylic acids in combination with inorganic phosphorus-containing salts have proven to be one of the most effective formaldehyde-free system capable of imparting durable press properties to cotton fabrics. In this work the 1,2,3,4 butanetetracarboxylic acid (BTCA) and sodium hypophosphite NaH2PO2 . H2O (SHP) were used to treat cotton fabric in order to get easy care properties. In adittion, we study the behauviour of BTCA as bonding agent for particles without any affinity for the cellulosic fibres. This research focuses on determining the influence of BTCA on the TiO_2 nanoparticles loss of the fabrics during washing treatments and the difference of UV protection using or not using BTCA as a linking agent in the treatment. The scanning electron microscopy was used to verify the presence of the TiO_2 on the cotton fabric before and after the launderings. We conclude that with BTCA, more TiO_2 nanoparticles remain on the fabric surface. It was shown that the UV protection of treated fabric using BTCA as a binder is lower than treated fabric only with TiO_2 nanoparticles.*

Key words: *easy care, BTCA, TiO_2, linking agent, UPF.*

1. INTRODUCTION

Cellulosic fibres are characterized by good properties which generate comfort to the users who are wearing these type of fabrics. However, during their use and maintenance, these fabrics show high capacity shrinkage, wrinkling and little wrinkle recovery. These properties are not desirable and are removed by applying crosslinkers to the fibre. So far, the most widely used product is the dimetildihidroxietilenurea (DMDHEU) [1], whose main disadvantage is the release of formaldehyde, a product that is considered a carcinogen.

Currently some new products are under study. They are supposed to be environmentally friendly and from the point of view of human health they should be formaldehyde free. The polycarboxylic acids are gaining importance in this field being studied in some papers [2-4]. Recent investigations indicate that these products can be used not only as crosslinking agents [5] but as bonding agents for certain substances with no affinity for the cellulosic fibres too [6].

In this study, carboxylic acid was used to bind TiO_2 nanoparticles to cotton fabric in order to provide new properties to the fabric and give easy care effects as well. The functionality provided by the particles to the fabric was characterized using specific techniques in order to test the properties to evaluate. The level of protection against UV radiation was analyzed by measuring the transition at different wavelength [7].

2. EXPERIMENTAL

We used a 100% cotton fabric with the weight of 210 gr/m^2. These fabrics samples were impregnated with solutions containing 2 g/L TiO2 nanoparticles P25 (Degussa) and one sample 80 g/L of 1,2,3,4-butane-tetracarboxilyc acid (BTCA) was used as a linking agent and 40 g/L sodium hypophosphite monohydrate ($NaH_2PO_2 \cdot H_2O$) (SHP), which was used as catalyst for the reaction of cellulose with BTCA. The samples were treated by padding and we obtain between 80-85 % pick-up. After that, samples were crosslinked following the procedure of dry crosslinking, drying at 85ºC, and crosslinking at 180ºC during 2 min.

Treated samples were washed by following UNE EN ISO 6330 method no. 2A, 10 cycles of washes were carried out.

To verify the existece of silica particles on the fiber surface, treated samples were observed with a scanning electron microscope FEI model Phenom (Fei, Oregon, USA). Prior to sample observation, samples were covered with a gold–palladium alloy in a Sputter Coater EMITECHmod. SC7620 (QuorumTechnologiesLtd, EastSussex, UK). Samples were then examined with suitable accelerating voltage and magnification.

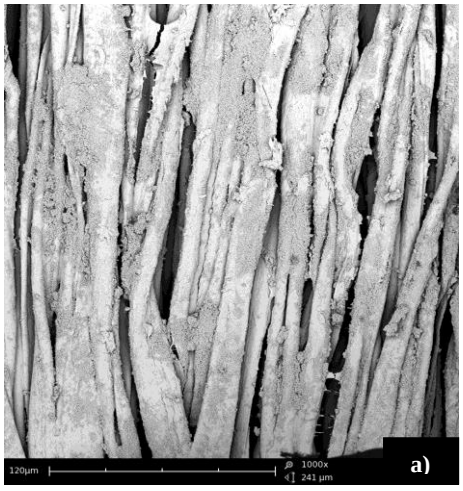
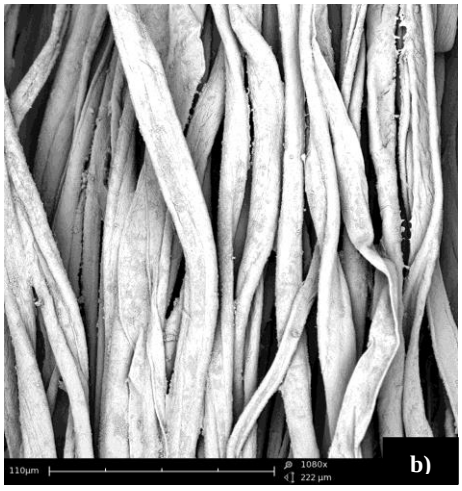
The method used to evaluate was described by the authors Campos et al [7]. This method is based on a UV-lamp that irradiates on the fabric at 312 and 365 nm, which belongs to UVB and UVA radiation respectively. The UPF can be calculated by equation:

$$UPF = \frac{E(312) \cdot \varepsilon(312) \cdot \Delta(\lambda) + E(365) \cdot \varepsilon(365) \cdot \Delta(\lambda)}{E(312) \cdot \varepsilon(312) \cdot T(312) \cdot \Delta(\lambda) + E(365) \cdot \varepsilon(365) \cdot T(365) \cdot \Delta(\lambda)} \quad \textbf{(1)}$$

The equation for determining the UPF by this method only works on two specific wavelengths such as 312nm (UVB) and 365nm (UVA). It works only at these two wavelengths because it is considered to represent optimally ultraviolet radiation.

3. RESULTS AND DISCUSS

To check the presence of the particles on the surface cotton fiber, some images from SEM were taken from the fabrics that have been studied in this work. In Figure 1, we can observe the TiO_2 treated samples using or not using BTCA and these fabrics after 10 laundries.

	Unwashed fabric	Washed fabric (10 times)
Without BTCA		

With BTCA

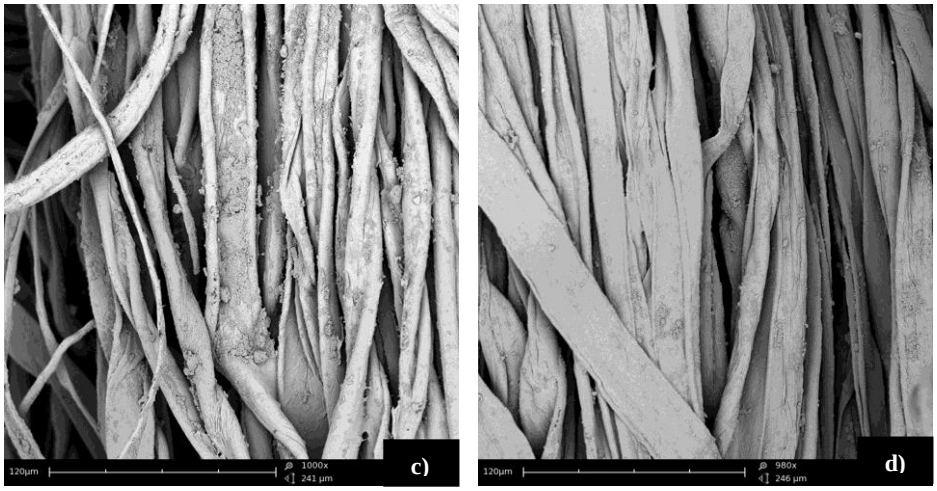


Fig. 1: *SEM images of the treated samples, before and after 10 washes.*

After 10 washing cycles, we can observe the presence of particles on the fabric in both cases, but it seems that when we used BTCA as a linking agent in the treatment bath together with TiO_2 nanoparticles, the quantity of nanoparticules is slightly higher, although the difference is not significant. To verify this behaviour, specific techniques, like particles counter or scanning electron microscopy with energy dispersive X-ray spectroscopy, should be used.

The measurements of the UVA and UVB and the result of the UPF calculated on these two values are provided in table 1. To compare the effect of both treatments conducted on the UV protection, we analyze the untreated fabric too.

Table 1: *UVA, UVB and UPF results*

	UVA (312 nm)	*UVB (365 nm)*	*UPF*
Co-210	0,25	0,11	**1,54**
TiO_2	0,06	0,00	**302,89**
TiO_2 + BTCA	0,05	0,00	**263,22**

The results of UV protection of both treated fabric show higher UV protection than in untreated sample. According to AS/NZ 4399:1996 standard, it has to be considered that the analysed fabric has an acceptable UV protection from UPF 15 value, the fabric is though to have good protection between the range of 25 to 39 and excellent when values are over 40. Thus it should be high lighted that treated samples give UV protection to cotton fabrics, being it excellent in both cases. When the fabric is treated using BTCA, then the UPF is lower than the treatment without this agent.

4. CONCLUSIONS

We can conclude that there is not evidence about the bind effect of the BTCA between cotton fibres and TiO2 nanoparticles, as if we compare the SEM images of the treated fabric after 10 laundries, both fabrics have nanoparticles on the surface fibers. On the other hand, BTCA blocks the

UV protective action characteristic of TiO_2. Despite that, both treatments show high UV protection.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

POTENTIAL USE OF WOOL WASTE AS ADSORBENT FOR THE REMOVAL OF ACID DYES FROM WASTEWATER

BUCIŞCANU Ingrid[1], MAIER Stelian-Sergiu[1], CREŢESCU Igor[2]

[1]"Gheorghe Asachi" Technical University of Iaşi, Faculty of Textiles, Leather and Industrial Management, Department of Textile and Leather Chemical Technology, 29 Prof. dr. docent Dimitrie Mangeron Blvd, 700050, Iaşi, Romania, E-Mail: decanat@tex.tuiasi.ro

[2]"Gheorghe Asachi" Technical University of Iaşi, Faculty of Chemical Engineering and Environmental Protection, Department of Environmental Engineering and Management, 73 Prof. dr. docent Dimitrie Mangeron Blvd, 700050, Iaşi Romania, E-Mail: decanat@ch.tuiasi.ro

Corresponding author: Bucişcanu Ingrid, E-mail: iiacomi@ch.tuiasi.ro ibuciscanu@yahoo.com

Abstract: *At present, great amounts of raw wool are treated as waste and raise disposal problems. In the sustainable development context , wool is regarded as a biodegradable renewable resource and due to its complex chemical composition and fiber morphology, can find different useful applications. It is the aim of this paper to investigate the potential use of raw wool waste as a non-conventional adsorbent for Acid Red 337(AcR) ,currently used for leather and wool dyeing. Two wool-based adsorbents were prepared, namely scoured coarse wool (Wool-S) and wool activated with alcoholic solution of sodium hydroxide (Wool-A). Adsorbent dosage, dye concentration, pH and treatment time were factors taken in consideration for the assessment of the sorbate-adsorbent interaction. The removal efficiency (R %) is mainly dependent on the solution pH and on the activation treatment applied to wool: at pH 3, the removal efficiency reaches the highest values of 42% on Wool-S and 99% on Wool-A. The adsorption rate is slow and needs almost 6 h to reach equilibrium. The experimental data best fitted the Langmuir equilibrium adsorption model, which proves that the adsorbent possess surface active sites to which the dye sorbate binds in monomolecular layer. Raw wool waste is a potential cheap, biodegradable and effective adsorbent for colored wastewater treatment.*

Key words: *renewable resources, wool, keratin, low-cost adsorbent, acid dye, coloured wastewater.*

1. INTRODUCTION

Removal of dyes from wastewater is receiving considerable attention, both from aesthetic reasons and because of their toxicity [1], and mutagenic and carcinogenic potential [2]. Azo dyes, which account for more than 60-70% of the global dyestuffs industry, exhibit these adverse effects on humans and living organisms at particularly high levels [3].

Currently, adsorption is the preferred treatment technology for low-concentration colored wastewater, and activated carbon is considered the most efficient adsorbent [4], but has the disadvantage of being too expensive for many environmental applications. The increased interest in the valorization of renewable resources has driven the development of alternative low-cost adsorbents derived from agricultural and animal wastes, which proved their efficacy in removing different classes of dyes from aqueous solution, both in their native or chemically modified state [5].

During mankind history, wool has been one of the most widely used natural fibers. Keratin, the main constituent of the wool fiber, is responsible for its unique properties. In the last decades, wool has lost ground to the cheaper and performant synthetic fibers, and huge amounts of raw wool are considered a waste that raise serious disposal problems. Valorization of this renewable resource is achieved mainly by keratin solubilization and regeneration into value-added products, such as fertilizers [6] or biomaterials [7]. In the field of pollution treatment, research is focused on the potential use of wool waste as nonconventional adsorbent for heavy metals [8, 9] and dyes [10, 11].

The aim of this paper is to investigate the adsorptive capacity of raw coarse wool and chemically activated wool for one acid dye with mono azo structure, currently used for wool and leather dyeing. Effect of the sorbent dosage, dye concentration, working pH and contact time upon the dye removal efficiency was determined. The adsorbent–adsorbate interaction was investigated by means of kinetic curves and adsorption isotherms.

2. MATERIALS AND METHODS

2.1 Adsorbate and adsorbent materials

The anionic dye chosen as targeted adsorbate was Sellacid Red PF [C.I. Acid Red 337, single azo, molecular formula: $C_{17}H_{11}F_3N_3NaO_4S$, molecular weight: 433.34], supplied by TFL Ledertechnik GmbH, Germany. A dye stock solution was prepared at a concentration of 1000 mg/L, from which the experimental solutions were obtained by dilution to the required concentrations. The pH of the dye solutions was adjusted with NaOH 0.1 N for pH 5 and with H_2SO_4 0.1 N for pH 3 and pH 4 and measured on a WTW InoLab 720 pH meter.

Raw coarse wool from a local farmer, was scoured through a conventional process, with anionic detergent and sodium carbonate. The activation treatment was performed with 1% NaOH and 20% ethanol in aqueous solution at room temperature, under vigorous agitation in a reciprocating shaker, for 2 h. The scoured wool (Wool-S) and the activated wool (Wool-A) were thoroughly washed with distilled water, dried, disentangled, cut into 5 mm pieces and conditioned. A supplementary adsorbent (Wool-H) was obtained by plain hydrolysis with 1% NaOH.

2.2. Equilibrium sorption and kinetics experiments

Batch sorption experiments were carried out in glass vials containing 100 mL dye solution with different initial concentrations (20, 40, 60, 80, 100, 120 mg/L) and wool sorbent amounts accounting for doses of 1, 1.5, 2, or 2.5 g/L. The mixtures were agitated on a magnetic stirrer at 250 rpm and 25°C for 6h, in order to assure the reach of equilibrium. The residual solutions were separated from the wool sorbent by filtration through an inert synthetic polymer mesh.

Dye concentration in residual solutions was photometrically determined on a HACH DR/2010 single-beam spectrophotometer. For the tested acid red dye (AcR), maximum absorbance was recorded at 500 nm. The dye uptake at equilibrium, Qe (mg/g) was calculated from Eq. 1:

$$Q_e = [(C_0 - C_e) \cdot V] / m_a \quad \textbf{(1)}$$

where C_0 and Ce (mg/L) are the initial and the equilibrium concentration of the tested dye, V (L) is the volume of the solution sample and m_a (g) is the mass of adsorbent. The dye removal efficiency, R% was calculated with the relationship given in Eq. 2:

$$R\% = [(C_0 - C_e) \times 100] / C_0 \quad \textbf{(2)}$$

The kinetics study was conducted at the same temperature and mixing regime. The initial concentration of all dye solutions was 100 mg/L, the adsorbent dose was 2 g/L, the working pH 3. The supernatant samples were withdrawn at preset time intervals between 15 min and 480 min, and the dye uptake at each time was calculated with a relationship similar to Eq.1.

To estimate the feasibility of the adsorption treatment, several preliminary adsorption tests were conducted with Wool-S, Wool-A, and Wool-H on dye solutions with the initial concentration of 100mg/L and adsorbent dosage of 2 g/L, at pH 5 and pH 3, respectively. The mixtures were contacted for 6h and left overnight before the absorbance of the residual solutions was measured.

3. RESULTS AND DISCUSSION

3.1. Preliminary adsorption tests

Comparative values of the removal efficiency, R of the AcR dye from aqueous solution on the tested sorbents are presented in **Fig. 1.** The scoured wool (S-W) exhibited a modest adsorptive capacity both at pH 5 and pH 3; the increase of R from 29% to 42% show a little influence of pH upon the native wool affinity for the dye. Both activation treatments improved the AcR dye uptake, which proves that the alkaline treatment created new functional groups that act as active sites on the sorbent material. Addition of alcohol to the treatment solution produced a slight but visible improvement of R, by about 8%. At pH 3, the Wool-A product was able to remove the dye almost entirely (R= 99 %), which is more than twice as much as the removal ability of Wool-S (R = 42%). PH lowering had a great influence on the adsorption capacity of the tested wool. The R values show that a simple chemical treatmen can significantly improve the affinity of wool fiber for acid dyes

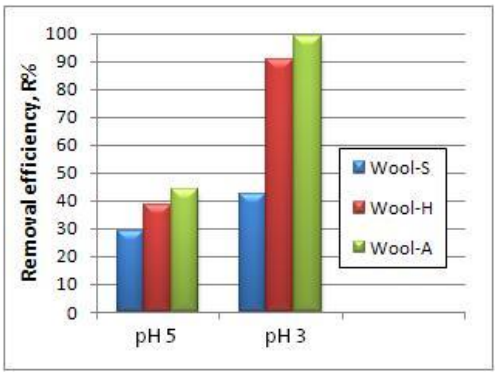

Fig. 1*: Estimative values of removal efficiency of Acid Red 337 on the wool adsorbents (C_0=100 mg/L; adsorbent dosage: 2g/L)*

3.2. The influence of adsorbent dosage and pH on the dye uptake

For a given initial dye concentration of, the removal efficiency increases with the increase of the adsorbent dosage up to a point and then suffers a slight decrease **(see Fig. 2)**.

The pH influence is very strong and must be related to the keratin protein properties and to the activation treatment. Keratin macromolecule is an amphoteric polyelectrolyte, whose overall charge depends on the pH of the aqueous media. The pH at which the macromolecule is electrically neutral due to the balance between the positive and the negative charge of the side chains is called the isoelectric point (pH_{iz}). The pH_{iz} of keratins specific to wool is around 5 [12]. At pH < pH_{iz}, the protein carries a net positive charge, given by the $–NH_3^+$ protonated groups while at pH > pH_{iz}, has a net negative charge given by the $–COO^-$ deprotonated groups; at pH 5, Wool-A is in the isoelectric

domain, and few positively charged groups are available to interact with the dye anion. At pH 3, the number of the positively charged active sites, is significantly increased, and also the retention capacity of the activated wool fibers, which determines a removal efficiency of more than 90%.

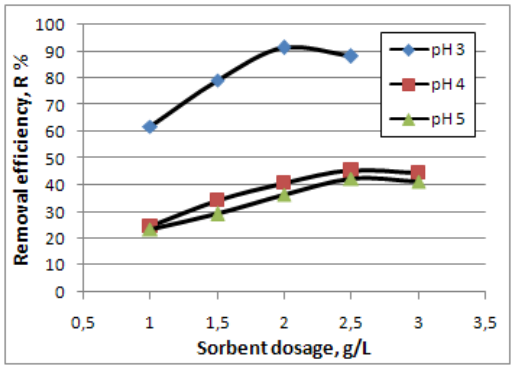

***Fig. 2**: Influence of sorbent dosage on the removal efficiency of AcR, at different pH values (C_0 = 100 mg/L)*

3.3. The process kinetics

The experimental kinetic curves are presented in **Fig. 3.** The overall sorption process is slow and needs almost 6 h till completion on activated wool, and about 2 h on nonmodified wool. Both on Wool-S and Wool-A, high adsorption rates were observed within the first 60 min but the equilibrium dye uptake was low on Wool-S (about 10 g/mg), and high on Wool-A (about 48 mg/g).

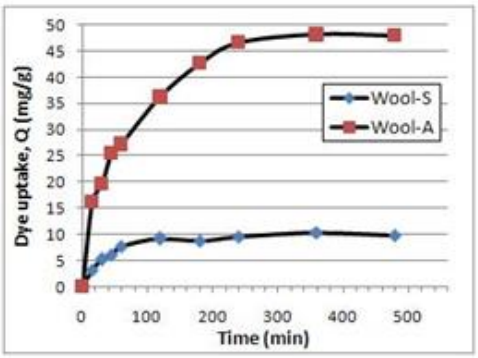

***Fig. 3:** Experimental kinetic curves of AcR on tested wool adsorbents (C_0 = 100 mg/L; adsorbent dosage: 2 g/L, mixing rate = 250 rpm, t° = 25°C)*

This behavior must be correlated to the changes induced in the wool fiber morphology by the activation treatment. The outer surface of the native wool is hydrophobic and blocks the penetration of more dye molecules inside the wool fiber; the adsorption process will stop in a short time. The activation treatment removes the superficial greasy matter and opens up the fiber structure; the dye uptake is higher but the penetration of dye molecules inside the fibers till the reach of equilibrium will last longer.

3.4. The equilibrium isotherms and sorption process modeling

The experimental sorption isotherms are given in **Fig. 4.** At the working pH, the maximum

adsorption capacity of 58 mg/g was recorded on the Wool-A sorbent, while a minimum dye uptake, of 13 mg/g was recorded for the Wool-S material. The higher equilibrium uptake on Wool-S is due to the increased number of active sites, which are created inside the wool fiber as the result of keratin macromolecule splitting during the alkaline hydrolytic treatment.

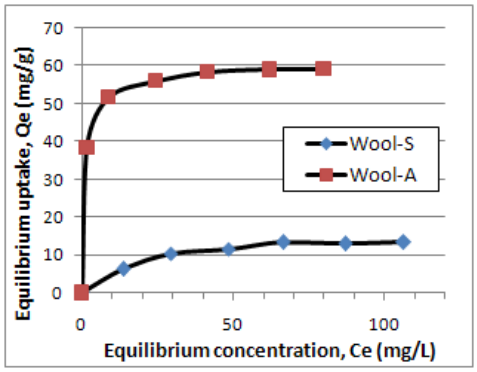

***Fig. 4**: Adsorption isotherms of Acid Red dye at pH 3 (Wool-A dosage = 1 g/L)*

The Langmuir isotherm model assumes that adsorbent surface is homogeneous and possess identical active sites, on which the adsorbate accommodates in a monomolecular layer; the model coefficients are the maximum adsorption capacity, Qm (mg g^{-1}) and k (L mg-1), a thermodynamic constant related to the free energy of adsorption. A dimensionless constant termed as separation factor, R_L is defined as $R_L = 1/ (1+k \cdot C_{0M})$, where C_{0M} is the highest initial dye concentration; values of $0 < R_L < 1$ indicate favourable conditions for sorbate-adsorbent interaction in accordance with the Langmuir model [13]. The lower R_L, the stronger the interaction between the sorbate and the substrate and irreversible attachment of the sorbate molecules.

***Table 1:** Calculated parameters of the Langmuir isotherm model*

Adsorbent material	Wool-S				Wool-A			
Model coefficient	Q_m (mg g^{-1})	k (L mol^{-1})	R_L	R^2	Q_m (mg g^{-1})	k (L mol^{-1})	R_L	R^2
	15.67	0.0591	0.123	0.9915	60.24	0.712	0.00996	0.999

The values of the calculated parameters of the Langmuir isotherm model, as given in **Table 1**, show that the equilibrium experimental data are best fitted by the Langmuir model. The predicted maximum monolayer adsorption capacities, Qm are close to the experimental equilibrium uptake and correlation coefficients, R^2 are close to unity. The decrease of the R_L value with one order of magnitude proves that the alkaline treatment created new active sites with high binding capacity.

5. CONCLUSIONS

Coarse raw wool activated through a simple chemical treatment can be used for efficient removal of acid dyes from aqueous solution.

The alkaline activation treatment determines chemical alteration of the keratin macromolecules and changes of the wool fiber morphology, with a positive influence on the adsorption capacity of the tested wool.

The removal efficiency is significantly influenced by the solution pH and the adsorbent dosage. Best results were obtained at solution pH 3 and sorbent dose of 2 g/L, on solutions with dye concentration lower than 100 mg/L.

Raw wool waste is a renewable resource that can find valuable application as a cheap, biodegradable adsorbent for colored wastewater treatment. Further research is needed to analyze the influence of chemical auxiliaries on the dye uptake in real wastewater-sorbent systems.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

THE BEHAVIOUR OF FABRICS USED FOR *ANTIMIS* PRODUCTION TO PILLING

CHIRILĂ Mihai Maxim[1], CIOARĂ Ioan[2]

[1]"Gheorghe Asachi"University, Faculty of Textile, Leather and Industrial Management, Department of Textile Engineering and Design, Postal address: Bulevard Profesor Dimitrie Mangeron, nr. 56, 700050, Iassy, Romania,
E-Mail: dr_socratesit@yahoo.com

[2] "Gheorghe Asachi"University, Faculty of Textile, Leather and Industrial Management, Department of Textile Engineering and Design, Postal address: Bulevard Profesor Dimitrie Mangeron, nr. 56, 700050, Iassy, Romania,
E-Mail:icioara2012@yahoo.com

Corresponding author: Chirilă Mihai, E-mail: dr_socratesit@yahoo.com

Abstract: *The present study about the behaviour of plain textiles used for the production of antimis (Christian-orthodox liturgical item used in the liturgy) to pilling explores the functional classification of different types of antimis as a textile product made out the following different types of fabrics: natural silk, flax, viscose, polyamide 6.6.*
Pilling is a phenomenon which consists of the formation of small balls made out of fibre congeries on the textile's surface due to attrition and fatigue.
For textiles used as liturgical items, the process of pilling formation includes the following stages: the emergence of the pilling surfaces (the formation of fuzzy), fibre tangle (appearance of small balls), and the detachment of small balls from the fabric's surface.
The analysis method of pilling for liturgical items made out the four types of fabrics mentioned above consists of stereoscopic microscopy techniques and electronic microscopy methods (SEM). The images of textiles samples (yarns and fabrics) will be captured using a video microscope. Quantitative tests have been done to determine the metric number and the tex title of the above-mentioned fabrics.
The increased resistance of silk to pilling compared to nylon, flax, and viscose can be attributed to the chemical properties of fibres and structural characteristics of silk fabric. The structural compactness of the same fiber mixture of natural silk fabric with bonded fabric will have a higher resistance coefficient to pilling compared to the other mentioned fabrics. Through this, the value of use and durability of the antimis will increase.

Key words: *liturgical item, pilling, textile surface, structure characteristics, fastness*

1. INTRODUCTION

The present study about the behaviour of plain textiles used for the production of antimis (Christian-orthodox liturgical item used in the liturgy) to pilling explores the functional classification of antimis as a textile product made out the following different types of fabrics: natural silk, flax, viscose, polyamide 6.6.

Pilling is a phenomenon which consists of the formation of small balls made out of fibre congeries on the textile's surface due to attrition and fatigue.The phenomenon of pilling appears both in the case of chemical fibres and natural fibres.

As in the study of engineering textile surfaces have a leading role both macro and microtextiles units (microfibers, yarns, fibers, fibrils), in the present work will analyze the behavior of each part of textile fabric in relation to the phenomenon of pilling.

2. GENERAL INFORMATION

For textiles used as liturgical items, the process of pilling formation includes the following stages: the emergence of the pilling surfaces (the formation of fuzzy), fibre tangle (appearance of small balls), and the detachment of small balls from the fabric's surface.

Observations made by L. Szego [1], P. Braun, W. Albrecht [3] concerning the cause of formation of small balls show that the ends of the fibers, which are fixed in the product in a superficially way, formed first on the surface of plain textiles a loop, which is exacerbating the friction by surface rubbing, favoring the agglomeration of yarns.

In practice, high adhesion to fiber slows the migration of fibres from the inside. A similar effect is obtained in the case of a high bending stiffness. Fiber tenacity determines the length and density of the pilling layer; if fiber breaks easily, it forms a dense and shorter coat. Therefore, we first modify the design of macro-molecular textile surface appearance fluffy layer (fuzzy). It finds changing the layout macro-molecular textile surface appearance fluffy layer (fuzzy). As an intermediate stage for quality depreciation of plain textiles, it could be reported the occurrence of pilling small balls, which feature the ravel the fibers stemming from the yarns of weft or warp of fabric. A final stage of pilling formation is the detachment of small balls from the fabric's surface.

The basis of the occurrence of pilling is the formation of loops that start immediately after the piling layer has reached a specific density and length (length criticism). [4]

The phenomenon is more pronounced in articles of man-made fibres or mixtures of synthetic and natural fibres, textile structures open and flexible being altered after the fibres emergence and by the persistence of built-up areas which is generated. Occurrence of pilling is determined by the mechanical properties of the fibres components through the tensile strength, rigidity to inflection, through repeated bending, by the geometrical features of fibers, by the yarn structure (the degree of twisting, the original hairiness), by the structure of the textile fabric.

A key feature of the aspect is the ability of the pilling formation, which is in close connection with the uniformity of the surface (flatness, color), degree of gloss (glossy, matte, semi matte), crease resistance. [5]

The tendency of pilling – the resistance to pilling assessment of subjective evaluation methods and measuring objective, involving: initiation of the test-pieces, using standardized test machines, methods of evaluation and relevant indices of expression; modeling phenomena with detailing each phase of generation and its use in optimization of textile structure.

After several experiments, on specific test s pilling imulators, emerges a predominant idea experimentally confirmed, influencing the pilling, namely, structural compactness. [6]

Therefore, the pilling it is a typical emergence of flat textiles, which consists in shaping of agglomerated areas of fibres, being adherent, as a result of the action of the forces of friction which are affecting their appearance.

Because the effect of pilling affects the quality of look and functionality of the textile products referred to above, namely, of *antimis*, its quantification by simulating operating conditions, is mandatory, and it standardizes. [7]

Therefore, for the higher coefficient of torsion and for the minimum length of push-ups, the resistance to pilling, for the yarns from the fabric structure, has maximum values for the fibrous materials with the same composition. [8]

2. EXPERIMENTATIONS

3.1.Presentation of antimis

It is a liturgical use textile object, present at the Holy altar, placed on the Holy table, under the Gospel. Antimis' dimensions are: length = 60 cm, width = 45-50 cm; the shape is generally rectangular or square. It has function, which must withstand more bending and compression, during his use , whereas every time, it's unfolded and folded during divine service, and on the stretched surface bread crumbs with a sponge and are also placed the holy gifts (disc and chalice) [9]. It is necessary that the crumbs to not slip during mass, does not pass through the fabric.

On the self, the antimis sits folded on the Holy Table, forming the 9 borders which correspond to 3 layers overlapping (sheaths). Here, we encounter the permanent bending of the folds (streaks) that constitute the nine frames.

***Fig. 1**: Antimis printed on woven natural silk, private collection, 1848*

Repeated bending, flexing, and above all, generates fatigue, faster than repeated laying, because it determines the reduction of the reduction of the connections between the fibers. This may explain why synthetic fiber products presents a high resistance to repeated requests of traction, but significantly less from repeated bending requests. [10]

To individualize the reaction of a certain type of fiber and a particular type of fabric from which different, apply the methods of testing standard for yarn samples (wires) or pieces from fabrics.

Test methods with one-way stretch-looping - Schieffer, leads to the following observations: molecular structure of fibers and fiber surface condition influence the friction between fibres and thus resistance to repeated past participles during evaluation of textile products.

Test method with two-way stretch and looping-Schopper [11], is used to characterize the wires (samples) and fabric strips for standardized dimensions.

The return of the antimis from the folding reaction analysis leads to the reaction to request alternative bending of antimis. The entire set of fibre (yarn, fabric), during the request for alternate bending-permanent, structural factors are involved for further disruption as frictional forces between yarn and fibers.

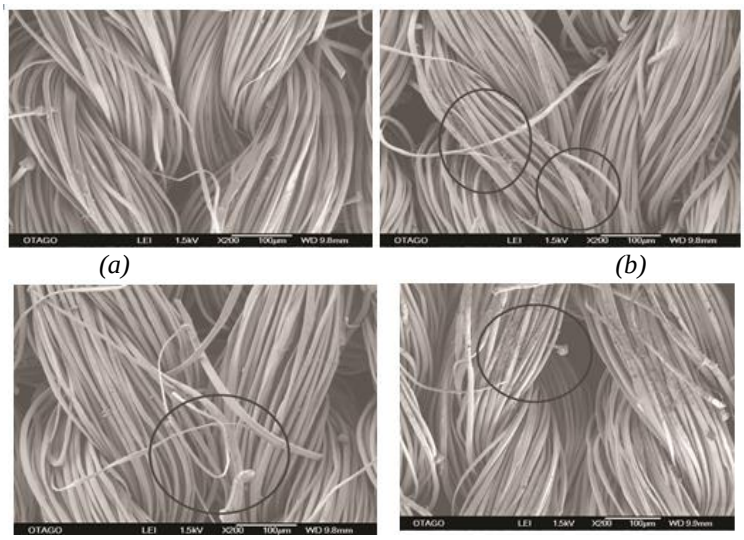
3.2. Textile raw material of antimis

According to liturgal writers, as well as major Nicholas Cabasilas and Symeon of Thessaloniki, Theodor Studite, Nicephorus the confessor [12], which have become normative for Church decoration rules and functions in the cultic act, the antimis must be matter of provenance protein (silk) or belong to the plant kingdom (flax, cotton, sisal, bamboo, stinging nettle). This

tradition with respect to the raw materials from which is made the antimis is quite old, starting with III-IV centuries a.Hr. until nowadays.

3.3. Methods

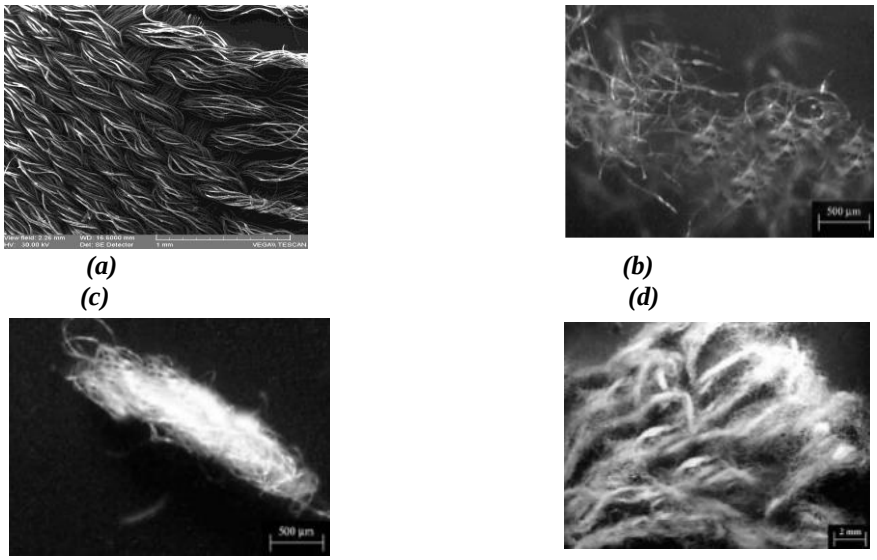
Methods of analysis of the pilling phenomenon for: silk fabrics, nylon 6.6 fabrics (polyamide 100%), natural flax fabrics, viscose fabrics - optical microscopy techniques of reflection and electron microscopy methods-methods of scanning electron microscopy (SEM). It has sought to highlight some tranforation or damage generated by processes of use or as a result of wear or mechanical stresses (abrasion caused by rubbing the sponge of textile surface). Standard samples shall be taken from the raw materials intended for confecion of antimis.



(a) *(b)*

(c) *(d)*

***Fig. 2**: Bundles of yarns present in natural silk fabric (catch SEM 200 X). (a) prior to the formation of pillingului; (b) formation of downy-layer fuzzy; (c) tangle of fibres (appearance of small balls); (d) the occurrence of small balls and separation.*



(a) ***(b)***

(c) ***(d)***

***Fig. 4**: Fragment of woven nylon 6 (polyamide)-SEM video capture: (a) prior to the formation of pillingului (100 X); (b) formation of downy-layer fuzzy (1000 X);(c). pill ball (1000 X); (d) the occurrence of small balls and separation.*

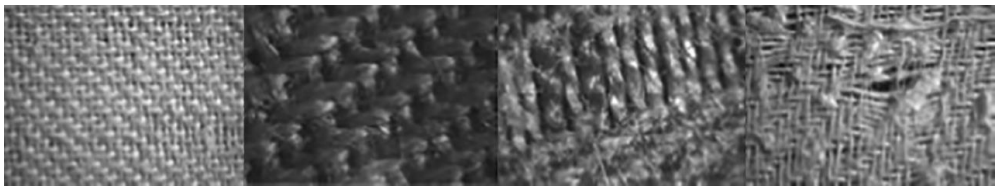


Fig. 3*: Fragments of woven flax - capture video microscope (electron steroscopic microscopy).(a) prior to the formation of pillingului; (b) formation of downy-layer fuzzy; (c) tangle of fibres (appearance of small balls); (d) the occurrence of small balls and separation.*

It have been highlighted some deterioration stemming from attrition on the textile surface of antimis due to the mechanical stresses and abrasion leading to the formation of pilling.

3.4. Cantitative experiments for determining the metric number and title of tex metric of fabrics of which were made from four different types of antimis textile raw material.

Have got ten pieces from bits of yarn with length = 10 cm from natural silk type, flax, polyester and polyamide. We mention that the fabric is simple-type bond cloth, with an average rate of compactness and both wires from the warp and the weft are of the same size.Were weighed on an electronic balance Partner Was 220/C/2 laboratory TPMI Iași and found the following average value:

Table 1: *Metric number*

Pieces of yarns	Natural silk	Flax	Polyamide	Viscoze
dimension	10 cm	10 cm	10 cm	10 cm
Mass	2,4 mg	3,4 mg	2,8 mg	2 mg
Nm (m/g)	41	29	35	50

Table 2. Thinness index number

Index	Natural silk	Flax	Polyamide	Viscoze
Ttex	24, 39	34,48	28,57	20

T

No	Type of yarn	The value of the coefficient A
1	Natural silk yarn	0.0410
2	Flax yarn	0.0350
3	Polyamide yarn	0.0474
4	Viscoze yarn	0.0340

Knowledge of the degree of thinness yarns (including yarn diameter) and number of wires from weft and warp lead us to appreciation of the quality of the fabric that can cover the value of utilizing of antimis. During the evaluation, the antimis, from rest position (folded), is unfolded and subjected to tensile force and tension.

4. CONCLUSIONS

Personal contribution within original research lies in reevaluating natural silk fabrics for the production of antimis conforms to the XVII, XVIII, XIX centuries.

Structural compactness of the natural silk fabrics, generated by the type of connection, will have a higher resistance to pilling in relation to woven fabrics of viscose, woven fabrics of nylon polyamide 6.6 (100%), 100% woven fabrics of flax and thus will increase the amount of use and durability of the textile product.

The occurrence of pilling in the case of antimis, unlike clothing products, which can still be functional in its early phase, makes the value of utilizing it to be compromised.

When are gathered on the surface of antimis, the crumbs from wheat (Holy Flesh) and poured into the chalice, where its are mixed with matter of wine (Holy Blood) the priest and the faithful shares, these pilling small balls swallow with Holy Communion.

The presence of pilling involves another shortcoming of the symbolic meanings of textile surface printed illustration of antimis, couldn't understanding clearly religious scenes or characters' faces displayed in the illustration of antimis. Pilling influence the sensory comfort of touch. Pilling, as a determining factor in reaction to wear during use, amplifies or lowers the life of textile product.

Testing of textiles behaviour from repeated mechanical stresses (fatigue) is one of the most appropriate methods for the assessment of the durability of the textile products. Fatigue of the raw materials (fabrics of antimis production) quantify through objective and indices are evaluated subjectively by visual analysis and sensory perception. [13] Thus, standard mechanical properties indices are welking until reaching destruction. The phenomena is installed in dynamic and alternative request. Can be seen from simple requests (compression, tensile, bending, friction) or complex (dissolution, erasing contour drawing).

Analyzing the four types of antimis made of natural silk fabrics, of polyamide, of flax, and of viscoze, it could be noted, according to the index table and quality *Engineer Handbook Plumber* [14], that behaves best at destroying phenomenon the antimis of silk products. Even to the antimis kept in privat colections or in museums, restored after the use, the silk is presented in the best possible conditions.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

DESIGN OF ASYMMETRIC LADIES' DRESSES WITH 3D ELEMENTS

DINEVA Petya[1]

[1]Trakia University of Stara Zagora, Faculty of Technics and Technologies of Yambol
Graf Ignatiev 38, 8600, Yambol, Bulgaria, E-Mail: petya.dineva@trakia-uni.bg

Abstract: *The balance is one of the principles in design. According to the bilateral symmetry in the human body, we can describe that in fashion the designed model has to be in equal "weight" in left and right regardless of the mirror symmetry of the model – symmetrical or asymmetrical one. The balance is very important in design of asymmetrical garments. The paper presents balancing in design of asymmetrical ladies' dresses with the help of 3D elements and connections between 3D elements and other features in the design. Six ladies' dresses in asymmetrical design with different type of three dimensional elements are presented. In the models 3D elements are used in both functions: design and design constructional ones. In the design of the models it is searched for the variety of three dimensional elements and the variety of other types of fashion design features. Every type of 3D elements – plates, frills, flounces, gathers, tucks, and draperies can be used in the fashion design of asymmetrical garments as basic element or as balancing element. One 3D element can be in balance with another three dimensional element or with other features in the design – details, elements, locations, lengths, sizes, volumes, forms, directions, additional elements and accessories, etc.*

Key words: *fashion design, balance, 3D elements.*

1. INTRODUCTION

The balance is one of the principles in design. [1] According to the bilateral symmetry in the human body, we can describe that in fashion the designed model has to be in equal "weight" in left and right regardless of the mirror symmetry of the model – symmetrical or asymmetrical one. [1, 2] The balance is very important in design of asymmetrical garments.

The paper presents balancing in design of asymmetrical ladies' dresses with the help of 3D elements and connections between three dimensional elements and other features in the design.

2.BALANCE OF ASYMMETRIC LADIES' DRESSES WITH 3D ELEMENTS

Figures from 1 to 6 present asymmetrical models of ladies dresses with different types of 3D elements. The dresses are in different silhouettes [3] and lengths to the knees or a little over the knees. In the models 3D elements are used in both functions: design and design constructional ones. In the design of the models it is searched for the variety of three dimensional elements and the variety of other types of fashion design features.

Figure 1 shows a model of one shoulder dress in close fitted silhouette with a whole peplum in the waist. The asymmetric neckline in the front is formed with soft concave line which formed the strap by the left shoulder. The neckline in the back is in similar form. The fitted form of the body is

a result of design constructional seams in vertical direction. A decorative detail, which is similar to a sleeve, with frills is set on the strap on the left shoulder. The peplum is in asymmetric form too. Its length in the right is larger than the length in the left. Two one-sided wide pleats are situated in the right part of the peplum in the front and back. [4]

The asymmetric length of the peplum balances the shoulder strap with decorative details, as the pleats which are located in the right part of the peplum balance the frills in the decorative detail on the shoulder strap in the left.

Figure 2 presents another model of one shoulder dress with drawn with additional details shoulder strap. The model of the lady's dress is in close fitted silhouette too as the fitted form is in result of design constructive seam type redingote and the neckline is similar to the neckline in the model, shown in Figure 1. A cascade of three flounces is situated on the neckline and the shoulder strap. A cascade of three flounces is situated in the left part of the skirt.

At first it is seen that the cascade of flounces in the neckline is located more in the left part, and the cascade of flounces on the skirt is located in the left part too. But the design of the dress is balanced. The 3D cascades of flounces are balanced with the large form of the right part of the dress, which is without a seam in the waist and the detail is one and the same for the down and the upper part of the model, or the bigger detail in the right balances the smaller details in the left.

In both models, presented in Figures 1 and 2, the 3D elements give femininity in the elegant models.

Figure 3 shows a model of one shoulder lady's dress in flower silhouette [5]. The upper part of the dress is with asymmetric neckline, formed with more intensive then previous models concave curved line. The neckline forms the strap on the left shoulder. The fitted form of the upper part is formed with design decorative seams in vertical direction. The skirt of the dress is in big volume which forms the flower silhouette and is a result from intensive gather in the waist. The down part of the dress is symmetrical.

The asymmetrical one shoulder upper part of the dress is balanced with a big ribbon from several layers, which is connected with dress in the waist with intensive gather. Of course the ribbon is situated in opposite right part of the dress. The silhouette with the ribbon gives the romantic character of this lady's dress.

Figure 4 presents another model of one shoulder dress in which balance is a result of a ribbon. In the lady's dress in Figure 4 the elegant vision is a result of the form of the neckline, the ribbon, and the close fitted silhouette. The neckline in the front is formed with a curved line which is soft bulged in the right and concave in the left, and in the left the curve makes the shape of the strap. The fitted form of the dress is a result of design constructional seams in vertical direction.

The asymmetrical one shoulder upper part of the model is balanced with a big ribbon from several layers, which is connected with dress in the left design constructional seam with multitudinous plates. The big volume ribbon covers the opposite right part of the skirt of this lady's dress.

Figure 5 presents a lady's dress in semi fitted silhouette. The semi fitted silhouette is a result of draperies, which in the model are not only decorative, but constructive elements too. The asymmetrically located draperies are fixed in the right part of the neckline and forms cascades of folds in diagonal direction, which fall on the left part of the dress. Of course the shapes of the draperies are more intensive in the left side of the dress. The form of the necklines is asymmetric too and it is shapes the left shoulder string. The right shoulder strap is formed by three rows of necklaces which covered the folds of the draperies. [6]

In this model the balance is a result of connection between the draperies and the rows of necklaces.

Figure 6 shows a model of a lady's dress in fitted silhouette. The close fitted form in the bust area is a result of multitudinous one-sided tucks, which in this model of course are not only decorative but constructive function too. The tucks are located in diagonal direction around the asymmetrical neckline formed with a bulged curved line. The skirt is formed with a cascade of multitudinous draperies in diagonal direction, opposite to the directions of the tucks. [6]

In this lady's dress the balance is a result of the opposite directions of the tucks and the draperies.

In both models, presented in Figures 5 and 6, the 3 D element – draperies and tuck bring extravagant notes.

***Fig. 1**: One shoulder dress with detail with frills on the left shoulder and one-sided pleats in the right part of the peplum*

***Fig. 2**: One shoulder dress with cascades of flounces in opposite directions*

***Fig. 3**: One shoulder dress with gathered ribbon in the waist in opposite side to the shoulder strap*

***Fig. 4**: One shoulder dress with plated ribbon in the design constructional seam in opposite side to the shoulder strap*

***Fig. 5**:*
An asymmetric lady's dress with draperies in diagonal direction

***Fig. 6**:*
An asymmetric lady's dress with tucks and draperies in opposite diagonal directions

3. CONCLUSIONS

Every type of 3D elements – plates, frills, flounces, gathers, tucks, and draperies can be used in the fashion design of asymmetrical garments as basic element or as balancing element. One 3D element can be in balance with another three dimensional element or with other features in the design – details, elements, locations, lengths, sizes, volumes, forms, directions, additional elements and accessories, etc.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

ANTI-MICROBIAL AND ANTI-AMOEBIC ACTIVITY SOME AZOMETHINES - POTENTIAL TEXTILE DYESTUFFS

DJORDJEVIC Dragan[1], AMIN Goran[2], MICIC Aleksandra[3], MILIC Dragan[4], SMELCEROVIC Miodrag[5]

[1, 2]University of Nis, Faculty of Technology, Textile Department, Bulevar oslobodjenja 124, 16000 Leskovac, Serbia,
E-Mail: drdrag64@yahoo.com

[3, 5]Higher Vocational School for Textile, Textile Department, Vilema Pusmana 17, 16000 Leskovac, Serbia,
E-Mail: msmelcerovic@yahoo.com

[4]Center of the Ministry of Defence Leskovac, Majora Tepica 4, 16000 Leskovac, Serbia,
E-Mail: drdrag64@gmail.com

Corresponding author: Djordjevic, Dragan, E-mail: drdrag64@yahoo.com

Abstract: *In this paper, new synthesized three azomethine derivatives applied in dyeing textiles checking the anti-microbial properties of active components, at the same time [1-3]. The emphasis is thrown on the verification of anti-microbial properties that are important for obtaining textile with significantly improved performance. All compounds were characterized and evaluated for their anti-microbial activity against 7 pathogenic bacteria, 1 parasitic protozoan and 1 fungus. It estimated anti-bacterial activity in vitro against the following microorganisms Staphylococcus aureus, Bacillus anthracis, Streptococcus faecalis, Enterobacter sp., Escherichia coli, Pseudomonas aeruginosa, Proteus mirabilis, and Candida albicans. The anti-amoebic activity in vitro was evaluated against the HM1: IMSS strain of Entamoeba histolytica and the results were compared with the standard drug, metronidazole. The synthesized azomethines, showed very good substantivity for wool fibers, gave fine coloring, with good degree of exhaustion after dyeing. The combination of extended synthetic analogues of natural molecules leads to discovery of chemical entities which might be excellent anti-microbial and anti-amoebic compounds as depicted in our results. Being highly the effects this compound can be explored in future as an option for decreasing pathogenic potential of infecting from different sources. Azomethines containing hydrazone (dyestuff 1) and phenylhydrazone (dyestuff 2) as moiety show average yield and moderate inhibition activity while azomethines containing thiosemicarbazone (dyestuff 3) as moiety show higher yield and greater inhibition activity towards gram-negative and gram-positive bacteria as well as a fungus.*

Key words: *Azomethine, Anti-bacterial, Anti-amoebic, Dyeing, Wool.*

1. INTRODUCTION

Indole ring compounds possess potent pharmacological properties such as antioxidant, antibacterial, anticonvulsant and anti-inflammatory. Azomethine (indole -1H -2, 3-dione) is a versatile heterocyclic molecule with indole as core molecule and find significant importance in medicinal chemistry. It is one of the constituent found in most of the drugs including antibiotics, anticancer and antidepressants. Isatin and its derivatives have profound application in wide range of

products like pesticides, analytical reagents and dyestuffs other than drugs. Most of the compounds of biological interest are derived from plant sources. Isatin is also a natural product obtained from the plants *Couropita guianancis Aubl* and *Calanthe* discolor *Lindl* belonging to the genus *Isatis* [1, 2].

Azomethines (isatin derivatives) are also produced biochemically by *Altermones* sp strain inhibiting the surface of Cardiean shrimp *Palaemon macrodectylus* embryos which protect them from the pathogenic fungus *Lagenidium callinectes*. The synthetic importance of Isatin has led to the extensive use of this compound in organic synthesis [3, 4].

The biological activities of azomethines have been revealed due to the imine moiety present in these compounds. The azomethines have broad applications in food and dye industries, and in analytical chemistry, catalysis and also in the field of agrochemical. These have played an influential part in the improvement of modern coordination chemistry, but also they can also be found at key points in the development of inorganic biochemistry, catalysis and also in optical materials [5, 6].

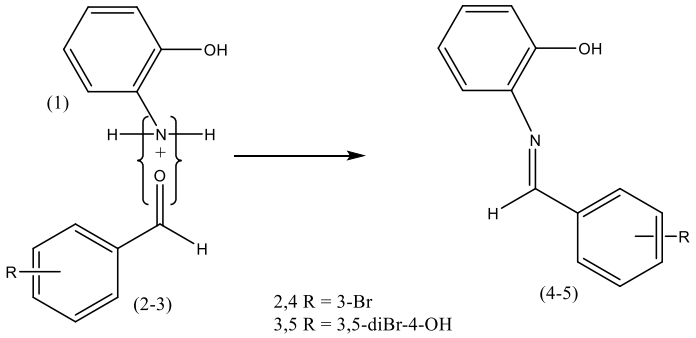

Fig. 1: *The condensation reaction for synthesis of azomethines*

Azomethine will mainly react at three different sites, namely aromatic substitution at C-5, *N*-alkylation, and carbonyl reactions at C-3. If the system carries electron-withdrawing groups in the benzene ring or at the nitrogen attack at C-2 can also occur [7, 8].

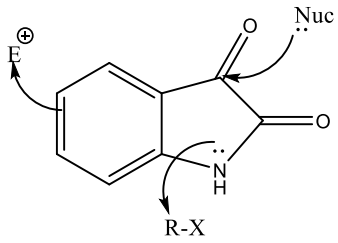

Fig. 2: *Reactivity of azomethine*

Azomethines can be synthesized from an aliphatic or aromatic amine and a carbonyl compound by nucleophilic addition forming a hemiaminal, followed by a dehydration to generate an imine. Compounds having the structure $RN{=}CR_2$ ($R \neq H$). Many consider the term to include the compounds $RN{=}CRH$ ($R \neq H$), thus making azomethines synonymous with Schiff bases [8].

Derivatives of isatin are known to possess a wide range of pharmacological properties including antibacterial, anticonvulsant, anti-HIV, antifungal and antiviral activity [5, 6]. But, there is enough results about isatin derivatives when it comes to coloring properties in textile industry.

The aim of this work was to used synthesized isatin azomethines, and tested it on anti-bacterial and anti-amoebic activity, as well as coloring properties after wool textile dyeing. It is assumed that the anti-microbial activity of azomethine transferred to the textile material after processing, i.e. after dyeing.

2. EXPERIMENTAL

2.1. Materials and methods

The chemicals used for the synthesis of the compounds were obtained from Aldrich and Merck Chemical Company without further purification. The solvents used were of spectroscopic grade.

Equimolar amounts of isatin and amine component (hydrazine, phenylhydrazine and thiosemicarbazide) were dissolved in 95 % ethanol. The solution was heated under reflux for 1 hour. The products were filtered, washed with ethanol and dried in vacuum over $CaCl_2$ [6, 7].

Azomethines were used to verify the *in vitro* anti-bacterial activity against the following microorganisms *Staphylococcus aureus, Bacillus anthracis, Streptococcus faecalis, Enterobacter sp., Escherichia coli, Pseudomonas aeruginosa, Proteus mirabilis,* and *Candida albicans*.

Anti-bacterial screening was performed by the agar diffusion method using a paper disc. The sterilized (autoclaved at 120°C for 30 min.) agar was inoculated (1 cm^3/100 cm^3 medium) with the suspension of the microorganism (matched to a McFarland Barium sulphate standard) and poured into a Petra dish. The paper discs impregnated with the azomethine (500 $mg \cdot cm^{-3}$) in N, N-dimethylformamide (DMF) were placed on the solidified medium. The plates were incubated at 37°C for 24 h [6, 7].

The anti-amoebic activities of azomethines in vitro were carried out using the HM1:IMSS strain of *E. histolytica* to ascertain the effectiveness of those compounds in comparison with metronidazole as the reference drug with IC50 1.8 μM. The *E. histolytica* strain HM1:IMSS was cultured using Diamond TYIS-33 medium. All the compounds were dissolved in DMF, which maximum concentration of DMF did not exceed 0.1 % at which level no inhibition of amoebae growth occurred. All the experiments were carried out in triplicate at each concentration level and repeated twice. The optical density of the resulting solution in each well was determined at 490 nm with a microplate reader. The % inhibition of amoebae growth was calculated from the optical densities of the control and test wells and plotted against the logarithm of the dose of the drug tested. Linear regression analysis was used to determine the best fitting straight line from which the IC_{50} value was found [8, 9].

2.2. Dyeing procedure

The wool fabric dyeing was performed in Linitest device for laboratory dyeing. The dyeing was performed at 60°C, for 60 minutes, finally followed by rinsing and drying. The process was carried out in a solution of ethanol/water (50/50 %) without additives in the presence of the new dyestuffs.

Dyestuff 1 represents isatin-3-hydrazone (yellow powder), dyestuff 2 represents isatin-3-phenylhydrazone (orange crystalline) and dyestuff 3 represents isatin-3-thiosemicarbazone (orange powder).

The degree of dye bath exhaustion as a function of time describes the rate and extent of the dyeing process:

$$\%\, Exhaustion = \frac{C_0 - C_s}{C_0} \times 100 \quad \textbf{(1)}$$

Where C_o and C_s are the concentrations of dyestuff in the dye bath initially and at some time during the process, respectively.

3. RESULTS AND DISCUSSION

3.1. Anti-microbial activity

Azomethine dyestuffs were tested for its in vitro anti-microbial activity against 7 pathogenic bacteria, one ameba and one yeast (Table 1-3).

From Table 1, dyestuff 3 shows significant results, the inhibition zone is largest, 30, 34 and 20 mm for *S. aureus, B. anthracis and S. faecalis,* respectively. Synthetic drug, Sulfamethoxazole gives similar results as azomethine 3 (isatin-3-phenylhydrazone), that is 35, 30 and 25 mm for *S. aureus, B. anthracis and S. faecalis,* respectively. Sulfamethoxazole, is an antibiotic and it is used for comparison of the results. It was used for bacterial infections such as urinary tract infections, bronchitis, and prostatitis and is effective against both gram negative and positive bacteria.

Other dyestuffs, i.e. azomethines, give inferior results in an average of 50 %, as compared to the dyestuff 3.

Table 1: *The inhibition zones (mm) of azomethines against gram-positive bacteria*

Active components	*S. aureus*	*B. anthracis*	*S. faecalis*
Dyestuff 1	16	10	13
Dyestuff 2	16	12	15
Dyestuff 3	30	34	20
Sulfamethoxazole	35	30	25

According to the results in Table 2, azomethine 1 and 2 possesses moderate activity against all gram-negative bacteria and fungi, while azomethine 3 is the most active against all, especially toward *P. aeruginosa* and *C. albicans,* where the inhibition zones is 30 and 31 mm, respectively.

As expected, the antibiotic Sulfamethoxazole showed generally the best results, i.e. inhibition zones against all bacteria are the broadest.

Therefore, all dyestuffs show significant anti-bacterial activity, especially azomethine 3. Since all compounds are soluble in DMF, the different activities cannot be correlated with different solubility, but can with azomethine structure, since azomethine 3 possess C=N and C=S groups, which are known to be anti-bacterial active. The anti-bacterial activity is slightly higher at azomethine 2 then 1, which can be explain with similar structure and aromatic moiety within azomethine 2.

Table 2: *The inhibition zones (mm) of azomethines against gram-negative bacteria and fungi*

Active components	*Enterobacter* sp.	*E. coli*	*P. aeruginosa*	*P. mirabilis*	*C. albicans*
Dyestuff 1	15	14	14	14	22
Dyestuff 2	16	17	17	16	26
Dyestuff 3	20	22	30	20	31
Sulfamethoxazole	22	16	35	28	-
Clotrimazole	-	-	-	-	35

For the anti-fungal activity of azomethines, we can say that they show significant activity, and here again the best is dyestuff 3, but not far behind either the dyestuffs 1 and 2. Anti-fungal drug Clotrimazole, as expected, gives the best result, considering that it is designed specifically for the

fungus *C. albicans*. Otherwise, Clotrimazole (brand name Canesten or Lotrimin) is an anti-fungal medication commonly used in the treatment of fungal infections both humans and other animals.

Amoebiasis, an infectious disease caused by *Entamoeba histolytica*, results in severe liver and brain abscess and causes high rate of morbidity and mortality in humans. The anti-amoebic effect of applied dyestuffs was compared with the most widely used anti-amoebic medication Metronidazole. Metronidazole has been the synthetic drug of choice for several decades in the treatment of amoebiasis and it is used to treat bacterial infections of the stomach, skin, joints, and respiratory tract [12].

Applied azomethines possess a good anti-amoebic activity and all results give in Table 3, together with the antibiotic value. The results showed that the dyestuff 1 (IC_{50} = 4.11 μM), dyestuff 2 (IC_{50} = 4.05μM) and dyestuff 3 (IC_{50} = 3.90 μM) exhibited quite enough anti-amoebic activity as well as standard drug metronidazole (IC50 = 4.80 μM).

Detailed studies of the toxicity of these compounds, mechanism of action as well as *in vivo* studies are in progress.

Table 3: *In vitro amoebic activity of dyestuffs against the (HM1: IMSS) E. histolytica*

Active components	IC_{50}/μM	*Standard deviation*
Dyestuff 1	4.11	0.10
Dyestuff 2	4.05	0.11
Dyestuff 3	3.90	0.14
Metrodinazole	4.80	0.10

3.2. Dying properties

The results of the degree of exhaustion of dyestuffs from dye baths are given in Fig. 3.

The tendency is that the degree of exhaustion is as large as possible in order to be less loss of dyestuff (wastewater), although in this case does not need to worry too much because it is some readily biodegradable natural active agents.

The range of the degree of exhaustion of the dyestuffs goes from 54 % to 58 %, depending on many parameters, but considering it was under the same reaction conditions, to the exclusion of common parameters leads to the fact that visible and decisive contribution have applied dyestuff.

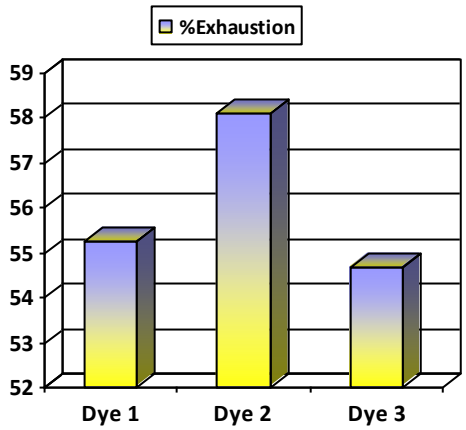

Fig. 3: *The degree of exhaustion after wool fabrics dyeing by some azomethines*

5. CONCLUSIONS

The synthesized azomethines, showed very good substantivity for wool fibers, gave fine coloring, with good degree of exhaustion after dyeing.

The combination of extended synthetic analogues of natural molecules leads to discovery of chemical entities which might be excellent anti-microbial and anti-amoebic compounds as depicted in our results. Being highly the effects this compound can be explored in future as an option for decreasing pathogenic potential of infecting from different sources.

The inhibition depends on type of bacterial strain, solvent as well as the structure of compound. All the azomethine compounds contain the same central moiety with different side chains. So in a particular solvent, for a particular effect side chains play important role in inhibition.

Azomethines containing hydrazone (dyestuff 1) and phenylhydrazone (dyestuff 2) as moiety show average yield and moderate inhibition activity while azomethines containing thiosemicarbazone (dyestuff 3) as moiety show higher yield and greater inhibition activity towards gram-negative and gram-positive bacteria as well as a fungus.

Based on all the results, it can be assumed that applied azomethines exhibit anti-bacterial and anti-parasitic properties on textile materials too, since they can dyestuff them. Thus, the process of dyeing we receive new properties woolen textiles that protect the skin of external influences from bacteria and fungi but it is a new additional research.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

FUNCTIONAL ANALYSIS OF THE WEBBING USED IN AUTO SEATBELTS

DRUG (LUCA) Alexandra[1], CIOARĂ Ioan[2]

[1] "Gheorghe Asachi" Technical University of Iaşi, Faculty of Textiles & Leather Engineering and Industrial Management, Technology and Textile Design Department, Postal address, 700305, Iaşi, Romania, E-Mail: xandra_drug@yahoo.com

[2] "Gheorghe Asachi" Technical University of Iaşi, Faculty of Textiles & Leather Engineering and Industrial Management, Technology and Textile Design Department,, Postal address, 700050, Iaşi, Romania, E-Mail: icioara2012@yahoo.com

Corresponding author: Drug (Luca), Alexandra, E-mail: xandra_drug@yahoo.com

Abstract: *The reason this paper was made was to identify the functions with the highest importance factor of webbing used in auto seatbelts. For these functions to satisfy all the requirements of operating, functions resulted from analyzing the properties of the webbing. Depending on the importance of each function was developed an objective hierarchy of them, pursuing the imposed decisions technic. Using the Analysis and engineering value it was possible to do the functional analysis of the properties of webbings. By setting the functions value it was possible to obtain a series of decisions, specifying that a function corresponds to a single operating property. Following this analysis it was observed that the main characteristic of webbings is that they have a very good resistance to tensile stresses, characteristic imposed by the manner of operation during use. An important factor that was taken into account in analyzing the webbings was the fabric structure. The structure has a major impact on the function and use of webbings in the belt assembly, considering the fact that their primary role is to save the life of the user, in case of impact of a vehicle. Based on this study the following research is focused on the functional properties of the seatbelt, in order to design and manufacture seatbelts with appropriate exploitation properties.*

Key words: *properties, webbing, functions, utility, development, seatbelt*

1. INTRODUCTION

Seatbelt is an arrangement of straps with a securing buckle, adjusting devices and attachments which is capable of being anchored to the interior of a vehicle. It is designed to diminish the risk of injury to its wearer, in the event of collision or of abrupt deceleration of the vehicle, by limiting the mobility of the wearer's body [1]. The base element of this assembly is the webbing.

The webbing is designed to provide positional stability in the case of impacts created by a collision. The main function of the webbing is used to provide safety to the passengers against uncontrolled movements during collisions or similar incidents.

The webbing of the seatbelt assembly provides a balancing force, that brings the user from a state of moving into a state of positional rest.

The main functional characteristics, required in operation of the webbing from the seatbelts assembly are: abrasion resistance, light resistance and heat, capacity to be removed and replaced easily and a good behavior of retraction [2].

2. MATHERIALS AND METHODS

The property is the quality of a product to render a precise notion or the idea expressed, meaning it is the characteristic necessary to make the product useful [3], [4], [5], [6]. Due to the great importance that it has in use, the webbing has a number of properties that have a major impact on the proper functioning. The functionality analysis of the webbing shows that this must satisfy a set of properties that are shown in Table 1.

Table 1: *Functional properties of webbing used in seatbelts*

No.	Properties oriented webbing belt
1.	Tensile stress
2.	Tensile elongation
3.	Dry and wet strength dyeing
4	Endurance resistance
5	Resistance to displacement
6.	Resistance to sliding
7.	Abrasion resistance
8.	UV resistance
9.	Dimensional stability
10.	Resistance to perspiration acid and alckaline dyeing
11.	Dyeing whashability
12.	Flexibility
13.	Durability

To each specific functionality properties of webbing corresponds to a characteristic function.

Function is the first fundamental concept with which the value engineering operates and is a result of the product's properties which is capable to satisfy a necessity [3], [4], [5], [6]. A function is useful, distinct whether there can be independence of other functions. Each function has a use value, and the total use values of functions, render the global use value of the product used - the seatbelt webbing.

The application of engineering value is done in three steps: functional analysis, value of functions and design or redesign of the product based on the required functions.

Functional analysis answers the question "what?" and "what makes the product?". At the same time, the analysis and engineering value allows drawing up a list of functions which the analyzed product performs.

The value of the functions that answer the questions: "how important is the function for the user?" and "how well it meets user requirements?", allows precise highlighting of the importance level of each function.

Based on the principles from the Analysis and engineering value have established a set of functions of the webbing, as shown in Table 2. Each function of the webbing corresponds to a single operating property.

Table 2: *Webbing functions*

Symbol	Function name	Technical dimension	Function type
F1	Be cyclic tensile	Tensile stress, [7]	Primary, objective, necessary, general
F2	To have limited breaking elongation	Tensile elongation, [7]	Primary, objective, necessary, general
F3	Be resistant to abrasion	Dry and wet strength dyeing, [8]	Primary, objective, necessary, general
F4	Be resistant to repeated bending	Endurance resistance	Primary, objective, necessary, general
F5	Be easy to use/ have o good withdrawal behavior	Resistance to displacement	Primary, objective, necessary, general
F6	To have resistance to seam stitching	Sliding resistance	Primary, objective, necessary, general
F7	To have resistance in contact with other textile materials (peeling) or abrasive materials	Resistance to abrasion, [9]	Primary, objective, necessary, general
F8	To have light resistance	UV resistance	Secondary, objective, necessary specific to webbing
F9	To keep their shape and dimensions in terms of temperature and humidity	Dimensional stability, [10]	Secondary, objective, necessary specific to webbing
F10	Be resistant in alkaline and basic environment	Resistance to perspiration acid and alckaline dyeing, [11]	Secondary, objective, necessary specific to webbing
F11	To have soil resistance	Washability resistance	Secondary, objective, necessary specific to webbing
F12	To have low rigidity in longitudinal direction	Flexibility	Secondary, objective, necessary specific to webbing
F13	To have ageig resistance	Durability	Secondary, objective, necessary specific to webbing

The contributions of the functions to the achievement of the use value are uneven. Thus, each of them participate differentiated to the completion of the use value of the seat belt webbing, which enables us to rank them in rapport with properties. For ranking the functions is used the technique of imposed decisions from engineering value. This involves comparing the functions two by two and application of scores by the form (1 – 0), (0.5 – 0.5) or (0 – 1), with the specifications that the score 0 represents low importance, 0.5 represents a level of medium importance and 1 is the utmost importance level [3], [4], [5], [6].

The total number of decisions resulted from comparing the 13 functions of the seatbelts is calculated with the equation (1):

$$D = C_2^2 = \frac{n(n-1)}{2} \quad \textbf{(1)}$$

The coefficient of importance for each function is calculated as the ratio between the sum of the score awarded, N and the total of the decisions D, as follows:

$$I = \frac{N}{D} \quad \textbf{(2)}$$

3. RESULTS AND DISCUSSION

The 13 functions of the webbing used in seatbelts obtained using the analysis and engineering value in Table 2 are divided into 7 pimary and 6 secondary functions, according to the importance attributed to them in application. Thus equation (1) leads to determining the number of decisions necessary to analyze primary and secondary functions, namely:

- The number of decisions Dp, for the primary functions:

$$D_p = C_7^2 = \frac{7 \cdot (7-1)}{2} = 21 decisions \quad \textbf{(3)}$$

- The number of decisions Ds, for the secondary functions:

$$D_s = C_6^2 = \frac{6 \cdot (6-1)}{2} = 15 decisions \quad \textbf{(4)}$$

In Tables 3 and 4 are presented the comparative analysis of primary and secondary functions. The values of the coefficients of importance are given by the ranking of the primary and secondary functions. Of these functions, important in terms of the ranking, is taken into account in designing or redesigning the webbing of the seatbelt

Table 3: *Comparative analysis of primary functions*

Functions	Decisions for primary functions																					Sum of the score awarded	Functions coefficient of importance
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	N	I
F1	1.0	0.5	0.5	1.0	1.0	1.0																5.0	0.714
F2	0.0						0.5	1.0	0.5	0.5	1.0											3.5	0.500
F3		0.5					0.5					0.5	0.5	0.0	0.5							2.5	0.357
F4			0.5					0.0				0.5				0.0	0.0	0.5				1.5	0.214
F5				0.0					0.5				0.5			1.0			0.5	0.5		3.0	0.429
F6					0.0					0.5				1.0			1.0		0.5		0.5	3.5	0.500
F7						0.0					0.0				0.5			0.5		0.5	0.5	2.0	0.286

Table 4: *Comparative analysis of secondary functions*

Functions	Decisions for secondary functions															Sum of the score awarded	Functions coefficient of importance
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	N	I
F8	0.0	1.0	1.0	0.5	0.5											3.0	0.500
F9	1.0					0.5	0.5	1.0	1.0							4.0	0.667
F10		0.0				0.5				0.5	1.0	1.0				3.0	0.500
F11			0.0				0.5			0.5			0.0	0.5		1.5	0.250
F12				0.5				0.0			0.0		1.0		1.0	2.5	0.417
F13					0.5				0.0			0.0		0.5	0.0	1.0	0.167

Following the ranking of functions of webbing of the seatbelt and comparing them with each other, two by two, we observe that the main function which has the highest level of importance is the function F1 (0.714), function which shows that, priority, the webbing must be resistant to tensile stresses. Equally, the next level of importance have functions F2 (0.500) and F6 (0.500) respectably tensile elongation and resistance to sliding. Of medium importance could be considered functions F3 (0.357) and F5 (0.429), while those of lesser importance are the functions F4 (0.214) and F7 (0.286).

As for the secondary functions, the maximum level of importance presents function F9 (0.667). This indicates that, under conditions of temperature and humidity, the webbing must meet the requirement for dimensional stability. The following functions, on the next level of importance are F8 (0.500) and F10 (0.500). Functions F8 and F10 aim that the next conditions which car seat belt webbing must meet, are UV resistance and resistance to perspiration acid and alkaline dyeing. Function F8 (0.417) has a medium importance, while those with lower importance are the functions F11 (0.250) and F13 (0.167). Thus, resistance of painting to webbing washing and its durability are not functions with an important priority.

4. CONCLUSIONS

Structural characteristics of the fabrics have a major importance in designing webbing for auto seatbelts.

The properties of webbings used in the analyzed auto seatbelts, must be in accordance with the final process of utilization.

Designing or redesigning of the seatbelt webbing requires a thorough knowledge of their operating procedures in order to define properly the functions they perform in operating.

Using value engineering was possible to achieve an objective hierarchy of the functions of webbing for seatbelt with the purposes to identify the characteristic with the highest level of importance that will be taken into account in designing these products.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

DYEING OF WOOL YARNS WITH *LAURUS NOBILIS* L. BERRIES

ERKAN Gökhan[1], YILMAZ Derya[1]

[1]Dokuz Eylül University, Faculty of Engineering, Textile Engineering Department, Tınaztepe Campus Buca, 35397 İzmir, TURKEY, gokhan.erkan@deu.edu.tr

Corresponding author: Erkan, Gökhan, gokhan.erkan@deu.edu.tr

Abstract*: Nowadays natural dyes have been attracted by many researchers and firms due to demands on sustainable and nontoxic products. In this study the mature berries of bay laurel (Laurus nobilis L.) were collected from trees located Kuşadası Turkey. The berries dried at 25°C and % 20-25 relative humidity. Dried berries milled and extracted with ethanol. Extracted dye was used. Three mordanting procedure (pre, meta and post mordanting) and two concentrations were applied to wool yarns. Cupric sulfate, ferric sulfate, potassium dichromate and alum was used as mordant Color strength and colorimetric values were measured by Konica-Minolta 3600D spectrophotometer. Fastness to washing, perspiration and light were applied according to ISO 105C06 (A1S), ISO 105E04 and ISO 105B02 (method 2) respectively. The highest color strength (K/S) value was 16.6405 and was obtained in the case of premordanting with cupric sulfate at 2 gr/L concentration. If the a* and b* values were examined, the conditions at highest color strength, the yarns had yellow color with a reddish hue. Generally, the fastness properties were moderate and good results were obtained in the case of premordanting procedure. The results show us ethanol extract of bay laurel berries can be used for dyeing of woolen products.*

Key words : *natural dyes, mordanting, bay laurel, colorimetry, fastness*

1. INTRODUCTION

The history of natural dyes is as old as the history of humankind. Natural dyes are obtained from renewable sources such as crops, insects and so forth, and they may decrease the dependence on petrochemical sources [1]. These considerations have led to the publication of several studies on natural dyes from a number of sources [2–6]. Compounds present in extracts obtained from the most widely used natural dyes belong to a few main classes: flavonoids, anthraquinoids, indigoids and tannins [7]. *Laurus Nobilis* L. (bay laurel) is an aromatic evergreen small tree, native to the mediterranean area. Its berry is a drupe, oval shaped and the color of mature berries are black [8].

2. EXPERIMENTAL

2.1 Materials

100% wool yarn (402 tex) was supplied as ready to be dyed. Cupric sulfate was purchased from Kimetsan (Turkey); ferric sulfate, potassium dichromate and alum were obtained from SigmaAldrich (Germany). All mordants were of analytic grade. All chemicals were used without purification. Ethanol was purchased by Merck (Germany).

Mature laurel berries were collected from trees located in Kuşadası, Turkey (at sea level, latitude 37°44′ N and longitude 27°15′ E) during the lately October. The collected berries were dried in dark room. Dried berries were milled using coffe mill (Bosch).

2.2 Extraction

Extraction had been performed using ethanol at the liquor ratio of 3.9 (v/w) for 23 days. Extracted liquid was concentrated using rotary evaporator (IKA).

2.3 Mordanting

Figure 1 depicts the scheme for both mordanting and dyeing. Three mordanting procuders were applied premordanting, metamordanting, postmordanting. Rinsing was applied to yarns after mordanting using tap water. Two mordant concentrations were used, 0.5 and 2 gr/L. Liquor ratio was 1:15. Mordanting was performed using laboratory dyeing machine (ATAÇ-Turkey).

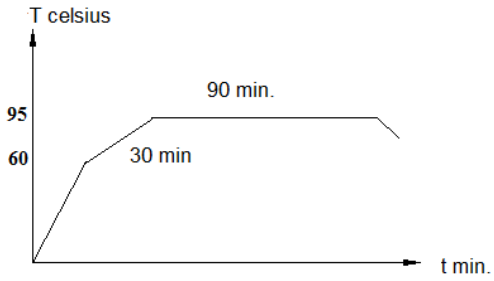

***Fig 1:**. Scheme of mordanting and dyeing*

2.4 Dyeing

Dyeing was performed using laboratory dyeing machine (ATAÇ-Turkey). The liquor ratio was 1:15. Dyeing was carried out according to scheme in Figure 1. Washing off procedure after dyeing was 5 min. warm rinsing, two times of 5 min. duration involving cold rinsing.

2.5 Color measurment

All colour measurements were performed using Minolta 3600D spectrophotometer (D65 illuminant, specular included, 10^o observer angle). The spectrophotometer was equipped with software, which was able to calculate CIEL*a*b*C*h^0 and colour strength (K/S) values from the reflectance values at the appropriate λmax for each dyeing automatically. Color strengths of fabrics were determined by using the Kubelka– Munk formula (Eq. (1)), which is shown below.

$$K/S = (1-R)^{2/}2R \quad \textbf{(1)}$$

where K is the scattering coefficient, S is the absorption coefficient,
R is the reflectance.

2.6 Fastness measurtments

Washing fastness, light fastness and perspiration fastness of the dyed yarns were performed according to ISO 105 C06 (A1S), ISO 105 B02 (method 2), ISO 105-E04 respectively. The specific tests were applied by using the following instruments: Atlas Xenotest Alpha for light fastness, Atlas perspirometer for perspiration fastness and Atlas Linitest for washing fastness. ECE non-phosphate standard detergent was used in washing fastness trials.

3. RESULTS and DISCUSSION

3.1. Colorimetric values

The colorimetric values of dyed samples were listed in Table 1. When the effect of mordant type was examined, highest L* values were obtained mordanting with Alum. Type of mordanting procedure did not affect on L* values. The parameters that affect the L* values were mordant type and concentration. The lowest L* value was obtained in the case of postmordanting with 2 gr/L cupric sulfate. Highest vividness (C*) was obtained by premordanting with 0.5 gr/L ferric sulfate. a* and b* values were compatible with the colors that obtained, which are shown in Figure2.

Table 1: *Colorimetric Values of Dyed Yarns*

Mordanting Procedure	Mordant Type	Mordant Concentration (gr/L)	L*	a*	b*	C*	Hº	K/S
-----	-----	-----	50.221	5.383	23.253	23.868	76.966	8.8679
Premordanting	Cu	0.5	47.963	5.220	25.169	25.705	78.282	11.9281
		2	43.950	3.280	25.575	25.785	82.692	16.6405
	Al	0.5	55.353	6.312	27.717	28.426	77.171	8.3552
		2	55.815	5.404	26.793	27.332	78.596	7.7749
	Fe	0.5	53.326	5.764	30.348	30.891	79.246	9.2425
		2	49.164	5.313	29.540	30.015	79.803	11.0689
	Cr	0.5	45.794	3.709	19.238	19.593	79.087	9.8690
		2	45.272	4.940	20.056	20.656	76.162	10.6765
Metamordanting	Cu	0.5	50.290	4.731	25.427	25.864	79.460	10.3942
		2	43.197	0.771	24.224	24.236	88.177	16.1770
	Al	0.5	58.733	5.311	27.912	28.413	79.228	7.0185
		2	51.458	6.899	25.071	26.003	74.615	8.3842
	Fe	0.5	49.156	3.379	20.280	20.559	80.542	8.7157
		2	43.971	5.396	20.302	21.007	75.116	12.0740
	Cr	0.5	48.705	5.451	25.797	26.367	78.069	10.3771
		2	42.438	4.532	19.903	20.412	77.172	12.0967
Postmordanting	Cu	0.5	44.964	5.975	23.687	24.429	75.843	12.8812
		2	42.215	-0.582	23.095	23.102	1.442	16.2164
	Al	0.5	54.134	6.248	26.344	27.075	76.657	8.0747
		2	54.434	5.608	25.436	26.047	77.568	7.4614
	Fe	0.5	44.649	5.085	19.613	20.261	75.464	10.5601
		2	43.720	5.978	19.036	19.952	72.566	11.6673
	Cr	0.5	45.538	6.702	24.751	25.643	74.848	12.0400
		2	42.444	5.602	22.182	22.878	75.827	14.0768

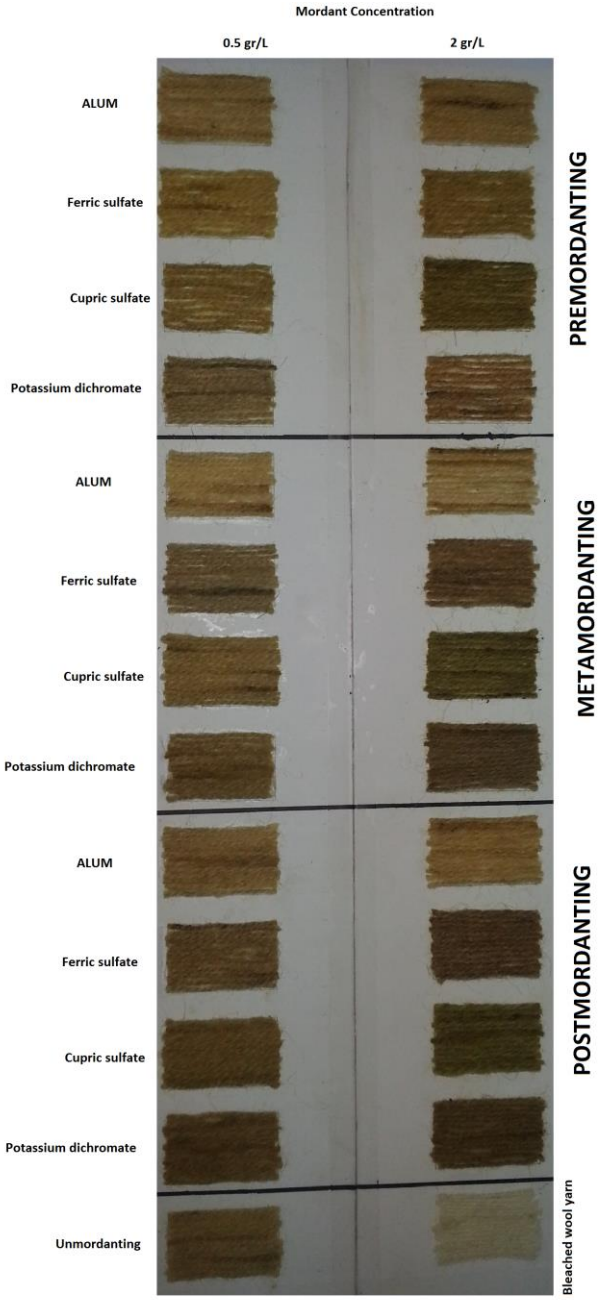

***Fig. 2**: Colour Catalgue of Dyed Yarns*

3.2. Color Strength

K/S values are listed in Table 1. Highest color strength was observed in the case of premordanting with 2 gr/L cupric sulfate. Altough mordanting procedure did not significiantly affect on K/S values, mordant type and concentrations had effect on color strength values

3.3. Fastness Properties

Washing, perspiration and light fastness properties are shown in Table 2.

***Table 2**: Fastness Properties*

Mordanting Procedure	Mordant Type	Mordant Concentration (gr/L)	Washing Fastness		Perspiration Fastness				Light Fastness
					Acidic		Basic		
			Stainning	Color change	Stainning	Color change	Stainning	Color change	
-----	-----	-----	5	3	3/4	3/4	3/4	3	3
Premordanting	Cu	0.5	5	3	4	4/5	4/5	4	6
		2	3/4	3	4	4	3/4	4/5	5
	Al	0.5	3/4	2/3	4	2/3	4	2	3
		2	4/5	2	4	3	4/5	2	3
	Fe	0.5	4	3	4/5	4	4/5	4	5
		2	4/5	3	3/4	3/4	4	4/5	3
	Cr	0.5	4/5	2/3	4/5	3	3/4	2/3	5
		2	1/2	1	2	3/4	2	2/3	6
Metamordanting	Cu	0.5	4/5	3/4	2/3	5	1/2	3/4	5
		2	1/2	3/4	1/2	2/3	2	2/3	4
	Al	0.5	4	3	3	5	3	4/5	5
		2	4	3	3/4	5	2/3	5	3
	Fe	0.5	3/4	2/3	3	4/5	1/2	3/4	4
		2	1/2	1	1/2	3/4	1	3	5
	Cr	0.5	3/4	3/4	2/3	3/4	2/3	5	5
		2	2/3	3	3/4	4/5	2	5	3
Postmordanting	Cu	0.5	4/5	3/4	3	5	2	4/5	5
		2	2/3	1/2	2/3	2/3	2	1	6
	Al	0.5	3	2/3	3	4/5	3	4/5	3
		2	2/3	2/3	2/3	3/4	3	3/4	3
	Fe	0.5	2/3	1/2	1/2	4	1/2	3/4	5
		2	1	1	1	3	1	2	5
	Cr	0.5	4	3	3/4	3/4	3/4	3	3
		2	4/5	4	3	4	2/3	4/5	3

Satisfactory results were obtained for light fastness; however wet fastness were poor. There are no correlation fastness results with mordanting procedure and type and concentration of mordants.

4. CONCLUSIONS

Bay laurel is an important plant in food and detergent industry. In this study the dyeing properties of mature berries were investigated. Satisfactory dyeing results were obtained. Highest color strength was observed in the case of premordanting with 2 gr/L cupric sulfate. The highest L* values were obtained mordanting with Alum. Vividness of yarns increased with premordanting of wool yarns. However wet fastness results were not satisfied. Light fastness of yarns were moderate.

ACKNOWLEDGEMENT

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

THE EFFECT OF PHASE CHANGE MATERIALS ON THE TENSILE STRENGTH

HERROELEN Thomas, BOU_BELDA Eva, BONET-ARACIL Marilés, VAN DEN BROECK Freya, BELINO Nuno

[1,4] Hogeschool Gent, Department of nature and technique, Valentin Vaerwyckweg 1, 9000, Gent, Belgium.

[2,3] Universitat Politècnica de València, Textile and Paper Department, Plaza Ferrándiz y Carbonell s/n, 03801, Alcoy, Spain.

[5] Universidad da Beira Interior, Sciences and Textiles Technologies Department, Convento de Sto. António, 6201-001, Covilhã , Portugal.

Corresponding author: Bonet-Aracil, Marilés, E-mail: maboar@txp.upv.es

Abstract:. *PCM's need some important properties to have use such as high heat storage capacity, easy availability and low cost and can have different effects such as flavour, softness or exchange of heat. They are put inside of microcapsules, so they can be inbedded inside the strain, otherwise it wouldn't be so effective. So basically the microcapsules consist of a core that's the PCM and a polymer shell. This shell needs to be strong enough to hold the PCM and also withstand up to a certain level of heat and mechanical damage. This study investigates the tensile strength of fabrics composed by fibres, some of these fibres have benn inbedded phase change microcapsules (PCM's). The investigated fabrics are divided by composition and by structure. By knitting the fabrics in different structures you could be able to investigate which knitting way could be the most effective to have a high tensile strength. Tensile strength tests are performed on specimens with different structures but also with different compositions which could indicate that some strains are tougher then others and more specifically if the PCM's have a different effect on them*

Keywords: *Tensile strength, PCM, Microcapsules, different knitting structure, different compositions*

1. INTRODUCTION

Everyday new chemical fibers are being developed in order to improve the properties of conventional fibres, because nowadays textiles are required to have extra properties [1]. They should offer active functionality. Now they are also called smart textiles: the term refers to textiles that are able to react when an external effect is present [2]. Fibers are polymers and they are made out of a polymer solution that can be modified in many ways, such as variations in the degree of polymerization and crystallinity whose application depends on the property to be improved.

Phase Change Materials (PCM), such as paraffin waxes, are more and more often used for their thermoregulating properties because they have a great capacity to absorb and slowly release latent heat involved in a phase change process [3-5]. PCM's have been used as thermal storage and control materials because of the heat absorbtion and release that occurs upon a change of phase: the PCM materials absorb energy during the heating process as phase change takes place (from solid to

liquid) and release energy to the environment in the phase change during a reverse cooling process (from liquid to solid) [6].

Different compositions have long taken the attention of many researchers and companies to enhance the composites' properties. The tests were performed to analyse these properties, more specifically the mechnanical properties. It's important to know if the fabrics with the PCM's inbedded don't weaken the fabrics and if so in which combination with other fabrics it could be used to reinforce them again and increase their strength again.

2. EXPERIMENTAL

2.1 Materials

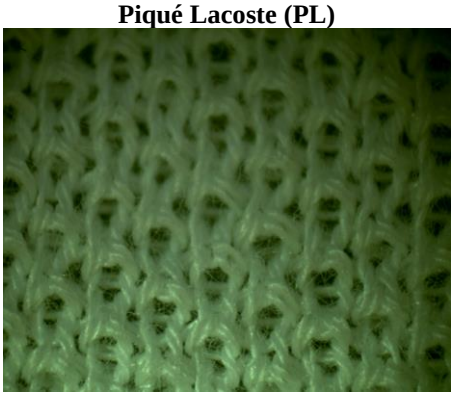
A total of 12 fabrics were used in this work, divided by different structures and different compositions. Details of the samples are shown in table 1 and different structures used are shown in figure 1.

Table 1: *Composition and structures of the different samples*

Sample	Composition (%)					Structure
	Viscose Outlast	Cotton	Polyester	Bioactive fiber	Tencel	
1JER	30	70				Jersey
2JER	30		20	50		
3JER	30				70	
4JER		100				
1PL	30	70				Piqué Lacoste
2PL	30		20	50		
3PL	30				70	
4PL		100				
1PD	30	70				Piqué Dullo
2PD	30		20	50		
3PD	30				70	
4PD		100				

Jersey (JER)

Piqué Lacoste (PL)



Piqué Dullo (PD)

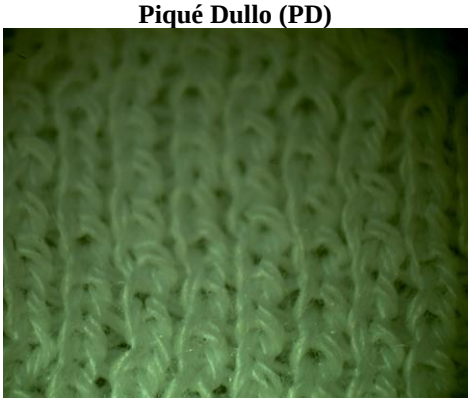


Fig. 1*: *Knitting structures used.

2.2 Methods

The machine used to analyse the tensile strength of the fabrics was Zwick/Roell 2005 testing unit according to UNE EN ISO 13934-1 standart.

3. RESULTS AND DISCUSSION

The tensile behaviour of each fabric in both directions, columns and row, are compared by a graphic in figure 2.

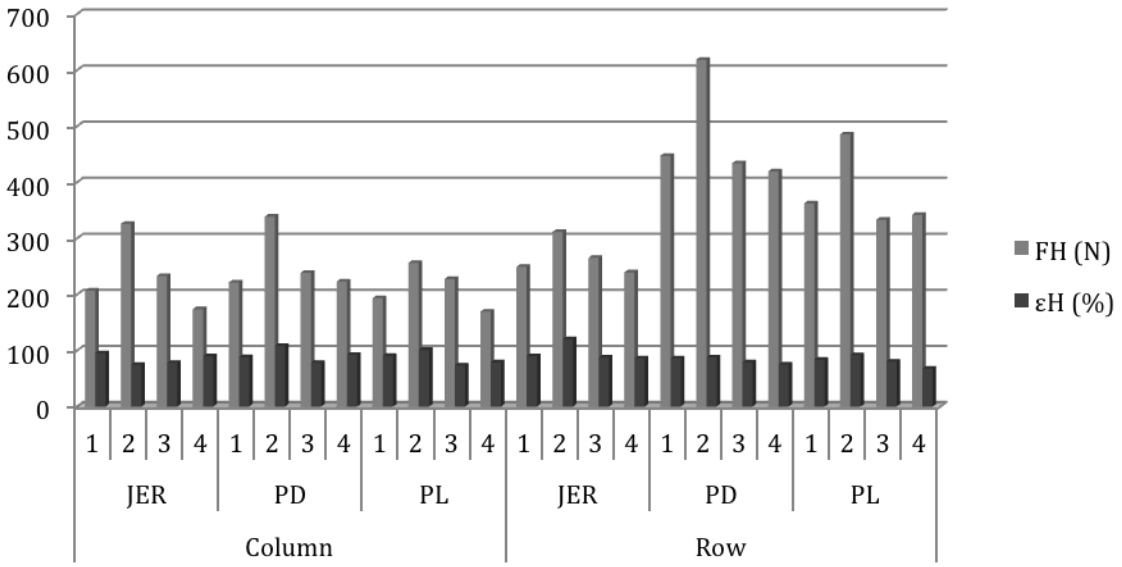


***Fig. 2 :** The tensile strength and elongation of all samples in row and column direction*

The graphic can be separated in two pieces: the row section and the column section. As can be seen in figure 2 the column samples all have approximately the same value, except for 2PD and 2JER. All the other samples are around 200N while 2JER and 2PD of the column samples are significantly higher at around 300N.

By comparing the different row structures, it can be clearly seen that PD_{ROW} has the biggest Tensile strength. This is followed by PL_{ROW} and finally by JER_{ROW} which has the lowest tensile strengths of the ROW samples. If we don't look at them in groups but each separately you can see a clear consistency: 2PD (618N) has a higher value than 2PL (485N) which is higher than 2JER (311N). 1PD (430N) is followed by 1PL (362N) and then finally again by 1JER (249N). This is the same for 3PD (433N) is bigger than 3PL (332N) which is again bigger than 3JER (265N). And finally the 4 row samples have the same effect: 4PD (419N) which is bigger than 4PL (341N) which is bigger than 4JER (239N).

The elongation is for all the samples practically the same, around 90%.

4. CONCLUSIONS

By comparing the different composition and different structures we could distinguish a clear difference in what sample(s) are the strongest. It can be concluded that by comparing the different structures we can see that the PD-structure in column direction has the highest tensile strength and is therefor the strongest of the 3 different structures and that the row direction does not have much effect on the tensile strength.

From comparing the different compositions we could see with all of them that the 2 samples were the strongest and the 1, 3 and 4 were more or less the same. So for those 3 samples it's not a big influence which one is used to make a fabric with high tensile strength, but it's clear that a 2PD sample cut in row direction has the highest tensile strength.

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ANNALS OF THE UNIVERSITY OF ORADEA
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ASPECTS OF THE INFLUENCE OF TECHNOLOGICAL PARAMETERS ON THE TENSION PROPERTIES OF THE YARNS

HRISTIAN Liliana[1], BORDEIANU Demetra Lacramioara[1] and OSTAFE Maria Magdalena[1]

[1]*"Gheorghe Asachi" Technical University of Iasi, Faculty of Textile, Leather & Industrial Management, Department of Engineering and Design of Textile Products, Blvd. Mangeron, No.28, Iasi, Romania*

Corresponding author: Hristian Liliana, e-mail: hristian@tex.tuiasi.ro

Abstract: *This paper presents the results of some experiments performed using the power system bands directly from the card to the rotor spinning machine and the spinning system used by passing the lanes on two passages mill and fed to the spinning rotor. In this study we analized the influence of technological parameters of the preparation drawing on the assessing indicators for the tensile strength of the Nm20, Nm24, Nm27 Nm34 and Nm40 yarns. The fineness range studied was made of three fiber mixtures of different varieties of cotton, coded as follows: A1-85% Soviet cotton+15% Chinese cotton medium II; A2-100% Turkish cotton medium III; A3-100% American cotton mdium IV.*
The method of preparation of the bands which are to be powered to the rotor spinning machine, respectively with the aggregate pile-card and the powered bands directly to the rotor spinning machine and the adding of two rolling mill, detemines different structures of bands and different degrees of untangling and orientation of the fibers, which influences the quality of the obtained yarns. This study reveals a considerable improvement of the tensile properties when the yarns are made from rolled band, which is explained by the high degree of correction and parallelization of the fibers of the rolled band, which allows a greater participation of fibers with their resistance to the resistance of the yarns.

Key words: *fiber fineness, coefficient of variation, the rotor spinning machine, yarns strength, technological parameters*

1. INTRODUCTION

The parameters of the raw material significantly influence the basic quality parameters of the yarns. Numerous studies have shown that the quality of ring-spun yarns is influenced primarily by length, strength and fineness of fibres, and that of rotor-spun yarns by strength, fineness of fibres, length of fibres and regularity of fibre length, as well as impurity content [1-3].

In comparison with classic yarns produced from raw materials of the same characteristic, rotor-spun yarns have a different geometrical construction with a smaller degree of fibre arrangement along the yarn axis [4-6]. Hence we also have lower strength of the yarn and lower irregularity of linear density and strength [7].

Today, rotor spinning has a production rate exceeding 200 m/min, as compared to a maximum of about 40 m/min in ring spinning [8-10]. Rotor spinning eliminates the need for roving, since rotor yarns can be spun directly from drawn sliver. Unlike a ring frame, the winding and

twisting functions are separate and this permits the building of large yarn packages [11-13]. Both these characteristics allow much higher levels of productivity than ring spinning [12-14].

Rotor spinning was initially developed with two main objectives: to provide a more economical spinning system than conventional ring spinning through higher productivity, and to produce yarn of a quality that matches or surpasses that of the conventional ring spinning [14].

The properties most affected are the elongation at break and yarn imperfections, particularly thick places, so that the yarn irregularity is also affected. Increases in winding tension above a given value reduce the yarn quality quite independently of the package mass [13-15]. When the winding tension is low, however, this mass exerts some influence, the yarn quality deteriorating as the package mass increases

2. EXPERIMENTAL PART

2.1. Materials and methods

The main features of the cotton fibers from the sorts analyzed in the study are shown in Table 1.

Table 1: *The cotton fibers characteristics*

Type and sort of cotton	The length (mm)	Short fiber (%)	Breaking length (km)	Strength (cN /fb)	Impurities (%)	Fineness (Nm)
Turkish medium III	28,5	23,7	25,5	4,42	4,32	5770
American medium IV	30,0	27,8	24,03	4,23	6,92	5682
Chinese medium II	30,1	17,65	20,08	3,81	2,06	5272
Sovietic medium II	28,8	20,0	27,76	4,04	3,08	5736

To minimize the number of the impact parameters on the quality of the studied fibers it was adopted the same spinning plan for all fiber blends. The technological parameters used in the experiment are shown in Table 2.

Table 2: *The used spinning Plan*

Machine name		Nm_d	L	D	α_p	T (răs/m)	The speed of characteristic organ/element
4C card		0,25	100	-	-		14 rot/min
Rolling mill LB	LB I	0,25	6	6	-		150 m/min
	LB II	0,25	6	6	-		150 m/min
Spinning machine BD 200		20	80	1	80	590	31.000 rot/min
		24	96	1	80	666	31.000 rot/min
		27	108	1	82	738	31.000 rot/min
		34	136	1	80	840	31.000 rot/min
		40	160	1	80	937	31.000 rot/min

The properties of blended rotor spun yarn depend upon various factors such as fibre characteristics, machine variables and processing variables. Twist factor is one of the main processing variables in the rotor spinning system.

2.2. Results and discussions

Strength parameters of yarns are especially important for rotor-spun yarns. Due to their different method of forming, these parameters are lower than for ring-spun yarns. Because of their higher elasticity, rotor-spun yarns are used mainly for knitting purposes. This feature makes up for the lower tenacity of these yarns. Table 3 presents the main features of the card and mill blanks obtained for the two versions of spinning system, in the study performed by us.

Table 3: *Characteristics of blanks*

The name of textile commodity	The mixture	The fineness		Irregularity U(%)
		$\overline{Nm}$	CV%	
Card blanks	A_1	0,245	2,01	4,0
	A_2	0,252	1,80	4,6
	A_3	0,255	1,67	5,3
The I st mill blanks	A_1	0,242	1,90	3,5
	A_2	0,250	2,10	4,2
	A_3	0,253	1,50	4,2
The II nd mill blanks	A_1	0,250	1,75	3,6
	A_2	0,252	1,57	4,2
	A_3	0,247	1,48	4,5

The average values of the coefficient of variation of resistance to tearing for the range yarns fineness, from the three mixtures, obtained using the supply system of bands directly from the card to the BD rotor spinning machine, are shown in graphical representation of Fig.1.

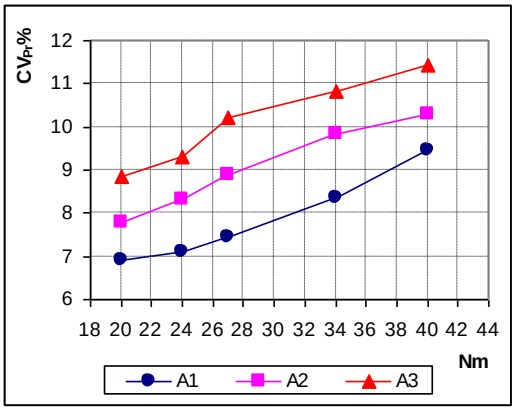

Fig. 1: *The coefficient of variation of tensile strength depending on the smoothness of yarns obtained on the spinning system directly from the ban, from the card to the BD rotor spinning machine*

The average values of the coefficient of variation of resistance to tearing for the range yarns fineness of the three mixtures obtained by passing the bands from card to the two passages mill and then supplied at the BD rotor spinning machine, are shown in Fig.2 .

It finds that withthe yarns increasing fineness, it increases, also, the coefficient of variation of the ultimate strength, irrespective of the adopted spinning system. For the same finesse yarns it was recorded a substantial variation decrease of the coefficient of resistance to tearing, in spinning yarns from rolled bands.

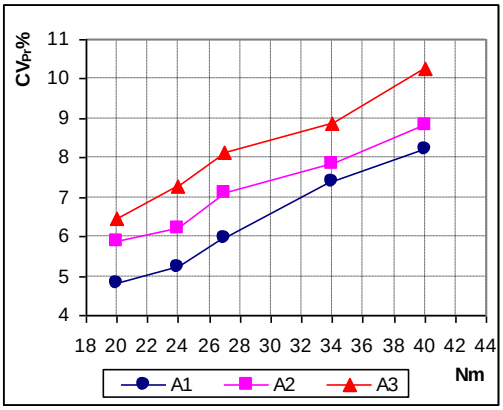

Fig. 2: *The coefficient of variation of tensile strength depending on the fineness of yarns obtained on rolled bands spinning system and supplied to the BD rotor spinning machine*

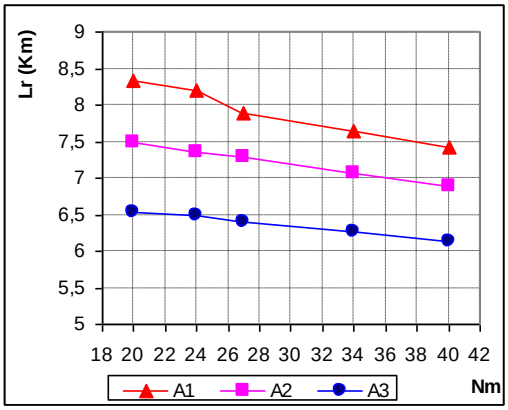

Fig. 3: *The variations of length breaking ,depending on the fineness of the yarns obtained from the spinning system directly from band card to the BD rotor spinning machine*

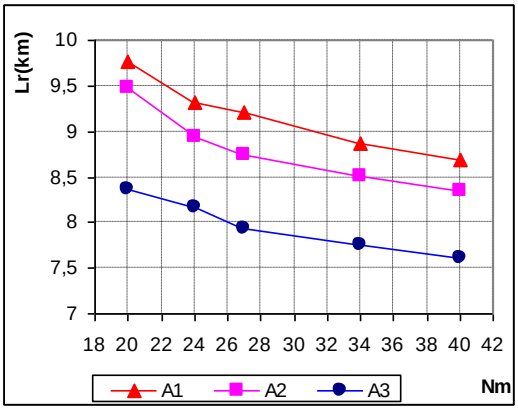

Fig. 4: *Length variation depending on the smoothness of breaking wires obtained filariae system rolled strip and fed the BD rotor spinning machine*

It finds that the breaking length decreases as the threads increases smoothness (Fig. 3), finesse same thread but is higher when using two passages mill to obtain strip that feeds the rotor spinning machine (Fig..4).
So the utilisation of fibre strength is greater than that of the rotor spinning system. Rotor spun yarns are generally produced using high twist factor in order to ensure adequate tenacity in subsequent processing and mechanical performance in use.

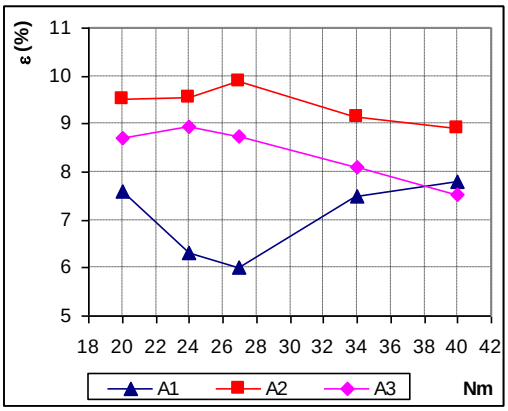

Fig. 5: *The variations of the elongation according to finenesse of the yarns obtained from the spinning system supplied directly from card bands to the BD rotor spinning machine*

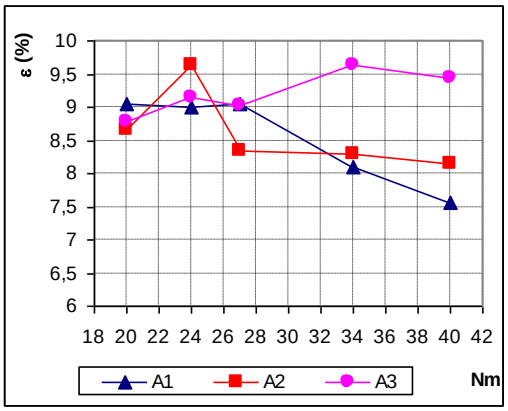

Fig. 6: *The variations of the elongation according to finenesse of the yarns obtained from the spinning system supplied directly from mill bands to the BD rotor spinning machine*

Elongation at break is significantly influenced by the fineness of the threads and no technological solution adopted in preparation spinning differences înegistrate not exceed one unit (Fig.5, Fig. 6).

3. CONCLUSIONS

From the data obtained, we can conclude the following :
The fineness irregularity increases with the increasing of the fineness. It is noticeably higher when spinning is directly from the band card, due to not only the supplied band irregularity, higher in case of card bands (U = 4.6%) than for mill bands (U = 4.2%) but also the density decreases and the influence of the degree of parallelization of the fibers.

Regarding the quality of the cotton, it is observed that the fineness irregularity is less for cotton yarns spun from Medium II cotton (U = 4%) than the yarns obtained from Medium III cotton (U = 4.6%) or Medium IV cotton (U = 5.3%).

Strength improves considerably when the yarns are made from rolled/mill bands, because of the increased degree of correction and parallelization of the fibers from rolled bands, which allows a greater participation of fibers with their resistance to the yarns resistance.

The irregularity of the resistance increases with the increasing fineness of the yarns. For the yarns with the same finesse it was registered a substantial decrease of the variation coefficient for breaking load, if spinning yarns are from rolled band.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

TEXTILE DESIGN ON THE BASE OF THE GOLDEN GEOMETRY AND BULGARIAN NATIONAL TRADITION

ILIEVA Julieta

Trakia University of Stara Zagora, Faculty of Technics and Technologies of Yambol
Graf Ignatiev 38, 8600, Yambol, Bulgaria, E-Mail: zhulieta.ilieva@trakia-uni.bg

Abstract: *The Golden and Fibonacci geometry forms are symbols of beauty and harmony. The shapes and symbols in the national traditions are always a source of creative ideas. The paper presents textile designs on the base of creations from the Golden and Fibonacci geometry and Bulgarian national tradition. Fourteen textile design project are presented with the use of the Golden spiral in the Golden square, Fibonacci series tiling with equalitarian triangles named Fibonacci rose and the spiral square with four Golden spirals from the Golden and Fibonacci geometry, and the three turtles – symbols from Kolobar tradition in Bulgarian national culture. The forms from the Golden and Fibonacci geometry are used directly as ornaments, constructional elements for ornaments, or as frames for entered elements. The symbols from Kolobar tradition are used directly as ornaments. Every design is presented in suitable two, three or four color model. The used geometrical forms from the Golden geometry and the Bulgarian national tradition are the base for successful textile design using the mirror, radial and translated symmetry and the plain rhythms as result from their combinations. The design is more successful when the geometrical ornaments are combined with suitable colors according to the connections between colors and lines on the base of their meaning, the latest fashion trends, and national traditions.*

Key words: *textiles, the Golden spiral, Fibonacci rose, the spiral square, Kolobar tradition*.

1. INTRODUCTION

There are so many geometrical forms, which are created on the base of the Golden and Fibonacci geometry. There are very interesting geometrical symbols and shapes in Bulgarian folklore and national tradition. The paper presents design of textiles with geometrical ornaments on the base on creations from the Golden and Fibonacci geometry and Bulgarian national tradition.

2. THE GOLDEN AND FIBONACCI FORMS

Figures from 1 to 5 present geometrical forms, which are created on the base of the Golden and Fibonacci geometry. These creations are used for design of textile ornaments, parts of which are shown in this paper.

2.1 The Golden Spiral

The Golden spiral, presented in Figure 1, is created in the frame of a rectangle with sides in proportions of the Golden ratio or 1,618. For the creation of the spiral the rectangle is divided in a square and a rectangle. The smaller rectangle is divided in a square and a rectangle, and that

continues in a spiral direction. Squared circles are entered in every square and by that way the Golden spiral are created. [1]

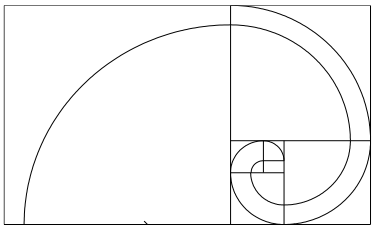

***Fig. 1**: The Golden spiral in the Golden rectangle*

2.2 Fibonacci Rose

Fibonacci sequence is a sequence of numbers, in which every next number is a sum of previous two ones. Geometrical mosaics from equalitarian polygons have been created with proportions between sides, which are equal to Fibonacci sequence. The tiling with equalitarian triangles is named Fibonacci rose. Fibonacci rose, in which the triangle tiling forms two spirals, is presented in Figure 2. [2]

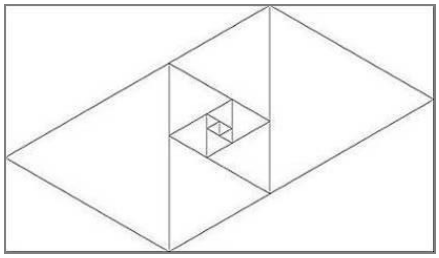

***Fig. 2**: Fibonacci rose*

2.3 The Spiral Rectangle

Figures 3, 4, and 5 present variants of geometrical ornaments, created on the base of the spiral square (Figure 3). [3] The spiral square includes four logarithmic or Golden spirals.

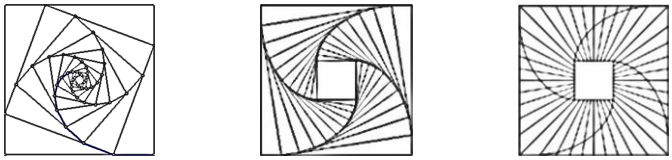

***Fig. 3, 4, and 5**: Variants of geometrical ornaments, created on the base of the spiral square*

3. GEOMETRICAL CREATIONS IN BULGARIAN NATIONAL TRADITION

One of the main symbols in Bulgarian national culture, especially in Kolobar tradition, is the Turtle. The Kolabar tradition includes three turtle, which symbolize the universe, the stars and the planets. [4] The three turtles are presented in Figures 6, 7, and 8. These symbols are used as ornaments in textile design, presented in the paper.

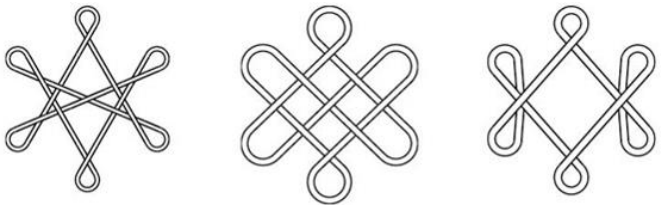

***Fig. 6, 7, and 8**: The three turtles*

4. TEXTILE DESIGN ON THE BASE OF THE GOLDEN AND FIBONACCI FORMS

4.1 Textile Design with the Golden Spiral

Figures 9-13 present textile designs with ornaments, which are created on the base of the Golden spiral. Presented designs use three color models.

The textile designs, shown in Figures 9-11, are formed by ornaments in square shapes, which are designed with four Golden spirals arranged around a center using a radial symmetry or a radial rhythm. The square ornaments are set in order of a plain rhythm, formed by two perpendicular linear rhythms, based on symmetry of translation.

In the design, presented in Figure 9, the ornament is formed as the start points of the spirals are situated close to the angles of the square and the biggest arcs of the spirals are located close to the center of the radial symmetry or the radial rhythm.

In the design, which is shown in Figure 10, the ornament is created as the start points of the spirals are situated close to the centers of the square sides and the last point of the biggest arcs of the spirals are situated in the angles of the squares.

In the design, which is presented in Figure 11, the ornament is formed as the start points of the spirals are situated close to the angles of the square, the biggest arcs are located close to the centers of the square sides, and the last point of the biggest arcs are located near to the center of the radial symmetry or the radial rhythm.

***Fig. 9, 10, and 11**: Textile design on the base of square ornaments designed using four Golden spirals arranged by a radial symmetry or a radial rhythm*

The Golden rectangle and the Golden spiral can be used as a frame for entered geometrical elements. Figures 12 and 13 show textile designs formed on the base of an ornament which is created on the base the Golden rectangle and the Golden spiral, and entered diagonals in the squares

in the rectangle. The diagonal lines are chords of the arcs of the Golden spiral. The ornament is designed in three color model. [5]

In the textile design, which is shown in Figure 12, at fists the ornament is arranged in the mirror symmetry. In results a secondary ornament in form of a hearth is designed. The secondary ornaments are set in order of a plain rhythm, formed by three linear rhythms or a triangle net.

In the design, presented in Figure 13, the ornament is arranged with the help of a radial symmetry or a radial rhythm in a secondary square ornament in a form of a flower. The secondary square ornaments are set in order of a plain rhythm, formed by two perpendicular linear rhythms, based on symmetry of translation.

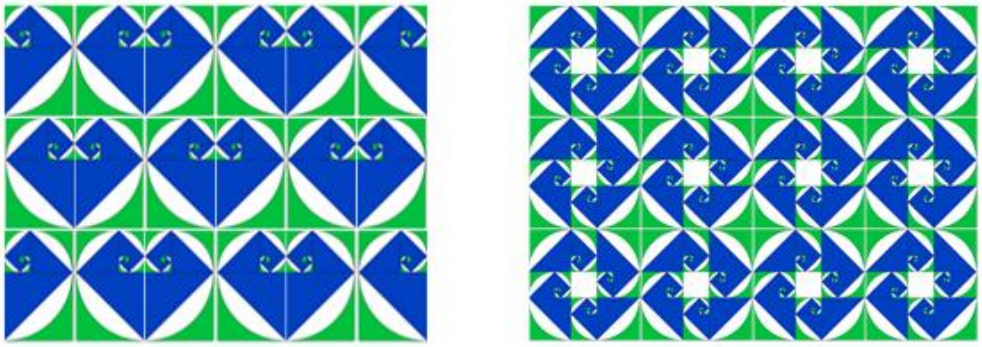

***Fig. 12 and 13**: Textile designs on the base of ornament with entered diagonals in the frame of the Golden rectangle and the Golden spiral*

4.2 Textile Design with Fibonacci Rose

Figures 14-16 present textile designs with ornaments, which are created on the base of Fibonacci rose. Presented designs use two and three color models.

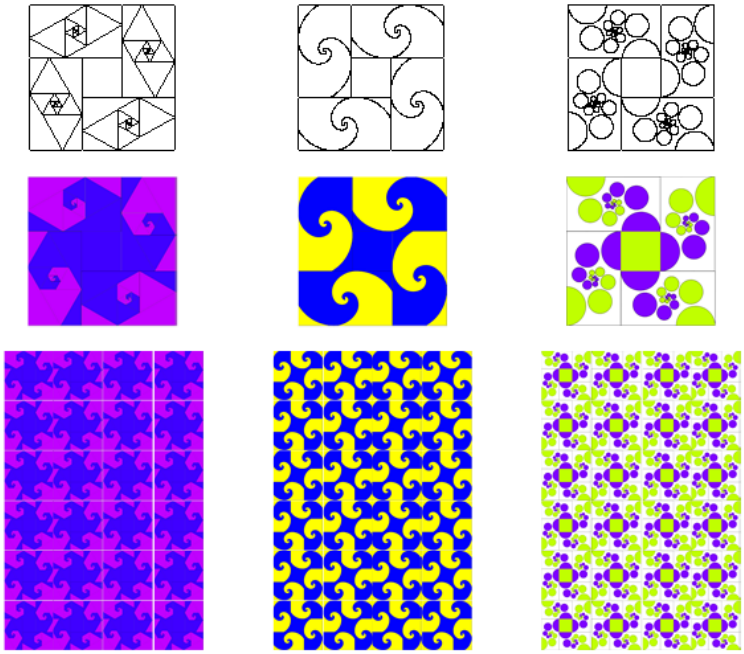

***Fig. 14, 15, and 16**: Textile design on the base of square ornaments designed using four Fibonacci Roses arranged by a radial symmetry or a radial rhythm*

The ornaments in textile designs in Figures 14-16 are in square shapes, which are designed with four Fibonacci roses or geometric elements created on the base of Fibonacci rose arranged around a center using a radial symmetry or a radial rhythm. The square ornaments are set in order of a plain rhythm, formed by two perpendicular linear rhythms, based on symmetry of translation.

In the design, presented in Figure 14, the both spiral areas, which are formed with triangles in Fibonacci rose, are colored in different colors.

The design, shown in Figure 15, use double curved spiral, created on the base of the triangles' spiral forms in Fibonacci rose. The areas between both curved spirals are colored in different colors. [6]

The design, presented in Figure 16, use double circles' spiral, created on the base circles entered in the triangles of Fibonacci rose. The both circles' spirals are colored in different colors. [6]

4.3 Textile Design with the Spiral Square

Figures 17-19 present textile designs with the Spiral squares as ornaments in three and four color models.

In the textile design, presented in Figure 17, the spiral squares are arranged in a square set by a plain rhythm which is result of two perpendicular linear rhythms on the base symmetry of translation.

In the textile design, presented in Figure 18, the spiral squares are arranged with the help of a plain rhythm, which is a result of repeated mirror symmetries in both perpendicular directions.

In the textile design, shown in Figure 19, the spirals squares are set in a plain rhythm which combines the mirror symmetry in the one of the both linear rhythms, and the symmetry of translation in the other perpendicular linear rhythm.

***Fig. 17, 18, and 19**: Textile design on the base of the spiral square using the radial symmetry and the symmetry of translation*

5. TEXTILE DESIGN ON THE BASE OF SYMBOLS IN BULGARIAN NATIONAL TRADITION

Figures 20-22 present textile designs on the base of the turtles from Kolobar tradition, part of Bulgarian national culture, which are presented in Figure 6-8. The turtles are used directly as ornaments in a plain rhythm, formed by two perpendicular linear rhythms, based on symmetry of translation. The geometry of the ornaments is combined with colors, which are traditional for Bulgarian national costume. [7]

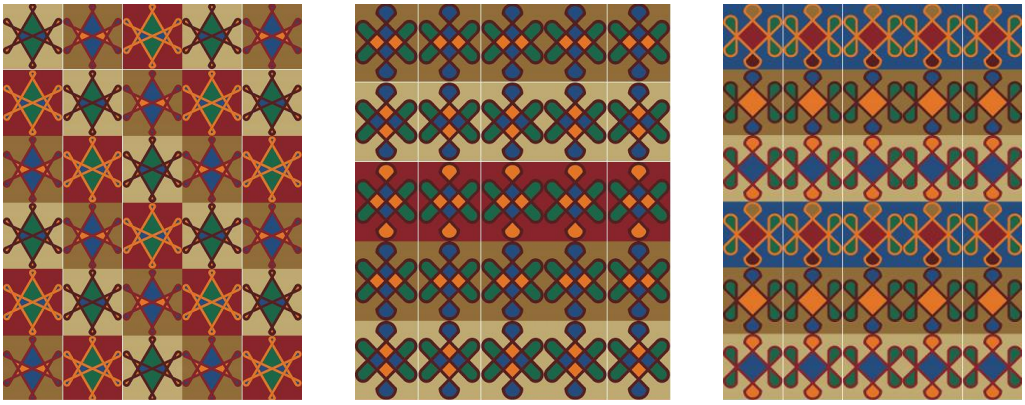

Fig. 20, 21, and 22*:*
Textile design on the base of the turtles from Kolobar tradition, a part of Bulgarian national culture

6. CONCLUSIONS

The presented geometrical forms from the Golden geometry and the Bulgarian national tradition are the base for successful textile design using the mirror, radial and translated symmetry and the plain rhythms as result from their combinations.

The design is more successful when the geometrical ornaments are combined with suitable colors according to the connections between colors and lines on the base their meaning, the latest fashion trends, and national traditions.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

USING THE PRINCIPLES OF TRANSFORMATION IN THE DEVELOPMENT OF NEW DESIGN CLOTHES-MAKING FOR WOMEN

IROVAN Marcela[1], TUTUNARU Irina[1], BALAN Stela[1], LABUTINA Valeria[1]

[1] Technical University of Moldova, Faculty Light Industry, Departement of Modelling of Textiles and Knitwear Confections, blvd Stefan cel Mare si Sfant, 168, MD 2004, Chișinău, Republic of Moldova

Corresponding author: Irovan Marcela, E-mail: marcela.irovan@gmail.com

Abstract: *The transformable garments represent an actual group in the assortment of contemporary clothing, providing wide possibilities of obtaining multifunctional shapes. The work presents the results of theoretical and applied research in the design of garments with flexible structure for women. The scope of study consists in the analysis of possibilities to develop modern assortments of garments for women by using morphological transformation techniques. The transformable products include an ensemble of garments designed with diverse techniques and methods, both traditional and non-traditional. The morphological transformation techniques are based on the principles of reconstruction and transformation, facilitating the transformation of one product shape into another and transformation of elements in the interior of the same shape. The study has defined several development directions for transformable products in the actual wardrobe: products made with two different texture, color and structure faces; products with attachable or detachable elements; products with a separate structure that by location, wrapping or connection of elements allow to obtain diverse shapes; products with changing shapes with the aid of various types of accessories; multifunctional product elements. The experimental studies were aimed at the elaboration of assortments of garments for women by applying the morphological transformation procedures with elaboration and manufacturing of models of transformable skirts for women. The transformable models demonstrate the universality of products, their functional possibilities, capacity to change the external appearance and aesthetic properties. When designing women's skirts one may use all types of transformation, several types of transformation may be used in one product simultaneously thus achieving several functional scopes.*

Key words: *transformable garments, transformation procedures, multifunctional shapes.*

1. INTRODUCTION

The transformable garments represent an actual group in the assortment of contemporary clothing, providing wide possibilities of obtaining multifunctional shapes. [1] The transformable products include an ensemble of garments designed with diverse techniques and methods, both traditional and non-traditional. The morphological transformation techniques are based on the principles of reconstruction and transformation, facilitating the transformation of one product shape into another and transformation of elements in the interior of the same shape. [2] The transformable garments are elaborated in order to satisfy the requirements imposed by the dynamic lifestyle, determined by the rapid change of functional processes and intense rhythm of events. [3] The

morphological transformation technique plays an important role in the process of creation of a spatial shape of contemporary garments. [4], [5]

The scope of the study consists in the identification of development directions of the assortment of modern garments by applying the morphological transformation techniques for creating garments for women.

2. TRANSFORMABLE PRODUCTS IN ACTUAL TRENDS

The transformable products are now occupying a special place in the fashion trends, they are included in the collections of the designers *Hussein Chalayan, Yohji Yamamoto, Martin Margiela, Gareth Pugh,* etc. One may also mention the products of the Italian brand *Loro Piana* - topcoats with two faces, cardigans, fur and tricot jackets; the products of *Rachel Rachel Roy* 4 in 1 – demi-coat, jacket, dress and topcoat, the component elements are affixed or detached as the case may be; the transformable products of *Donna Karan* allowing to obtain various shapes by installation, winding or connection of elements; the products of *PennyBlak* – jacket-type products with detachable elements – the lower part of product, hood, the sleeves, the thermal isolation undercoat and the additional reference elements made of fur; the products of *Jolier* - two models of dresses with shapes modified by tacks - at terminations and sleeves, or double-face products made of materials with different texture and color. [6]

Analyzing the assortment of transformable garments one may determine certain *development directions for the transformable products in the modern wardrobe* [7]:

- The products are made of two different types of fabric with different texture, color, structure and may be worn on one side or another depending on occasion,
- The products have attachable or detachable elements allowing to obtain several types of modification variants for the same type of product,
- The products have a separate structure (integral structure with a minimum number of seams, mad of elastic materials) that by fixation, winding or connection of elements allow to obtain diverse shapes,
- The products with changing shapes (length, expansion degree, etc.) using diverse types of accessories (zippers, buttons, tacks, lacing, etc.),
- Elements of multifunctional products.

3. CLASSIFICATION OF METHODS AND PRINCIPLES OF TRANSFORMATION OF WOMEN'S GARMENTS

Some techniques of constructive-technological and composition solutions of morphological transformation of garments and their elements were elaborated during many centuries. Morphological transformation is a tool used for conferring a functional universality to the product.

The leading specialists in transformable clothing have worked out twelve prototypes of morphological transformation joined into nine basic principles [3,5]:

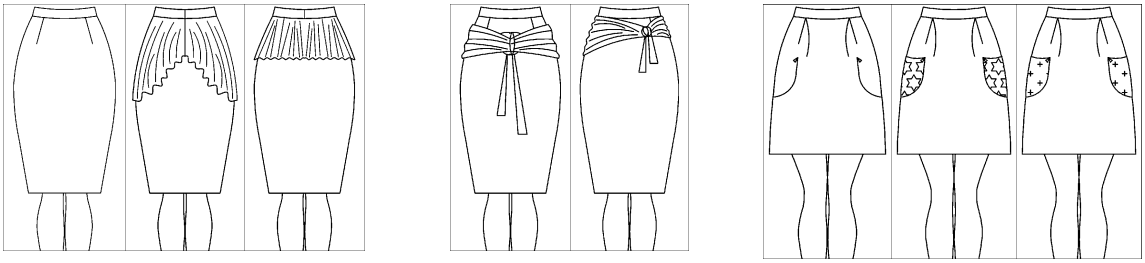
1) „substitution" of parts or elements of product by other parts or elements;
2) „detachment-attachment" of parts or elements;
3) „adjustment –fixation" of size, volume and shapes of product parts;
4) „stretching – compression" of parts or elements;
5) „wrapping-unwrapping" of parts or elements;
6) „disappearance-appearance" of volume of entire product;
7) „combination – insertion" of parts;

8) „orientation”;
9) „recombination” of parts or elements of products.

4. ELABORATION OF THE ASSORTMENT OF WOMEN'S SKIRTS BASED ON THE TRANSFORMATION TECHNIQUES

The design of new models of garments is a complex solution of image formation; it is a process combining the solution of artistic, technical, ergonomic, technological and economic tasks. When designing new models of women's skirts it is important to improve and enlarge the assortment based on the development and improvement of transformation techniques. For this purpose, the method of morphological analysis has been chosen in order to find new solutions for transformable women's skirts and select the best possible options taking into account the available tools and methods of executing new models of transformable women's skirts. For a more efficient usage of transformation techniques when designing models and constructions of women's skirts, as well as when compiling the wardrobe one need to systematize the constructive solutions of transformable elements.

The „substitution” transformation type is based on the substitution of some elements or constructive modules with other ones with preservation of basic elements, not all the modules being used simultaneously. For this type of transformation, the theory of combinatory analysis is used and the principle of different resistance levels of used parts. The location of substituted elements and their variants may be different. So, one of the many variants of this type of transformation may be the straight skirt with different types of belts substituted with others of different color, texture or construction. On the figure 1 one may consider the models of skirts elaborated based on the "substitution" morphological transformation principle. The model 1 (fig. 1,a) represents the basic skirt of narrowed silhouette and longitudinal junction. The shape is made on the account of lateral seams and waist darts, with three seams, with a zipper at back. The skirt ends at the knee level. The essence of transformation process in this model consists in the replacement of detachable upper frills of different shapes. The model 2 (fig. 1,b) – the essence of the transformation process in this model consists in the substitution of belts of different shapes. The model 3 (fig. 1,c) is a women's skirt of trapezoid silhouette, longitudinal junction. Its shape is made on the account of lateral seams and waist folds; it has three seams and a zipper at the back. The skirt ends above the knee level. The essence of transformation process in this model consists in the replacement of detachable pockets of various trimming patterns. The transformation tool here is the zipper on the frontal side of skirt.



a *b* *c*

Fig. 1: *Models of skirts elaborated in accordance with the „substitution” morphological transformation technique.*

Below one may consider some variants of applying the „detachment-attachment” transformation type in the manufacturing of waist-zone garments for women. This type of

transformation is based on the detachment or attachment of constructive-decorative or decorative elements of a multifunctional wardrobe. It allows improving the aesthetic properties of products and modifying their external appearance, thus making the wardrobe more varied at minimum cost. In this case one will use the principles of the theory of decomposition of construction, disassembly into details, and division into component elements. Detachable elements of products may be made of different materials. The conducted analysis allowed outlining the following solutions for the location of detachable elements: attachment as a flounce to the lateral seam of basic product; attachment of flounce into the curve junction line of front cloth, attachment of flounce over the front cloth of skirt. The attachment of detachable elements to the basic product in the place of basic fixation may differ and may use the buttons, zippers, etc. Different options are possible for the second solution of problem –both for junction lines and additional fixation of detachable element. On the figure 2 one may consider the models of skirts elaborated in accordance with the «detachment-attachment» morphological transformation technique. The model 4 (fig.2,a) – the essence of the transformation process in the model consists in the detachment-attachment of decorative element, specifically of the decorative flounce using the zipper under the belt. The model 5 (fig. 2,b) – the essence of the transformation process in this model consists in the detachment-attachment of decorative element – specifically - of the decorative flounce using buttons on the left side of the frontal cloth of product. The model 6 (fig.2,c) – the essence of the transformation process in this model consists in the detachment-attachment of decorative element – flounce – using a zipper on the front cloth of skirt. There is a junction curve on the front cloth of product with a seamed-in zipper. The zipper has a decorative and functional destination, being also a transformation tool. The model 7 (fig. 2,d) – the essence of the transformation process in this model consists in the detachment-attachment of decorative element – flounce – using a zipper on the lateral seam of skirt. The model 8 (fig. 2,e) – the essence of the transformation process in this model consists in the detachment-attachment of decorative element – flounce – using the buttons on the inner side of lower edge of skirt.

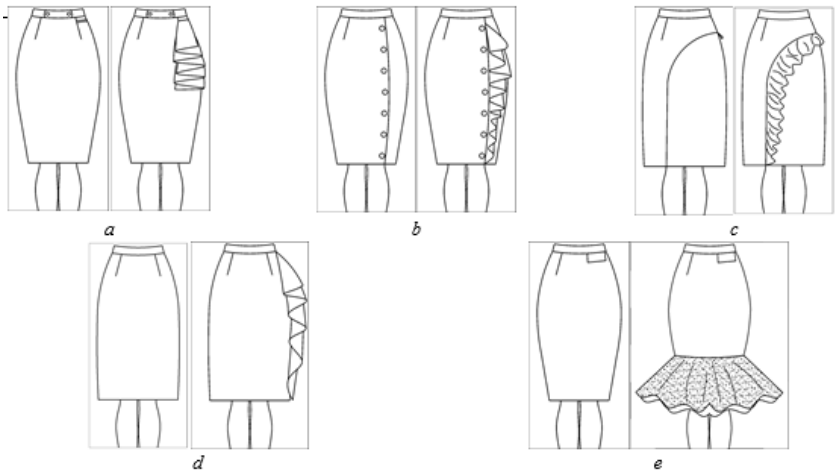
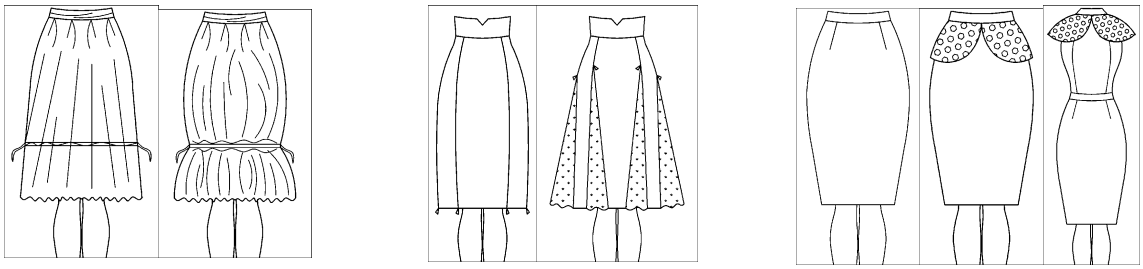


Fig. 2: *Models of skirts elaborated based on the „detachment-attachment" morphological transformation technique.*

The „adjustment-fixation" transformation is done by changing the volume, shape and other characteristics of products or constructive element (fig.3a, b). Transformation is done using special elements: zippers, links and lacing. The variants of constructive solutions for waist garments in this kind of transformation are the non-elastic constructive-decorative inserts into the element junction seams with volume adjustment possibility; design of main element with possibility to adjust the size;

free adjustable assembly. The location of free adjustable assembly may be different. It may be located in the upper part of the product over the entire perimeter; only on the front part of product; only in the area of lateral seams, in the lower part of the product over the entire perimeter. In order to reduce the volume one may use a band inserted into a superimposed coulisse. As an alternative, one may pass a band or a lace through eyelets. The model 9 (fig.3, a) – Women's skirt of trapezoid silhouette, longitudinal junction, the shape is made by «sun»-type cut with folds on waist, three seams, one zipper on the back side. The skirt length is at the knee level. The essence of transformation process in this model consists in adjustment– fixation of product volume. The volume adjustment tool is the decorative band in the coulisse installed in parallel with the lower edge of skirt. The model 10 (fig.3, b) – Women's skirt of straight silhouette, longitudinal junction, the shape is made on the account of lateral seams and relief elements located on the front and back of skirt. The skirt has three seams, with a zipper at back. The skirt length is at knee level. The essence of transformation process in this model consists in adjustment – fixation of product volume. The volume adjustment is done by zippers and wedges in the relief elements and lateral seams of skirt. When the zipper is opened, the skirt gets its volume.

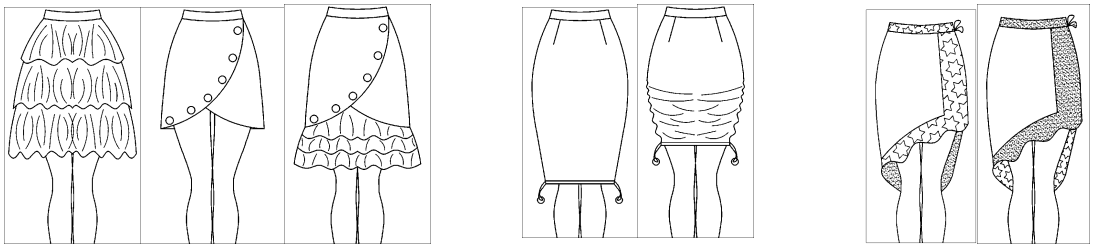


a *b* *c*

Fig. 3: *Models of skirts elaborated based on the „adjustment-fixation" morphological transformation technique a, b and of «recombination» technique - c*

The model 11 (fig.3, c) – Women's skirt of narrowed silhouette, longitudinal junction. Its shape is made by lateral seams and waist tucks, with three seams, with a zipper at back. The skirt ends at the knee level. The essence of transformation process in this model consists in the relocation of transformed element – upper frill that may be worn as a shawl over a dress or blouse. The upper frill is fastened on hooks.

The model 12 (fig.4, a) – Basic skirt of trapezoid silhouette, horizontal junction, the shape is made by gathered flounces, with a single seam, one zipper at back. The skirt length is above knee level. The essence of transformation process in this model consists in combination – insertion of one more skirt over the basic skirt, fastened on buttons. The second skirt may serve both as an auxiliary element and a separate product. Also this principle is called «matryoshka». The second skirt is a product of trapezoid silhouette, vertical junction; the shape is made on the account of lateral seams, three seams, with buttons on the front cloth. The model 13 (fig.4, b) – Women's skirt of narrowed silhouette, longitudinal junction, the shape is made by lateral seams and waistline tucks, three seams with a zipper at back side. The skirt ends at knee level. The essence of transformation process in this model consists in wrapping-unwrapping of length. The process is based on the coulisses provided in lateral seams. When the bands are tightened, the skirt length is wrapped. The model 14 (fig.4, c)– Women's skirt of straight silhouette, longitudinal junction, the shape is made by lateral seams and waistline tucks on the back side of skirt, the skirt has three seams and a wrap-over. The skirt ends at knee level. The essence of transformation process in this model consists in the orientation technique. The product has no face and no reverse side, the product is double-sided and double-colored.



a *b* *c*

Fig. 4: *Models of skirts elaborated in accordance with the morphological transformation procedures a – „combination – insertion", b- „wrapping-unwrapping" - b and c- „orientation"*

5. CONCLUSIONS

The use of transformation techniques and methods in elaborating women's garments is a perspective practice, since it allows to resolve a series of actual problems: to enlarge the assortment of products; to increase the number of products in the women's wardrobes without significant additional costs; to extend the product exploitation periods; to raise the universality, the functional possibilities and aesthetic properties of garments. When designing women's skirts one may use all the main types of transformation, several types of transformation may be used in a single product thus allowing to attain an entire series of objectives.

From their very first appearance and to these days the transformable garments have suffered significant changes, from draperied clothing to complex shapes and developed together with the wearers. However, they remained an unchanged attribute allowing to diversity and rationalize the volume of wardrobe and to point out the wearer's individuality. So, the transformable products may represent the future of garments.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

NANOFIBER PRODUCTION [REVIEW]

KESKIN Reyhan[1], GOCEK Ikilem [2]

[1] Pamukkale University, Engineering Faculty, Dept. of Textile Engineering, Kinikli, 20070, Denizli, TURKEY, reyhank@pau.edu.tr

[2] Istanbul Technical University, Textile Technologies and Design Faculty, Dept. of Textile Engineering, Gumussuyu, 34437, Istanbul, TURKEY, goceki@itu.edu.tr

Corresponding author: Keskin, Reyhan, E-mail: reyhank@pau.edu.tr

Abstract: *Nanofibers are very thin fibers having diameters lower than 100 nm and their lengths might be as long as possible within production limits. The large surface area of nanofibers gives opportunity to functionalize them. Nanofibers have several applications including both applications for industrial production in many sectors and for research studies. Nanofibers find applications in energy devices such as solar cells, fuel cells and nanogenarators; in filtration applications (such as water/oil filtration, fine particle filtration, aerosol filtration, air filtration, nanoparticle filtration) and in several medical applications including antibacterial efficacy, wound healing, drug delivery and scaffolds for tissue engineering.*
There are several methods to produce nanofibers: Electrospinning, self assembly, phase separation, bacterial cellulose, templating, drawing, extraction, vapor-phase polymerization, kinetically controlled solution synthesis, conventional chemical polymerization for anyline. Electrospinning is the most widely used method to produce nanofibers.In electrospinning, a high electric field, which is in kilovolts, is applied to a polymer solution. The polymer solution is drawn from a syringe to a collector surface.Electrospinning requires usage of appropriate solvent, removal of evaporating solvent, an adequate power supply to overcome the viscosity and surface tension of the polymer solution; while, jet instability and jet control remain as challenges in electrospinning. Nanofiber production methods possess some disadvantages as: higher cost compared to conventional fiber production methods, health hazards such as inhale risk of nanofibers during production and keeping the environment safe from evaporating solvents used during nanofiber production. Up to date, many researches have been conducted on nanofibers and electrospinning; still, more controllable, more cost effective, more environmentally friendly and safer methods are of essential importance to future applications of nanofibers.

Key words: *Nanofibers, nanofibrous mats, nanotechnology, electrospinning, functionalization.*

1. INTRODUCTION

As nanotechnology refers to the study of materials, structures and devices having at least one dimension equal to or less than 100 nm, nanofibers are very thin fibers having diameters lower than 100 nm [1].

The root of electrospinning stems from studies of 1600s. William Gilbert studied the electrostatic attraction of a liquid in 1600, Schönbein produced nitrated cellulose in 1846; and in 1887, C.V. Boys published a paper on nanofiber production [2]. The first electrospinning patent was issued by John Francis Cooley in 1900 [3]. John Zeleny studied the fluid behavior under electrostatic

forces in 1914 [4]; Zeleny's study opened a path for mathematical modelling studies of electrospun nanofibers. In 1934, Formhals took his first patent on electrospinning. In 1938, Rozenblum and Petryanov-Sokolov produced electrospun fibers. Between 1931 and 1944, Anton Formhals got more than 20 patents for electrospinning [2-4]. Between 1964 and 1969, Sir Geoffrey Ingram Taylor studied the cone of polymer fluid under electrostatic forces, those mathematical models led to this cone be named as 'Taylor cone' after him [2, 5, 6].

Since 2000s nanofiber research has shown a huge increase in scientific studies. We searched for publications about nanofibers using Web of Science search system with keys as 'electrospinning' or 'nanofiber' or 'nanofibrous' and the results of the search are given in Table 1 and the graph for nanofiber publications for years 1975-2016 is shown in Figure 1.

Table 1: *The number of published papers about nanofibers since 1975 (search done using Web of Science)*

year	Number of papers published	year	Number of papers published	year	Number of papers published	year	Number of papers published	year	Number of papers published
1975-1992	0	1997	5	2002	127	2007	594	2012	1774
1993	1	1998	13	2003	230	2008	869	2013	3111
1994	0	1999	17	2004	210	2009	989	2014	3580
1995	4	2000	23	2005	283	2010	1211	2015	3709
1996	3	2001	66	2006	453	2011	1542	2016	1001 *

*: until the 18th April of 2016

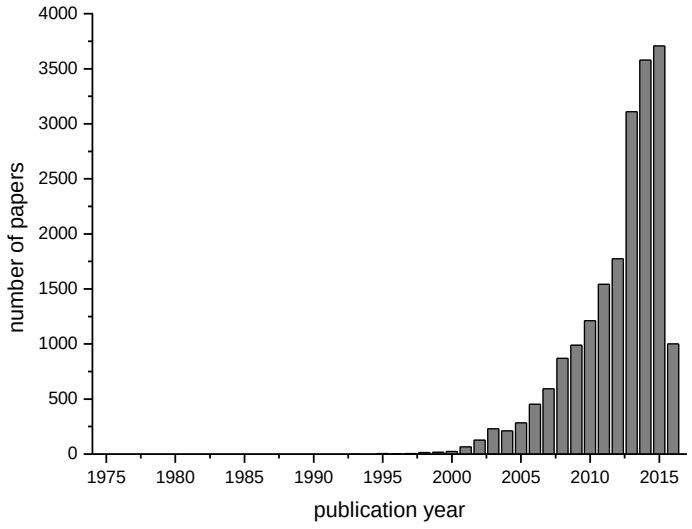


Fig. 1: *The annual number of published papers about nanofibers since 1975 (untill April 18 th of 2016)*

2. APPLICATIONS OF NANOFIBERS

The first commercial application of nanofibers dates back to 1930s indeed. The Soviet Union kept nanofiber studies secret and Petryanov successfully produced an electrospun filter named 'Filter of Petryanov' used for nuclear protection too; those filters were being mass produced in the Soviet Union [7, 8].

Nanofibers have several applications including both applications for industrial production in

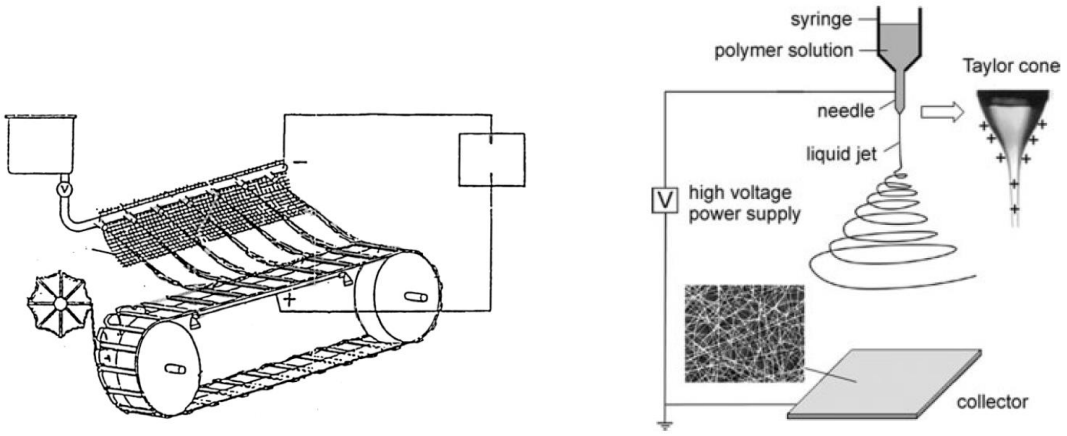
many sectors [31] and for research studies. Nanofibers find applications in energy devices such as solar cells, fuel cells and nanogenarators [9]; in filtration applications such as water/oil filtration [10, 11], fine particle filtration [12], aerosol filtration [13], air filtration [14], nanoparticle filtration [15] and in several medical applications including antibacterial efficacy [16], wound healing [17-21], drug delivery [22] and scaffolds for tissue engineering [23].

3. PRODUCTION OF NANOFIBERS

There are several methods to produce nanofibers: Electrospinning, self assembly, phase separation, bacterial cellulose, templating, drawing, extraction, vapor-phase polymerization, kinetically controlled solution synthesis, conventional chemical polymerization for anyline [24].

Nanofiber production methods possess some disadvantages as: higher cost compared to conventional fiber production methods, health hazards such as inhale risk of nanofibers during production and keeping the environment safe from evaporating solvents used during nanofiber production [1, 25].

In electrospinning, a high electric field, which is in kilovolts, is applied to a polymer solution. The polymer solution is drawn from a syringe to a collector surface [6]. The schematic for Formhals' 1934 patent and a modern schematic for electrospinning equipment are given in Figure 2a [26] and Figure 2b respectively [6].



(a) *(b)*

Fig. 2: (a) *The schematic in the 1934 patent of Formhals for electrospinning [26],* ***(b)*** *A schematic for a modern version of electrospinning equipment [6]*

There are many parameters affecting electrospinning such as process and system parameters (electric voltage, flow rate of polymer fluid, concentration of polymer solution, viscosity of solution, spinning distance between nozzle and collector, relaxation time, molecular weight, chemistry of polymer used); nozzle and set-up configuration (single nozzle, multiple nozzle, side by side nozzle, co-axial nozzle, aligned set-up, horizontal set-up); ambient parameters (temperature, humidity, air velocity) [2, 27].

Both experimental studies and theoretical models explain how several parameters affect fiber morphology (fiber diameter, surface roughness, porosity) and fiber physical properties

(stiffness, toughness, electrical conductivity, thermal properties and biocompatibility and degradation properties for biomedical applications) [2, 28].

Each method has some disadvantages: drawing is a discontinuous method; phase separation is limited to several polymers; and controlling of nanofiber dimensions is not possible for drawing, phase separation and self-assembly methods while electrospinning method enables control of nanofiber dimensions and is capable of producing nanofibers at several meters length as well as nanofibrous mats [1].

Fiber lengths might be in microns for template synthesis and self-assembly methods; fibers produced by drawing method can have lengths from 10 microns to millimeters, while phase separation yields either porous structures or continuous networks [1, 24]. Electrospinning requires usage of appropriate solvent, removal of evaporating solvent, an adequate power supply to overcome the viscosity and surface tension of the polymer solution; however, jet instability and jet control remain as challenges in electrospinning [1, 3, 4].

4. FUNCTIONALIZATION OF NANOFIBERS

Nanofibers have higher surface area per weight ratios compared to microfibers and fibers [25]. The large surface area of nanofibers gives opportunity to functionalize them [29]. Nanofibers can be functionalized either by adding the functionalization material to the melt/solution during production or by surface modification by post-spinning functionalization [29, 30]. Nanofibers produced by adding the functionalizing material (such as TiO_2 ,ZnO,MgO) inside the spinning melt or solution have the material particles within the nanofiber while the surface modified nanofibers obtained by post-spinning functionalization have the material particles only on the nanofiber surface [31]. Adding the functionalization material to the melt/solution might cause increase in nanofiber thickness and decrease in mechanical properties due to agglomeration of the functionalization material particles [32].

5. CONCLUSIONS

Nanofibers have several usages including filtration and medical applications. Nanofibers exhibit superior properties compared to conventional micron scaled fiber. There are several methods to produce nanofibers. Fiber length is limited in most of the production methods, while electrospinning gives opportunity to produce long nanofibers.

Electrospinning requires usage of appropriate solvent, removal of evaporating solvent; while, jet instability and jet control remain as challenges in electrospinning [1, 3, 4]. In electrospinning, a high electric field, which is in tens of kilovolts, is applied to produce nanofibers; this high electric voltage requires attention during production [6].

Nanofiber production methods possess some disadvantages as: higher cost compared to conventional fiber production methods, health hazards such as inhale risk of nanofibers during production and keeping the environment safe from evaporating solvents used [1, 25]. Up to date, many researches have been conducted on nanofibers and electrospinning; still, more controllable, more cost effective, more environmentally friendly and safer methods are of essential importance to future applications of nanofibers.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

INFLUENCE OF TECHNOLOGICAL PARAMETERS ON AGROTEXTILES WATER ABSORBENCY USING ANOVA MODEL

LUPU Iuliana G.[1], GROSU Marian C.[2]

[1.] "Gheorghe Asachi" Technical University from Iaşi, Faculty of Textile-Leather Engineering and Industrial Management, Dimitrie Mangeron no.28, 700050, Iaşi, Romania, iuliana68lupu@yahoo.com

[2] The National Research and Development Institute for Textiles-Leather, 16th Lucreţiu Pătrăşcanu Street, 030508, Bucharest, Romania, catalin.grosu@certex.ro:

Corresponding author: Lupu Iuliana Gabriela, iuliana68lupu@yahoo.com

Abstract: *Agrotextiles are now days extensively being used in horticulture, farming and other agricultural activities. Agriculture and textiles are the largest industries in the world providing basic needs such as food and clothing. Agrotextiles plays a significant role to help control environment for crop protection, eliminate variations in climate, weather change and generate optimum condition for plant growth.*
Water absorptive capacity is a very important property of needle-punched nonwovens used as irrigation substrate in horticulture. Nonwovens used as watering substrate distribute water uniformly and act as slight water buffer owing to the absorbent capacity. The paper analyzes the influence of needling process parameters on water absorptive capacity of needle-punched nonwovens by using ANOVA model. The model allows the identification of optimal action parameters in a shorter time and with less material expenses than by experimental research. The frequency of needle board and needle depth penetration has been used as independent variables while the water absorptive capacity as dependent variable for ANOVA regression model. Based on employed ANOVA model we have established that there is a significant influence of needling parameters on water absorbent capacity. The higher of depth needle penetration and needle board frequency, the higher is the compactness of fabric. A less porous structure has a lower water absorptive capacity.

Key words: *nonwoven, viscose, polypropylene, horticulture, absorptive capacity, ANOVA*

1. INTRODUCTION

Nonwovens are used effectively for optimising the productivity of crops, gardens and greenhouses. Their protective nature means that the need for pesticides is reduced and manual labour is kept to a minimum.

Water absorptive capacity is a very important property and an important criterion for the performance of needle-punched nonwovens used as irrigation substrate in horticulture [1]. Nonwovens used as watering substrate distribute water uniformly and act as slight water buffer owing to the absorptive capacity. So, the irrigation solution is brought directly to the root zone. At the same time, the using of nonwovens with higher water holding capacity affects the frequency of irrigation which depends by existing environmental conditions. Nonwovens can have a higher water absorbency if contain in the composition cellulose-based fibers. The advantages of using in the fibrous blend of PP fibers include lighter weight, high wet strength, resistance to rot and chemicals and quick wicking action.

Needle punching is a process for converting webs of fibre into coherent fabric structures, normally by means of barbed needles, which produce mechanical bonds within the web [2, 3]. In order to understand more about the influence of needling process parameters on nonwoven water absorbent capacity it is essential to use mathematical modelling which is an investigation method of technological processes based on experimental data collection and processing [4].

ANOVA model allows the identification of optimal action parameters in a shorter time and with less material expenses than the experimental research. One of the attributes of ANOVA which ensured its early was computational elegance. The structure of the additive model allows solution for the additive coefficients by simple algebra rather than by the matrix calculations. The determination of statistical significance also required access to tables of the Fisher function which were supplied by early statistics test [4, 5, 6, 7].

2. EXPERIMENTAL

2.1 Materials

A blend of 50% polypropylene (6.7dtex/50mm) + 50% viscose (3.3dtex/38mm) was used for the preparation of needle-punched nonwoven fabrics.

2.2 Methods

Web of polypropylene/viscose fibers was formed by carding and lapping process, respectively. The basis weight of the web was controlled as 150g/m^2. Then the nonwoven fabrics were made by using an Automatex needle loom having 15x18x42x3CBA Foster needles. The experiments took place under pilot unit condition.

Before performing the water absorptive capacity measurements, the samples were conditioned at 65%, relative humidity and 20^{0}C temperature for 24 h. The fabric water absorptive capacity was tested according to ISO 9073-6 using a cylindrical wire basket that has been dropped on to the surface of the liquid from a hight of 25 mm.

The water absorptive capacity in % was calculated using the following relation:

$$C_a = \frac{M_d - M_w}{M_w} x100(\%) \quad \textbf{(1)}$$

where:

Md: mass in g of the dry test sample,

Mw: mass in g of the wet test sample at the end of test.

There is an increase of water absorptive capacity at low values of needle board frequency and depth penetration. A porous structure has a higher absorptive capacity because of a higher number of pores which contain a higher air amount.

Experimental results concerning the needle-punched nonwoven water absorptive capacity were statistically processed using ANOVA model.

3. RESULTS AND DISCUSSION

3.1. Collection, systematization and processing of experimental data

Econometric modelling is performed using numeric variables. In ANOVA regression model were included the following variables:

- dependent variable (Y) representing the water absorptive capacity, expressed in %;
- independent variables representing needle board frequency (X_1) respective needle depth penetration (X_2), expressed in cycles/min respective in mm.

In Table 1 are indicated the experimental data regarding the influence of independent variables on water absorptive capacity of needle-punched nonwovens comprising PP fibers and viscose fibers.

Table 1: *Experimental data*

Independent variables		Mean measured value of dependent variable
X_1	X_2	Y
94	6	1850
115	8	1979
165	6	2119
165	9	2102
215	8	2017
236	6	1974

3.2. Hypotheses formulation

H_0: Needle board frequency respective needle depth penetration has not significant influence on mean values of water absorptive capacity;

H_1: Needle board frequency respective needle depth penetration has significant influence on mean values of water absorptive capacity (H_0 is reject).

3.3. Formulation of the regression model

The Anova model is defined by relation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon \quad \textbf{(2)}$$

The SPSS (Statistical Package for the Social Sciences) program was used in the modelling process. The coefficients defined in Table 2 were determined for the established model and the t-test show if the influence of the needle board frequency respective needle depth penetration is "significant" on mean values of water absorptive capacity.

Table 2: *Coefficients of ANOVA model*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1639.838	123.005		13.331	0.000
	Needle board frequency	0.703	0.359	0.396	1.958	0.039
	Needle depth penetration	35.138	14.832	0.479	2.369	0.032

a. Dependent Variable: Water absorbent capacity

From Table 2 it can be noticed that Sig<0.05, so the H_0 is rejected and H_1 accepted. Hence, the needle board frequency and needle depth penetration has a significant influence on water absorptive capacity.

The estimated ANOVA model has the following expression:

$$Y = 1639.84 + 0.703 X_1 + 35.138 X_2 \quad \textbf{(3)}$$

3.4. Hypotheses confirmation over errors

3.4.1. M(ε)=0 (errors mean is null)

The hypotheses are the following:

$$H_0 : M(\varepsilon) = 0$$
$$H_1 : M(\varepsilon) \neq 0 \quad \textbf{(4)}$$

The student t-test for errors (unstandardized residual) evaluation was applied as see in Table 3.

Table 3: *Student t-test for testing of mean errors*

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Water absorptive capacity	93.030	17	0.000	2007.611	1962.08	2053.14
Unstandardized Residual	0.000	17	1.000	0.000	-35.67	35.67

Sig=1>0.05, so hypothesis H_0 is accepted

3.4.2. V (ε_i) = σ^2 (homoscedasticity hypotheses)

A non-parametric correlation test is applied between the estimated errors and dependent variable. The correlation coefficient Spearman was calculated and the Student t-test for this coefficient was performed (see table 4). The hypotheses are:

- H_0: correlation coefficient is insignificantly larger than zero (null hypothesis of Student t-test is accepted),
- H_1: correlation coefficient is significantly larger than zero (null hypothesis of Student t-test is rejected).

Table 4: *Spearman test for verifying the homoscedasticity hypothesis*

Correlations				
			Water absorptive capacity	Unstandardized Residual
Spearman's rho	Water absorptive capacity	Correlation Coefficient	1.000	0.720**
		Sig. (2-tailed)	0.000	0.001
		N	18	18
	Unstandardized Residual	Correlation Coefficient	0.720**	1.000
		Sig. (2-tailed)	0.001	0.000
		N	18	18

***. Correlation is significant at the 0.01 level (2-tailed).*

The values of sig. for correlations water absorptive capacity – estimated errors (Sig=0.000) are equal and constant. The correlation Spearman coefficient (r = 0.720) and Student t-test for this Spearman coefficient are indicated in Table 4. The significance of Student t-test (Sig t = 0.000) leads to the decision to reject the null hypothesis of Student test (hypothesis that correlation coefficient is insignificantly larger than zero). Therefore, is rejected the homoscedasticity hypothesis for regression model between the water absorptive capacity and dependent variables (needle board frequency and needle depth penetration) with a probability of 0.95.

3.4.3. $\varepsilon i \sim N(0, \sigma^2)$ – normality hypothesis

Testing normality errors distribution can be done using non-parametric tests like Kolmogorov-Smirnov test, Skewness test and Kurtosis test [3] (see Table 5 and Table 6).

Table 5: *Kolmogorov-Smirnov Test*

		Water absorptive capacity
N		18
Normal Parameters[a,b]	**Mean**	2007.61
	Std. Deviation	91.557
Most Extreme Differences	**Absolute**	0.190
	Positive	0.096
	Negative	-0.190
Kolmogorov-Smirnov Z		0.807
Asymp. Sig. (2-tailed)		0.534

a. Test distribution is Normal. b. Calculated from data.

The Sig = 0.534 >0.05, so it is accepted the normality hypothesis (H_0).
Estimates of distribution errors form are the folowing:

- Fisher asymmetry coefficient: sw = 0.924, for a positive asymmetry (sw > 0);
- Fisher vaulting coefficients: k = - 0.109 for a flattened distribution (k <0).

***Table 6**: Skewness and Kurtosis test for normality hypothesis*

Statistics			
		Water absorptive capacity	**Unstandardized Residual**
N	**Valid**	18	18
	Missing	0	0
Skewness		-0.508	0.924
Std. Error of Skewness		0.536	0.536
Kurtosis		-0.222	-0.109
Std. Error of Kurtosis		1.038	1.038

As seen in Figure 1, the parameter estimations indicate a deviation of errors distribution from the normal distribution.

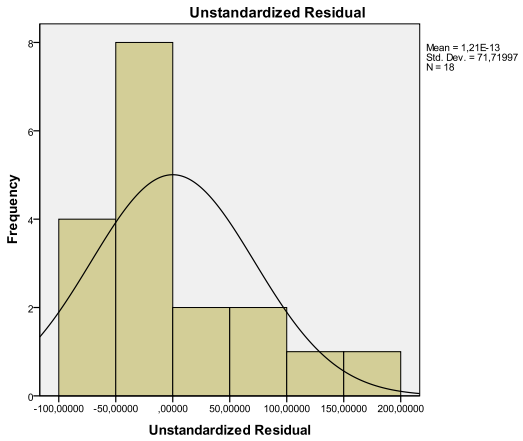

***Fig. 1**: Estimated errors distribution*

3.4.4. cov (εi, εi) - testing of errors autocorrelation

The hypotheses are:

- H_0: ρ = 0 (the errors are not auto-correlated);
- H_1: ρ ≠ 0 (the errors are auto-correlated).

For the verification was used the Durbin-Watson test and the results are presented in Table 7.

***Table 7**: Durbin Watson test for errors auto-correlated testing*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.783	0.614	0.589	58.663	0.681

The value of 0.681 is compared with test calculated value (dl, du). It is noted that the obtained value is in the range (0, dl). Therefore, the null hypothesis is rejected which means that the recorded errors have a positive auto-correlation.

The test statistic is the following: $DW = d = 2(1-\widehat{\rho})$ where $\widehat{\rho}$ is the correlation coefficient error estimator and fulfilling the following condition: $-1 \le \widehat{\rho} \le 1$. If $d = 2(1-\widehat{\rho})$, the statistic values

are in the range: $0 \le d \le 4$. In table 7 is shown the calculated value of Durbin-Watson statistic d_{calc} = 0.681. This value is compared with the critical values, noted d_L = 1.158 (lower limit) and d_U=1.391 (upper limit) which are read from the Durbin-Watson table for a threshold of significance 0.05, for a regression model with two parameters.

4. CONCLUSIONS

To establish the influence of independent variables (X_1 and X_2) and dependent variable (Y), a mathematical modelling was performed as described in "Experimental" section.

ANOVA model permits us to evaluate the homogeneous character of population by separating and testing of the effects caused by considered factors. Based on ANOVA model has been established that sig < 0.05. So, the hypothesis H_0 is rejected and H_1 is accepted. Hence, employing ANOVA model on needle-punched nonwovens used in horticulture has revealed that needling process parameters have a significant influence on water absorptive capacity.

It is known that the water absorptive capacity of nonwoven increases with the increasing of proportion of cellulose-based fibers. Even the needling process parameters, namely, needle board frequency and needle depth penetration in web can increase water absorptive capacity until to certain values. Based on experimental data, it is noticed that an increase of needle frequency and depth penetration have the same effect on nonwoven water absorptive capacity. It is found that 6 mm depth of needle penetration and 165 cycles/min needle board frequency is an optimum combination which might be considered for a maximum value of absorptive capacity because deviation from any of the independent variables may be responsible for the decreasing in absorptive capacity.

In general, with the increase of needle board frequency or depth penetration, absorptive capacity parameter decreases. The higher is fabric compactness, the lower is the number of pores (amount of voids) in structure. A less porous structure has a lower absorptive capacity.

The using of nonwovens with higher water holding capacity affects the frequency of irrigation which depends by existing environmental conditions.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

STUDY OF THE INFLUENCE OF WOOL TYPE USED IN A YARN, IN TERMS OF TENSION

OANA Dorina [1], OANA Ioan – Pavel[1]

[1]University of Oradea, Romania, Department of Engineering and Industrial Management in Textiles and Leatherworks, Faculty of Energy engineering and Industrial Management, B.St.Delavrancea str. No. 4, 410058, Oradea, Bihor, E-mail:textile@uoradea.ro

Corresponding author: Oana. Ioan-Pavel, E-mail: oanaioanpavel@yahoo.com

Abstract: *The use of yarns for manufacturing textiles is increasing in modern times, and new, better methods for making yarns are employed. Yarns are the elements of which textiles are made. In order to diversify the assortment of textile products, more and more types of yarn are made, called heterogeneous yarns, which are yarns made using different types of fibers or filaments.*
From a technological standpoint, the purpose of mixing fibers is to seek to improve certain physical and mechanical characteristics such as fineness, strength, uniformity etc., which influence the properties of the textile products. A significant increase in yarn strength is achieved by introducing in a mix of wool fibers a certain percentage of synthetic fibers, such as polyester, which have double or even triple the strength of wool fibers. Synthetic fibers however have the downside of having a low hygroscopicity. For this reason, the yarns commonly used are those which have a a natural component, namely wool.
One of the main objectives of mixing is to better use the available raw materials. Thus, from soft yarns one can make soft fabrics and knits, and, with the same quantity of raw material, can obtain a larger surface of fabric or knits, with direct impact on costs. With regard to the quality and properties of the textile products, the decisive element is not only the type of the fiber and the proportion in which it is present in the mix, but, fundamentally, the right choice of characteristics for those components (length, fineness, cross-section).

Key words: *fibers, fineness, tensile properties, traction resistance, quality, uniformity, wool*

1. INTRODUCTION

In this study, we looked at two batches of yarn with 45% wool, and 55% PES-Grisutin, from France. The yarns in the two batches have the same fineness T_{tex} = 25 (N_m40/1) and the same twist of 450 turns/m, as they are meant for textile works. The difference in the batches consists in the fact that the wool used for the first batch is from China, and the wool used for the second batch is from Indonesia.

The tensile properties of the yarns in the two batches were analysed and it was discovered that the second batch shows improved properties due to the wool from Indonesia. The conclusion is that the wool from Indonesia has tensile properties superior to those displayed by the wool from China.

Textile products (knits, unconventional textiles etc.) are made from yarn positioned in a certain order, called structure [1], [2] . The yarn represents the element on which making a textile product is based, and the stucture of the product represents the way in which the yarn fibers were mixed. In order to diversify the assortment of textile structures, different types of fibers are mixed

and yarns are produced based on these mixes. Mixed yarns are yarns which different types of fibers in their composition, and they are called heterogeneous yarns[3].

From a technological standpoint, the purpose of mixing fibers is to seek to improve certain physical and mechanical characteristics such as fineness, color, strength, uniformity etc., which influence the properties of the textile products. A significant increase in yarn strength is achieved by introducing in a mix of wool fibers a certain amount of synthetic fibers, such as polyester, which have double or even triple the strength of wool fibers. Polyester fibers have a much lower density compared to natural fibers, which, when the fibers are mixed, leads to the manufacture of lighter, more comfortable textile products [3]. As a consequence to the way fibers are allocated in the transversal section of the yarn, the visual characteristics of the product will be affected as well. Synthetic fibers however have the downside of having a low hygroscopicity.

From an economical point of view, in order to cut costs, the goal is to obtain cheaper mixes by replacing the more expensive fibers with less expensive ones or by changing the proportions of the components in the mix. One of the main objectives of mixing fibers is to obtain superior value from the raw materials. Thus, from soft yarns one can make soft fabrics and knits, and, with the same quantity of raw material, can obtain a larger surface of fabric or knits, with direct impact on costs.

With regard to the quality and properties of the textile products, the decisive element is not only the type of the fiber and the proportion in which it is present in the mix, but, fundamentally, the right choice of characteristics for those components (length, fineness, shape of the cross-section). Since the number of fibers in the yarn's cross-section has limited value, in order to obtain finer yarn, it is necessary to use finer fibers. And since the fineness of natural fibers is also limited, it becomes clear that synthetic fibers must be used. Synthetic fibers such as polyester, when mixed with wool fibers, improve the maintainability of the textiles made from the resulting yarn, as well as shrinkage and dimensional stability.

2. THE EXPERIMENTAL PART

In order to study the tensile properties of yarn, the following physical and mechanical characteristics are looked at: the tensile strength of the yarn, elongation, the stress-elongation diagram and the irregularities in all these characteristics. Tensile strength is one of the main characteristics of yarn because it influences the way yarn behaves during processing – the preparation for weaving or knitting determines the technological parameters for tuning the machines, as well as the productivity level of the machines. Also, tensile strength of the yarn is a qualitative property because its value has inpact on the value of the product. For these reasons, this characteristic is specified in internal rules and standards by the minimum accepted value based on raw materials, manufacturing technology and intended use. The indicators for determining the yarn's tensile strength are [4]:

- skein breaking strength – the maximum value of the force applied on the skein which leads to breaking (cN), and for thick yarn, N
- variation coefficient % of breaking strength,
- specific breaking strength, this measurement is used to compare the breaking strengths of yarns of different thickness. It is calculated by dividing the beaking strength of the yarn to the initial fineness (tex), and it is measured in cN/tex

The tensile strengths of the yarns and the values of the variation coefficient depend on the nature of the raw materials, fineness of the yarn, the technology used for producing the yarn and the intended use. Yarns have mechanical characteristics which allow them to be transformed in textile

patterns. These characteristics are determined by the corresponding characteristics of their components and are affected overall by a number of aspects, primarily by the yarn's structure.

Heterogeneous mixes are blends of fibers which have different mechanical characteristics. The mix obtained from two different components are binary mixes. In this paper we studied the tensile properties of two batches of binary mix yarns, with 55%PES from France called Grisutin and 45% wool. The yarns in the two batches have the same length density T_{tex} = 25 (N_m40/1) and the same twist of 450 turns/m, intended for woven textile patterns. The only difference between the two batches of yarn is the wool component used in the binary mix – in the first batch, the wool mixed with PES is from China, and the wool used in the second batch is from Indonesia. The study of the tensile properties of the yarns in the two batches is in fact, in this case, the study of the influence of the wool component in the binary mix from an origin point of view, and the way in which these tensile properties are affected by the geoclimatic area of origin and how this affects tensile strength. The study was done using the tensile testing dynamometer Uster R Tensojet, shown in figure 1. Ten tests were also carried out for each of the batches, to obtain the values for skein breaking strength, elongation on break (%), yarn tenacity, the stress-elongation diagrams of the yarns.

The stress-elongation curve shows the interdependency between elongation and the force applied to stress the yarns. This curve allows an early appraisal of the processing capacity and the durability of the products by indicating resistance to repeated stress during processing. The stress-elongation curve enables the calculation of the following indicators: maximum elongation upon breaking and mechanical work upon breaking. The mechanical work upon breaking indicates the capacity of a yarn to withstand the stress of processing and can be described as the quantity of energy needed to break the yarn [5]. It is expressed as the surface delimited by the stress-elongation curve and the coordinate axis, and it represents the product between stress and elongation and is measured in cN cm.

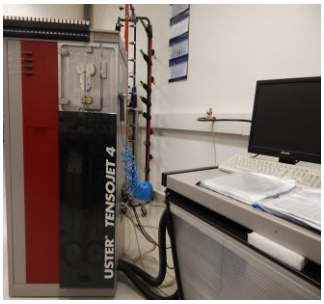

Fig. 1: *The USTER® TENSOJET 4 machine* [6].

The following data was obtained based on the tests on the yarns from the two batches:

Figure 2 shows the resistance to breaking dispersion diagram for the first batch, pointing out the irregularity in resistance to breaking for the ten tests done on the first batch.

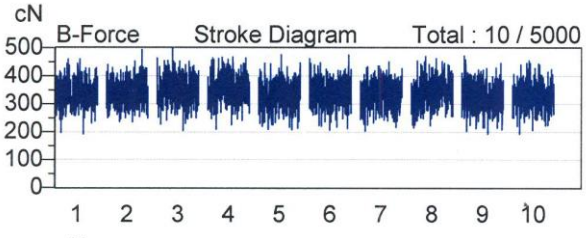

Fig. 2*: The resistance to breaking dispersion diagram for the yarn in the first batch*

Figure 3 shows the dispersion diagram for elongation upon breaking for the yarn in the first batch, pointing out the irregularity in elongation upon breaking for the ten tests done on the first batch.

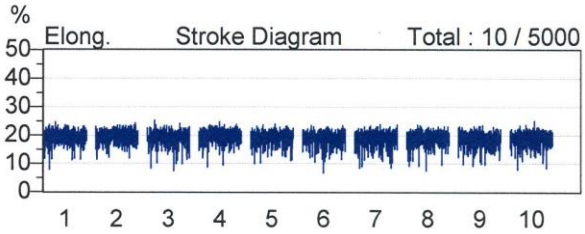

***Fig. 3**: The dispersion diagram for elongation upon breaking for the yarn in the first batch*

Figure 4 shows the stress-elongation diagram which indicates the variation in pull force and the elongation upon breaking for the ten yarns in the first batch.

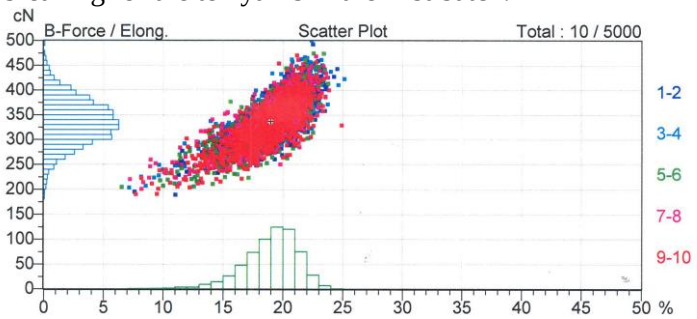

***Fig. 4:**The stress-elongation diagram of the yarns în the first batch*

Table 1 shows the individual values for the pull forces în the ten yarn tests, and the elongation upon breaking relative to these forces. The statistical and mathematical processing of this data produces the tenacity, the arithmetic mean and the variation coefficient for the yarns în the first batch**.**

***Table 1**: The statistical and mathematical processing of individual data for the yarns in the first batch*
Total 10/5000 Single test (4)

Nr.	B-force cN	Elong %	Tenacity cN/Tex	B-Work cN cm
1/500	336,0	19,16	13,44	2206
2/500	341,5	19,27	13,62	2245
3/500	348,6	19,03	13,94	2280
4/500	349,3	19,48	13,97	2318
5/500	326,7	18,87	13,07	2124
6/500	336,0	18,62	13,44	2166
7/500	333,8	18,88	13,35	2174
8/500	341,2	18,86	13,65	2223
9/500	326,5	18,67	13,06	2110
10/500	328,0	18,73	13,12	2130
Mean	336,6	18,96	13,47	2198
Cv	13,28	12,24	13,28	20,51
s	44,69	2,32	1,79	450,7
Q95	1,239	0,06	0,05	12,49
Min	189,3	6,53	7,57	451,0
Max	499,9	25,12	20,00	3659
Po.o1(0)				
P0.05(2)	190,5	7,21	7,62	531,3
P0.1 (5)	201,0	7,71	8,04	56,135
P0.5(25)	215,7	10,08	8,63	863,1

The second batch taken for analysis is the woollen yarn

Figure 5 shows the dispersion diagram for resistance to breaking for the yarn in the second batch, pointing out the irregularity in resistance to breaking for the ten tests done on the second batch.

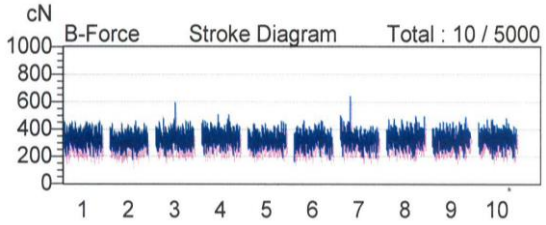

***Fig. 5**: The dispersion diagram for resistance to breaking for the yarn in the second batch*

Figure 6 shows the dispersion diagram for elongation upon breaking for the yarn in the second batch, pointing out the irregularity in elongation upon breaking for the ten tests done on the second batch.

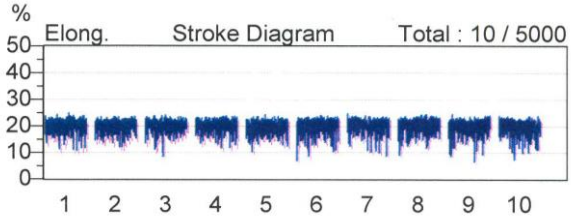

Fig. 6: *The dispersion diagram for elongation upon breaking for the yarns in the second batch*

Figure 7 shows the stress-elongation diagram which indicates the variation in pull force and the elongation upon breaking for the ten yarns in the second batch.

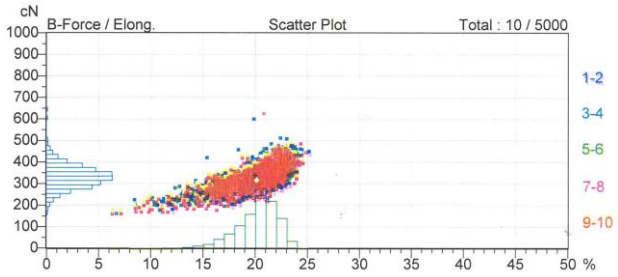

***Fig. 7:** The stress-elongation diagram of the yarns în the second batch*

Table 2 shows the individual values for the pull forces în the ten yarn tests, and the elongation upon breaking relative to these forces. The statistical and mathematical processing of this data produces the tenacity, the arithmetic mean and the variation coefficient for the yarns în the second batch**.**

***Table 2**: The statistical and mathematical processing of individual data for the yarns in the second batch Total 10/5000 Single test (4)*

Nr.	B-force cN	Elong %	Tenacity cN/Tex	B-Work cN cm
1/500	344,1	20,23	13,76	2308
2/500	324,8	20,10	12,99	2182
3/500	339,1	20,18	13,56	2281
4/500	351,2	20,23	14,05	2363
5/500	331,1	19,79	13,24	2198
6/500	329,1	2003	13,16	2204
7/500	333,3	20,10	13,33	2236
8/500	346,6	20,26	13,86	2336
9/500	334,7	19,68	13,39	2221
10/500	338,9	19,40	13,56	2217
Mean	337,3	20,00	13,49	2255
Cv	14,64	11,35	14,64	20,21
s	49,36	2,27	1,97	455,7
Q95	1369	0,06	0,05	12,63
Min	167,1	6,20	6,69	374,1
Max	647,1	25,08	25,88	4316
Po.o1(0)				
P0.05(2)	185,7	7,01	7,43	448,6
P0.1 (5)	187,8	8,42	7,51	624,1
P0.5(25)	209,8	10,90	8,39	872,5

By comparing the values found for the tensile properties we got, for the first batch, a mean pull force of 336,6cN and the mean mechanical work upon breaking of 2198 cN.cm, and for the second batch, a mean pull force of 337,3 cN and the mean mechanical work upon breaking of 2255 cN.cm. We can see that the second batch has slightly higher values for these tensile properties.

3. CONCLUSIONS

Based on the study of the tensile properties of the two batches of yarn with 45% wool and 55% PES, with a fineness of T_{tex}=25 and twist of 450 turns/m, it was concluded that the yarns in the second batch show improved properties due to the wool component of the mix. The conclusion is that the wool from Indonesia used in these yarns has superior tensile properties compared to the wool from China, used in the yarns from the first batch.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

RESEARCH ON THE BEHAVIOUR OF ECOLOGIC FURS OBTAINED BY TUFTING

OANA Ioan – Pavel[1], OANA Dorina[1]

[1] University of Oradea, Department of Textiles-Leather and Industrial Management, Faculty of Energy Engineering and Industrial Management, B.St.Delavrancea str. No. 4, 410058, Oradea, Bihor, Romania,
E-mail: textile@uoradea.ro

Corresponding author: Oana Ioan-Pavel, E-mail: oanaioanpavel@yahoo.com

Abstract: *Unconventional textiles are goods obtained by methods other than the classic spinning, weaving and knitting. They are manufactured by mechanically or chemically reinforcing a fabric consisting of fiber layers or a combination of fiber, weavings, yarn or textile layers. Also, unconventional textiles can be obtained by mechanically or chemically reinforcing a yarn pattern or multiple yarn patterns. The tendency of the industry to increase production of synthetic fibers în comparison to natural fibers is also visible în the field of unconventional textiles. Additionally, there is more and more emphasis on using fibers recovered from recycled materials and products which resulted from a classic textile manufacturing process.*
A TUFTING product is made from a backing fabric, usually cloth, reinforced with yarn introduced through the fabric in loops spaced equally relative to the stitches, and raised at the ends.
The fur substitutes can also be obtained with unconventional TUFTING technologies, by reinforcing a backing cloth and then undergoing a final reinforcement by raising and felting on one side.
The TUFTING product obtained by reinforcing and weaving can be used în the manufacturing process because it is predisposed to unraveling and has an inadequate aspect.
For an optimal uniformity în Tufting fur substitutes, it is recommended that the backing cloth has a mean apparent density of 300Kg/m^3 with a 5% irregularity. It is recommended to use the goods for manufacturing childen's clothing, coat linings and children's hats.

Key words: *knitting, raising, breaking strength, tensile strength, apparent density*

1. INTRODUCTION

For TUFTING products, the technological process consists of all the operations that the yarn for the tuft loops and the backing fabric have to undergo to become the final product [1],[2]. For TUFTING products, the raw material comes on bobbins, and the backing cloth is bundled în rolls. The diagram of the technological process for manufacturing TUFTING fur substitutes is shown în figure 1. In the paper there are also instructions on how to use TUFTING fur substitutes for manufacturing clothing.

2. CHARACTERISTICS OF TUFTING GOODS FOR FUR SUBSTITUTES

The characteristics of TUFTING goods for fur substitutes are:

2.1. Finding the thickness, mass per square meter and apparent density.

To determine these characteristics, 10 samples were manufactured, each in the shape of a 100x100 mm square.

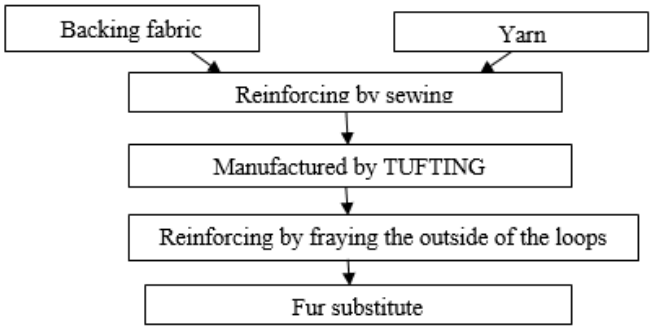

Fig. 1: *The diagram of the technological process for obtaining TUFTING fur substitutes*

The samples were weathered for 25 hours. The thickness was found by using a DM-100 disk micrometer, and mass was determined with the help of an analytical balance with 0,1 mg readability. Mass per square meter can be calculated based on the mass of each sample, using the relationship [3]:

$$Mmp = \frac{m_i}{0,01},\ [g/m^2] \quad \textbf{(1)}$$

Apparent density is the mass per unit of volume of weaved textiles, which include capillary pores and air in the fabric. The relationship is as follows:

$$\gamma = \frac{Mmp}{d},\ [kg/m^3] \quad \textbf{(2)}$$

- Yarn usage for reinforcing one square meter of backing fabric

After weighing the ten 100x100m samples, the quantity of yarn used to reinforce one square meter of backing cloth can be calculated:

Backing cloth M_{mp1}=118,8 [g/m^2]
Tufting good M_{mp2}=396,32 [g/m^2]

The quantity of yarn needed for reinforcing one square meter of backing cloth:

$M_F=M_{mp2}-M_{mp1}$=396,32-118,8 **(3)**
M_F=277,52[g/m^2]

2.2 The final reinforcement by raising is done by using certain machines configured with well-determined parameters.

Raising the goods is extremely important, the plush is set exclusively by sewing. The process takes place in order to prevent the unraveling of the loops. Raising is done on a Lamperti raising machine with needle rollers [3,4].

- Technological losses derived from raising

After weighing the ten 100x100m samples, the yarn used to reinforce one square meter of backing cloth and the losses derived from raising can be calculated.

M_F=277,52[g/m^2]
Reinforced product: M_{mp3}= 322,19[g/m^2]
Mass of yarn in the reinforced product: M_F=203,39[g/m^2]
Losses derived from raising:

$Ps = Mf - MF$, [g/m^2] **(4)**

Ps= 277,52-203,39
Ps= 74,13[g/m^2]

Table 1: *The values obtained by calculating apparent density*:

No.	Thickness d [mm]	Mass m [g]	Mass per sqm [g/m^2]	Apparent density [kg/m^3]
1	2,45	4,109	410,9	167,714
2	2,45	4,182	418,2	170,693
3	2,47	4,184	418,4	169,392
4	2,4	4,160	416,0	173,333
5	2,36	4,124	412,4	174,745
6	2,4	3,810	381,0	158,75
7	2,41	3,731	373,1	154,813
8	2,4	3,783	378,3	157,625
9	2,38	3,802	380,2	159,747
10	2,41	3,747	374,7	255,477
Σ	24,13			1642,289

Table 2 shows the irregularity in the thickness of the TUFTING goods. Table 3 shows the irregularity in the apparent density of TUFTING goods

Table 2: *Irregularity in the thickness of the goods*

No.	di	di-d	(d1-d)^2
1	2,45	0,037	0,0013
2	2,45	0,037	0,0013
3	2,47	0,057	0,0032
4	2,4	0,013	0,00016
5	2,36	0,053	0,0028
6	2,4	0,013	0,00016
7	2,41	0,003	0,00009
8	2,4	0,013	0,00016
9	2,38	0,033	0,0010
10	2,41	0,003	0,00009
Σ	24,13		0,01

Table 3: *Irregularity in the apparent density of the goods*

No.	mi	mi-m	(m1-m)^2
1	167,714	3,485	12,145
2	170,693	6,464	41,784
3	169,392	5,163	26,657
4	173,333	9,104	82,884
5	174,745	10,516	110,588
6	158,75	5,478	30,018
7	154,813	9,415	88,659
8	157,625	6,603	43,611
9	159,747	4,481	20,087
10	155,477	8,751	76,595
Σ	1642,289		533,028

2.3. Calculating the yarn length for one stitch

The length of a stitch can be determined practically or by using a formula for calculating it. In the first approach, 30 yarns were unraveled from one 100x100m sample, not before counting the stitches corresponding to each yarn [5]. Each yarn was measured and after the calculations, the values in table 4 were found:

Table 4: *Computation of the yarn length*

No.	Yarn length per 100 mm L[mm]	No. of stitches per 100mm	Yarn length for one stitch	li-l	(li-l)^2
1	277	30	9,233	0,141	0,019
2	280	30	9,333	0,041	0,0016
3	283	30	9,4	0,026	0,0067
4	281	30	9,266	0,008	0,000064
5	284	30	9,466	0,092	0,0084
6	283	30	9,433	0,059	0,0034
7	287	30	9,566	0,192	0,0036
8	284	30	9,466	0,092	0,0084
9	282	30	9,4	0,026	0,00067

10	288	30	9,6	0,226	0,0051
11	284	30	9,466	0,092	0,0084
12	276	30	9,2	0,174	0,03
13	282	30	9,4	0,026	0,00067
14	285	30	9,5	0,126	0,015
15	270	30	9	0,374	0,0139
16	280	30	9,5	0,126	0,015
17	275	30	9,466	0,092	0,0084
18	284	30	9	0,374	0,139
19	275	30	9,333	0,041	0,0016
20	274	30	9,166	0,208	0,043
21	276	30	9,466	0,092	0,0084
22	275	30	9,166	0,208	0,043
23	287	30	9,133	0,241	0,058
24	283	30	9,2	0,174	0,03
25	285	30	9,5	0,126	0,015
26	287	30	9,966	0,192	0,036
27	283	30	9,433	0,059	0,0034
28	288	30	9,6	0,226	0,051
29	282	30	9,4	0,026	0,00067
30	284	30	9,466	0,092	0,0084
Σ		30	281,244		0,783

Next, the following will be calculated:

- Average length

$$L = \frac{\sum li}{30} \quad \textbf{(5)}$$

$$L = \frac{281,224}{30} = 9,374 \text{ mm}$$

- Standard deviation

$$S = \frac{\sum(li-l)x^2}{n-1} \quad \textbf{(6)}$$

S=0,164

- Variation coefficient

$$Cv = \frac{S}{L} \cdot 100[\%] \quad \textbf{(7)}$$

$$CV = 1,74\ \%$$

Using the second approach, the yarn length for one stitch can be found with the following formula:

$$lc = 2d - 2,875F + 3,15S + \sqrt{P^2 + 2,25F^2} + \sqrt{S(25 - 44 - 5F + 6,25F^2 + 44^2)} \quad \textbf{(8)}$$

Lc=14,12 mm

The values of the parameters used in the formula are determined based on the product sample, and are as follows:

- Loop height: h= 3 mm
- Row size s=1,923 mm
- Stitch size p=3,125 mm
- Yarn thickness F=0,37 mm
- Backing cloth thickness d=0,399 mm
- Correlation coefficient Cv=0,66

Next we will describe the characteristics of the finished products:

- Fabric length 190±5 m
- Mass per surface unit 322,19 g/m^2

- Needle density 50±2 ace/10cm
- Number of stitches 30 stitches/10cm
- Raw material PNA 100%

To determine these characteristics, 10 samples were manufactured, each in the shape of a 100x100 mm square. The samples were weathered for 25 hours. The thickness was found by using a DM-100 disk micrometer, and mass was determined with the help of an analytical balance with 0,1 mg readability. The data obtained is shown in table 5.

Table 5: *Computation of apparent density*

No.	Thickness d [mm]	Mass m [g]	Mass per m^2[g/m^2]	Apparent density [kg/m^3]
1	4,84	3,410	341	70,454
2	4,65	3,298	329,8	70,924
3	4,46	3,315	331,5	74,327
4	4,83	3,143	314,3	65,072
5	4,93	3,207	320,7	65,05
6	4,28	3,129	319,2	74,579
7	4,35	3,188	318,8	73,287
8	4,36	3,069	306,9	70,389
9	4,36	3,154	315,4	72,339
10	4,6	3,243	324,3	70,5
Σ	45,66	32,219		706,921

Tensile strength is determined with the help of the dynamometer. The value of the load upon breaking P can be read directly off the scale shown on the gauge [6]. The elongation upon breaking can also be read on a drawn scale, its value expressed in mm. Table 6 shows the values of the load upon breaking and resistance to tear.

Table 6: *Values of the load upon breaking, elongation and resistance to tear*.

Load upon breaking	U	55	52	50	47	50	50,8
	B	38	37	38	43	37	38, 6
Elongation	U	32	33	30	35	30	32
	B	29	30	32	30	27	29,6
Resistance to tear	U	4	6	7	7	7	6,2
	B	3	3	3	3	3	3
							AVERAGE

Table 7 shows the irregularity in the thickness of the reinforced product. Table 8 shows the irregularity in mass per surface unit

Table 7: *The irregularity in the thickness of the goods*

No.	di	di-d	$(d1-d)^2$
1	4,84	0,274	0,075
2	4,65	0,084	0,007
3	4,46	0,106	0,011
4	4,83	0,265	0,069
5	4,93	0,364	0,132
6	4,28	0,286	0,081
7	4,35	0,216	0,046
8	4,36	0,206	0,042
9	4,36	0,206	0,042

Table 8: *The irregularity in mass per surface unit*

No.	mi	mi-m	$(m1-m)^2$
1	341	18,81	353,816
2	329,8	7,61	57,912
3	331,5	9,31	86,676
4	314,3	7,89	62,252
5	320,7	1,49	2,22
6	319,2	2,99	8,94
7	318,8	3,39	11,492
8	306,9	15,29	233,78
9	315,4	6,79	46,104

10	4,6	0,034	0,001
Σ	45,66		0,506

10	324,3	2,11	4,452
Σ	3221,9		867,642

Table 9 It holds the values found for resistance to tear by abrasion.

***Table 9**: The values for resistance to tear by abrasion*.

Direction	Test	Initial mass	Time t	No. of cycles	Mass of sample		Time until raised layer is destroyed	No. of cycles until destuction	Final mass
longitudinal	1	11,803	30	1800	10,951	7,21	69,5	4170	9,003
	2	13,101	30	1800	12,488	4,67	88	5280	12,111
	3	12,543	30	1800	11,893	5,18	60	3600	10,545
	average	12,482	30	1800	11,777	5,68	72,55		10,553
transversal	1	12,057	30	1800	11,025	8,55	86	5160	10,649
	2	11,999	30	1800	10,997	8,35	93,5	5160	10,737
	3	11,663	30	1800	11,061	6,02	93,5	5160	10,447
	average	11,906	30	1800	11,027	7,64	91		10,611

2.4. Susceptibility to Pilling

Susceptibility to Pilling is determined by counting the number of balls of fluff on the cloth. The sample is cut in the shape of a circle with a diameter of 60 mm. On this surface, the number of balls is counted. A Pill tester device is used to calculate the Pilling effect.

3. CONCLUSIONS

Fur substitutes can also be obtained by means of unconventional technologies such as TUFTING, which involve firstly reinforcing a backing cloth and then a final reinforcement by raising on one side. The TUFTING semi-finished goods obtained through the process of reinforcing by sewing can be used in the manufacturing process because it is predisposed to unraveling and has inadequate aspect. For an optimal uniformity in Tufting fur substitutes, it is recommended that the backing cloth has a mean apparent density of 300Kg/m^3 with a 5% irregularity.

In the final reinforcing by raising, the mass decreases by 26,7%. Raising can be done on a Lamperti raising machine. For a finished product with an average mass of 322,19g/m^2 the backing cloth represents 37% and the yarn is 62%. For the Tufting semi-product with a mass of 396,32g/m^2 the backing cloth represents 30% and the yarn is 70%.By analyzing the product its susceptibility to Pilling increases. On the transversal direction the following results were recorded: a drop in average mass from 1,906 g to 11,026 g in 30 minutes. It is recommended to use the semi-product goods for manufacturing children's clothing, coat linings and children's hats.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

REUSE OF DECOLORIZED DYEING EFFLUENTS IN REPEATED DYEINGS

ÖNER Erhan[1], ATAK Onur[2], GÖMEÇ Ramazan[3]

[1,2,3]Marmara University, Faculty of Technology, Department of Textile Engineering,
Göztepe Campus, Kuyubaşı, 34722, Istanbul, Turkey, E-Mails: eoner@marmara.edu.tr ; onur.atak@marmara.edu.tr

Corresponding author: Öner Erhan, E-mail: eoner@marmara.edu.tr

Abstract: *In this experimental work, the effluents of the reactive and disperse dyeings were reused in the next dyeing after the decolourization by ozone gas. Accordingly, the polyester woven samples were dyed with C.I. Disperse Yellow 160, C.I. Disperse Red 77 and C.I. Disperse Blue 79:1, and the cotton woven samples were dyed with C.I. Reactive Yellow 176, C.I. Reactive Red 239 and C.I. Reactive Blue 221. The effluents of the dyeings with these dyes and also with their mixtures were decolorized by ozone gas. The colours of the samples dyed with the decolorized effluents were compared with the original dyeings (standards) and the colour differences were calculated. Under the experimental conditions of this investigation, the many of the dyeing effluents were decolorized successfully, except the effluent of C.I. Disperse Red 77. In the case that this red disperse dye present in the dyebath, the decolorized effluent had a slight reddish colour. The colour differences between the original dyeing (standard) and the samples dyed with the decolorized effluent are mostly below the tolerance (DE<1) or slightly above the tolerance. The solid colours and uniform dyeings were achieved in the dyeings. The method seems promising in decreasing the amount of water used in textile dyeings.*

Key words: *ozone treatment, reuse of dyebaths, decolourization, disperse dyes, reactive dyes*

1. INTRODUCTION

The textile dyeing and finishing processes consume large amount of energy and produce large amount of effluent. The process effluents are usually characterized by high chemical oxygen demand, dissolved solids, large amount of organic chemicals, low biodegradability, strong colour and salinity. In the last two decades, new technologies have been utilized in order to minimize the processing time, energy consumption, water consumption and the amount of effluent [1-6]. The Best Available Techniques (BAT) for water reuse in textile SMEs were summarized elsewhere [7]. "Green production" is a preventive business strategy in textile dyeing and finishing industry and may include the following emerging technologies:

- use of ultrasonic energy in textile dyeing and finishing,
- use of microwave energy in textile dyeing, drying, and dye fixing,
- use of plasma technology in dyeing and finishing,
- use of supercritical fluids in dyeing,
- use of ozone in bleaching of textiles and also in the treatment of effluents,
- use of combined enzymatic processes in the pre-treatment of textiles,
- use of the direct dyebath reuse technology to minimize the amount of water to be

used, and

- reuse of decolorized effluent in dyeing and finishing.

The aim of this work was to reuse the decolorized dyebath effluents in dyeings. Accordingly, the ozone gas treated dyeing effluents of disperse and reactive dyes were reused in the repeated dyeings. The coloristic properties of the repeated dyeings were compared with the results of the dyeings which were carried out conventionally.

2. EXPERIMENTAL

2.1 Fabrics

In this work, 100% cotton (125 g/m^2) and 100% polyester (138 g/m^2) woven fabrics were used in dyeings. The fabrics were already pretreated and ready for dyeing [2].

2.2 Dyes and Chemicals

The dyes and the chemicals used in this experimental work are given in Table 1 and Table 2, respectively.

Table 1: *Disperse and reactive dyes used in the experimental work.*

Trade Name	Producer	Colour Index No.	Constitution
Dianix Yellow S.G.	Dystar	C.I. Disperse Yellow 160	Quinoline
Dianix Red S.G.	Dystar	C.I. Disperse Red 77	-
Dianix Navy S.G. (%200)	Dystar	C.I. Disperse Blue 79:1	Monoazo
Remazol Yellow 3RS	Dystar	C.I. Reactive Yellow 176	Azo
Remazol Brilliant Red 3BS	Dystar	C.I. Reactive Red 239	Monoazo
Sumifix Blue BRF	Sumitomo Chemicals	C.I. Reactive Blue 221	Formazan

Table 2: *The chemicals used in the experimental work.*

Chemical	Trade Name	Producer
Sodium hydroxide	-	Merck
Sodium dithionite	-	Merck
Dispersing agent	Dispersege PTR	Clariant
Sodium sulphate	-	Merck
Sodium carbonate	-	Merck
Nonionic washing agent	Perlavin OSV	Dr. Petry
Acetic acid	-	Merck

2.3 Equipment

The main equipment used is given in Table 3. Decolourization treatment is carried out in a gas washing bottle which was connected to 3 g/h ozone gas generator.

Table 3: *The equipment used in the experimental work.*

Equipment	Producer
Roaches HT Sample Dyeing Machine	Roaches Eng. LTD.
Reflectance Spectrophometer (SF600+)	Datacolor
Ozone Generator [BNP OZ-3G,Ozone (3g/h)]	BNP Ozone Technology Co. Ltd.

2.4 Dyeing of Polyester

1 g samples of polyester fabric were dyed at the concentrations of 1%,1.5%, and 2% o.w.f. in a HT dyeing machine with a bath containing deionized water, 0.25 g/L dispersing agents, pH 4.5-5, L:R 40:1 at 130°C for 80 minutes. After each dyeing, the reductive clearing process was carried

out with a bath containing 2 g/L sodium dithionite, 2 g/L NaOH, 2 g/L dispersing agent, 1 g/L detergent at 75°C for 20 minutes. The Liquor Ratio was 40:1.

2.5 Dyeing of Cotton

1 g samples of cotton fabric were dyed at the concentrations of 1%,1.5%, and 2% o.w.f. in a HT dyeing machine with a bath containing deionized water, 65 g/L sodium sulphate, 5 g/L sodium carbonate, L:R 40:1 at 60°C for 150 minutes. The dyed samples were later given 2 rinses at 70°C for 10 minutes, neutralized and soaped with 1 g/L Perlavin OSV at the boil. Two more rinses were later given at 70°C and 50°C for 10 minutes with fresh water.

2.6 Decolourization of Dyeing Effluents

The disperse dyeing effluents were decolorized by ozone gas at pH 10.5-11, at 25°C for 1 hour in a gas washing bottle which was connected to a 3 g/h ozone gas generator. A very clear, decolorized water was achieved with the yellow and blue disperse dyes, but a complete decolourization was not possible with the red disperse dye. The decolourization of the reactive dyeing effluents for three dyes were successful at pH 7-8.5, at 25°C for 30 minutes.

2.7 Dyeing with Decolorized Effluents

The reactive and disperse dyeings with decolorized effluents were carried out as described above and if necessary, small amounts of fresh water were added to the dyebaths in the preparation of the dyebaths for the next dyeing. The samples were coded in respect to the origin of the decolorized effluent and the dyes used for the next dyeing. The decolorized effluents and the dyeings were coded as shown below:

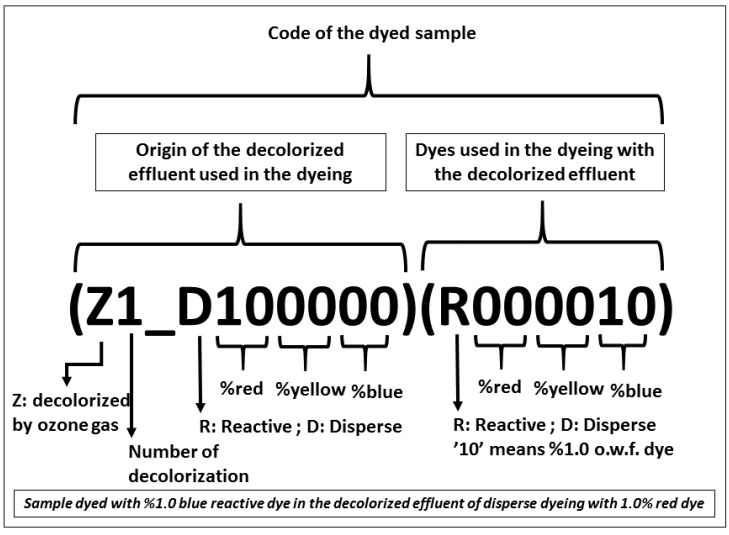

Fig. 1: *Key to the code of the dyed samples.*

As an another example, the sample coded as **(Z1_D001000) (D050505)** is the sample dyed with a mixture of 0.5% o.w.f. red, 0.5% o.w.f. yellow and 0.5% o.w.f. blue disperse dyes in the decolorized effluent of disperse dyeing with 1.0% o.w.f. yellow dye. "**K**" is used to describe the conventionally dyed sample (standard). For example, **(K_D050505)** is the sample dyed with 0.5% o.w.f. disperse red, 0.5% o.w.f. disperse yellow and 0.5% o.w.f. disperse blue conventionally.

3. RESULTS AND DISCUSSIONS

The decolourization process for many of the dyes except the red disperse dye (C.I. Disperse Red 77) was successful, and the clear decolorized water was achieved for the reuse in the next dyeing. Because of the failure of the decolourization process for the red disperse dye under the test conditions of this investigation, the colour differences were higher than the tolerance between the original dyed samples and the samples dyed with the decolorized effluents including red disperse dye. The best results of the reuse of the decolorized effluents in dyeings were summarized in Table 6 and Table 7. The CIELab values of the conventionally dyed samples (standards) and the samples dyed in the decolorized effluents are given in Table 4 and Table 5, respectively. The colour differences are mostly below the tolerance (DE < 1); however, in some dyeings, DE is slightly higher than the tolerance.

Table 4: *CIELab and tristimulus values of the conventional dyeings.*

Dye	Code of Dyeing	CIELab and Tristimulus Values							
		L^*	a^*	b^*	C^*	h°	X	Y	Z
Disperse Dyes	(K_D100000)	40.85	56.03	18.49	59.00	18.26	20.70	11.77	6.75
	(K_D200000)	36.34	52.56	21.31	56.71	22.07	16.32	9.19	4.39
	(K_D001000)	84.94	-4.88	84.61	84.76	93.30	60.39	65.89	9.59
	(K_D002000)	83.96	-4.73	87.23	87.36	93.11	58.68	63.98	8.27
	(K_D000010)	30.03	0.40	-29.30	29.30	270.77	5.96	6.25	17.21
	(K_D000020)	23.40	3.42	-21.66	21.93	278.98	3.94	3.92	9.65
	(K_D050505)	25.88	8.90	-2.21	9.17	346.09	5.15	4.70	5.53
	(K_D101010)	21.40	4.74	-1.82	5.07	339.03	3.47	3.35	3.91
Reactive Dyes	(K_R000010)	46.74	-2.89	-28.72	28.87	264.26	14.53	15.82	34.42
	(K_R200000)	55.43	52.26	-9.98	53.49	349.25	35.52	23.35	31.65
	(K_R002000)	71.56	26.84	72.81	77.60	69.76	50.11	43.01	6.40
	(K_R000020)	35.52	-0.12	-30.18	30.81	269.78	8.29	8.76	22.97
	(K_R050505)	43.32	-2.85	1.69	3.32	149.32	12.26	13.37	13.65

*Key to the codes: "**K**" is used to describe the conventionally dyed sample.*

Table 5: *CIELab and tristimulus values of the samples dyed with decolorized effluents.*

Code of Dyeing	CIELab and Tristimulus Values							
	L^*	a^*	b^*	C^*	h°	X	Y	Z
(Z1_R050505) (D100000)	40.56	56.45	19.33	59.66	18.91	20.53	11.59	6.41
(Z1_R050505) (D000010)	28.19	0.77	-28.74	28.75	271.54	5.31	5.23	15.30
(Z1_R050505) (D000020)	23.14	2.78	-19.87	20.07	277.96	3.82	3.84	8.94
(Z1_R000010) (D000020)	23.03	3.83	-22.17	22.50	279.81	3.86	3.81	9.61
(Z1_R001000) (D000020)	21.76	3.94	-21.54	21.90	280.15	3.51	3.45	8.73
(Z1_R100000) (D000020)	22.61	3.87	-21.63	21.98	280.15	3.74	3.69	9.20
(Z2_R000010) (D050505)	24.60	9.16	-3.25	9.72	340.48	4.74	4.29	5.27
(Z1_D001000) (D000020)	22.28	3.19	-21.36	21.60	278.48	3.75	3.74	9.21
(Z1_D000010) (D200000)	35.95	51.85	20.66	55.81	21.73	15.91	8.98	4.39
(Z1_D000010) (D000020)	23.33	3.92	-21.86	22.21	280.16	3.96	3.90	9.67

(Z1_D001000) (D050505)	25.39	9.41	-2.23	9.67	346.68	5.03	4.54	5.35
(Z1_D000010) (D050505)	26.64	8.51	-2.57	8.89	343.20	5.39	4.97	5.91
(Z2_D050505) (R000010)	46.04	-3.05	-28.48	28.64	263.89	14.02	15.30	33.34
(Z1_D001000) (R200000)	54.94	51.37	-9.31	52.20	349.72	34.55	22.87	30.59
(Z1_D001000) (R002000)	71.17	26.90	72.45	77.28	69.63	49.50	42.43	6.33
(Z1_D001000) (R000020)	35.48	0.02	-30.25	30.25	270.04	8.29	8.74	22.62
(Z1_D001000) (R050505)	44.43	-2.40	1.96	3.10	140.86	13.04	14.14	14.34
(Z1_D000010) (R200000)	55.15	53.44	-9.50	54.28	349.92	35.42	23.07	30.97
(Z1_D000010) (R002000)	73.32	27.25	74.00	78.86	69.78	53.14	45.65	6.87
(Z1_D000010) (R000020)	36.96	0.15	-31.84	31.84	270.27	9.04	9.52	25.06
(Z1_D000010) (R050505)	43.24	-1.20	2.27	2.57	117.96	12.45	13.32	13.27
(Z1_D050505) (D050505)	26.73	9.17	-1.21	9.25	352.48	5.48	5.00	5.63

Table 6: *Colour Differences between the original dyeings and the dyeings in the decolorized bath.*

Colour Differences	(Z1_R050505) (D100000) Standard: (K_D100000)	(Z1_R050505) (D000010) Standard: (K_D000010)	(Z1_D000010) (D200000) Standard: (K_D200000)	Z2 (D050505) (R000010) Standard: (K_R000010)	(Z1_D001000) (R000020) Standard: K (R000020)	(Z1_D000010) (R000020) Standard: (K_R000020)	(Z1_D001000) (R200000) Standard: (K_R200000)	(Z1_D000010) (R200000) Standard: (K_R200000)	(Z1_D001000) (R002000) Standard: (K_R002000)	(Z1_D000010) (R002000) Standard: (K_R002000)	(Z1_D050505) (D050505) Standard: (K_D050505)
$\Delta E_{CMC(2:1)}$	0.981	1.957	1.038	0.757	0.576	1.793	1.447	1.040	0.534	2.164	2.061
ΔL^*	-0.289	-1.897	-0.386	-0.699	-0.038	1.442	-0.494	-0.283	-0.393	1.758	1.035
ΔC^*	0.661	-0.556	-0.902	-0.229	-0.557	1.031	-1.289	0.783	-0.314	1.262	-0.146
ΔH^*	0.664	0.390	-0.339	-0.182	0.139	0.271	0.434	0.624	-0.179	0.030	1.473

Table 7: *Colour Differences between the original dyeings and the dyeings in the decolorized bath.*

Colour Differences	(Z1_D001000) (D000020) Standard: (K_D000020)	(Z1_D000010) (D000020) Standard: (K_D000020)	(Z1_R000010) (D000020) Standard: (K_D000020)	(Z1_R001000) (D000020) Standard: (K_D000020)	(Z1_R100000) (D000020) Standard: (K_D000020)	(Z1_R050505) (D000020) Standard: (K_D000020)	(Z1_D001000) (R050505) Standard: (K_R050505)	(Z1_D000010) (R050505) Standard: (K_R050505)	(Z2_R000010) (D050505) Standard: (K_D050505)	(Z1_D000010) (D050505) Standard: (K_D050505)	(Z1_D001000) (D050505) Standard: (K_D050505)
$\Delta E_{CMC(2:1)}$	0.731	0.536	0.750	1.722	0.915	1.919	1.231	1.748	1.671	0.931	0.702

ΔL^*	-0.624	-0.068	-0.369	-1.639	-0.795	-0.265	1.115	-0.075	-1.281	0.760	-0.485
ΔC^*	-0.330	0.279	0.568	-0.032	-1.864	-1.864	-0.218	-0.750	0.545	-0.285	0.498
ΔH^*	-0.188	0.453	0.321	0.527	-0.372	-0.372	-0.473	-1.577	-0.923	-0.455	0.097

The decolorized effluents of the reactive dyeings were used in the dyeing of disperse dyeings, and vice versa. Overall, the results are quite promising. DE values in many dyeings are below the tolerance (DE < 1). DH^* values are also quite small in many of the dyeings, which mean that there are no dramatic hue changes.

4. CONCLUSIONS

Under the experimental conditions of this investigation, many of the dyeing effluents were decolorized successfully, except the effluent of C.I. Disperse Red 77. In the case that this red disperse dye present in the dyebath, the decolorized effluent had a slight reddish colour. The colour differences between the original dyeing (standard) and the samples dyed with the decolorized effluent are mostly below the tolerance (DE<1) or slightly above the tolerance. The solid colours and uniform dyeings were achieved in the dyeings. The method seems promising in decreasing the amount of water used in textile dyeings and the further investigations are required. Much better results can be achieved by carefully control of the decolourization process and the dyebath conditions.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

THE INFLUENCE OF DOUBLING OF TEXTILE MATERIALS THROUGH THERMOFUSING ON THEIR HIDROPHILICITY

Viorica PORAV[1], Cristina SECAN[1], Adina ALBU[1]

[1]University of Oradea, Faculty of Energy Engeneering and Industrial Management, Department of Textiles – Leather and Industrial Management, B. Şt. Delavrancea no. 4, 410058, Oradea, România.

Corresponding author: Porav Viorica, Secan, Cristina, E-Mail: viorica.porav@gmail.com, cris_secan@yahoo.com

***Abstract**: In the textile industry, the majority of clothing products, especially outerwear products, have some parts doubled up through thermofusing with other textile fabrics, woven or nonwoven, in order to provide some volume of shape, to fix contours, or to confer dimensional stability to the respective area . In this paper, we aim to highlight the influence on hydrofilicity of natural fiber materials of vegetable origin - flax and cotton - and of mixed natural fiber materials, by the process of doubling through thermofusing with chemicalized materials, woven or nonwoven. From laboratory measurements of the moisture absorption ability for these materials, fused or nonfused, woven or nonwoven, we conclude on the influence of these processes on the hydrofilicity of the fused ensemble and over the sanogenetic indicators that any fashion product must ensure for the wearer. Ensuring the comfort and compliance of clothing products is a priority of the producers of fabrics and textile garments. A clothing item should ensure optimum insulation, breathability, moisture absorption and air permeability to give the wearer comfort, wellbeing and safety. We focused on natural fiber materials of plant origin, since they are increasingly being used in the textile industry with beneficial influences on the state of comfort of the wearer.*

***Key words:** hidrophilicity, textile material hidrophilicity, woven chemicalized materials, nonwoven chemicalized materials, thermofusing*

1. INTRODUCTION

The permanent concern of producers of textiles and garments is to get clothing ensembles that do not influence the important characteristics of basic raw materials. The majority of clothing products, especially outerwear products, have some parts doubled up through thermofusing with other textile fabrics, woven or nonwoven, in order to provide some volume of shape, to fix contours, or to confer dimensional stability to the respective areas [1,2,3].The analysis of the influence of technological processes on indicators of comfort eases the selection of compatible materials for the construction of multi-layered clothing ensembles.

2. GENERAL INFORMATION

Hydrophilicity is the ability of a body to absorb water. Fabrics can absorb water quickly, slowly or not at all.

The fabric is a porous surface with a high content of air which is replaced out of micro or macro capillaries in the process of dampening by water [4,5,6].

3. MATERIALS AND METHODS

For measurements in the laboratory, we use Berzelius beakers, distilled water, a graded ruler, an immersed sample support system, samples of dimensions 280 mm x 30 mm, taken on warp and weft direction, materials with canvas fabric structure with compositions of 100% linen, 100% cotton and 64% linen 34% viscose and 2% elastane mixture respectively. For the doubling of base materials through thermofusing, chemicalized woven and nonwoven materials were used, with a composition of wool mixed with polyamides. The woven fabric has twisted warp threads, but weft threads are polyfilamentary.

The method used to determine hydrophilicity for each material and fusing assembly is the immersion method. The samples were previously subjected to humidity $\varphi = 65\pm 5$ %, and a temperature of $t = 20 \pm 2^{\circ}$ C.

From each material or fusing assembly, 4 samples were taken, on the two directions, warp and weft. The final results represent the arithmetic mean of the determinations [4].

3.1. Methods

The test specimens are immersed in an upright position, at a depth of approximately 20 mm. The aim is to measure the rise of water in the capillaries using the graded ruler. The ascent height readings are recorded after 10, 20 and 30 minutes of immersion.

The speed of ascension is calculated using the following formula: [4]

$$V = h_m / t \quad [\text{mm/min}] \qquad \textbf{(1)}$$

where: h_m = average height of ascension;
t = immersion time;

4. RESULTS

Table 1: *Average ascension height in the capilaries and the speed of ascension for material (1) 100% linen, thermofused with a chemicalized woven material (1') and a chemicalized nonwoven material (1").*

Material / thermofused ensemble	Average ascension height in the capilaries h(mm)						Ascension speed in the capilaries $V=h_3/30$ (mm/min)	
	Warp			Weft			Warp	Weft
	10 min.	20 min.	30 min.	10 min.	20 min.	30 min.		
1 (100% linen unfused)	40.0	55.0	58.0	50.0	60.0	65.0	1.93	2.17
1' (100% linen fused with chemicalized woven material)	0	3.0	5.0	5.0	8.0	10.0	0.17	0.33
1" (100% linen fused with chemicalized nonwoven material)	30.0	60.0	70.0	0	30.0	35.0	2.33	1.17

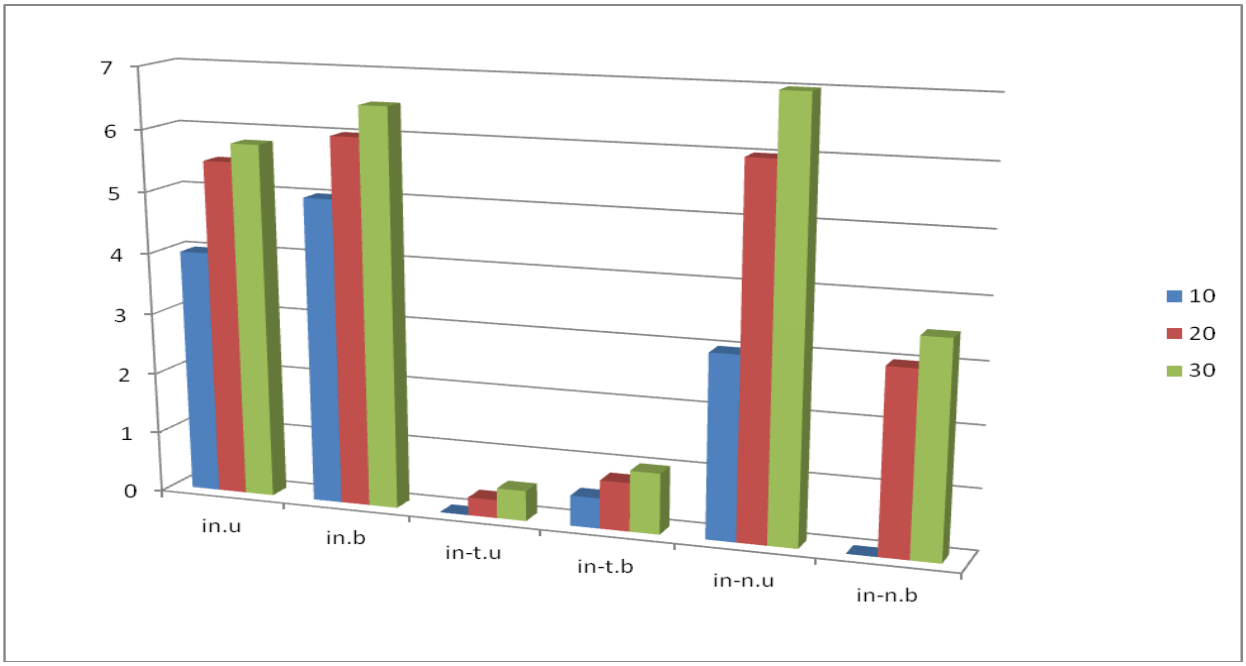

Fig. 1. *Average ascension height of water for the material with a composition of 100% linen, unfused or fused with a chemicalized woven or unwoven material.*

Water absorption capacity is strongly influenced negatively if the material is doubled using a chemicalized woven fabric, both on warp and weft directions. If a chemicalized nonwoven fabric is used, the water absorption capacity is adversely affected in the weft direction but very little in the warp direction. In this direction, the speed of water absorption is increased.

Table 2: *Average ascension height in the capilaries and the speed of ascension for material (2) 100% cotton, thermofused with a chemicalized woven material (2') and a chemicalized nonwoven material (2").*

Material / thermofused ensemble	Average ascension height in the capilaries h(mm)						Ascension speed in the capilaries $V=h_3/30$ (mm/min)	
	Warp			Weft			Warp	Weft
	10 min.	20 min.	30 min.	10 min.	20 min.	30 min.		
2 (100% cotton unfused)	80.0	95.0	112.0	75.0	92.0	105.0	3.73	3.50
2' (100% cotton fused with chemicalized woven material)	70.0	105.0	120.0	90.0	90.0	102.0	4.00	3.40
2" (100% cotton fused with chemicalized nonwoven material)	90.0	100.0	115.0	75.0	95.0	105.0	3.80	3.50

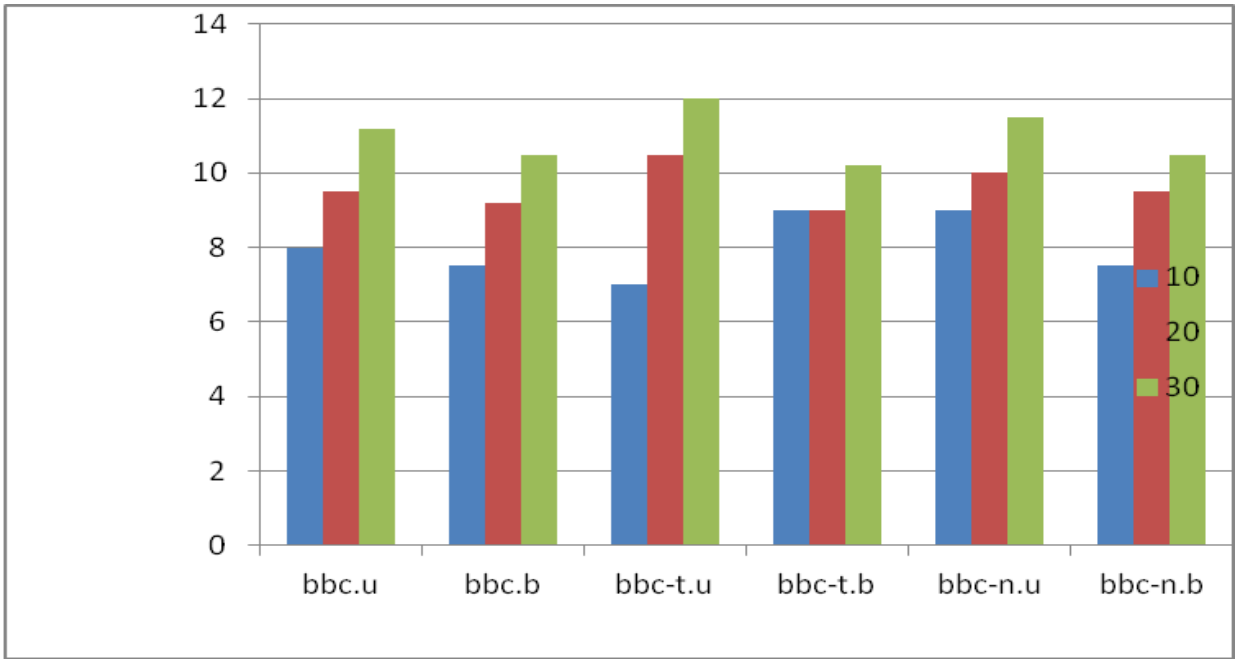

Fig. 2. *Average ascension height of water for the material with a compozition of 100% cotton, unfused or fused with a chemicalized woven or unwoven material*

In the case of fusing 100% cotton, the capacity of water absorption is positively influenced in the warp direction, and negatively but insignificantly in the weft direction.

Table 3: *Average ascension height in the capilaries and the speed of ascension for material (3) mixed linen, thermofused with a chemicalized woven material (3') and a chemicalized nonwoven material (3").*

Material / thermofused ensemble	Average ascension height in the capilaries h(mm)						Ascension speed in the capilaries $V=h_3/30$ (mm/min)	
	Warp			Weft			Warp	Weft
	10 min.	20 min.	30 min.	10 min.	20 min.	30 min.		
3 (mixed linen, unfused)	75.0	88.0	100.0	80.0	90.0	105.0	3.33	3.50
3' (mixed linen fused with chemicalized woven material)	5.0	10.0	10.0	2,0	5.0	5.0	0.33	0.17
3'' (mixed linen fused with chemicalized nonwoven material)	33.0	35.0	35.0	30.0	30.0	30.0	1.17	1.00

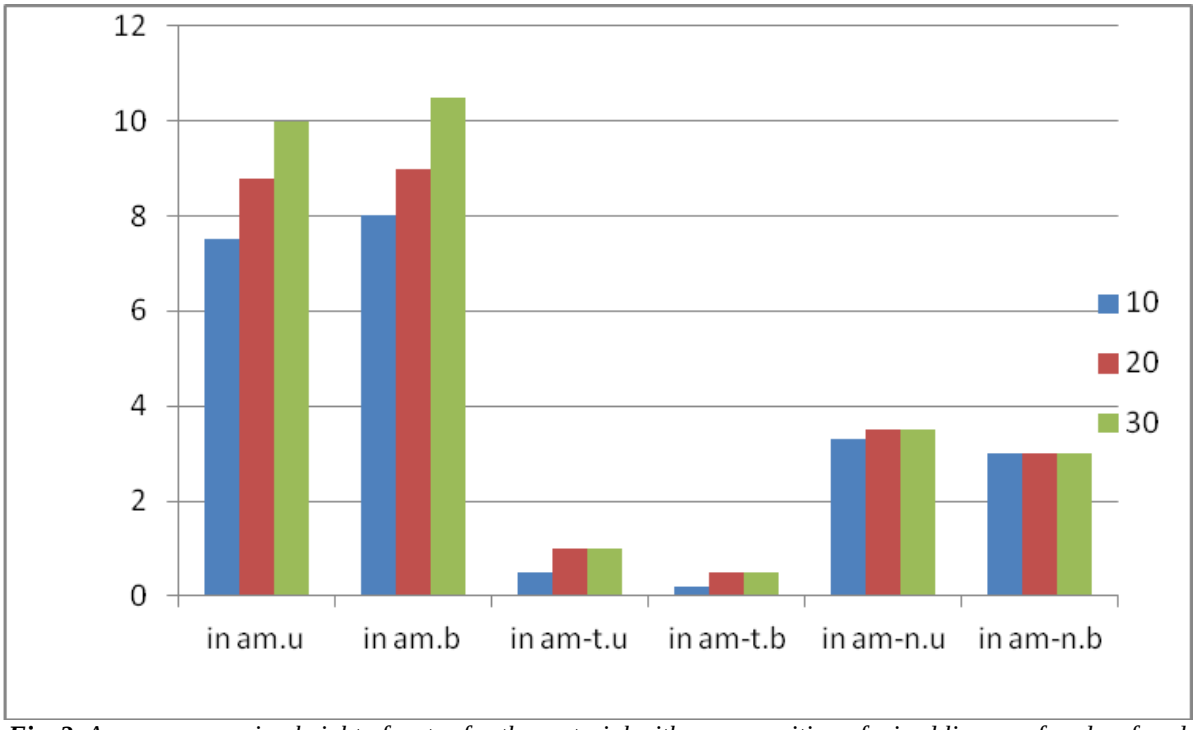

Fig. 3. *Average ascension height of water for the material with a compozition of mixed linen, unfused or fused with a chemicalized woven or unwoven material*.

Water absorption capacity is strongly influenced negatively in the case of fusing with a woven chemicalized fabric and negatively if fused with a nonwoven chemicalized fabric.

5. CONCLUSIONS

Water absorption capacity is strongly influenced negatively if the material is doubled using a chemicalized woven fabric, both on warp and weft directions. If a chemicalized nonwoven fabric is used, the water absorption capacity is adversely affected in the weft direction but very little in the warp direction. In this direction, the speed of water absorption is increased.

In the case of fusing 100% cotton, the capacity of water absorption is positively influenced in the warp direction, and negatively but insignificantly in the weft direction.

Water absorption capacity is strongly influenced negatively in the case of fusing with a woven chemicalized fabric and negatively if fused with a nonwoven chemicalized fabric.

We observed a negative influence on the hydrophilicity of materials that have linen in their composition in both directions (warp and weft), in particular in the case of fusing with a woven chemicalized material. We emphasize that this material with a cloth structure has a composition of wool mixed with polyamides, with twisted warp yarns and multifilament weft yarns.

Fusing 100% cotton material insignificantly affects the water absorption capacity.

From this follows the need to consider the compatibility between materials that form a fused assembly, with the aim of not affecting sanogenetic and comfort parameters.

The analysis of the influence of technological processes on indicators of comfort eases the selection of compatible materials for the construction of multi-layered clothing ensembles.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

ESTIMATION OF COLOUR DIFFERENCES IN THE CASE OF WOOL DYEING WITH NATURAL DYES EXTRACTED FROM GREEN NUTSHELL

PUSTIANU Monica[1], BUCEVSCHI Adina[1], POPA Alexandru[1], AIRINEI Erzsebet[1]

"Aurel Vlaicu" University of Arad, Engineering Faculty, 77 Revolutiei Bd., 310130 Arad, Romania

Corresponding author: Pustianu Monica, pustianumonica@yahoo.com

Abstract: *In this paper were experimentally determined the colour differences between two pattern (standard and sample) with CIELAB formula in case of dying with natural dyes extracted from green nutshell. The dyes were made according to an experimental program at different concentration. The obtained dyes were used to estimate the colour differences that are usually a mixture of differences of brightness, saturation and nuance. In order to determine the intensity of the dyeing was measured at spectrophotometer Specord 200 the remission of the dyed samples. With their help were calculated the trichromatic values X, Y, Z and then the rectangular coordinates: L*- lightness coordinate, a* - the chromaticity coordinate for red-green colour area, b* - the chromaticity coordinate for yellow-blue colour area in CIELAB space. From these values derive the cylindrical coordinates: L^*- lightness, C^* -chroma, H* - nuance. The differences in colour ΔE between the samples and the standard sample are represented by distances between respective positions in CIELAB field and were calculated with some standardized relations. This colour differences were decomposed in: ΔL^* - the difference in lightness ΔC^* - the difference in chroma, ΔH^* - the difference in nuance and calculated in CIELAB units. Were also made the diagrams: the position of the colours in CIELAB field, the chromatic diagram a*=f(b*), the lightness position and the colour differences between the samples and the standard sample.*

Keywords: *CIELAB space, remission, colour difference, lightness, chroma, nuance, natural colorant, dyes.*

1. INTRODUCTION

Over time, the determination and assessment of colour differences between two or more colour samples was done visually, being a cheap and fast method but not precise [1].

The objective of measuring the colour consists in numerical characterization of colour sensation, so it is removed the possibility of taking wrong decisions on a full assessing whether the equality of the two colours is proper or improper requirements [1].

The colour is a subjective sensation sent by nervous stimulus to the brain by a light beam that penetrates through the retina in the eye [1].

Correct perception of colour depends on three aspects: light source, the coloured object and colour receiver (human eye) that are quantified and standardized [1], [2].

Colour differences are generally a mixture of differences in brightness, chroma and nuance. In the purpose of calculating the difference of the colour were used several standardized formulas. [1,3,4].

The natural dyes extracted from green nutshell take place in naphthoquinonic dyes class and has a structure like the complexable dyes. From structural point of view naphtochinona has two carbonyl groups and a hydrolytic group and will form chemical bonds salt type with the textile support.

The dye extracted by green nutshell is used for natural fibres dye with or without mordant.

2. EXPERIMENTAL PART

The purpose of this research is to obtain and characterize natural dye extracted from green nutshell, to detect the compounds responsible for the brown colour of the extract, to optimise the dye process of wool with this dye without mordants, to verify the efficiency of the treatment and to calculate the colour differences with CIELAB relation. The wool dying with dye extracted by green nutshell was made in accordance with a central, correlation, rotable, second order compound program with two independent variables. [5, 6, 7, 8]

The variation limits and the code parameters [6,7,8], are presented in table 1.

Table 1: *The variation limits and the code parameters*

Code value /real value	-1.414	-1	0	1	1.414
x-concentration (g plant/g fabric)	0.5	0.7	1	1.3	1.5
y-temperature (^{0}C)	80	84	90	96	100

The central, correlation, rotable, second order compound program with two independent variables was used to set the optimum conditions for dying. [6,7,8].

The dyeing has been lead under the following conditions:

-x - the concentration of the dye (g plant/g fabric); 2% acetic acid; 2% sodium sulphate;

-y - the temperature (^{0}C); ratio 1:100; -M_{fabric} =1 g.

Before dying was made an activation of the wool fibre in the following conditions: 2% glacial acetic acid; ratio 1:100; - t =15 min; - T= 100^{0}C.

3. RESULTS AND DISCUSSIONS

Determination of colour chart of the samples dyed in CIELAB space.

In order to determine the intensity of dying was measured the dyed samples remission at SPECORD 200. With these values were calculated the X,Y, Z values with the following equations [1,2,3,4, 9-13]:

$$X = 0.782 \cdot R_X + 0.198 \cdot R_Z \quad \textbf{(1)}$$

$$Y = R_Y \quad \textbf{(2)}$$

$$Z = 1.181 \cdot R_Z \quad \textbf{(3)}$$

The rectangular coordinates of CIELAB space, L^* a^* b^*, are calculated with the following equations [1,2,3,4, 9-13]:

$$L^* = 116 \cdot \left(\frac{Y}{Y_0}\right)^{\frac{1}{3}} - 16 \quad \textbf{(4)}$$

$$a^* = 500 \cdot \left[\left(\frac{X}{X_0}\right)^{\frac{1}{3}} - \left(\frac{Y}{Y_0}\right)^{\frac{1}{3}}\right] \quad \textbf{(5)}$$

$$b^* = 200 \cdot \left[\left(\frac{Y}{Y_0} \right)^{\frac{1}{3}} - \left(\frac{Z}{Z_0} \right)^{\frac{1}{3}} \right] \quad \textbf{(6)}$$

where:

- X, Y, Z - represents the trichromatic values of the samples
- X_0, Y_0, Z_0 - represents the trichromatic values of illuminant C
- L^* - represents the bright variable named brightness coordinate or luminance. It has (+) value if the sample is lightish, pale and (-) value if the sample is dark. If all the values are (+), the more it is higher the intensity of the dying is smaller.
- a^* - represents the chromaticity coordinates for the red - green space
- b^*- represents the chromaticity coordinates for the yellow - blue space

These equations are applied to:

$$\frac{X}{X_0}; \frac{Y}{Y_0}; \frac{Z}{Z_0} > 0.001 \quad \text{and} \quad X_0=98{,}075;\ Y_0=100{,}0\ ;\ Z_0=118{,}224 \quad \textbf{(7)}$$

Cylindrical coordinates deduced from these expressions have the following forms [1,2,3,4, 9-13]:

$$L^* = 116 \cdot \left(\frac{Y}{Y_0} \right)^{\frac{1}{3}} - 16 \quad \textbf{(8)}$$

$$C^* = (a^{*2} + b^{*2})^{1/2}; \quad \textbf{(9)}$$

$$H^* = arc\ tg\ (b^*/a^*) \quad \textbf{(10)}$$

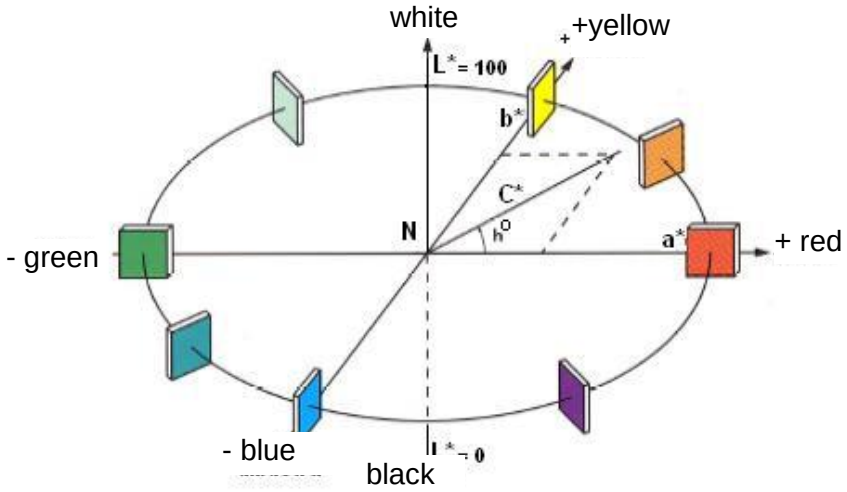

***Fig.1**: The rectangular and cylindrical coordinates of CIELAB space [14]*

H* is expressed in scale 0^0-360^0 ($a^+=0^0$; $b^+=90^0$; $a^-=180^0$; $b^-=270^0$).

Where:

- L^*- represents the lightness
- C^*- represents chroma

- H*- represents nuance

The rectangular and cylindrical coordinates of CIELAB space are presented in figure 1.

The difference in colour between the sample and standard sample is represented by the distance between the respective positions in CIELAB space and is given by the equation: [1,2,3,4, 9-14]:

$$\Delta E = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2} \quad \textbf{(11)}$$

If each colour difference can be decomposed into components: brightness difference, chroma difference and nuance difference and if ΔE, ΔL^*, ΔC^* may be calculated in CIELAB units than colour difference can be calculated in the same units as in the equation: [1,2,3,4, 9-14]:

$$\Delta H^* = [(\Delta E)^2 - (\Delta L^*)^2 - (\Delta C^*)^2]^{1/2} \quad \textbf{(12)}$$

It was agreed to write down with (+ ΔH^*) when the sample is added counter clockwise direction versus standard sample and (- ΔH^*) when the sample is found in the clockwise direction toward standard sample.

The tristimulus values X_n, Y_n, Z_n, define normal white colour of the object colour - stimulus for tristimulus values of the illuminant.

Thus it were made chromaticity diagrams $a^*=f(b^*)$ and L* for dying variant. The results are presented in table 2, figure 2 and figure 3

Table 2: *The trichromatic values and the rectangular coordinates*

sample	X	Y	Z	L*	a*	b*	C^*	H^*	ΔE	ΔL^*	Δa^*	Δb^*	ΔC^*	ΔH^*
1	5.880	5.830	5.345	28.979	1.820	6.302	6.560	0.060	6.316	-5.696	1,678	2.154	2.409	1.286
2	5.000	4.916	5.000	26.494	2.238	3.584	4.225	0.028	8.464	-8.181	2,096	-0.564	0.074	2.17
3	6.181	6.102	5.516	29.668	2.134	6.738	7.068	0.055	5.979	-5.007	1,993	2.59	2.917	1.472
4	5.127	5.043	4.636	26.857	2.230	5.943	6.348	0.046	8.289	-7.818	2,089	1.795	2.197	1.661
5	6.492	6.438	5.894	30.492	1.868	6.549	6.810	0.061	5.123	-4.183	1,727	2.401	2.659	1.293
6	4.551	4.481	4.254	25.202	2.083	5.010	5.426	0.042	9.709	-9.473	1,942	0.861	1.275	1.699
7	5.523	5.490	5.095	28.087	1.621	5.893	6.112	0.063	6.973	-6.588	1,479	1.744	1.961	1.178
8	4.768	4.669	4.461	25.770	2.445	4.936	5.508	0.035	9.232	-8.905	2,304	0.787	1.357	2.021
9	5.476	5.349	4.757	27.707	2.716	6.823	7.344	0.044	7.896	-6.968	2,575	2.674	3.193	1.895
10	5.582	5.493	5.019	28.096	2.266	6.257	6.655	0.048	7.229	-6.58	2,125	2.109	2.504	1.641
11	5.476	5.349	4.757	27.707	2.716	6.823	7.344	0.044	7.896	-6.968	2,575	2.674	3.193	1.895
12	5.668	5.542	4.939	28.226	2.685	6.855	7.362	0.045	7.442	-6.449	2,544	2.707	3.211	1.867
13	4.961	4.911	4.740	26.480	1.816	4.789	5.122	0.046	8.389	-8.195	1,675	0.64	0.971	1.508

The differences ΔL^*, Δa^*, Δb^*, ΔC^* şi ΔH^* are expressed in CIELAB units.

The value ΔE is a measure of the colour difference size perceived between a standard sample and the sample analyzed, but cannot indicate the nature of that difference. Considering colour difference

components, they can be interpreted:

- ΔL^* - the difference in brightness is (+) for samples 1, 3, 5,7 that are lighter than the standard sample (more living) and is (-) for samples 2,4,6, 8,9,10,11,12,13 that are full shade.
- Δa^* and Δb^* - show the differences between the positions of samples (samples and standard samples) in diagram a^*b^*
- ΔC^* – the difference in saturation is (+) for samples 1,3,4,5,7,9,10,11,12,13 that have a higher saturation that the standard sample and is (-) for the samples 2,6,8 that have a lower saturation.
- ΔH^* – difference in shade (nuance) is (+), samples are in the counter clockwise direction toward standard

Red (+) - the sample is more yellow than the standard sample
Yellow (+) - the sample is greener than standard sample
Green (+) - the sample is bluer than standard sample
Blue (+) - the sample is greener than standard sample

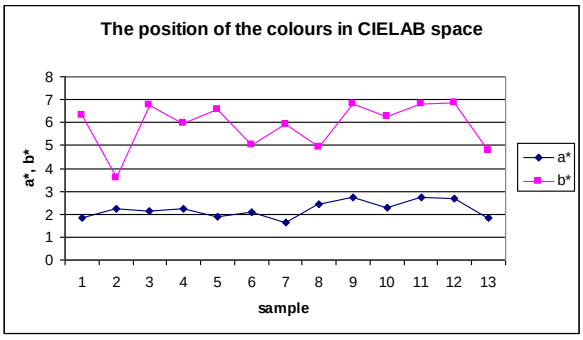

***Fig.2**: The position of the colours in CIELAB space*

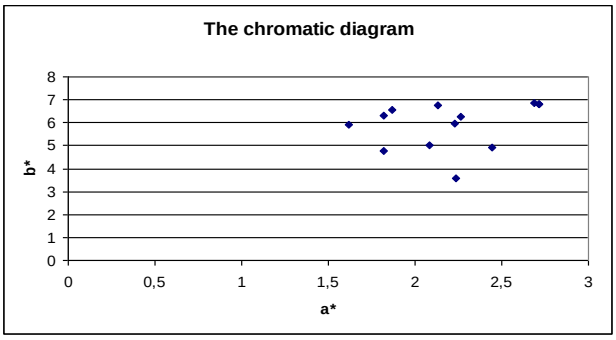

***Fig.3**: Chromatic diagram a*=f(b*) for the variant of dye*

It is found that maximum absorption is achieved for sample 6, which was confirmed by minimum brightness registered within the same samples (fig. 4)

From this graph results that sample 5 has the highest brightness, having the lowest concentration 0,5 g plant/g material, followed by sample 3 with the concentration 0,7 g plant/g material, than sample 1 with concentration 0,7 g plant/g material, sample 7 with 1g plant/g material, samples 9-13 with 1g plant/g material, samples 4 and 2, sample 8 and sample 6.

The biggest difference between samples and standard colour has sample 6, followed by sample 8, sample 2, sample 13, sample 4, sample 9, sample 11,12,10,7,1,3 and sample 5, So the colour difference decreases with decreasing concentration of dye extracted

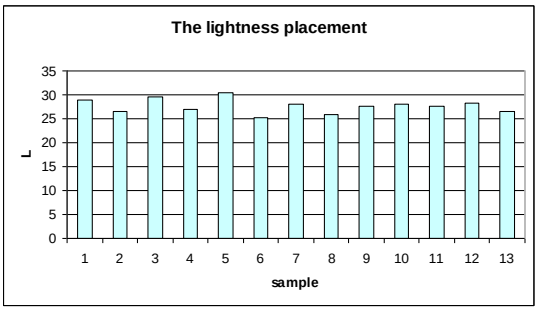

***Fig. 4**: The lightness placement*

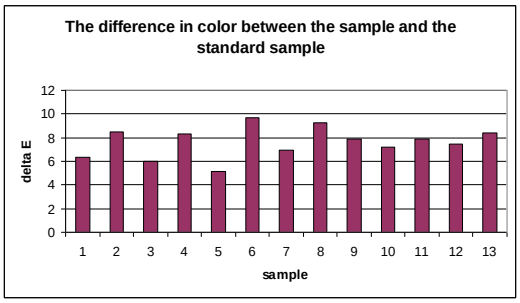

***Fig. 5**: The difference in colour between the sample and the standard sample*

4. CONCLUSIONS

- Differences in colour are due to a dependence between the capacity of absorption, dye concentration in dyeing bath and the temperature at which the dying is done
- Differences in colour are generally a mixture of differences of brightness, saturation and nuance
- It is found that maximum absorption is achieved for sample 6 confirmed by minimum brightness recorded within the same samples
- Minimal absorption is achieved for sample 5 as confirmed by the maximum brightness

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ANNALS OF THE UNIVERSITY OF ORADEA
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EFFECT OF ULTRAVIOLET LIGHT ON THE PROPERTIES OF DYED COTTON CELLULOSE

ROSU Liliana[1], GAVAT Cristian-Catalin[2], ROSU Dan[1], VARGANICI Cristian-Dragos[1]

[1]Advanced Research Centre for Bionanoconjugates and Biopolymers
"Petru Poni" Institute of Macromolecular Chemistry, Gr. Ghica Voda Alley 41A, 700487, Iasi, Romania, lrosu@icmpp.ro; drosu@icmpp.ro; varganici.cristian@icmpp.ro

[2] University of Medicine and Pharmacy "Gr. T. Popa" Iasi,
16 University Street, 700115 Iasi, Romania, ccgavat@yahoo.com

Corresponding author: Rosu, Liliana, E-mail: lrosu@icmpp.ro

Abstract: *Textile dyes have been reported of causing various stages of contact dermatitis. Reactive dyes are widely applied in dyeing cellulose fiber based textiles (100% cotton), skin fibers (hemp, flax), regenerated cellulose (cellulose acetate, viscose), protein fibers (natural silk, wool). The human body comes in contact daily with such compounds. This aspect is important for elucidating their biological effects on the human body, in correlation with physico-chemical properties. Dyes are chemical compounds containing chromophore and auxochrome groups. Authors herein report results concerning the influence of UV irradiation with* $\lambda >$ *300 nm on the structure and properties of different colored textiles. Subjects to study were textiles painted with four azo-triazine based dyes which were exposed to 100 h UV irradiation time and irradiation dose values up to 3500 J* cm^{-2}*. The five azo dyes were: reactive orange 13, reactive red 183, reactive yellow 143, reactive blue 204 and reactive red 2. Structural modifications as a result of irradiation were undertaken by UV-Vis spectroscopy. It was observed that during UV exposure there occurred partial dyes detachment from the textiles, accompanied by glucosidic units and dye photodecomposition by C–N bond scission and degradation of aromatic entities and azo based chromophores. Color modifications were also investigated. Color differences significantly increased with the irradiation dose for all the studied samples.*

Key words: *azo-triazine dyes, cellulose, ultraviolet protection, photodegradation.*

1. INTRODUCTION

Natural fabrics generally provide poor skin protection due to the low absorption of UV radiation [1]. The protection provided by is dependent on a series of factors, such as fiber type, color, structural characteristics, dyeing intensity and optical brightening agents or UV absorbers, if any [2], [3]. Most textiles are usually exposed to varying doses of sunlight. Solar light intensity generates important photochemical processes [4]. Textiles assure protection against visible light, for which sunscreens offer much less protection than for UV light [5]. A compound turns colored after absorbing specific electromagnetic radiations in the visible region. The entities existing in the coloring substance, which are responsible for electromagnetic radiation absorbtion and which reflect in the visible region are chromophores [6]. The UV radiation represents 5% of the total incident sunlight reaching the earth surface (visible light 50%, IR radiation 45%). Even in such a low proportion, UV radiation exhibits the highest quantum energy. Light is electromagnetic in its nature.

The human eye distinguishes visible light in the range 380–700 nm [7]. Dyes absorb electromagnetic radiation of in the visible spectrum range. The human eye detects visible radiations only for the corresponding complementary colours. ***Fig. 1*** indicates the different spectrum regions with their corresponding wavelengths.

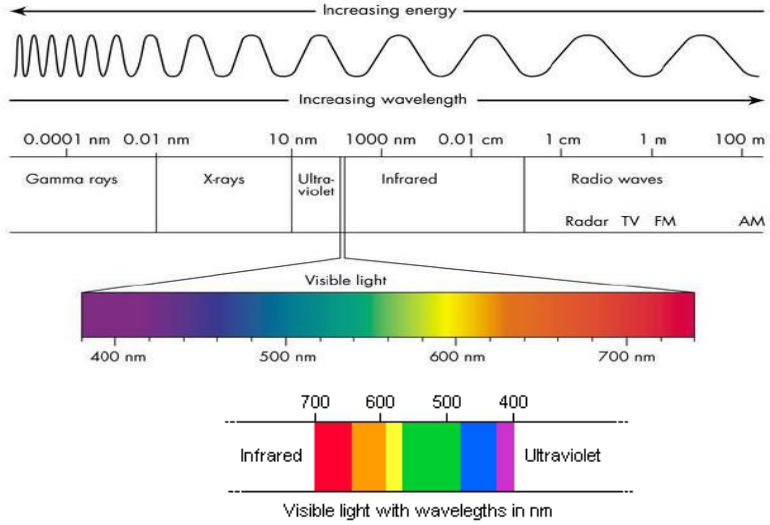


Fig. 1: *Regions of electromagnetic spectrum [8]*

Cellulose (***Fig. 2***) is comprised of glucose units linked through oxygen atoms. About 94 % of cotton is comprised of cellulose. What is remained includes 1.3 % protein, 1.2 % pectic substances, 0.6 % waxes and 4 % of other components. Of the three hydroxyl groups on the cellulose ring one is primary and two are secondary. Most reactions occur at the primary hydroxyl groups.

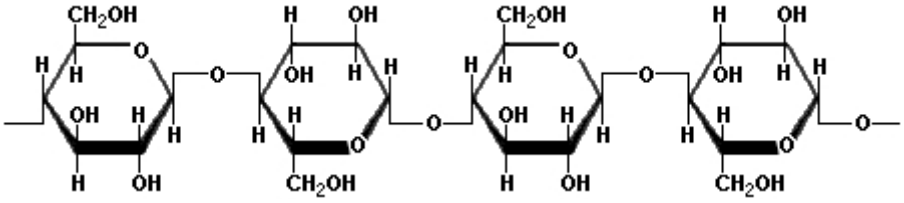


Fig. 2: *Chemical structure of cellulose fibers [8]*

When cellulose is modified with different cationic and anionic groups, its molecular chains are modified. This determines changes in the chemical and physical properties of cellulose fibers. Also, chemical modification enhances cellulose fibers reactivity. Several classes of dyes, such as direct, azo and reactive ones may be successfully applied on cellulose substrates. Applications of cationic dyes have not gained widespread success. Since the stability of the fabric-dye complex may affect human health, the behavior of the fabrics painted with reactive azo-triazine dyes under the action of UV radiation with $\lambda > 300$ nm represents the subject of this paper.

2. EXPERIMENTAL

2.1. Materials and methods

Five azo dyes, reactive yellow 143 (RY-143), reactive blue 204 (RB-204), reactive red 183 (RR-183), reactive red 2 (RR-2), reactive orange 13 (RO-13) were used as received. The fabric samples were exposed to light, using a middle pressure mercury lamp HQE-40 type, having a

polychrome emission spectrum in the field of 240-370 nm, with 30 mW/cm^2 intensity. Utilization of filters permits exposure to greater proportions of UV and at lower wavelengths than in the case of borosilicate filters. The upper temperature during the light cycle was 40-45 ^{0}C. The surface color difference (ΔE*) was measured using a Pocket Spec Color (USA) color comparison spectro-photometer. The surface color difference was calculated using the CIEL L* a* b* system. The color change as a function of UV treatment was calculated using Eq. (1).

$$\Delta E_{ab} = \sqrt{(L_2^* - L_1^*)^2 + (a_2^* - a_1^*)^2 + (b_2^* - b_1^*)^2} \quad \textbf{(1)}$$

where L*, a* and b* represent the lightness, yellowness and redness, respectively.

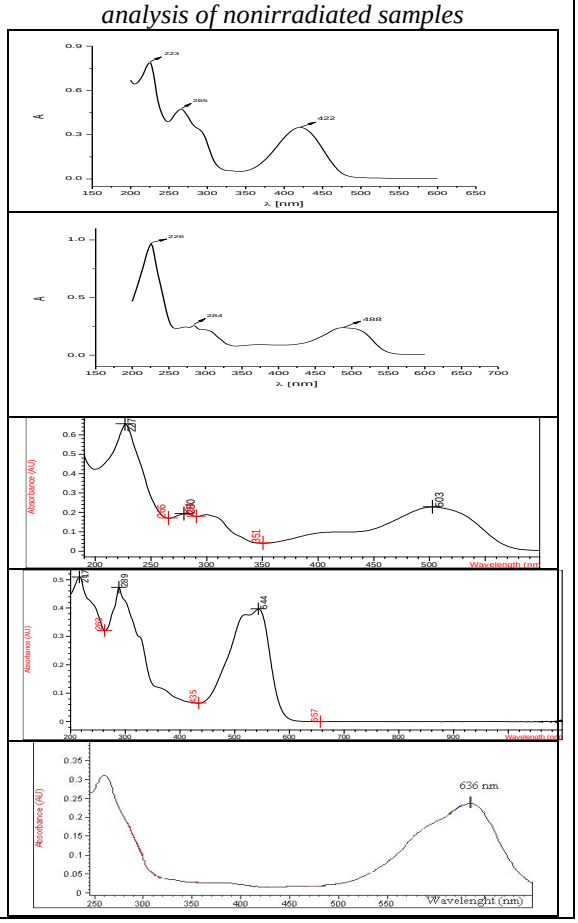
3. RESULTS AND DISCUSSION

Table 1 shows that color differences significantly increased with the irradiation dose for all the studied samples.

Table 1: *Variation of chromatic coefficients with irradiation dose*

Fabric type	Irradiation time (h)	L*	a*	b*
RY-143	0	69.90	-12.57	64.79
	25	61.06	-10.99	63.25
	50	69.82	-9.25	56.12
	75	60.30	-7.91	50.38
	100	61.26	-6.99	49.68
RO-13	0	49.41	33.83	40.82
	25	41.91	22.98	29.23
	50	45.05	21.29	26.92
	75	48.64	17.09	22.86
	100	49.35	15.35	21.43
RR-183	0	30.83	48.52	36.36
	25	28.16	44.19	32.97
	50	33.56	41.97	30.98
	75	29.66	40.55	29.30
	100	30.32	39.04	27.62
RR-2	0	29.07	48.26	24.03
	25	25.19	46.42	20.09
	50	29.63	42.10	17.05
	75	27.31	42.54	14.62
	100	27.40	39.25	11.90
RB-204	0	19.64	17.74	-33.33
	25	18.37	14.06	-28.72
	50	18.85	11.25	-23.20
	75	18.40	8.88	-19.83
	100	20.17	8.35	-19.06

Fig. 3: *UV-Vis spectrophotometric quantitative analysis of nonirradiated samples*



The increasing of irradiation time and dose decreased chromatic coefficients values in the case of fabrics painted with all studied dyes. Samples accumulated blue and green chromophores

during irradiation. It is possible for structural dye changes during irradiation to lead to simultaneous hypochrome and bathochrome displacements of the absorption maxima, thus colouring the sample in complementary colors (blue and green).

Fabrics dyied with RY-143 and RO-13 showed a darkening tendency (Eq. (1)), simultaneously with an insignificant variation of the L^* values of the fabrics painted with RR-2 and RR-183. This was explained by accumulation of blue and green chromophores, because of cellulose substrate photo-oxidation reactions. Changes in UV-Vis spectra as a result of irradiation supported these observations. It may be observed from ***Fig. 3*** that the absorbtion maximum of the used dyes is located at the following wavelenghts: RB-204: λ_{max} = 636 nm; RR-183: $\lambda_{max.}$ = 503 nm; RR-2: λ_{max} = 544 nm; RY-143: λ_{max} = 422 nm; RO-13: λ_{max} = 488 nm. UV-Vis spectra were recorded in order to identify specific absorption maxima of each dye. Even the cellulosic fabric could undergo some photo-oxidative degradation during UV exposure, the dye acting as a photo-sensitizer. It is known that the UV radiation may cause free radicals generation which are able to initiate photo-degradative reactions in the cellulosic materials such as depolymerization, dehydroxylation, dehydrogenation, dehydroxymethylation and the release of hydrogen, carbon monoxide, and carbon dioxide.

4. CONCLUSIONS

UV radiation influence on coloured dyed fabric has been studied. This was made with polychromatic light (λ > 300 nm). Structural changes during UV irradiation were monitored. Changes consisted especially in the resulting of carbonyl and aromatic entities from dye structures due to photo-oxidative processes. Color modifications were also investigated. Color differences significantly increased with the irradiation dose for all the studied samples.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

SAVE ENERGY IN TEXTILE SMES

SCALIA Mauro[1], RAMOS Luis[2], DE SABBATA Piero[3], TOMA Doina[4], GHITULEASA Carmen[4], NICULESCU Claudia[4]

[1] European Apparel and Textile Confederation (EURATEX), Rue Montoyer, 24/10, 1000, Bruxelles, Belgium, E-mail: Mauro.scalia@euratex.eu

[2] Technological Centre for the Textile&Clothing Industry of Portugal (CITEVE), Quinta da Maia, Rua Fernando Mesquita 2785, 4760034, Vila Nova de Famalicao, Portugal, E-mail: lramos@citeve.pt

[3] Agenzia Nationale per le Nuove Technologie, L'energia e lo Sviluppo (ENEA), Lungotevere Grande Ammiraglio Thaon di Revel 76, 00196, Roma, Italy, E-mail: piero.desabbata@enea.it,

[4] National R&D Institute for Textiles and Leather Bucharest (INCDTP), Lucretiu Patrascanu, 16, 030508, Bucharest, Romanaia, E-mail: certex@ns.certex.ro

Corresponding author: Toma, Doina, E-mail: doina.toma@certex.ro

Abstract: *Efficiency and competitiveness in textile and clothing manufacturing sector must take into account the current and future energy challenges. Energy efficiency is a subject of critical importance for the Textile & Clothing industry, for other sectors and for the society in general. EURATEX has initiated Energy Made-to-Measure, an information campaign running until 2016 to empower over 300 textile & clothing companies, notably SMEs, to become more energy efficient. SET(Save Energy in Textile SMEs) a collaborative project co-funded within the European Programme Intelligent Energy Europe II helps companies to understand their energy consumption and allows them to compare the sector benchmarks in different production processes. SET has developed the SET tool,* ***Energy Saving and Efficiency Tool,*** *a free of charge tool customized for textile manufacturers. The SET tool is made up of 4 elements: a stand-alone software (SET Tool) for self-assessment based on an Excel application; an on-line part (SET tool Web) for advanced benchmarking and comparison of the performances across years; a guiding document for the companies and overview of financial incentives and legal obligations regarding energy efficiency. Designed specifically for small and medium enterprises (SMEs), the SET tool enables the evaluation of energy consumption and recommends measures to reduce the consumption. Prior to modifying the company's production processes and making investments to increase energy efficiency, textile SMEs need to get different type of information, including legal context, economic and technical peculiarities.*

Key words: *energy efficiency, textile industry, energy saving and efficiency tool, energy indices, energy made-to-measure*

1. INTRODUCTION

All Textile and Clothing (T&C) companies are energy sensitive and energy consumption is an economic, environmental and competitiveness problem. Energy efficiency is becoming an urgent issue in the European T&C sector for several reasons: regulation for energy efficiency is becoming

stricter; energy prices are increasing; staying competitive requires controlling and optimising energy cost. European T&C companies already strongly rationalized human resources. To further increase competitiveness, other sources need to be dealt with. Energy is a crucial one with still large potential, especially at SME level.

SET (Save Energy in Textile SMEs**),** a collaborative project co-funded within the European Programme Intelligent Energy Europe II by EASME (Executive Agency for Small and Medium-sized Enterprises), is launched to enable the European textile SMEs to improve their energy efficiency and achieve tangible and countable economic and resource-efficiency benefits [1].

The consortium, co-ordinated by EURATEX, includes CITEVE (Portugal), DITF (Germany), ENEA (Italy), INCDTP (Romania), ATOK (Czech Republic), CENTEXBEL (Belgium), IVGT (Germany), TMT (Hungury).

SET creates and deploys a unique **Energy Saving and Efficiency Tool (SET tool)** for SMEs of the European textile industry, **enables energy efficiency** for 150 companies by applying the tool at 50 companies premises, followed by training and assistance to further 100 companies, unlocks energy saving potential for **further** 350 companies and joins **the Energy Made-to-Measure (EM2M),** an information campaign lanunced and managed by the European Textile and Clothing Confederation (EURATEX) to provide Textile and Clothing manufacturers with tools, best practices and training to assess options and take informed decisions on energy efficiency measures [1].

2. ENERGY SAVING AND EFFICIENCY TOOL

A major outcome of the SET project is the **SET tool**, an Energy Saving and Efficiency Tool designed for textile companies to autonomously assess their energy consumption and performances in the production process, ultimately to improve their energy efficiency [2].

The SET tool (Fig. 1) is made up of 4 elements: a stand-alone software (SET Tool) for self-assessment based on an Excel application; an on-line part (SET tool Web) for advanced benchmarking and comparison of the performances across years; a guiding document for the companies and overview of financial incentives and legal obligations regarding energy efficiency.

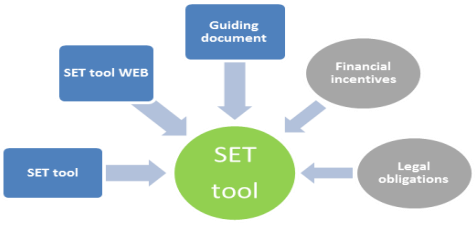


Fig. 1: *Elements of SET tool*

The **SET tool** runs on a Microsoft Excel file and is used to collect the company data on energy consumption and production. Based on this input the tool calculates the company's energy index and offers a selection of best practices, return on investment etc. The **SET tool Web** allows companies to benchmark, in strict confidentiality, its own energy performance data with data of comparable companies active in the same production processes. The **Guiding document** provides an overview of the data collection process and outcome. It is developed for companies' representatives to use and to be able to get the most from the energy efficiency tools [3].

In the SET project timeframe the SET tool application is supported by SET partners and is completed by a number of proposals to improve energy efficiency, taking into account the available financial support schemes and the legal framework [4], [5].

2.1 SET Tool

SET Tool (Fig. 2) has a multi-step session approach and collects data of one factory related to one year.

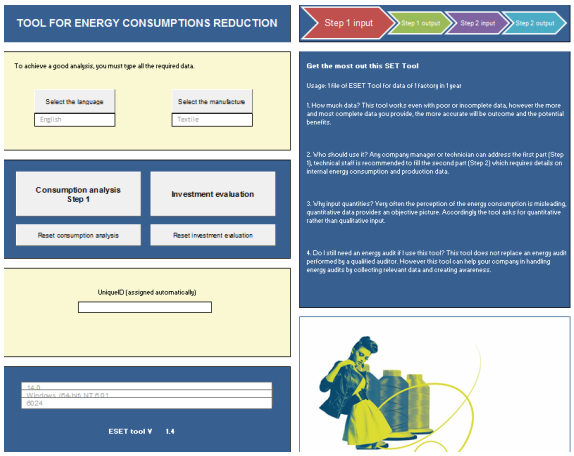
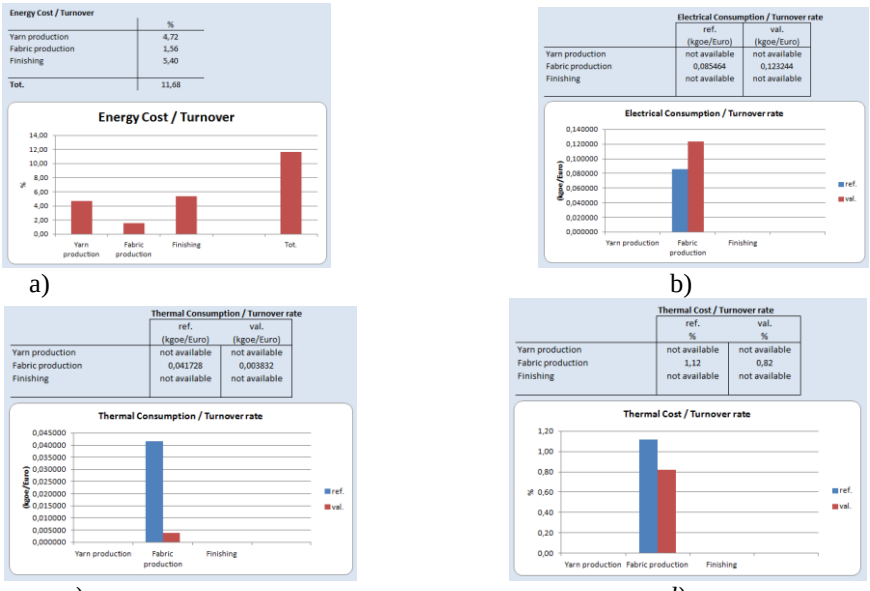


Fig. 2: *SET Tool*

In step 1 the application asks companies for basic yearly information about consumption and production and gives back as result some energy indices (energy cost/turnover, electrical consumption/turnover rate, electrical cost/turnover rate, thermal consumption /turnover rate, thermal cost/turnover rate) (Fig. 3) and some best practices (cross-cutting energy efficiency measures) [6].



a) b)

c) d)

Fig. 3: *Step1_Outputs – Global energy indices*

a) Energy Cost /Turnover b) Electrical Consumption/Turnover rate c) Thermal Consumption/Turnover d) Thermal Cost/Turnover rate

In step 2 the company is asked for more detailed and monthly data and description of the technologies used (Yarn Production, Fabric Production and Finishing). A wider set of Best Practices is evaluated (also related to the kind of machines) and more data, diagrams and indices describing the energy uses are showed (Monthly production and Electrical/Thermal Consumption graph, Electrical/Thermal Consumption vs Production - regression graph, Specific Electrical/Thermal Consumption vs Production- regression graph) (Fig. 4).

b)

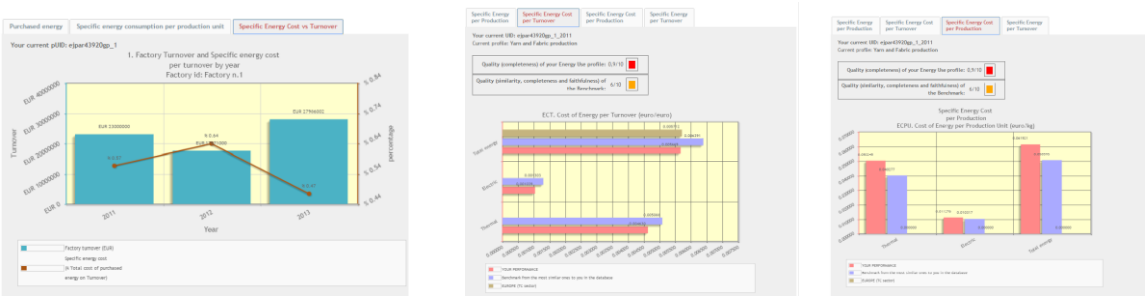
Fig. 4: *Step2_Outputs – Monthly variation*
a)Electrical Consumption vs Production b) Monthly Production and Electrical Consumption

In step 3 detailed data from machines is asked to build an electrical and thermal model of the company (Fig. 5) to compare against the macro values and obtain the shares of energy for the different uses.

2.2 SET tool Web

The SET tool Web is based on a constantly updated database and is a service free of charge for companies which contribute by sending confidentially their own energy data.
On the SET tool Web the **company can**

- Look at examples in the **demo** pages showing elaborations, graphs, benchmarks
- **Compare** own factory's energy performance with those of similar European companies (Fig. 6)
- Forecast **models** for energy consumption based on own technologies and production
- Compare own **progress** year by year.



a) b) c)

Fig. 5: *SET tool Web: Performance comparison*
a) Factory Turnover and Specific Energy Cost per Turnover by year
b) Specific Energy Cost per Turnover c) Specific Energy Cost per Production

1- Insert percentage of electrical energy for production (not considering energy of auxiliary systems) and production;

2– Data about your main production processes;

3- The tool estimates your expected specific energy consumption (red circle) based on the information of point 2 and compares it with your real value (green circle).

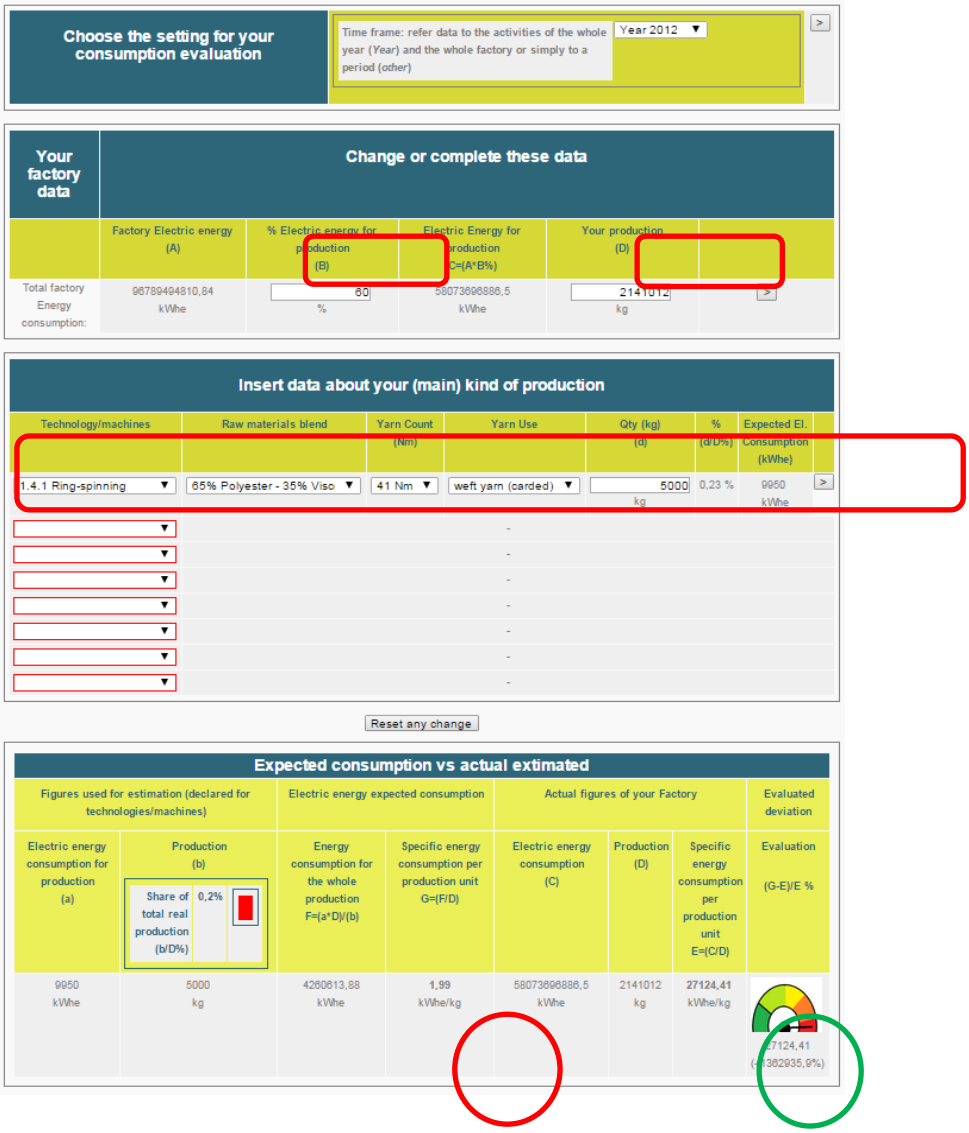


Fig. 5: *Technology based model for Yarn production*

3 APPLICATION OF SET tool

The SET tool, a self-assessment tool tailored on textile manufacturing processes has already been tested by over 50 companies selected along the three value creation steps: Yarn Production, Fabric production and Finishing, further 100 companies are planned to be supported in 2016. Application of SET tool on the companies was performed by the company itself with the help of SET partners. Based on the results of Application and Validation phases of SET tool there should be elaborated the Energy Consumption Rationalization Plan that contains the following items: Company characterization; Energy consumption and cost by type of energy (electrical and thermal); Energy indices provided the outputs of SET tool; Energy efficiency measures; Estimated savings and investments for each energy consumption of the selected measures; Estimation of energy consumption and energy indices after application of efficiency measures.

The implementation of a plan like this can be checked on a yearly basis using SET tool instruments to evaluate company's progress on energy consumption, since the web application of the tool allows the storage and presentation of data from several years.

The SET tool does not replace an energy audit performed by a qualified auditor. However this tool can help the company in handling energy audits by collecting relevant data and creating awareness.

4. CONCLUSIONS

Energy Saving and Efficiency Tool (SET tool) is a unique tool for SMEs to:

- Know and understand what legal obligations and financial incentives exist or are upcoming;
- What are the best practices in textile specific energy efficient measures;
- Evaluate energy consumption on specific textile processes;
- Calculate energy consumption per product;
- Benchmark the energy values;
- Get clear recommendation for energy efficiency measures;
- Evaluate the potential savings with recommended measures;
- Calculate economic profitability and the ROI (Return on Investment) of energy efficiency investments.

The SET project plans to support 150 European Textile SMEs to assess and effectively launch measures to reduce costs and become more competitive thanks to energy efficiency. Also, 350 European Textiles SMEs will receive all necessary elements (both technical and non-technical) to evaluate their options and to make well-informed decisions.

Prior to modifying the company's production processes and making investments to increase energy efficiency, textile SMEs need to get different type of information, including legal context, economic and technical peculiarities.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

IMPROVING THE AESTHETIC LOOK OF GARMENTS, USING COMPUTERISED GRAPHICS PROGRAMS

ŞUTEU Marius[1], STAN Ovidiu[1], DOBLE Liliana[1]

[1] University of Oradea, Department of Textile-Leather and Industrial Management, B.St.Delavrancea str. No.4, 410058, Oradea, Romania, E-mail: textile@uoradea.ro

Corresponding author: Marius Şuteu, E-mail: msuteu@uoradea.ro

Abstract: *The present paper explains the stages of clothing style improvement by using computer graphics programs. Ovidiu Stan, a student in the Department of Textiles and Leatherworking and Industrial Management, under our guidance, did research at the Ethnographic Museum of Transylvania in Cluj Napoca, where he selected a folk pattern specific to Transylvania area, reinterpreted it and digitized it in the vector graphics program CorelDRAW. This program allows the shape and size of drawings to be modified, and offers a vast chromatic palette which allows us to style the drawings. The pattern was printed on the T-shirt with an Azon Tex Pro printer, which can replace screen-printing or thermal transfer. The printing system is high-speed and very high quality, and the printed patterns can be unique, highly resistent to wear and washing. After the digitization stage, the next stage was to embroider the pattern on the T-shirt with the Happy embroidery machine. The embroidered pattern was designed by using the BERNINA Embroidery Software Designer Plus software. This embroidery software offers the freedom to design and edit elegant monograms, and complete freedom of creative design. All the projects completed with this software can bear their own distinct, individual mark, as an original work of art.*

Key words: *CAD Systems, CorelDRAW, BERNINA Embroidery Software Designer Plus, Happy embroidery machine*

1. INTRODUCTION

The variety of the traditional clothing pieces and the complexity of the decorative motifs became very fast inspirational sources for fashion designers [1] .

The traditional art represents an inexhaustible inspirational source helpful for those who process textile surfaces, leather, fashion products or accessories [2] .

Romanian ornamentation as a whole is the main source of inspiration and knowledge that can be redeemed successfully in textile creations [3] .

In the traditional descriptions, the embroidery represents the emphasized sewing by specific compositions with an aesthetic role of certain surfaces decoration highlighted by documentation and illustrated by personal fashion products.

Any image or drawing can be converted to embroidery through the programming of machines, so the ones that are part of this fascinating and boosted ambition towards the art ranks field, will always have the creative freedom [4] .

2. THE EXPERIMENTAL PART

Romanian traditional clothing is characterized by unity and continuity. This unity is given by the characteristics of the traditional clothing from all over the country, such as the composition of the costume, the raw material from which the pieces of clothing are made, the tailoring, colour or stitches points, and the continuity represents the long way it has lasted along the years [5].

The chromatics of Romanian traditional clothing is characterized by harmony and freshness, the colors are combined aesthetically. The colors obtained by vegetal dyeing were warm, noncontrasing colours. With the advent of industrial dyes, the colors began to be more intense and more contrasting [5] .

By this piece of clothing we wanted to show the beauty of the traditional Romanian patterns but at the same time we wanted to help the designers who want to implement these patterns by using drawing and design programs, which could ease their work without having to produce samples, being able to see the piece of clothing in the form, size and colour they wanted on a computer [6].

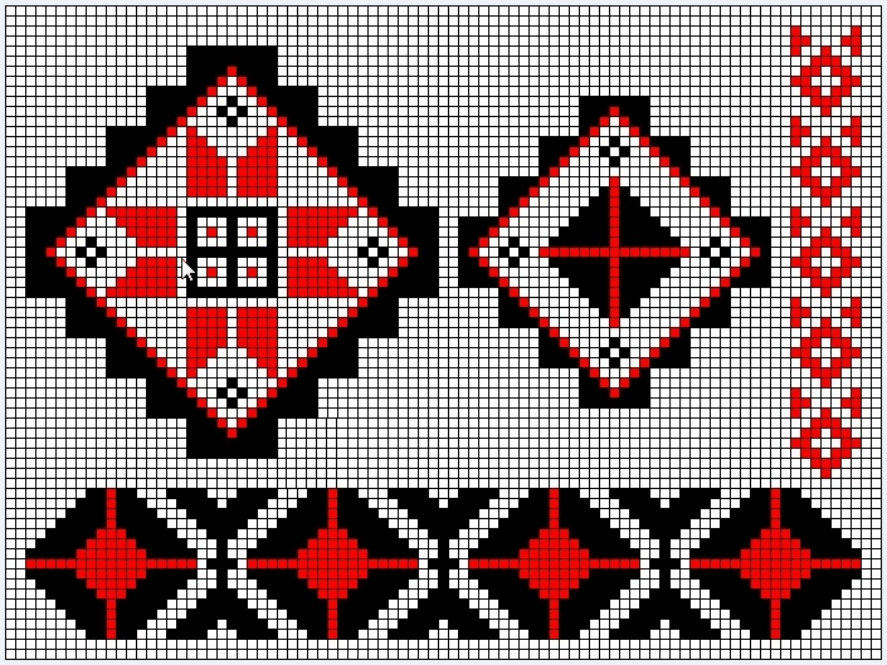

Fig. 1*: Processing the graphic pattern in Paint*

The documentation for this project was conducted in the Ethnographic Museum of Transylvania from Cluj-Napoca where we benefited from the expertise and experience of ethnologists. The chosen Romanian folk motif is specific to ethnographic area of Transylvania. After studying various motifs form the museum's collection we chose one motif specific to Transylvania ethnographic area [7].

The motif consists of four modules and is well balanced chromatically, the colors are white, black and red with chromatic accent.

The motif was stylized and reinterpreted in a modern way, but were preserved the characteristics of the form (diamonds, rectangles, triangles), composition (the way in which the modules are combined together) and chromatic in order to keep the degree of authenticity of the motif. The graphic model processing was done in Paint program (Figure 1).

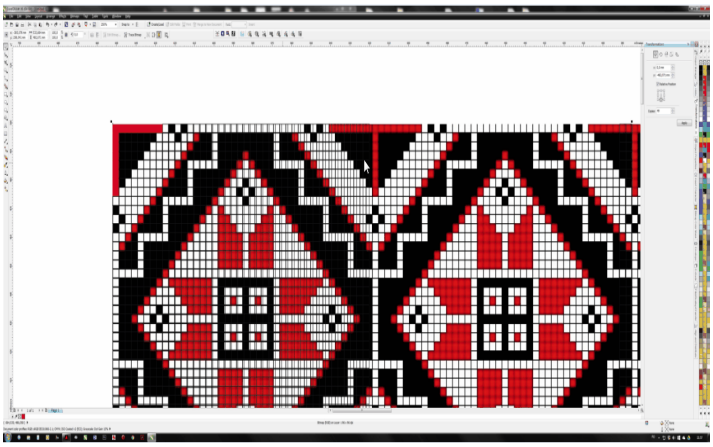

***Fig. 2**: Processing the pattern in CorelDraw-phase 1*

First time the motif was styled in a variety of sizes and color combinations, and after one variant was chosen we passed onto motif digitization using CorelDRAW graphics program.

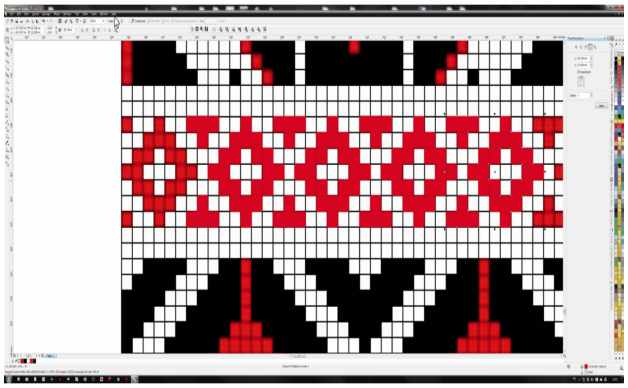

***Fig. 3**: Processing the pattern in CorelDraw-phase 2*

In (Figure 1, Figure 2, Figure 3, Figure 4) are presented the stages of processing the chosen model with the software CorelDraw, a program that allows the shape and dimension of drawings to be changed, also offering a vast colour palette allowing us to stylize the drawings.

***Fig. 4**: Processing the pattern in CorelDraw-phase 3*

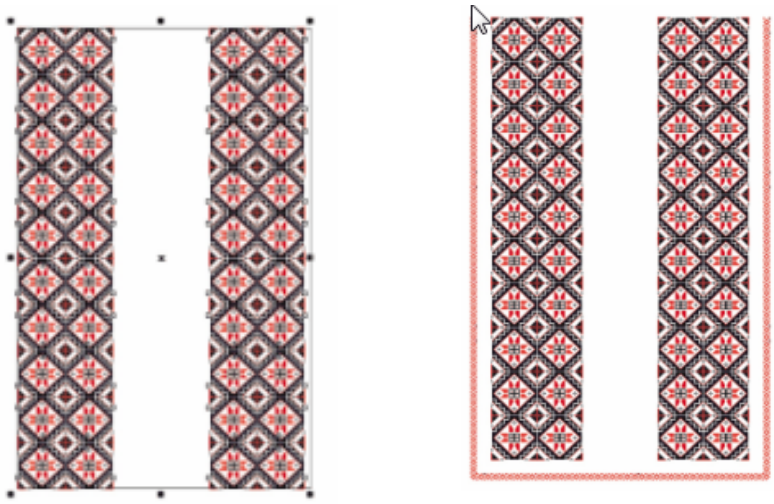

***Fig.5**: Processing the pattern in CorelDraw-phase 4*

Azon Tex Pro printer can be used as a replacement for screen printing or heat transfer. Printed patterns can be unique or in series with a high resistance to wear and washing. The printing system is a high speed and a very good quality / price one, consisting of 8 cartridges, 4 containing the 4 base colours and 4 containing white. The white layer is applied digitally directly to the desired location of the shirt immediately followed by colour print. The print is done at a resolution of 1440 dpi, with an amazing speed of 50 T-shirts per hour in case of white shirts and 15T-shirts per hour for dark T-shirts, the software used is Azon RIP [8].

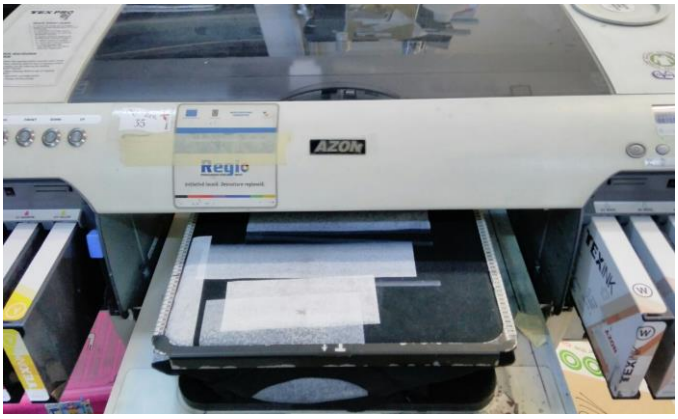

***Fig. 6**: Azon Tex Pro Printer [8]*

The embroideries that decorate the folk costume items contribute to keeping the unicity of the traditional folk costume. The yarns that were used for decorating the folk costume pieces are wool, raw silk, twisted cotton yarns and warped coloured cotton yarns or later, vegetal silk. It was essential the way in which the ornament was arranged on the white fabric, thus providing a balance between various ornamental fields, a good aesthetic taste [5].

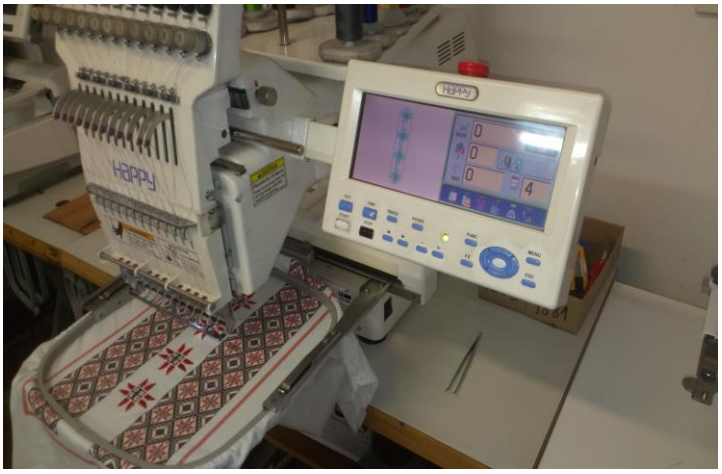

***Fig. 7**: Happy Embroidery machine [9] [10]*

After the digitization stage of the model we passed to embroidering the pattern on a T-shirt using the Happy embroidery machine. The embroidering of the T-shirt was done at S.C. CONFIDEX S.R.L Oradea [9] [10].

The embroided pattern was done using BERNINA Embroidery Software Designer Plus Software. This embroidery software gives you the freedom to design and edit elegant monograms, as well as complete freedom of creative design. All projects completed in this program may bear the individual and distinct signature as an original artwork.

In (Figure 8) is shown the T-shirt worn by the mannequin with the model chosen digitized and embroidered.

***Fig. 8**: T-shirt – final product*

3. CONCLUSIONS

- Versatility from a creative point of view of Romanian traditional folk motifs.
- Keeping the motifs and the degree of authenticity of traditional patterns.
- Possibility of motifs to be applied on various textile supports using modern technologies.

- Modern technologies allow a mix between old and new, combining the creative aspects with the technological ones, which can be stylized and reinterpreted with various graphics programs.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

RESEARCH ON TRANSFER OF LIQUID WATER ABSORPTION OF KNITED STRUCTURES FOR SOCKS DESTINATION

VLAD Dorin[1], BARBU Ionel[2], SZABO Monica[3]

[1] Lucian Blaga University, Engineering Faculty, MEI Department, Postal address, 550024, Sibiu, Romania,
E-Mail: dorin.vlad@ulbsibiu.ro

[2,3] Aurel Vlaicu University, Engineering Faculty, AIITT Department, Postal address, 333120, Arad, Romania,
E-Mail: ionelbarbu@yahoo.com szabomonica@yahoo.com

Corresponding author: Barbu, Ionel, E-mail: ionelbarbu@yahoo.com

Abstract: *For to adjust the heat, body removes heat. Depending on physical effort, it gives more or less moisture. Moisture removed from the body should be taken from the skin and directed outwards through clothing. This can be due to moisture absorption ability, and because of the capillary effect.*
This study is a part of a very extensive work on the influence of characteristics and raw materials, knitted structure and density on comfort properties of socks.
If a high level of perspiration, moisture liquid, it is important that it be removed as quickly from skin and clothing led outside. From here can evaporate into the environment. This is achieved through the capillary effect of fabrics that may effectively transport moisture. Storage capacity and moisture transfer of a textile depends on the composition and structure.
In laboratory conditions, methods for assessing the behavior of textiles against moisture is applied differentially depending on the state humidity: vapor or liquid. With this method of determining the capacity of absorbing water by capillary action, samples have dimensions of 200/200 mm and at one end is immersed in water. The samples knit were made in two versions of the fineness machine.

Key words: *Knitted structures, socks, physical properties.*

1. INTRODUCTION

For to adjust the heat, body removes heat. Depending on physical effort, it gives more or less moisture. Moisture removed from the body should be taken from the skin and directed outwards through clothing. This can be due to moisture absorption ability, and because of the capillary effect [1], [2], [3], [4], [5].

This study is a part of a very extensive work on the influence of characteristics and raw materials, knitted structure and density on comfort properties of socks.
If a high level of perspiration, moisture liquid, it is important that it be removed as quickly from skin and clothing led outside. From here can evaporate into the environment. This is achieved through the capillary effect of fabrics that may effectively transport moisture. Storage capacity and moisture transfer of a textile depends on the composition and structure. [6], [7], [8], [9].

2. METHOD AND PROCEDURE

In laboratory conditions, methods for assessing the behavior of textiles against moisture is applied differentially depending on the state humidity: vapor or liquid [1], [2], [3].

With this method of determining the capacity of absorbing water by capillary action, samples have dimensions of 200/200 mm and at one end is immersed in water. [10,11] The other end is fixed to a horizontal support pins - Figure 1.

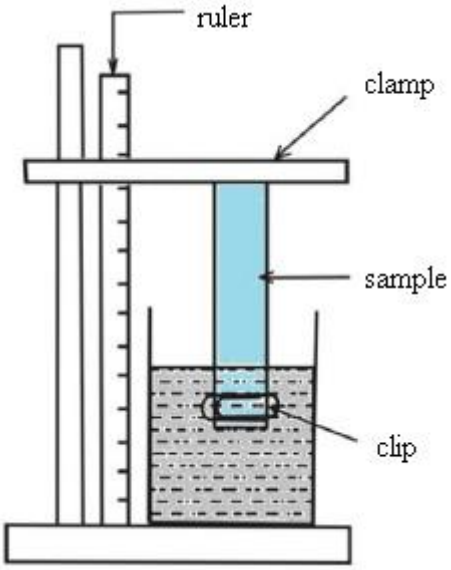

Fig.1*: Installation for determining water absorption capacity by capillarity [24]*

The ability of capillary water absorption of fabrics can be determined in two ways:

1. Measure the height of water rise in a predetermined period of time (3 min.) [26], [27], [28];
2. Determine the time required for the water to climb over a distance of 50 mm on the sample of textile material [26], [27], [28].

Speed of ascent of water on the fabric was calculated with: [26], [27], [28]

$$v = h_3 / 3 \text{ [mm / min]} \quad \textbf{(1)}$$

where:

h_3 - the height determined after 3 min. immersion; [mm]

v – speed of climb [mm/min]

The yarns were used for knitted samples:

1MDX – cotton 100%, Tt =30 tex
2MDX - cotton 100%, Tt =25 tex
3MDX - cotton 100%, Tt =20 tex
1DC – organic cotton 100% , Tt =30 tex
2DC - cotton 100%, Tt =25 tex
3DC - cotton 100%, Tt =20 tex
4DC - 50% cotton + 50% soy fiber, Tt =30 tex
5DC - 52% PES + 48% viscose, Tt =30 tex, relative humidity 3,2%
6DC - 52% PES + 48% viscose, Tt =30 tex, relative humidity 3,7%
7DC - 100% Tencel, Tt =30 tex
8DC - 50% bamboo + 50% viscose, Tt =30 tex

9DC - 90% viscose + 10% silk, Tt =30 tex
10 DC – PES 100%, recycled, Tt =30 tex
11 DC – PES 100%, Tt =30 tex

The samples knited were made in two versions of the fineness of machine, variants I and II: the plate jersey structures density 1, GV1, the plate jersey structures density 2, GV2, the plate rib fabric 4:2 density 1, PV1, the plate rib fabric 4:2 density 2, PV2, the plate links with draw links density 1, LV1, and the plate links with draw links density 2, LV2. The yarns for plate structures were PA6.

3. THE RESULTS

The measured values for the height h [mm] of distilled water up to samples a predetermined period of time, have been centralized in Tables 1, 2 si 3 calculating at the same time and the speed v [mm / min] of the water up to samples [1], [2], [3].

Table 1: *Parameter values for GV1 and GV2 structures*

Samples	h_3 (mm)	V(mm/min)	Samples	h_3 (mm)	V(mm/min)
GV1.1MDX	18	6	GV2.1MDX	16	5,3
GV1.2MDX	21	7	GV2.2MDX	18	6
GV1.3MDX	38	12,7	GV2.3MDX	20	6,7
GV1.1DC	26	8,7	GV2.1DC	18	6
GV1. 2DC	21	7	GV2. 2DC	19	6,3
GV1. 3DC	35	11,7	GV2. 3DC	26	8,7
GV1. 4DC	60	20	GV2. 4DC	51	17
GV1. 5DC	56	18,7	GV2. 5DC	51	17
GV1. 6DC	65	21,7	GV2. 6DC	61	20,3
GV1. 7DC	35	11,7	GV2. 7DC	33	11
GV1. 8DC	67	22,3	GV2. 8DC	48	16
GV1. 9DC	43	14,3	GV2. 9DC	41	13,7
GV1. 10DC	84	28	GV2. 10DC	72	24
GV1. 11DC	57	19	GV2. 11DC	36	12

Table 2: *Parameter values for PV1 and PV2 structures*

Samples	h_3 (mm)	V(mm/min)	Samples	h_3 (mm)	V(mm/min)
PV1.1MDX	20	6,7	PV2.1MDX	19	6,3
PV1.2MDX	23	7,7	PV2.2MDX	21	7
PV1.3MDX	36	12	PV2.3MDX	32	10,7
PV1.1DC	29	9,7	PV2.1DC	28	9,3
PV1. 2DC	22	7,3	PV2. 2DC	21	7
PV1. 4DC	63	21	PV2. 4DC	55	18,3
PV1. 5DC	43	14,3	PV2. 5DC	42	14
PV1. 6DC	65	21,7	PV2. 6DC	58	19,3
PV1. 7DC	36	12	PV2. 7DC	35	11,7
PV1. 8DC	76	25,3	PV2. 8DC	47	15,7
PV1. 9DC	54	18	PV2. 9DC	47	15,7
PV1. 10DC	74	24,7	PV2. 10DC	72	24
PV1. 11DC	28	9,3	PV2. 11DC	22	7,3

Table 3: *Parameter values for LV1 and LV2 structures*

Samples	h_3 (mm)	V(mm/min)	Samples	h_3 (mm)	V(mm/min)
LV1.1MDX	13	4,3	LV2.1MDX	12	4
LV1.2MDX	16	5,3	LV2.2MDX	15	5
LV1.3MDX	22	7,3	LV2.3MDX	14	4,7
LV1.1DC	14	4,7	LV2.1DC	12	4
LV1. 2DC	18	6	LV2. 2DC	14	4,7
LV1. 3DC	23	7,7	LV2. 3DC	21	7
LV1. 4DC	67	22,3	LV2. 4DC	52	17,3
LV1. 5DC	38	12,7	LV2. 5DC	37	12,3
LV1. 6DC	64	21,3	LV2. 6DC	53	17,7
LV1. 7DC	33	11	LV2. 7DC	31	10,3
LV1. 8DC	59	19,7	LV2. 8DC	37	12,3
LV1. 9DC	48	16	LV2. 9DC	41	13,7
LV1. 10DC	72	24	LV2. 10DC	68	22,7
LV1. 11DC	47	15,7	LV2. 11DC	29	9,7

4. CONCLUSIONS

By analyzing the results from the tables 1, 2, and 3 and figures 2, 3 and 4 it can be observed that:

1.The water's speed of ascension of the is direct proportional with the height's ascension;

2.The 100% cotton knitted fabrics present lower values of the speed of ascension (for all analyzed structures), higher values are recorded for the recycled polyester structures (10DC);

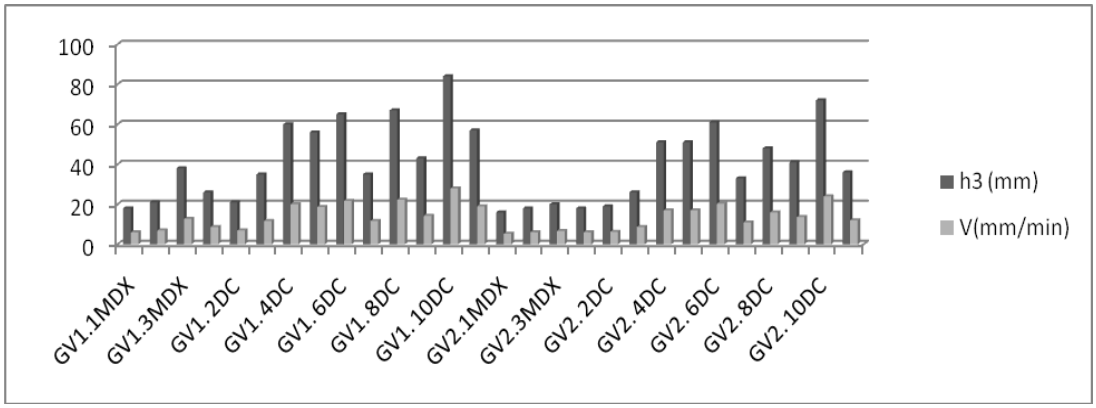

Fig. 2*: The parameter values for the fineness of the machine for GV structures*

3.In all versions analyzed, the height of ascension and speed of ascension values, are higher on the step density I, compared with step density II;

4.For the same type of raw material and same step density I, the plate jersey structures present the highest values regarding the speed of ascension;

5.For the knitted fabrics LV1.1MDX, LV1.2MDX, LV1.3MDX , obtained from the same raw material (100% cotton + polyamide 44/12x2 dtex), during a modification of the yarn's fineness, from 50/1 Nm to 40/1 Nm, the height of ascension decreases with 37,5%, and during a modification of the yarn's fineness, from 40/1 Nm to 34/1 Nm, the height of ascension decreases with 23%;

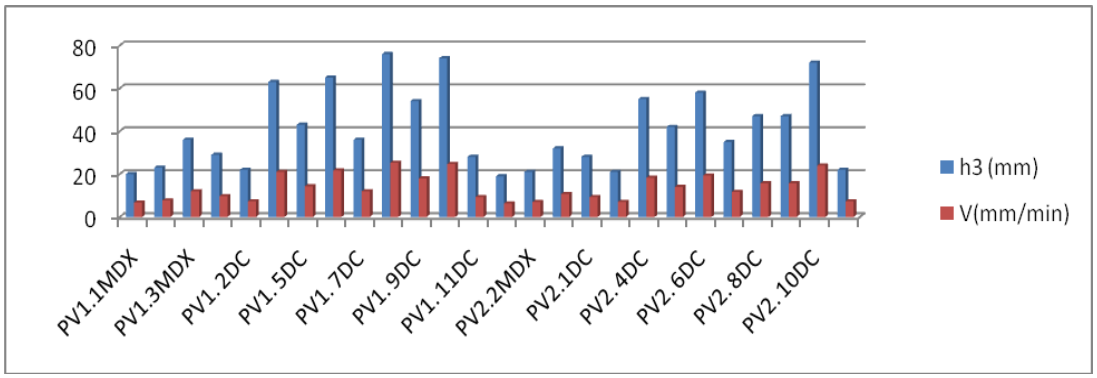

***Fig. 3**: The parameter values for the fineness of the machine for PV structures*

6.For the knitted fabrics types GV1.5DC and GV1.8DC, obtained from mixed fabrics, the percentage of 52% polyester increases the capillary effect with 19.64%;

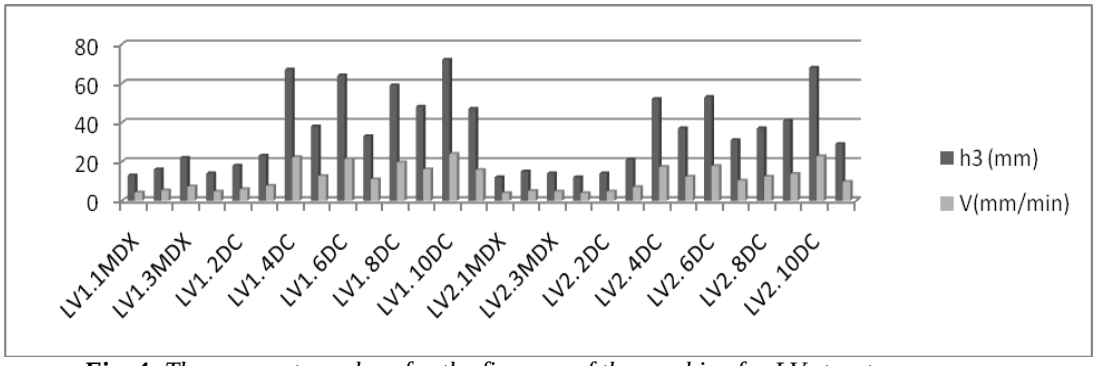

***Fig. 4**: The parameter values for the fineness of the machine for LV structures*

7.For the polyester knitted fabrics, GV1.10DC and GV1.11DC, the height of ascension is higher with 47,36%, in case of version GV1.10DC;

8.For the knitting fabric versions PV1.1MDX and PV1.4DC, the 50% soy percentage increases the capillary effect with 215%;

9.The knitted version PV1.1DC(organic cotton) presents a height of ascension higher with 45%, than the knitted version PV.1MDX

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

USEBILITY OF HYDROGELS IN ADSORPTION TECHNOLOGHY FOR REMOVAL OF HEAVY METAL AND DYE

AÇIKEL Safiye Meriç[1] and ASLAN Ahmet[2]

[1] İstanbul University, Technical Sciences Vocational School, Leather Technology 34320, İstanbul, Turkey, E-Mail: mericgokalp@gmail.com

[2] Ege University, Engineering Faculty, Leather Engineering Department, 35100, İzmir, Turkey, E-Mail: ahmetaslan@gmail.com

Corresponding author: AÇIKEL, Safiye Meriç, E-mail: mericgokalp@gmail.com

Abstract: *Heavy metals and Dyes are very toxic and nonbiodegradable in waste waters to cause adverse health effects in human body and to induce irreversible pollution. Adsorption offers many potential advantages for removal of toxic heavy metals being flexibility in design and operation, high-quality treated effluent, reversible nature for multiple uses, and many commercially available adsorbent materials, such as activated carbon, zeolite, clay, sawdust, bark, biomass, lignin, chitosan and other polymer adsorbents. Compared to conventional adsorbent materials above, hydrogelbased adsorbents recently have attracted special attention to their highly potential for effective removal of heavy metals and dyes. Hydrogels are named "Hydrophilic Polymer" because of care for water. Hydrogels is not solved in water; however they have been swollen to their balance volume. Because of this swell behavior, they can adsorb big quantity of water in this structure. So they can term of "three sized polymers" due to protect their existing shape [9]. Hydrogels with porous structures and chemically-responsive functional groups, enable to readily capture metal ions and dyes from wastewater. Hydrogels with porous structures and chemically-responsive functional groups, enable to readily capture metal ions and dyes from wastewater. In adsorption applications, hydrogels are used in water purification, heavy metal/dying removing, controlled fertilizer released, ion exchange applications, chromatographic applications, dilute extractions, waste water treatments. This article general inform about usage of hydrogels in Dye and Heavy Metal adsorption.*

Key words: *Hydrogels, Adsorption, Waste Water, Dye, Heavy Metal*

1. INTRODUCTION

Hydrogels are named "Hydrophilic Polymer" because of care for water. Generally hydrogels is not solved in water; however they have been swollen to their balance volume. Because of this swell behavior, they can adsorb big quantity of water in this structure. So they can term of "three sized polymers" due to protect their existing shape [1]. Their cross linked bound structures are able to covalent or ionic and also one polymer which can for use of hydrogel polymer, must have hydrophilic groups such as carboxyl, carbonyl, amine and amide in main chains or side chains, and because of these groups water bound the polymer and polymer start to swell with rising volume and mass. Swell behavior of hydrogel is interested in quantity of hydrophilic groups [2] Polymer that has got the much more hydrophilic group has increased swell effect of polymer. Also hydrogel polymer has the soft and flexible properties because of having much more water. In figure 1 show that A is four function cross bounding, B is multi-function cross bounding, C and D are chain

points, E is mixing chains, F is hooking of chain, G is cross bounding side chain, H is space of chain and Mc is molecule mass of two chain [3], [4].

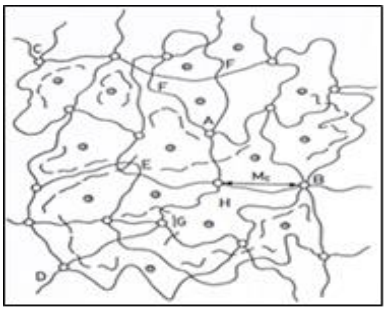

Fig.1: *Schematic View of Hydrogel [3].*

A polymer which has got the polar and hydrophilic function groups as –OH, -NH2,-COOH, -COOR, describe a hydrogel [5]. These groups are interacted with the water by the hydrogen bounding. Volume and mass of hydrogel polymer increase with this bounding water in hydrogel and gel start to swell. Also quantities of hydrophilic groups have raised the swell effect. Swell is characteristic feature of polymeric network structure and it is sudden change of volume in polymer. According to cross linked quantity, polymeric network can adsorb high quantity liquid without solved [6]. Swell feature of a polymeric gel is determined interaction of functional groups with each other and with diluent. Push and pull effect between chains, electrostatic interactions that are not covalent, Van der Waals; are not influenced from hydrogen bounding. Hydrophobic interactions are this type of physical cross linked interactions and this situation is affected of swell behavior [7].

2. ADSORPTION

Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid to a surface [8]. This process creates a film of the adsorbate on the surface of the adsorbent. This process differs from absorption, in which a fluid (the absorbate) is dissolved by or permeates a liquid or solid (the absorbent), respectively [9]. Adsorption is a surface-based process while absorption involves the whole volume of the material. The term sorption encompasses both processes, while desorption is the reverse of it. Adsorption process involves two components Adsorbent and Adsorbate. Adsorbent is the substance on the surface of which adsorption takes place.Adsorbate is the substance which is being adsorbed on the surface of adsorbent. Adsorbate gets adsorbed [10].

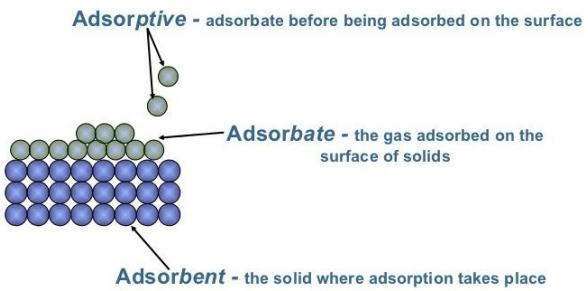

Fig.2: *Schematic View of Adsorption [11]*

The most common industrial adsorbents are activated carbon, silica gel, and alumina, because they present enormous surface areas per unit weight. Activated carbon is produced by roasting organic material to decompose it to granules of carbon - coconut shell, wood, and bone are common sources. Silica gel is a matrix of hydrated silicon dioxide. Alumina is mined or precipitated aluminum oxide and hydroxide. Although activated carbon is a magnificent material for adsorption, its black color persists and adds a grey tinge if even trace amounts are left after treatment; however filter materials with fine pores remove carbon quite well [12].

3. ADSORPTION APPLICATIONS WITH HYDROGELS

Adsorption, the binding of molecules or particles to a surface, must be distinguished from absorption, the filling of pores in a solid. In adsorption applications, hydrogels are used in water purification, heavy metal/dying removing, controlled fertilizer released, ion exchange applications, chromatographic applications, dilute extractions, waste water treatments.

3.1 Heavy metal adsorption by hydrogels

Xu, et al., made a research about a poly(sodium acrylate)–graphene oxide (PSA–GO) double network hydrogel adsorbent in order to remove Cd+2 and Mn+2 heavy metal ions from water solutions. The results of this research show that PSA-GO hydrogel polymer adsorbs 2383 mg/g Cr+2 and 165.5 mg/g Mn+2 heavy metal ions in pH6 and in 303 oK temperature. Also they found that this adsorbent kept high removal efficiencies of Cd+2 and Mn+2, indicating a good reusability after experiencing four cycles [13].

Bajpai and Johnson investigate poly (acrylamide-co-maleic acid) hydrogels for removing Cr+6 heavy metal ion and end of the research, was found that poly (acrylamide-co-maleic acid) hydrogels provide %72 Cr+6 removal (Fig. 3) [14].

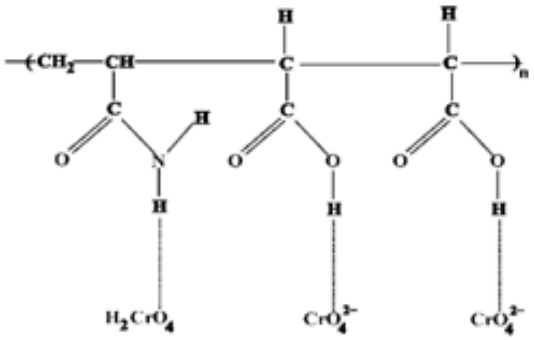

Fig. 3: *Interactions between chromium (VI) and hydrogel [14].*

In a research, the magnetic hydrogel sorbent was prepared with radiation-induced crosslinking polymerization of chitosan (CS), 2-acrylamido-glycolic acid (AMGA), and acrylic acid (AAc), which stabilized by magnetite (Fe3O4) as nanoparticles and this sorbet was used to isolate toxic heavy metal ions from the aqueous solution by the magnetic nanopolymers. The adsorption activity for heavy metals such as Cu+2 and Co+2 by nonmagnetic and magnetic hydrogels, Fe3O4/CS/ (AMGA-co-AAc), in terms of adsorption amount was studied. As a result of hydrogel networks with magnetic can effectively be used in the removal of heavy metal ions pollutants and provide advantageous over conventional ones [15].

Antic, et al., research in order to remove Cd+2 heavy metal ions from aqueous solution by novel hydrogels based on 2-hydroxyethyl acrylate (HEA) and itaconic acid (IA), P(HEA/IA) copolymers, were prepared by free radical cross-linking copolymerization. Desorption studies showed that hydrogel can be reused three times with only 15% loss of adsorption capacity. All results indicate that the sample with the highest IA content is the most promising adsorbent for Cd2+ removal [16].

Roy, et al., investigates the removal of Cr6+, Ni2+, Cu2+ , and Pb2+ by acrylic acid hydrogels. In this way the hydrogels prepared by redox polymerization of acrylic acid in the presence of polyethylene glycol diacrylate as the cross linker. The results show that this chelating hydrogel-bearing O, O donor groups exhibited high-metal sorption capacity of 41.1, 58.2, 43.1, and 81.2 mg/g for Cr6+, Ni2+, Cu2+, and Pb2+, respectively, under optimum conditions and also in desorption conditions sorbent could be used repeatedly for at least 10 cycles without any loss in chelating efficiency [17].

3.2 Dyestuff adsorption by hydrogels

Torun and Solpan studied about dye capacity of poly(N-vinylpyrrolidone-co-methacrylic acid) (P(VP/MAA)) hydrogels for cationic dye removal. In this way they prepared poly(N-vinylpyrrolidone-co-methacrylic acid) (P(VP/MAA)) hydrogel by gamma radiation and they prefer Janus Green B (JGB) and Magenta (M) cationic dyes. End of the research they found that P(VP/MAA) hydrogels may be successfully used in the purification of waste water containing certain textile dyes [18].

Bahram, et al., worked about removal of two azo dyes, methylene blue and methyl orange, from water using a synthesized hydrogel entitled poly (styrene-alt-maleic acid). For this purpose superabsorbent hydrogel poly (styrene-alt-maleic anhydride) was prepared through a thermally initiated free-radical polymerization of styrene and maleic anhydride. End of the research, they found that at the optimum conditions, 80-95 % of the mentioned dyes could be removed in less than 10 min and the synthesized hydrogel can use for the application in azo dyes removal from water [19].

Gupta, et al., was used 2-Hydroxyethylmethacrylate (HEMA), 2-Hydroxyethyl methacrylate–ethoxy ethyl methacrylate–methacrylic acid (HEMA–EEMA–MA), and Polyvinyl alcohol (PVA) as an adsorbent for the removal of two hazardous toxic azo dyes, being Malachite green (MG) and Congo red (CR). The adsorption affinity of MG onto HEMA–EEMA–MA is increased from 245 to 330 mg/g CR onto PVA 169-236 mg/g MG onto HEMA 130-205 mg/g CR onto HEMA–EEMA–MA 90-155 mg/g MG onto PVA 35-140 mg/g CR onto HEMA 17-57 mg/g, respectively [20].

Dhanapal and Subramanian used modified chitosan hydrogel as adsorbents for uptaking reactive blue 4 (RB4), arsenic (AsO_2^-) and mercury (Hg^{+2}) uptake and they found that the adsorption of hydrogel showed RB4 (701 mg/g), and the uptake of $AsO2^-$ (551 mg/g) and Hg^{+2} (455 mg/g) [21].

In another work, sulfonated graphene (SG) were incorporated into the poly (vinyl alcohol) (PVA) networks to fabricate the SG/PVA (SP) composite hydrogel. It was found that the SP hydrogel could be used as intelligent absorbent in selective adsorption and separation of the Methylene Blue (MB) and Malachite Green (MG) dye mixtures [22].

Lucic, M., used TiO2/hydrogel nanocomposite for investigation of photocatalytic degradation of three different groups of anionic azo dyes in aqueous solutions under solar light simulating source in order to evaluate its potential application for treatment of textile wastewaters. This TiO2/hydrogel based on chitosan, itaconic and methacrylic acid (monomers ratio Ch/IA/MAA = 1:1.56:10) was modified with synthetized 0.2 M colloidal TiO2 nanoparticles and

0.2 M commercial Degussa P-25. End of the research they found that TiO2 nanoparticles completely removed C.I. Acid Red 18, C.I. Acid Blue 113, C.I. Reactive Black 5 and C.I. Direct Blue 78, while removal degree of C.I. Reactive Yellow 17 was 55%. (Fig. 4) Also after four cycles TiO2/hydrogel nanocomposites could be reused without significant loses [23].

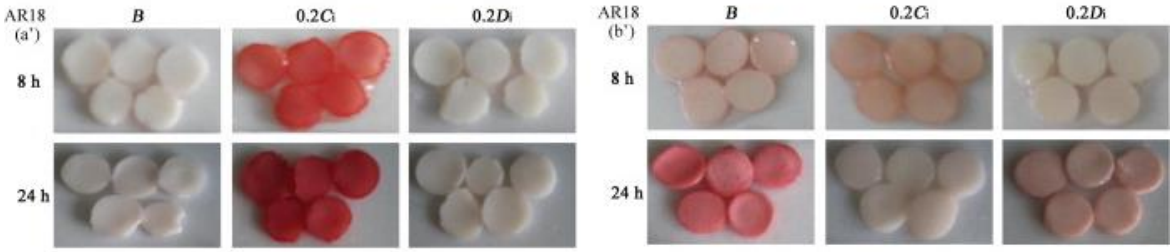

Fig. 4: After 8 h and 24 h; sample photographs of removal of dye by hydrogel [23].

5. CONCLUSIONS

Recently, many hydrogel based networks have been designed for different applications such as industry, environmental, medicine, healthy, etc.The favorable property of these hydrogels is either ability to swell when put in contact with an aqueous solution. The presented review demonstrates can be chosen in order to remove dye or heavy metal adsorption from waste waters. In this purpose loss of polymers and their combinations are utilised, and adsorption labours have made real according to target material which is wanted to adsorb.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

EXAMINING COMFORT PROPERTIES OF LEATHER and ARTIFICIAL LEATHER COVER MATERIALS

ÇETİN Münire Sibel[1], KARABAY Gülseren[2], ÖZTÜRK Hasan[3], KURUMER Gülseren[4]

[1, 2, 4] Dokuz Eylül University, Engineering Faculty, Department of Textile Engineering, Dokuz Eylül University, Faculty of Engineering, Department of Textile Engineering, Tınaztepe, Buca, 35397, Izmir, Turkey,
E-Mail: muniresibelcetin@hotmail.com, gulseren.karabay@deu.edu.tr, gulseren.kurumer@deu.edu.tr

[3] Dokuz Eylül University, Engineering Faculty, Department of Mechanical Engineering, Dokuz Eylül University, Faculty of Engineering, Department of Mechanical Engineering, Tınaztepe, Buca, 35397, Izmir, Turkey,
E-Mail: hasan.ozturk@deu.edu.tr

Corresponding author: ÇETİN, Münire Sibel, E-mail: muniresibelcetin@hotmail.com

Abstract: *The analysis and regulation of workplace, working instruments, the comfort of office chair, business environment (sound, lighting, climate, vibration, temperature, and humidity), work and break times, analysis and editing of the organization, are some of the topics of interest of ergonomics. Environmental impact and conditions have important role on the employee's working comfortably and efficiently. Therefore these conditions need to be aligned to the human body nature. Unsuitable working conditions (noise, etc.) cause additional load, which the human body endures, and this additional load reveals the signs of tiredness in the body. Even an office environment, unsuitable physical environment impairs health of workers and reduces the performance. Therefore, office climate, environmental factors such as lighting and noise must be harmonized with the employee's body nature in all working environments.*
Seating comfort is one of the important factors affecting the performance of employees in the office environment. There are so many studies about chair dimensions and the disorders on human body which were caused by the inappropriate chair dimensions and sitting positions. However, there are a spot of studies about the surface of the chair and the discomfort caused by the chair cover and its negative performance effects.
In this study, some results of seat cover analysis for the design of an ergonomic chair. Recently, ease of cleaning, low cost advantages caused the increasing of the use of artificial leather especially on the surface of the seat used in offices. The physical properties of natural leather and artificial leather were compared as the candidate covers to be used on the design of an ergonomic office chair.

Key words: *Natural leather, artificial leather, ergonomics, office chair, seat cover*

1. INTRODUCTION

Seating comfort is one of the important factors affecting the performance of employees in the office environment. Apart from its influence on posture and hence comfort, poor ergonomics of a workstation can have a bad effect on job satisfaction. This is so as people become increasingly aware of the existence of good furniture.(1) There are some diseases caused by chair dimensions not be eligible the dimensions of the human body. This discrepancy affects the performance of workers negatively. Besides, some physical properties of the surface of the chair can give discomfort to people and this low comfort can be the reason of negative performance of workers at the same time.

One of the most important features which form the clothing and textile surface comfort is physical properties. Therefore, there are many test devices and methods for detecting physical properties of leather today. Water vapor permeability, air permeability comes first for determination of physical properties. Water vapor permeability (%) is the material's capability of permeating water vapor. The water vapor or sweat permeability of the material affects the wear and surface comfort. The result of low moisture permeability cause excessive wet and this disturbs people. However, high moisture permeability is not sufficient solely. It should be coupled with high absorption capability. (2)

Although polymer materials have acceptable permeability, they are lack of good absorption properties of natural leather.

These tests are important physical properties in terms of hygiene and physiology. Air and water vapor permeability are required up to a certain degree.

According to Umbach (1993) the water vapor transfer is closely related to the moisture permeability characteristics of clothing. Also the materials with high increase evaporation amount even in variable ambient conditions. However, moisture transfer capacity is always sufficient to compensate the sweat. Moisture storage capability should be sufficient in order to give the feeling of dryness. The created buffer zone which is formed with the moisture storage capability can imply the comfort in variable ambient conditions.

As natural leather will not give the feeling of wetness, even if they have 30% moisture content, they provide a more comfortable use. However, the artificial leathers cannot bear more than 2-3% water within its build. (4) Water vapor permeability of natural and synthetic leather depends on applied finish. Because synthetics will typically have extremely limited water vapor permeability due their waterproof-coat.(5) The use of synthetic leather in garment production and the seating surfaces is highly increased in recent years.

This is because of their sales with meters, their effectiveness due to their not containing errors like natural leathers. Their most important feature is their dramatically lower cost advantage.

2. MATERIALS AND METHODS

2.1 Materials

A chrome tanned , water-based finish applied and pigment dyed cowhide leather and artificial leather, which is coated with polyurethane and polyvinyl chloride mixture and master batch pigment dyed and having 100% PES knitted lining the floor, were used in the scope of research

2.2 Methods

A variety of physical analysis, such as watervapour permeability, thickness, stitch tearing strength, extension set, air permeability test, absorbtion of water, abrasion resistance of automotive leather, colour fastness to water spotting, have been conducted with the leather and artificial leather used as upholstery.

The Sampling of leathers which were used for the physical analyzes was carried out as indicated in the TS EN ISO 2418 Leather - Chemical, physical and mechanical and fastness tests - Sampling location standard.

Test samples were taken and conditioned according to TS EN ISO 2419 "Leather - Physical and mechanical tests - Sample preparation and conditioning standard" in standard atmosphere, temperature of 23± 2°C and the relative humidity of 50± 5% for 48 hours before starting the physical tests. In the first step the samples were cut from the whole leather, in the second step Samples were cut with a press using molds of appropriate size from the first step taken parts for the physical tests.

The weight measurement was determined by 0.01 g precision Sartorius CPA2245 balance.

The physical tests are made according to the standards given in Table 1.

Table 1: *Standards of Physical Tests*

Test	Standard
Water Vapor Permeability %45 RH 15˚C	TS EN ISO 20366
Thickness	TS 4117 EN ISO 2589
Stitch tearing strength	TS 4138
Permanent elongation set	TS EN ISO 17236
Static water absorption	TS 4123 EN ISO 2417
Air Permeability	Method of Corporate
Automotive leather abrasion resistance	TS EN 14327
Color fastness to water spotting	After 30 min
	After 24 hours

3. RESULTS AND DISCUSSION

One of the most important features which form the clothing and textile surface comfort is physical properties. Artificial leathers are mostly used materials as seating covers. However they have some advantages and disadvantages while using in office environment.

Temperature and humidity of the contact surface has an essential influence on comfortable sitting. The following factors are related to microclimate: material and texture of the cover material, thickness and density of the cushion, compression of the cushion, perforations of the cushion and of the seat backrest shell.

Generally, water vapor permeability increases with increasing compression due to the shorter diffusion thickness, but starts to decrease sharply with 75.45% of compression due to the increase of foam density. In order to avoid a warm and humid microclimate, the listed components (cover fabric, foam, and seat shell) should be optimized with regard to their water vapor permeability. (6)

In our study the obtained results are given in below Table 2 and the results are consistent with the literature**.**

Table 2: *Results of Physical Tests*

Test	Results	
	Artificial Leather	**Leather**
Water Vapor Permeability %45 RH 15˚C	0.03 mg/cm^{2}h	0.48 mg/cm^{2}h
Thickness	0.78 mm	1.09 mm
Stitch tearing strength	507 N/cm	2196.5 N/cm
Permanent elongation set	4.1 mm/100 mm	6.3 mm/100 mm
Static water absorption	After 2 hours 42.8 mL/100 g	After 2 hours 151.98 mL/100 g
	After 24 hours 44.1 mL/100 g	After 24 hours 163.8 mL/100 g
Air Permeability	Grain Side:0.12 cm/s	Grain Side:0.07 cm/s
	Flesh Side: 0.05 cm/s	Flesh Side: 0.04 cm/s
Automotive leather abrasion resistance	50 rev :4/5	50 rev :4/5
Color fastness to water spotting	After 30 min:4	After 30 min:4
	After 24 hours:4	After 24 hours:4

Abrasion resistances, color fastness to water spotting features of artificial and natural leather are the same.

Thickness of artificial leather is less than natural leather and this is an advantage when we consider sewing process. Its tearing strength is also less but it is not a disadvantage when it is used as a

seat cover.

Abrasion resistance of natural and artificial leather is sufficient for upholstery material.

Even if thickness of artificial leather is less than natural leather, it has less water vapour permeability. This cause more disturbing sitting comfort than the natural leather, in the high temperature and humidity environment.

The less air permeability of natural leather can be explained by the processes of tanning, finishing and etc.

Beside this, the less thickness of artificial leather causes lower air permeability than natural leather. This allows a better seating comfort.

4. CONCLUSIONS

Recently, ease of cleaning, low cost advantages caused the increasing of the use of artificial leather especially on the surface of the seat used in offices. However it has some disadvantages when we consider sitting comfort. Its water vapor and air permeability is not good. Although it's a good choice for a cheap ergonomic office chair design, it will not be a preferable material, if ergonomics and sitting comfort are considered. In further study alternative textile covering will be examined for better choices.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

LOAD EQUILIBRATION OF WORKING PLACES ARRANGED ON CONVEYORS USED FOR FOOTWEAR UPPERS MANUFACTURING

HARNAGEA Florentina[1], HARNAGEA Marta[2], SECAN Cristina[3]

[1]Technical University of Iasi, Faculty of Textile, Leather and Industrial Management,"Gh.Asachi", Dimitrie Mangeron, No. 28, Iasi, 700050, România, E-Mail: harnagea@tex.tuiasi.ro

[3] University of Oradea, Faculty of Energy Engineering, Department of Textiles-Leather and Industrial Management, B.St.Delavrancea str., No. 4, 410087, Oradea, Romania, E-Mail: cris_secan@yahoo.com

Corresponding author: Harnagea Florentina, E-mail: harnagea@tex.tuiasi.ro

Abstract: *In the present paper there is presented how to achieve a load equilibration of workstations for a conveyor with imposed pace, in the case of manufacturing uppers for a women boots model. Equilibration of work charging is done by switching worker's operations in order to use at full time each worker placed in the technological flow process. In the manufacruring process of shoe uppers of the considered model, there have been established the operative time and production rates per operation. Thus there has been calculated the work necessary amount Nci for accomplishing different production rates: Q=600,650, 700, 750... 900pairs/ 8 h and the necessary amount of work Nai was adopted.*
A technology line of manufacturing a footwear item is used at its optimum capacity when the number of work vacancy is minimum, 0.013 corresponding to a flow production of 700pairs / 8h the highest labor productivity being obtained, ie 17.5 pairs / worker • 8h. By equilibrating the work charge for each operation, it is obtained, for a daily production of 700pairs / 8h, a reduction of the number of workspaces from 40 to 36 workers and hence a labor productivity of 19.44 pairs / worker • 8h.

Key words: *flow technology, women boots, degree of non occupation, work productivity, optimum capacity*

1. INTRODUCTION

The footwear industry is a labor intensive one, with many production processes done manually. Companies look for seting a condition where operator employment can generate more output, for increasing efficiency of the operations and thus reducing the production cost.

Researches on production time management of shoe making process reveals important for arranging production schedule, being also the significant index for estimating work cost, ensuring quality and proceeding smoothly.

In the footwear manufacturing process, the handling of cut pieces is done in three different workrooms, based on the nature of the materials used:

- ✓ workroom for processing and assembling flexible components (PC);
- ✓ workroom for processing and pre-assembling rigid components (PR);
- ✓ workroom for uppers closing and finishing (TTF). [1]

The characteristic of the activity carried out in these workrooms is that the distinct processing and assembly operations must be executed in a precise order, imposed by the technological process. Production and process analysis are significant for the footwear manufacturing companies to improve their productivity and to optimize usage of resources [2]. To assure high productivity while maintaining the established order in the shoe manufacturing processes, the parts and components are moved in a continuous flow defined by: cadence, speed, direction and orientation.

The technological process of manufacturing footwear uppers is usually organized in a continuous flow, and the transport between operations is automated by the use of conveyor belts, which have a predefined cadence.

Organizing production on the conveyor belt with a predefined cadence requires certains rules to be followed, such as:

- set up operations in a strict order prescribed by the technological process;
- minimize operative time for the workstations, if the conveyor belt speed is calculated correctly;
- ensure a high level of work distribution;
- reduce the volume of unfinished production if the assembling is done by a worker within the working area;
- for a single operation, divide the work load equally between workers, to ensure production goals are met or even surpassed etc.[1].

However, it is not always the case that these conveyor belts are used at their optimal capacity. The optimal capacity is defined as the capacity which ensures the best indicators for productivity, worker load, equipment usage etc.

Starting with these considerations, the present paper is looking for a solution to balance the working places in the technological flow along a conveyor belt with predefined cadence for manufacturing shoe uppers.

2. CASE STUDY

The efficient running of the tasks on upper-making lines depend on analysis and optimized scheduling of production techniques, which are the key points for fulfilling specific production rates.

In a footwear factory, the assembling and sewing of shoe components is done at different time intervals, depending on:

- type of operation;
- speed of the manual equipment (in the case of manual operations);
- speed of the equipment's working components;
- characteristics of the materials used [1], [3].

Equilibration of working places can be obtained by coupling operations. This coupling leads to situations where certain workers will have to execute compatible operations (which are done on the same machine or are manual operations that require the same, or similar, qualifications) [3], [4].

Regardless of situation, the coupling of operations must lead to a complete use of the operative time by each worker of the technological flow [5, 6].

The considered footwear item is a boot model for women, figure 1.

Fig.1: *Women boots*

After determining the production process for the uppers, the operative time and manufacturing rates were calculated (table 1):

Table 1: *Operative time and manufacturing rates for uppers*

Op. no.	Operation name	NT min/ pair	Np, pair/ 8h	Op. no.	Operation name	NT min/ pair	Np, pair/ 8h
1m	Cutting the uppers	0,80	600	15 M	Stitching quarter 1 on heel counter	0.92	522
2M	Skiving the uppers components	1,76	273	16 M	Stitching bellows to vamp and quarter 1	0.92	522
3m	Applying PU foam on the collar	0,40	1200	17M	Sewing quarter lining to vamp lining	0.91	527
4m	Cutting the textile strip	0.30	1600	18M	Sewing the lining to the tongue	0.61	787
5M	Sewing the label on the heel counter	1,32	364	19m	Applying PU foam on the tongue	0,50	960
6M	Stitching the textile strip on the shoe tongue	0.87	552	20m	Applying PU foam on the lining	0,50	960
7M	Applying and pressing the stiffener on the vamp	0,62	774	21M	Stitching quarter lining to heel collar	1,32	364
8M	Applying and pressing the stiffener on the quarter 1	0,62	774	22M	Inserting metal clips	0,80	600
9M	Applying and pressing the stiffener on the quarter 2	0,62	774	23M	Stitching rigid heel counter	0.87	552
10M	Stitching the bellows tongue	1,38	348	24M	Stitching toe cap	0.79	608
11M	Stitching the textile strip on the quarter 1	0.87	552	25m	Adjusting tongue and heel collar	1,60	300
12M	Stitching quarter 1 lining on to quarter 2	1.32	364	26m	Cleaning the lining of the upper part of quarter 1	1,60	300
13M	Stitching collar on quarter 1	1,32	364	27m	Quality control	0,80	600
14M	Stitching quarter 1 on quarter 2	1,32	364	28m	Transport to regrouping storage work room	0,80	600
					Total	27.08 min/pair	

m-manual operation; M-mechanical operation

According to table 1, the minimal and maximal operative time values of the technological process of manufacturing the product [3]:

- ✓ t_{min}=0,30 min/pairs, the minimum time corresponding to the most productive operation – cutting the textile strip;
- ✓ t_{max}=1,76 min/pairs, the maximum time corresponding to the least productive operation – skiving the flexible uppers components.

Under these circumstances, productivity within the technological process is also not uniform, and will show varying values for each operation. For the model used in this study, the maximum

productivity is 1600pairs/worker/8hours relative to the minimum operative time and 274pairs/8hours corresponding to the maximum operative time.

The required human resource Nci was calculated for different production goals: Q=600, 650, 700, 750, ..., 900pairs/8h. The required human resource expressed in integer values - Nai – (rather than the calculated values) was used, showing a varied degree of idleness.

The following table (table 2) exemplifies the calculated required human resources and the adopted values, corresponding to a production rate of 600pairs/8h.

Table 2: *Work resources corresponding to a production rate of 600pairs/8h*

Op. no.	Nc_i	$\pm \delta_i$	Na_i	Op. no.	Nc_i	$\pm \delta_i$	Na_i	Op. no.	Nc_i	$\pm \delta_i$	Na_i
1m	1,00	0	1	11M	1.08	-0.08	1	21M	1,65	0.35	2
2M	2,20	-0.20	2	12M	1.65	0.35	2	22M	1,00	0	1
3m	0,50	0.50	1	13M	1,65	-0.65	1	23M	1.08	-0.08	1
4m	0.38	0.62	1	14M	1,65	0.35	2	24 M	0.98	0.02	1
5M	1,65	0.35	2	15M	1.15	-0.15	1	25 m	2,00	0	2
6M	1,08	-0.08	1	16M	1.15	-0.15	1	26m	2,00	0	2
7M	0,78	0.22	1	17M	1.14	-0.14	1	27m	1,00	0	1
8M	0,78	0.22	1	18M	0.76	0.24	1	28m	1,00	0	1
9M	0,78	0.22	1	19m	0.62	0.38	1				
10M	1.72	0.28	2	20m	0.62	-0.62	1	Total	33.05	2.19	36

In the shoe manufacturing the production line is used at its optimal capacity when the number of workstations assures a minimal degree of idleness [3].
Therefore, the idleness degree was calculated with the following formula:

$$K = \frac{\sum \delta_i}{\sum N_a} \quad \textbf{(1)}$$

The resulting values of the idleness degree for different values of production rates on the flow are shown in table 3.

Table 3: *Idleness values for different production rates*

Q [prs/8h]	N_c	$\sum \delta_i$	N_a	K	Q [prs/8h]	N_c	$\sum \delta_i$	N_a	K
600	33.05	2.19	36	0.061	800	44.05	1.99	46	0.043
650	35.99	1.50	37	0.041	850	46.81	2.99	50	0.060
700	38.51	0.53	40	0.013	900	50.81	1.77	53	0.033
750	41.32	1.84	43	0.043					

It is considered that a technological line is used at its optimal capacity when the number of working places assures a minimal value of idleness (δ_i) per working place.

The graphical illustration in Figure 2 shows a minimal value of idleness 0,013 corresponding to a production flow of 700pairs/8h.

Work productivity is calculated as below:

$$W = \frac{P}{N_a} \quad \textbf{(2)}$$

where: P- flow production;

N_a- total number of working places;

$$N_a = \sum_{j=1}^{n} N_{a_j} \quad \textbf{(3)}$$

N_{aj}- total number of working places used for operation j.

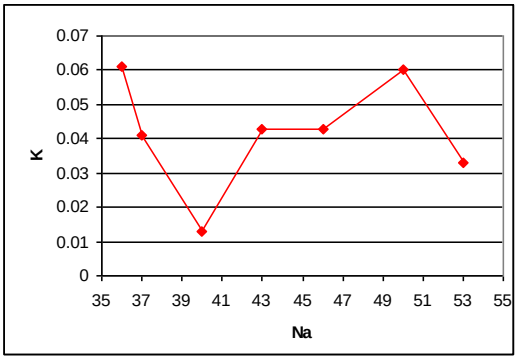

***Fig. 2**:The variation of the degree of idleness K*

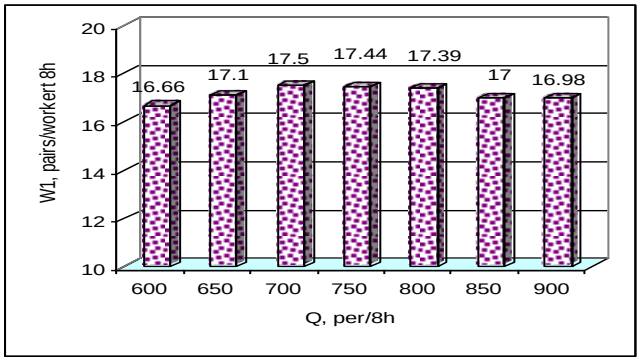

***Fig. 3**: Work productivity before equilibration of the working places*

Work productivity, calculated as the ratio between the production value and the number of workplaces used, defined as pairs/worker/8hours, is illustrated in figure 3.

As shown in figure 3, the greatest value for work productivity, 17.5 pairs/8h, is obtained for a production capacity of 700 pairs/8hours, corresponding to a minimal degree of idleness of 0.013.

For this type of conveyor belt it is possible to couple operations for load equilibration of working places. Therefore, table 4 illustrates the number of workers resulting from load-equilibration of workstations for a production of 600pairs/8h.

***Table 4:** Load equilibration of working places*

Q=600pairs/8h											
Op.op	Nc	Na	Na'	Op.op	Nc	Na	Na'	Op.op	Nc	Na	Na'
1m	1.00	1	1	11M	1.08	1	1	21M	1.65	2	2
2M	2.20	2	2	12M	1.65	2	2	22M	1.00	1	1
3m	0,50	1		13M	1.65	1	1	23M	1.08	1	1
4m	0.38	1	1	14M	1.65	2	2	24 M	0.98	1	1
5M	1.65	2	2	15M	1.15	1	1	25 m	2,00	2	2
6M	1,08	1	1	16M	1.15	1	1	26m	2,00	2	2
7M	0,78	1		17M	1.14	1	1	27m	1,00	1	1
8M	0,78	1		18M	0.76	1	1	28m	1,00	1	1
9M	0,78	1	2	19m	0.62	1					
10M	1.72	2	2	20m	0.62	1	1	**Total**	**33.05**	**36**	**33**

Na'- number of working places adopted, based on load equilibration

After load equilibration of the working places, the productivity was recalculated, showing improved values, table 5.

***Table 5:** Productivity rates after equilibration of working places*

Q pairs/8h	Na	Na'	W2 pairs/worker ·8 h	Q pairs/8h	Na	Na'	W2 pairs/worker ·8 h
600	36	33	18.18	800	46	42	19.04
650	37	34	19.11	850	50	47	18.08
700	40	36	19.44	900	53	50	18.00
750	43	40	18.75				

Following the load equilibration of working places, a maximum value of productivity of 19.44 pairs/worker·8h resulted, which corresponds to a flow production of 700 pairs/8h and an increase in work productivity of 1.94 pairs/worker/8h, figure 4.

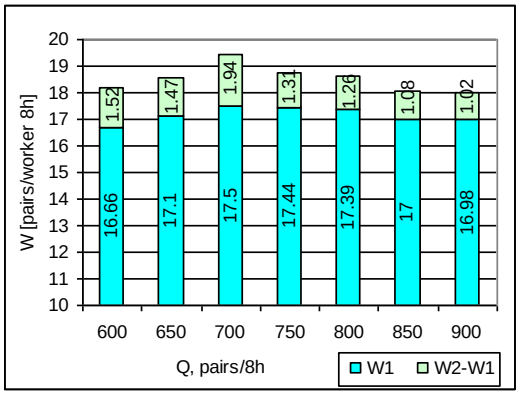

Fig.4: *The difference of productivity after equilibration of working places*

3. CONCLUSIONS

In this study case, variations in size for a production rate Q determine a modification of the degree of idleness for the workstations, resulting a minimum value of 0,013 which corresponds to a production rate of 700 pairs/8h.

Taking into consideration the way the conveyor belt is set up, load equilibration of working places is proposed where possible, and for a series of operations N_{ai} a rounding of N_{ci} is used for workers in training or skillful workers. In this case, for the same production rate for which a minimum degree of load per working place was obtained, the number of working places was reduced from 40 to 36 workers. A higher value of work efficiency was obtained by load equilibration of working places.

The choice considered optimal for a daily production is that of 700pairs/8h resulting in a work productivity of 19.44 pairs/worker·8h compared to the initial productivity of 17.5 pairs/worker ·8h. An improvement of work productivity and an optimization of the resources usage was obtained. Future research can be orientated towards analyzing production efficiency of more varied styles of shoe.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

A NEW DESIGN METHOD FOR FLAT FOOTWEAR SOLES

IONESCU Cozmin[1], LUCA Cornelia[2], SÂRGHIE Bogdan[3]

[1] "Gheorghe Asachi" Technical University of Iasi, Doctoral School of Faculty Textile, Leather and Management Industry, Bd. Dimitrie Mangeron 28 Postal code 70050, Iaşi, Romania, E-mail: ionescucozmin@yahoo.com

[2] "Gheorghe Asachi" Technical University of Iasi, Faculty Textile Leather and Management Industry, Bd. Dimitrie Mangeron 28 Postal code 70050, Iaşi, Romania, E-mail: cionescu@tex.tuiasi.ro

[3] "Gheorghe Asachi" Technical University of Iasi, Faculty Textile Leather and Management Industry, Bd. Dimitrie Mangeron 28 Postal code 70050, Iaşi, Romania, E-mail: bogdan.sarghie@ymail.com

Corresponding author: Luca Cornelia, E-mail: cionescu@tex.tuiasi.ro

Abstract: *Carried research regarding footwear soles revealed that by moulding footwear details can be obtained in a wide variety of models. Shoe soles are complex three dimensional objects and for attaching them with the uppers, the interor countour of the soles has to correspond to the featherline contour of the last. That's why, is necessary that soles design to be done with high accuracy and in strict accordance to the last. Nowadays, there are specialized software applications which can perform various computer aided design processes for footwear. Among the high performance systems used for the design of footwear soles and injection moulds for shoe soles, we may mention: Delcam Shoe Solution, Delcam PowerSHAPE-e, Padsy II and Padsy III, Shoe Master System, Lectra System, Parmel System and ATOS II System. This paper presents a 3D design method, developed by the authors, for footwear flat soles using PowerSHAPE-e software programm from of Delcam Crispin. The computer-aided design technique used in this paper highlights several important advantages that include: increased design quality; three dimensional viewing of soles, which can lead to immediate decisions, regarding the acceptance of newly developed models; it can be appreciated the complexity of mould cavities execution, without the need of making prototypes; the outlines of construction templates are accurately obtained for the mould cavities and for all size numbers; calculations can easily be done for determining the soles volume for the entire size number, with implications on estimating polymer blend consumption and so on.*

Key words: *footwear, shoes soles, shoes soles design, soles injection mould*

1. INTRODUCTION

The CAD/CAM design systems have been largely developed including for the domain of footwear uppers and footwear soles. Among the high performance systems used in the design of footwear soles and moulds for shoe soles, we may mention: Delcam Shoe Solution (3D), Delcam PowerSHAPE-e (2D and 3D) [1], [2] Padsy II (2D) and Padsy III (3D), Shoe Master System (2D and 3D), Lectra System (2D and 3D), Parmel System (2D) and ATOS II System (3D). These systems are equipped with colour graphical displays, plotters, digitizers, terminals and other peripheral equipments needed for computer assisted activities.

The footwear soles are produced as flat footwear soles, as partially spatial zed footwear soles and as spatial zed footwear soles [3]. The complexity of footwear soles design and mould cavities increases with the degree of spatialization. The Delcam Shoe Solutions and Delcam PowerSHAPE-e applications provide to the user the necessary tools to design the most complex footwear soles and footwear moulds.

In this paper is presented a method [4] developed by the authors, for the 3D design of the footwear flat soles which are formed in injection moulds, using the PowerSHAPE-e application.

2. FLAT SOLES FOOTWEAR DESIGN in PowerSHAPE-e. CASE STUDY

The flat sole is the easiest kind of sole to design from a geometrical point of view. A set of steps are followed to design the flat footwear soles [4].

Step 1. Copying the shoe last

The bottom contour of the shoe last is copied as a patter using one of the known methods. This pattern represents the shoe last insole (Fig.1).

Step 2. Inputting the insole outline, drawing the main axis and positioning the basic foot anatomical points

These operations are shown in Fig. 1. The insole outline is drawn as a Bezier curve using the *Create a Bezier Curve* tool under the *Curve* function.

After inputting the insole outline, the two axes are drawn: the insole axis and the shankpiece axis. These axes are drawn using the *Create a single line* tool in the *Line* function as simple lines, by specifying the coordinates.

The main anatomical points are positioned on the insole axis represented by the segment 1-7 in the Fig. 1b. Their coordinates are calculated according to the foot length Lp. The value of the foot length is equal with the footwear last size number, in centimetres. The reference points used for the footwear sole design are the following: 0 – rear foot curvature amplitude; 2 – heel centre; 3 – middle of the foot arch; 4 – centre of metatarso-phalangeal articulations I-V and 5 – extremity of toe V. The position of these points, respectively the length of the segments relative to the point 1, are calculated with the following relations: $0\text{-}1=0.025*L_p$; $0\text{-}2=0.18*L_p$; $0\text{-}3=0.48*L_p$; $0\text{-}4=0.66*L_p$; $0\text{-}5=0.81*L_p$; $0\text{-}6=L_p$. The length of the segment 6-7, represents the length of the footwear last tip whose size is variable and depends on the tip shape.

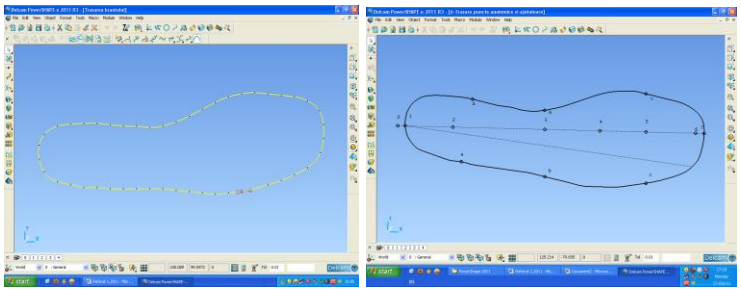

Fig. 1: *Step 1 and Step 2*

The posterior extreme point 0 is obtained by extending the insole axis in the rear zone. In order to accomplish this, a work-plane is positioned with its origin in point 1 and its ox axis overlapping the insole axis. To create this work-plane follow this procedure: select the *Workplane* function and then the *Create a single workplane* tool and position the new work-plane with its origin in the point 1; reposition this plane's ox axis along the insole axis; open de insole axis parameters

editor; select the newly created work-plane as the value of the *Workspace* field; fill the 1-0 segment inverted length in the X field of the start point.

To position the points 2, 3, 4, 5 on the insole axis follow this procedure: select the circle drawing tool; open the position dialog box; select the *Along* option; select the insole axis by clicking next to the start point; fill in the *Proportion* field with the corresponding proportion (e.g.: 0.18 for the point 2); click on *Apply* and then on *OK*.

The position of the point 6 will be determined using the *Line* function and drawing an added line whose length will be equal with the foot length. After positioning the point 6 the added line should be erased using the option *Delete*. The *Horizontal text* tool in the *Annotation* function is used in order to label the points. The position of the points will be marked by circles which are drawn using the *Create a full arc* tool in the *Arc* function. The radius value will be filled in the *Radius* field. The *Name* field is filled automatically with a number generated in the order of creation. However, each circle name can be manually set.

Step 3. Drawing the footwear sole interior contour

The sole interior contour is presented in Fig. 2.

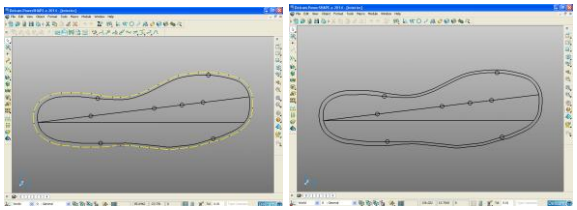

Fig. 2: *Step 3*

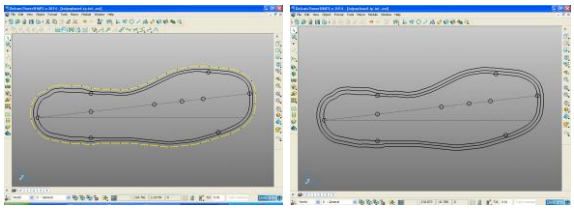

Fig. 3: *Step 4*

The sole interior contour is obtained by adding the thickness of the upper parts to the insole contour. This thickness varies along the insole perimeter depending on the number and the thickness of the layers. From the thickness variation point of view, the zones a-1-a, a-b, b-c and c-7-c are distinguished on the insole contour, represented in Fig. 1. The positioning of the points that separates these zones is accomplished by constructing a set of added lines as Bezier curves. The curves will be drawn in the outside direction using the point 1 as start point

The distance at which the sole interior contour will be positioned in relation with the insole contour is variable. To draw this contour, the *Variable offset* tool in *General edit options* is used. In the *Offset* window associated with this tool, the set of points for each zone is selected individually. If the transition from one zone to the other is not smooth, the curve should be fine-tuned to obtain a smooth curve.

Step 4. Drawing the footwear sole exterior contour

The sole exterior contour, presented in Fig. 3, is drawn at a constant distance in relation with the interior contour. This distance varies depending on the footwear sole model, between 0 and 8 mm. The *Offset items* tool from the *General edit options* is used to draw this curve. Select the sole interior contour and then select the *Offset items* tool. The offset value is specified in the associated window. The *Keep original* button must be activated in order to keep the sole interior contour.

Step 5. Defining the footwear sole gluing surface

The gluing surface, represented in Fig. 4, is the area where the upper and sole are assembled by gluing. This surface is continuous, without weight removal cavities and its width is of 14-15 mm. The exterior of the gluing surface is delimited by the sole interior contour. The interior limit of the gluing surface is obtained by drawing a contour parallel to the sole interior contour, at a distance equal with the gluing surface width. The tool used is *Offset items* in the *General edit options.* After

selecting the sole interior contour click the *Offset items* tool and then specify the offset distance and activate the keep original.

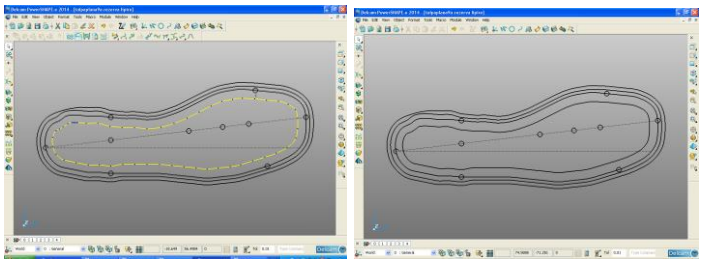

Fig. 4: *Step 5*

Step 6. Creating the solid that defines the volume occupied by the upper in the sole volume

In order to assemble the footwear upper by gluing with the sole a cavity in the sole volume is needed. This cavity represents the volume occupied by the lasted upper in the sole volume.

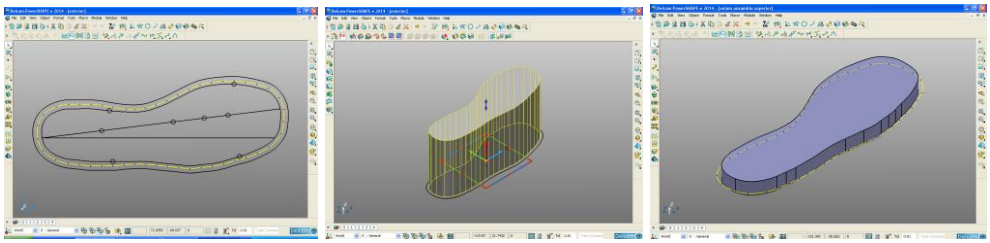

Fig. 5*: Step 6*

To accomplish this, an extrusion solid is created starting from the interior contour of the sole. This solid enters in the sole volume on a distance equal with the cavity height. This volume will be removed from the sole volume. Select the sole interior contour and using the *Create one or more solid extrusions* tool from the *Solid* function the solid is created. The solid extrusion height will be specified in the parameter editor for this solid in the *Negative Length* field. The *Length* occupied by the solid above the sole will be established big enough to allow an easy selection of the solid. In Figure 5 there are shown stages of the step [5], [6].

Step 7. Creating the solid that defines the sole volume. Obtaining the sole cavity

The thickness of the sole is obtained by summing the heel height, the sole cavity height and the sole thickness in the front sole zone.

Initially, the sole will be defined as a monolith solid, obtained by extruding in negative direction the exterior contour on a distance equal with the sole thickness. In order to accomplish this, the sole exterior contour is selected, the solid is created using the *Create one or more solid extrusions* tool in the *Solid* function and the value of the sole thickness is filled in the *Negative Length* field. The field *Length* is filled with the zero value because the sole will be delimited above by the XOY plane of the coordinate system associated to the work-plane. The sole cavity height is obtained by eliminating the solid that defines the cavity from the solid that defines the total sole volume. To operate on the solid that defines the sole, this solid must be activated by checking the option *Active.*

The tool used for solid removal is *Remove the selected solid, surface or symbol from the active solid* in the function *Feature.* Several operations are in Fig. 6.

Step 8. Defining the heel volume

The heel volume is obtained by removing an auxiliary solid from the solid that defines total volume of the sole. he auxiliary solid contour is obtained by drawing a set of straight line segments and/or curves which will be converted in a composite curve. After selecting the contour as a composite curve, the auxiliary solid is created using the *Create one or more solid extrusions* tool in the *Solid* function. The dimensioning of the auxiliary solid is done using the parameters editor: in the *Workspace* section is specified the vertical position of the auxiliary solid in relation with the bottom limit of the sole; in the *Dimensions* section is specified the *Negative Length* so that the auxiliary solid will pass the bottom limit of the sole; the *Length* is set to zero because the top limit is the vertical position of the contour set in the *Workspace* section. The removal of the auxiliary solid is obtained using the *Remove the selected solid, surface or symbol from the active solid* tool in the *Feature* function. The sequence of operations that led to the definition of the heel shape and volume is presented in Fig. 7.

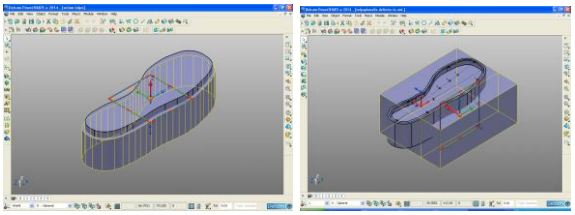

Fig. 6: *Step 7*

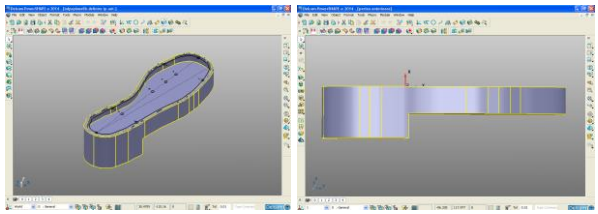

Fig. 7: *Step 8*

Step 9. Obtaining the sole weight removal cavities

A fast and precise method of drawing the weight removal cavities consists in using an auxiliary construction. Using the compound curve tool, each individual weight removal cavity contour is drawn. The auxiliary solids are created by extrusion using this contours solids which will be removed from the sole solid. The extrusion is done in negative direction on a length equal with the depth of the weight removal cavities. The weight removal cavities were obtained by removing the auxiliary solids from the sole volume using the *Remove the selected solid, surface or symbol from the active solid* tool in the *Feature* function. Several operations are in Fig. 8.

Step 10. Obtaining the anti-skid relief. Obtaining the sole templates, designing the mould cavities manufacturing templates

The work method is similar to that used to obtain the weight removal cavities. On the surface of the solid on which the anti-skid relief will be made, an auxiliary network is drawn which will be used to obtain the contours of the auxiliary solids that will be removed from the sole volume. Because the surface of the heel and the surface of the sole are situated on different levels an auxiliary network will be drawn for each of this two zones. For each of the two surfaces a work-plane will be associated. The tool used for the creation of the work-planes is *Create a single workplane.* In order to draw the anti-skid embossment design, the *Create a single line* tool from the *Line* function and *Curve* function will be used.

Finally, the drawings are used to obtain the composite curves using the *Create a Composite Curve by tracing* tool. The composite curves are used to obtain the auxiliary solids using the *Create one or more solid extrusion* tool in the *Solid* function.

The anti-skid relief will be obtained by removing or ading the auxiliary solids volume to the sole volume using the *Remove/Add the selected solid, surface or symbol to the active solid* tool in the *Feature* function. Steps the anti-skid relief drawing are shown in Fig. 9.

By designing the sole, the following templates are obtained: sole interior contour, sole exterior contour, sole contour with antiskid relief and longitudinal cross-section through the sole

axis. To design the mould cavity, these templates will be increased by one of the available methods, using the contraction coefficient value of the polymeric blends used for the sole.

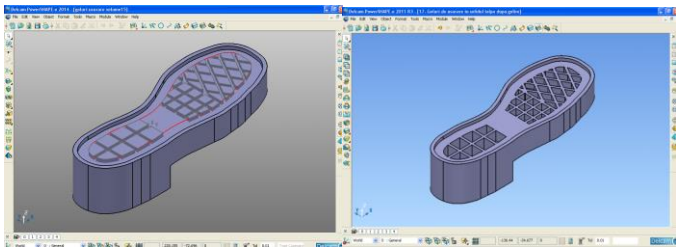

Fig. 8: *Step 9*

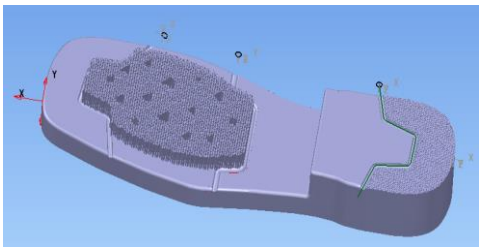

Fig. 9: *Step 10*

3. CONCLUSIONS

- The Delcam PowerSHAPE-e application provides a complete and intuitive computer aided design solution. Unlike other CAD solutions, using PowerSHAPE-e, the surfaces and 3D solids are created with a minimum effort. The method presented in this paper is approachable to any category of designers with basic skills in CAD systems.
- Hybrid modelling from PowerSHAPE-e, combines perfectly solutions for solid and surface modelling, providing the necessary flexibility to develop complex shapes like the footwear soles and mould cavities.
- The developed method allows the input of the 3D last contour, the 3D sole design, endless diversification possibilities of the soles designs, the three-dimensional visualization of the sole models, obtaining the patterns or casts needed for the execution of the mould nests, determining the polymer blends volume needed to obtain the soles, etc.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

THE FOURIER SERIES USED IN ANALYSE OF THE CAM MECHANISMS FOR THE SHOEMAKING MACHINES (PART I)

IOVAN-DRAGOMIR Alina[1], DRIȘCU Mariana[2]

[1, 2] „Gheorghe Asachi" Technical University, Textile, Leather and Industrial Management Faculty, Str.Prof.Dr.Doc. Dimitrie Mangeron, nr.28, 70050, Iasi, Romania, E-Mail: adragomir@tex.tuiasi.ro

Corresponding author: Iovan-Dragomir, Alina, E-mail: adragomir@tex.tuiasi.ro

Abstract: *A computer assisted procedure for the cinematic analysis of the mechanism of a cam is essential in making a certain type of research operations. They mainly refer to the optimization of operations running on specific machinery, or to the re-design of the mechanism, in order to make the mechanism digital. This analysis seems even more important, when we consider the fact that most of the machines used in shoe industry nowadays use a cam mechanism.*
The paper is devided in two parts.
In first part, it is elaborated a method of finding of a function G(x), belonging to a Fourier series, which approximates the numerical values {x_i, y_i}, with the biggest accuracy. Finding the function that approximates the most accurately the data set, for the position parameters of the follower $S(\omega)$, $\Psi(\varphi)$ will lead to a complete kinematic and dynamic analysis of the cam mechanism. These values repeat with $T = 2\pi$ period.
In second part, the method is tasted using MatCAD work sessions which allow a numerical and graphical analysis of the mathematical relations involved, in order to test the reability of the method. The set of experimental data are resulted after measuring a cam mechanism of a machine used in shoemaking.

Key words: *Fourier series, cam, machine, shoemaking,*

1. INTRODUCTION

Cam mechanisms are involved in construction of many machines for shemaking production, as are: lasting machines, steaching machines and so one. The analysis of a cam mechanism means determining these position parameters of the follower, as well as determing its momevent law.

Taking into account the fact that the follower always makes an alternative-period move, we will mathematically model the position parameters of the follower (its movement S and the rotation angle, Ψ) by using Fourier series (fig. 1).

To this aim, the paper presents theoretical analysis of: Fourier series, numerical calculus methods for a definite integral necessary for the determination of the Fourier coeficients, establishing optimization criteria in order to obtain the function that best approximates the position parameters of the follower.

2. GENERAL INFORMATION

2.1 Cam mechanisms

Cam mechanisms [1] are divided in two groups: planar and spatial. In case of the planar mechanisms, the cam and the follower roll also, have the movements in the same plan or in parallel plans. If the movements of the elements of the mechanism are in different plans, this is a spatial mechanism.

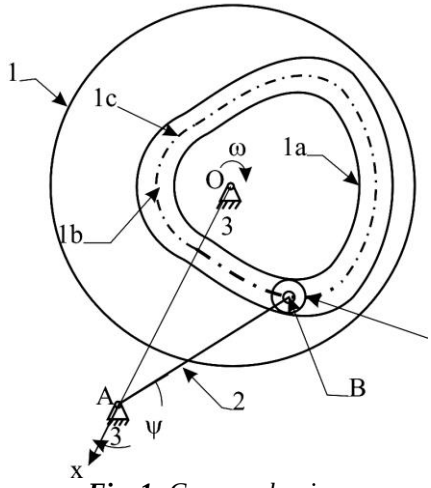

***Fig. 1**: Cam mechanism*

The mechanism presented in fig.1 is composed of: plan cam with groove 1 (bilateral contacts), oscillating follower roll 2 and the framework 3. The contact between the follower and the cam is made by a roll, which go in the groove of the cam.

The cinematic analysis of a cam mechanism can be made using the follow methods [5]: the method of the cinematic charts, the method of the vectorial equations and the method of the transformation of the cam mechanism in the mechanism with lower pairs.

2.2 Fourier series and functions

From the special literature one knows that a periodical function **f(x):[0,T]** with values in *R* can be approximated with **Fourier** [2], [3] series, according to the relation:

$$F(x) := \frac{a_0}{2} + \sum_n \left[a_n \cdot \cos\left[\frac{(2n \cdot \pi \cdot x)}{T} \right] + b_n \cdot \sin\left[\frac{(2n \cdot \pi \cdot x)}{T} \right] \right] \quad \textbf{(1)}$$

From this relation one can notice that, the Fourier series are an infinite sum of trigonometric functions sin, cos with arguments increasing in arithmetical progression and multiplied by a_n and b_n. To these one adds the a_0 term divided by 2.

The forms of the coeficiets of the the Fourier, [2], [3], [4], [6], are:

$$a_0 := \left(\frac{1}{T}\right) \cdot \int_0^T f(x)\,dx \quad \textbf{(2)}$$

$$a_n := \frac{2}{T} \cdot \int_0^T f(x) \cdot \cos\left[\frac{(2 \cdot n \cdot \pi \cdot x)}{T}\right] dx \quad \textbf{(3)}$$

$$b_n := \frac{2}{T} \cdot \int_0^T f(x) \cdot \sin\left[\frac{(2 \cdot n \cdot \pi \cdot x)}{T}\right] dx \quad \textbf{(4)}$$

Where n is a number having values from 0 and ∞.

For the period is T=2*π, the a_0, a_n and b_n are the Fourier series coefficients and, according with special literature, they have the form:

$$a_0 := \left(\frac{2}{\pi}\right) \cdot \int_0^{2 \cdot \pi} f(x)\, dx \quad \textbf{(5)}$$

$$b_n := \frac{1}{\pi} \cdot \int_0^{2\pi} f(x) \cdot \sin(n \cdot x)\, dx \quad \textbf{(6)}$$

$$b_n := \frac{1}{\pi} \cdot \int_0^{2\pi} f(x) \cdot \sin(n \cdot x)\, dx \quad \textbf{(7)}$$

and Fourier series will be:

$$F(x) := \frac{a_0}{2} + \sum_n \left(a_n \cdot \cos(n \cdot x) + b_n \cdot \sin(n \cdot x)\right) \quad \textbf{(8)}$$

This is an infinite sum of trigonometrical functions sin, cos multiplied by coefficients a_n and b_n calculated for different values of the argument *x*.

For a finite terms number of the series given by relation (8), Fourier functions will obtain. Hence, a **Fourier function** will have the following form:

$$G(x) := \frac{a_0}{2} + \left[\sum_{n=1}^{nf} \left(a_n \cdot \cos(n \cdot x) + b_n \cdot \sin(n \cdot x)\right)\right] \quad \textbf{(9)}$$

where:

- nf represents the number of terms of the series;
- n is a variable having values from 1 to *nf;*

- a_0, a_n and b_n are the Fourier series coefficients calculated with the relations (5), (6), (7) for n in the range [0, nf].

NOTE

The number nf, defining the Fourier function form, is choosing as function of convergence criterion of the series, so that the function G(x) approximates the function F(x) with the best accuracy.

3. RESULTATES

3.1 Method of approximation for a periodical experimental data set

In the most situations, a data set $\{y_i, x_i\}$ can not be approximated with an elementary analytical function f(x). For this reason, in computer assisted design, one applies to modern mathematical methods providing methods of finding of the functions which drive to the approximation of the data set.

In this paper, one presents a method of finding of the function G(x), belonging to a **Fourier series**, which approximates the numerical values $\{x_i, y_i\}$ with the biggest accuracy. These values repeat with $T = 2\pi$ period.

The work routines of the present methodology are:

- calculation of the Fourier series coefficients;
- execution of the integral calculus using the trapezes method;
- determining the Fourier function.

Calculation of the Fourier series coefficients

From the relation (2), (3), (4) or (5), (6), (7) an one observes that, for the coefficients a_0, a_n and b_n obtaining, one use an integral calculus from an analytical function **f(x)** or **f(x)cos(nx)** and **f(x)sin(nx)**. As long as the values of these functions are unknown, the integral calculus will apply to numerical methods of determination of a finite integral. According to these, the numerical value of the finite integral represents the area of the field limited by axis *Ox*, function g(x) and the segments of bee line: x=a and x=b, having the following relation:

$$\int_a^b g(x)\,dx := \sum_i g\left(x_i\right)\cdot h_i \qquad \textbf{(10)}$$

where:

- x_i – values of the independent variable for the range [a, b];
- $g(x_i)$ - values of the function $g(x)$ in the points x_i ;
- h_i – the distance between two consecutive values x_i, x_{i+1} like: $h_i = x_{i+1} - x_i$

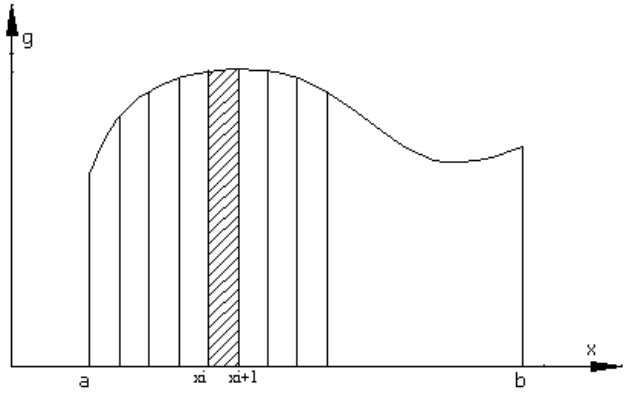

Fig.2: *The area of the field limited by axis Ox, function g(x) and the segments of bee line: x=a and x=b*

Execution of the integral calculus using the trapezes method

In the case of the periodical data set with period 2π, whose values are obtaining from 10° to10°, for example, the numerical data for the integral calculation will be:

$a=0 \quad b=2\pi \quad h_i=2\pi/360 \quad g(x_i)=Y_i.$

The professionals consider that the trapezes formula is the most accurate one for the integral calculation, that can be found in the special literature. Based on this methodology, for a data set Y_i determined in the points x_i= 0, 10°, 20°, 30°..360°, the relation (7), can be re- written as:

$$S := \left(\frac{h}{2}\right)\cdot\left(Y_0 + Y_{36} + \sum_{i=1}^{35} Y_i\right) \qquad \textbf{(11)}$$

From the above presentation, the relations for the coefficients a_0, a_n and b_n determination, the relations used are:

$$a_0 := \left(\frac{1}{36}\right)\cdot\left(Y_0 + Y_{36} + \sum_{i=1}^{35} 2\cdot Y_i\right) \qquad \textbf{(12)}$$

$$a_n := \left(\frac{1}{72}\right)\cdot\left(\sum_{i=1}^{35} 2\cdot Y_i\cdot\cos\left(\phi r_i\right) + Y_0 + Y_{36}\right) \qquad \textbf{(13)}$$

$$b_n := \left(\frac{1}{72}\right) \cdot \sum_{i=0}^{36} 2\, Y_i \cdot \sin\left(\phi r_i \cdot n\right) \qquad \textbf{(14)}$$

where:

- Y_i are experimental numerical values;
- Φr_i – angle belonging to the range $[0,2\pi]$, rad.

Determining the Fourier function

In this routine, one determines the number of terms of the series which will approximate with the biggest accuracy the routine of points $\{x_i, y_i\}$ obtained in the sessions of the getting of data, which will determine Fourier function. To this aim, one calculates with the relation:

$$F_i := \frac{a_0}{2} + \left[\sum_{n=1}^{nf} \left(a_n \cdot \cos\left(n \cdot \phi r_i\right) + b_n \cdot \sin\left(n \cdot \phi r_i\right)\right)\right] \qquad \textbf{(15)}$$

the values of the **Fourier function** for a finite variable number *nf* of terms and one selects that *nf* for which the difference between the initial values Y_i and F_i are minimum.
It results that the selection criterion of the number of terms of the series, and therefore of the Fourier function is:

$$| Y_i - F_i | < \varepsilon \qquad \textbf{(16)}$$

where ε is dependent of the application nature.

The elaborate method will be use in MathCAD sessions, in order to analyse cam mechanisms. The set of experimental data are resulted after measuring a cam mechanism of a machine used in shoemaking.

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ANNALS OF THE UNIVERSITY OF ORADEA
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THE FOURIER SERIES USED IN ANALYSE OF THE CAM MECHANISMS FOR THE SHOEMAKING MACHINES (PART II)

IOVAN-DRAGOMIR Alina [1], DRIȘCU Mariana [2]

[1, 2] „Gheorghe Asachi" Technical University, Textile, Leather and Industrial Management Faculty, Str.Prof.Dr.Doc. Dimitrie Mangeron, nr.28, 70050, Iasi, Romania, E-Mail: adragomir@tex.tuiasi.ro

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Key words: *Fourier series, cam, machine, shoemaking*

1. INTRODUCTION

The kinematic analysis [1] of a cam mechanism aims to determine the position and kinematic parameters, the low of the movement, mechanism design features and operating phases.

First, it is determined the numerical correlation between the rotation angle of the cam and the position parameter of the follower. Then, the low of motion of the follower is derided, in order to calculate the velocity and acceleration of the follower.

This paper uses a set of experimental data that resulted after measuring a cam mechanism of a machine used in shoemaking industry, in order to prove the reliability of the methodology develop in part I using Fourier series.

2. GENERAL INFORMATION

2.1 Experimental appreciation of the methodology

For the experimental appreciation of the elaborated methodology it was used the software MathCAD system which allows a numerical and graphical analysis of the mathematical relations involved.

For example, one considers a series of experimental data (Φ_i, S_i), which are processing with the following routines [2], [3], [4]:

1. One creates the vectors of the initial data. In this example, the initial data are the angles Φ_i for the range [0,2π] and length of a cam notated as S_i, mm.

2. For the appreciation of the elaborated methodology and the correctness of the data, the graph of the initial values is plotted in orthogonal coordinates, as can be seen in the Fig.1 and pollar coordinates, Fig.2, [3], [4], [5].

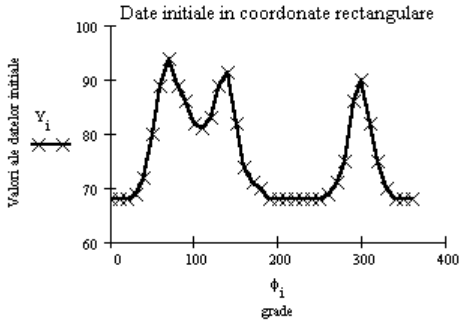

***Fig. 1**: The graph of the initial value in ortogonal coordinates*

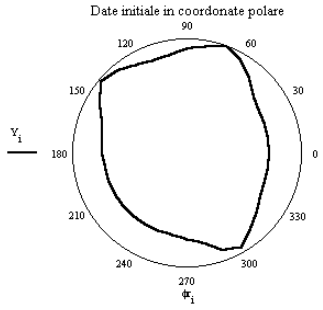

***Fig. 2:** The graph of the initial value in pollar coordinates*

3. Using **MathCAD**, one can calculate with the relations the coefficients of the Fourier series a_0, a_i, b_i for those 37 values (Φ_i, S_i), and Fourier functions [6], [7], [8]:

$$F_i := \frac{a_0}{2} + \left[\sum_{n=1}^{nf} \left(a_n \cdot \cos\left(n \cdot \Phi r_i\right) + b_n \cdot \sin\left(n \cdot \Phi r_i\right) \right) \right] \quad \textbf{(1)}$$

where:

- i is index of those 37 experimental data;
- Φ_{ri} - angle for the range [0, 2π], rad;
- N – degree of the Fourier coefficients;
- a_0, a_n and b_n - the Fourier coefficients;
- nf – the terms number of the Fourier series corresponding to the function $\mathbf{F_i}$.

2.2 Choosing of the number of coefficients a_n and b_n

The determination of that function approximating the initial data set with the best accuracy one proceeds as following:

1. One creates a matrix $\mathbf{G_{k,i}}$ of Fourier functions of 37 columns and *nf* lines like this:

$$G_{k,i} := \frac{a_0}{2} + \left[\sum_{n=1}^{k} \left(a_n \cos\left(n \cdot \Phi r_i\right) + b_n \cdot \sin\left(n \cdot \Phi r_i\right) \right) \right] \quad \textbf{(2)}$$

2. An analytical and graphical analysis will be made for the obtained functions. In this paper, for exemplification, the graph of the Fourier functions is presented for all points Φ_i=0°, 10°, 20° , 30°..360° and k=0, 5, 10..35, 36 (fig.3). Analyzing the graphical form, it results that the

numerical data are approximated with a good accuracy with the Fourier functions defined for k=5, 10..35.

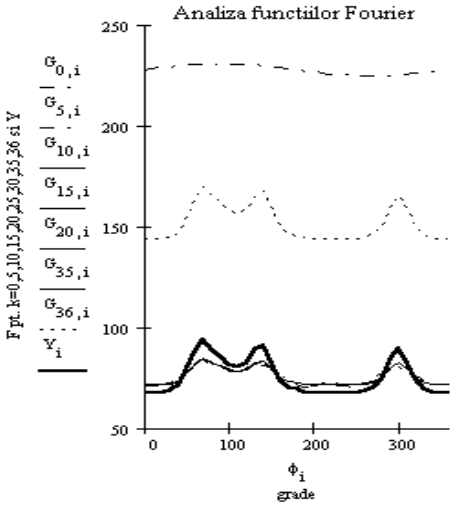

***Fig.3**: The graph of the Fourier function for all points for all points*

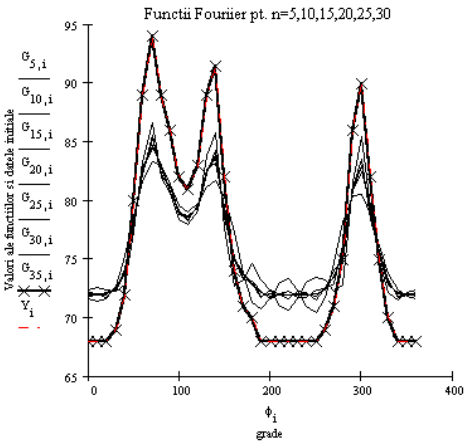

***Fig.4:** The graph of the Fourier function pentru n=10, 15, 20, 25,30 termeni*

3. One limits the field of the Fourier functions for k=5, 10..35 and the graphical form of the Fourier functions is re-analyzed by comparison with initial graph (Fig.4). For numerical determination of that function which approximates with best accuracy initial data, a matrix of the errors will be created having the form: $\mathbf{ER_{k,i}=| G_{k,i}-Y_i|}$
in which will be inscribed the differences between initial data and those obtained by approximation, i=0...36, for those 36 Fourier functions, then one creates the vector V: $\mathbf{V_i=min\{ER_{k,i}\}}$

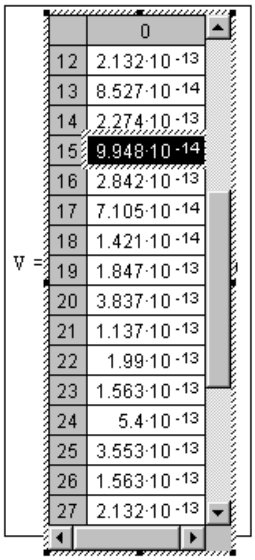

***Fig.5:** The analiz of the errors*

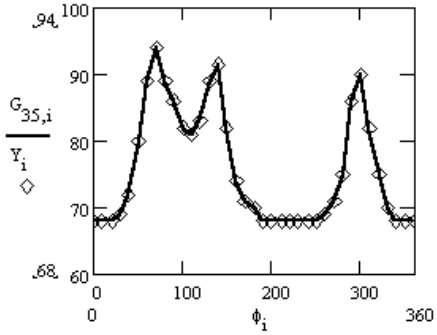

***Fig. 6:** The graph for the best Fourier function*

For the data set studied one inscribes the values of the Fourier function defined of 35 terms in the vector V. Analyzing the numerical values inscribed in the vector V (Fig.5), one observes that they are very small, about 10^{-13} or 10^{-14}.

One can certainly assert that the Fourier function defined for 35 terms approximates with the best accuracy the initial data set.

The determined Fourier function will be:

$$F(x) := \frac{a_0}{2} + \left[\sum_{n=1}^{35} \left(a_n \cdot \cos(nx) + b_n \cdot \sin(nx) \right) \right] \quad \textbf{(3)}$$

defined for 36 values of the coefficients a_n and b_n for n=0,1,2..35

The graph of the Fourier function calculated for 36 terms *a, b* and initial point Yi is presented in the fig. 6. The analysis of this graph shows the mode of the positioning of the initial values *Yi* on the Fourier graph. The values were obtained in the session of getting data.

3.CONCLUSIONS

From those above presented one can assert doubtlessness that the Fourier function belonging to a Fourier series, having 35 terms approximates with the best accuracy a periodical experimental data set.Once one finds the function of the position parameters of the S peg and the other sets, that best approximates the set of data, a complete cinematic analysis of the cam can be made.

This analysis seems even more important, when we consider the fact that most of the machines used in textile industry nowadays use a cam mechanism. Taking into consideration the fact that the peg always executes an alternative and periodical movement, the procedure one has to use Fourier series to mathematically model the position parameters following the shift of the S peg in second part.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

RECENT ADVANCES IN LEATHER TANNERY WASTEWATER TREATMENT

LOFRANO Giusy[1*], CELİK Cem [2], MERIC Sureyya[3]

[1] University of Salerno, Department of Chemistry and Biology "A. Zambelli", via Giovanni Paolo II, 132- 84084 Fisciano (Salerno), Italy

[2] İstanbul University, Leather Technology Program, Vocational School, Avcılar, Turkey, E-mail: celik44@gmail.com

[3] Namik Kemal University, Çorlu Engineering Faculty, Environmental Engineering Department, Çorlu 59860, Tekirdağ, Turkey, E-Mail: smeric@nku.edu.tr

*Corresponding author: Lofrano, Giusy, E-mail: glofrano@unisa.it

Abstract: *The tannery industry is one of the most important economic sectors in many countries, representing an important economic field also in developing countries. Leather tannery industry is water intensive and originates highly polluted wastewater that contain various micropollutants raising environmental and health concerns. Tannery wastewater is difficult to treat biologically because of complex characteristics like high salinity e high content of xenobiotics compounds. After conventional treatment (i.e., chromium precipitation–primary sedimentation–biological oxidation–secondary sedimentation), effluents still do not meet the required limits, at least for some parameters such as BOD, COD, salinity, ammonia and surfactants. The leather industry is being pressured to search cleaner, economically as well as environmentally friendly wastewater treatment technologies alternative or integrative to the conventional treatment in order to face the challenge of sustainability. The most spread approach to manage tannery wastewater is the steam segregation before conveying wastewaters to in treatment plants that typically include pre-treatment, mechanical and physico-chemical treatment, biological treatment, and treatment of the generated sludge. Thus proper treatment technologies are needed to handle tannery wastewater to remove effectively the environmental benign pollutants. However among various processes applied or proposed the sustainable technologies are emerging concern. This paper, as the-state-of-the-art, attempts to revise the over world trends of treatment technologies and advances for pollution prevention from tannery chemicals and wastewater.*

Key words: *Leather tannery, leather tannery wastewater, sustainability, innovative treatment technologies, BOD, COD*

1. INTRODUCTION

The tannery industry is one of the most important economic sectors in many countries, representing an important economic field also in developing countries [1]. Currently it is condidered that the environmental impact of the leather industry is equivalent to the pollution generated by 1000–4000 citizens for each ton of animal hide treated [2]. The concerns related to effluents originated from this industry are mainly due to severe toxic effects caused by the mixture of many

compounds used in the process that can be released to the environment because they even remain after conventional treatment [3],[4], [5] or may inhibit nitrification process as well [6].

The leather industry is being pressured to search cleaner, economically as well as environmentally friendly wastewater treatment technologies alternative or integrative to the conventional treatment in order to face the challenge of sustainability [1]. This paper reviewes the recent advances in leather tannery wastewater treatment, discussing their main findings.

2. WATER USE AND WASTEWATER CHARATERISTICS

Tannery wastewater production varies in wide range (10–100 m^3 per ton hide) depending on the raw material, the finishing products and the production processes. The streams released from several process units present very different characteristics [7]. For instance the beamhouse wastewater is characterized by an alkaline pH and the tanning effluent by a very acidic pH as well as high COD. The exhausted bath of the soaking contains excrements, salts and chemical additives. Degreasing steps are characterized by organic solvents [8,], [9]. In the dyeing step azo dyes are released [10].

3. TANNERY WASTEWATER TREATMENT

The most spread approach to manage tannery wastewater is the steam segregation before conveying wastewaters to in treatment plants that typically include pre-treatment, mechanical and physico-chemical treatment, biological treatment, and treatment of the generated sludge. In otherwords, stream segregation is the initial step in implementing in-plant controls. Due to the difference in wastewater characteristics from beamhouse (high pH, and sulfides), tanning and retanning (low pH and chromium) operations, more efficient control could be achieved trough the use of a treatment process specifically designed for the related pollutant [8],[10].

Various physiochemical techniques used for wastewater treatment can be applied to tannery wastewater (to the entire process or to separated streams in the process) including advanced oxidation processes [1]. However those processes needs to be properly calibrated in order to avoiding an excessive sludge production.

Tannery wastewater is difficult to treat biologically because of complex characteristics like high salinity e high content of xenobiotics compounds. After conventional treatment (i.e., chromium precipitation–primary sedimentation–biological oxidation–secondary sedimentation), effluents still do not meet the required limits, at least for some parameters such as BOD, COD, salinity, ammonia and surfactants [1,3,6].

4. ADVANCED WASTEWATER TREATMENT TECHNOLOGIES

The rising need of reducing the impacts and increasing resilience of water uses require a new wastewater management strategy that includes: i) the development of innovative wastewater technologies able to lead to the reuse or recycling of spent liquors and the recovery of materials; ii) the optimization of the water-energy nexus in this sector.

For instance the low pH, relatively high temperature (43–45 °C) and the high presence of aromatic compounds, especially in the streams of retanning baths make them attractive to use Fenton and Photo-Fenton processes [11], [12].

The use of high performance materials for tannery wastewater treatment has been recently investigated. De Martino et al. [13] reported a 99.9% Cr^{3+} removal and a decreasing of COD from 13.17 g L^{-1} to 8.70 g L^{-1} in tanney wastewater treated by using an on an organo-mineral complexes adsorbent tested the potential use of plasma-sprayed photocatalytic TiO2 coatings in tannery wastewater treatment, reporting a decreasing of TOC and colour under acidic conditions. A cobalt oxide doped nanoporous activated carbon (Co-NPAC) has synthesized and used as a heterogeneous catalyst for the Fenton oxidation of organic dye chemicals used in tannery process by.

The solid waste productions represent a further aspect in the sustainability assessement of tannery wastewater treatment. Therefore their reuse should be promoted in a sustainable wastewater management. In a recent study carried out in a pilot-scale tannery drum, solid waste from tanneries, i.e., chromium-tanned leather shaving waste, was used as the adsorbent reaching 86.6% dye removal form effluents generated through a wet end process [10].

Finally Souza et al. [2] demonstrated the feasibility of energy recovery through the photocatalytic conversion of sulfide-rich tannery sludge into hydrogen using CdS as a photocatalyst, platinum as a co-catalyst and visible light.

Table 1 gives a cumulative comparison approach to the the innovative technologies searched in tannery wastewater management.

Table 1. *Evaluation of innovative technologies proposed/applied for tannery wastewater management*

Process	Matrix	Innovation	Objectives	Scale	Main findings	Ref.
Photocatalytic hydrogen production	Sludge	Sludge was treated photocatalytically with visible light irradiation, under anaerobic conditions, using CdS as a photo- catalyst and Pt as co-catalyst	Energy recovery	Laboratory	The tannery sludge concentration and pH were the most important factors in producing the highest hydrogen levels. The strong interaction between these two factors was associated with the consumption of hydrogensulfide ions during the reaction. In contrast, the Pt content and mass of CdS were less relevant factors.	[2]
Adsorption	Dyeing wastewater	Wastewater was treated by using solid waste from tanneries, i.e., chromium-tanned leather shavingwaste as adsorbent	Optimizing adsorption parameters	Pilot	86.04% dye removal and 16.05 mg g−1adsorption capacity of the adsorbent at equilibrium, predictedby the pseudo-second-order model	[10]

Adsoprtion	Wastewater	Wastewater was treated with an organo-mineral complex, named LDH–HP, obtained in turn by sorption of polymerin, the humic acid-like fraction occurring in olive oil mill wastewater, on a layered double hydroxide (LDH) of magnesium and aluminium with carbonate in the interlayer.	Removing Cr3+ from tannery	Laboratory	This process allows the complete removal of Cr3+ from wastewater and also the abatement of chemical oxygen demand, indicating to be a very promising purification process for an industrial application	[13]
Fenton oxidation (FO)	Dyeing wastewater	Wastewater was treated by Fenton oxidation using a cobalt oxide doped nanoporous activated carbon (Co-NPAC) prepared from rice husk	Enhancing removal of refractory organics in tannery dyeing wastewater	Laboratory	The maximum percentage of COD removal was found to be 77%	[15]
Photocatalysis	Methylene blue dye in aqueous solution.	Application of plasma-sprayed TiO2 coatings	Enhancing photocatlysis performance	Laboratory	The findings showed that there was a clear organic matter mineralisation and colour removal by photo-catalysis beyond the photolysis effect under acidic pH.	[14]
Biological treatment +FO	Wet –blue wastewater	Integrated Anoxic/Oxic (A/O) and Fenton of oxidation	Removal of organic pollutants	Laboratory	In the A/O process, the suitable OLR was at least up to 0.8 kg COD m_3 d_1. In the Fenton for post-treatment the highest predicted COD removal percentage was 55.87%.	[16]

5. CONCLUSIONS

The ongoing development of advanced treatment systems may facilitate the whole wastewater processes promoting its reuse inside the industrial water cycle. Most of these technologies are still at lab scale therefore the costs related to full scale application can not be estimated.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

CONTRIBUTIONS TO THE CALCULATION OF NORM TIME EDGE THINNING OPERATIONS PARTS OF FOOTWEAR

MALCOCI Marina[1], PASCARI Ioana[1], GHELBET Angela[1]

[1] University Technical of Moldova, Faculty of Light Industry, Postal address MD 2045, S. Rădăuțan str., 4, degree block number 11, Chisinau, Republic of Moldova, E-Mail: mmalcoci2005@yahoo.com

Corresponding author: Malcoci Marina, E-mail: mmalcoci2005@yahoo.com

Abstract: *It is known that regulations allow the introduction in production regimes efficient operation of equipment and methods of rational organization of production. To ensure accuracy imposed regulations must meet the following conditions: to take into account the main factors influencing consumption of work; depending on the types of production which they are intended to ensure adequate precision. In this work the analysis literature authors proposed a new relationship for calculating the standard time for the operation of thinning also set the value of two coefficients K1 and K2. K1 is a constant coefficient for thinning operation of 1,0549; and K2 - a constant that depends on the degree of automation of the machine. Knowing the degree of mechanization machines and time required to perform operation coefficient was determined K2, namely Km – 1,0833; KM – 1,0460; KA – 0,0785. Since the relationship for the calculation of the time aids not it into consideration that a part may contain from 3 to 5 types of profiles, it has been proposed that it be included in the relationship, so there was obtained a new relationship calculation. The study conducted also allowed the optimization of computing time assistant relationship, including the number of adjustments in relation computing machine. Proper use of normative values, taking into account the type of machine, but also their knowledge calclulul methodology allow us to identify the following positive effects on the company's footwear: reducing workload; achieving balanced labor standards; saving human effort; reducing worker fatigue etc.*

Key words: *thinning, time, landmarks, footwear, equipment.*

1. INTRODUCTION

Labor regulations that expresses the size, depending on the factors of influence, shows the need for labor to carry out the various elements of the production process. May be normative: consumption of time, consumption of raw materials, energy etc. Establishing norms is a process times by taking advantage of the lead time before launching the product manufacture. Regulations allow the introduction in production regimes efficient operation of equipment and methods of rational organization of production. To ensure accuracy imposed regulations must meet the following conditions: to take into account the main factors influencing consumption of work; depending on the types of production which they are intended to ensure adequate precision etc. [1].

For the application of labor standards in the production of certain general conditions necessary to ensure their quality. These conditions relate to: the type knowledge production, knowledge of the job (manual, mechanical, automated, robotic, cybernetic), and providing accurate technical and organizational conditions envisaged in developing standard employment etc. Among the factors that

may influence particular elements to change the duration of time we can include: means of labor, working conditions, workplace organization, the movements of the performer, type of production, the level of mechanization of the process. It is known that most often come from the waste of time planning flawed, the mistakes of organization, failure to control, from normative values obsolete or not adapted to the type of machine in the company etc. [1].

2. GENERAL CONSIDERATIONS

By the time norm means the time allotted to a contractor who is suitably qualified to carry out one unit of product, organizational and technical conditions specified in the workplace.

Emission time is calculated with [1-6]:

$$N_t = T_{pî} + T_{op} + T_{dl} + T_{îr} \quad \textbf{(1)}$$

where: $T_{pî}$ is the time of preparation - closing; T_{op} - operative time; T_{dl} - time maintenance of employment; $T_{îr}$ - regulated during interruptions.

Force is the time during which the performer performs or supervises the work needed to transform quantitative and qualitative labor oboiectelor, performing and helpful actions with its components. Operative relationship computing time in s, is next [1-6]:

$$T_{op} = t_b + t_a \quad \textbf{(2)}$$

where: t_b is the time base, the contractor overseeing work performed or for direct labor objects change; t_a - time assistant, the performer runs needed careful handling quantitative and qualitative transformation.

$$t_b = t_{b1} + t_{b2} \quad \textbf{(3)}$$

where: t_{b1} - for curved parts; t_{b2} - for straight sections;

$$t_a = t_{a1} + t_{a2} + t_{a3} + t_{a4} + t_{a5} \quad \textbf{(4)}$$

where: t_{a1} - taking commission from a box and placing it on the machine table; t_{a2} - settlement the part thinned to the right, taking another landmark and its introduction in the car; t_{a3} - stops for changing direction; t_{a4} - adjustment work for another thinning; t_{a5} - gathering thinned parts of the machine table and putting them in a box.

3. PARTICULARS OF TECHNOLOGY THINNING EDGE PARTS FOR FOOTWEAR

Operation of thinning margins parts aims to reduce the thickness of certain areas of contour parts to avoid thickening in areas overlapping edges in assembly parts and assembly parts play an aesthetically pleasing superior [7; 8].

In the footwear industry, after performing the operation mode, we distinguish thinning - mechanical and automated machines made from thinned and hand [7; 10].

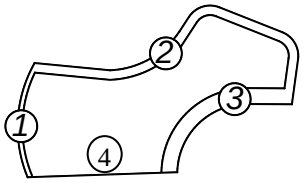
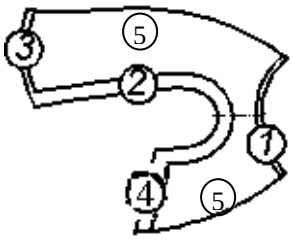
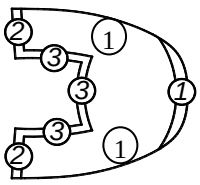
By changing the position of the spacer foot depressor and can get different types of thinning after profile [8]:

- *Thinning right,* should be made to bend the edge and stitch 180º.
- *Thinning slash the size zero* is performed on the parts to be processed for overlapping parts.
- *Thinning oblique finite size* is used to avoid thickening in areas held reserve, but also for parts to be processed by burning.

Table 1 shows the number of adjustments to the machine configuration thinned by parts of

footwear and mechanization machines [7-9].

Table 1: *Analysis of the number of adjustments to the machine thinned*

Graphical presentation of the piese	Type of profile	Name bodies working to be modified	The number of adjustments	
			Clasic machine, M	The automatic machine, A
	1	Spacer, heavy foot (thickness)	+	+
	2	Spacer, heavy foot (thickness)	+	
	3	Spacer, heavy foot (thickness, angle thinning)	+	
	4	Spacer, heavy foot (thickness)	+	
	1	Spacer, heavy foot (thickness, angle thinning)	+	+
	2	Spacer, heavy foot (thickness)	+	
	3	Spacer, heavy foot (thickness)	+	
	4	Spacer, heavy foot (thickness, angle thinning)	+	
	5	Spacer, heavy foot (thickness, angle thinning)	+	
	1	Spacer, heavy foot (thickness, angle thinning)	+	+
	2	Spacer, heavy foot (thickness, angle thinning)	+	
	3	Spacer, heavy foot (thickness)	+	

Analysis configurations of parts of footwear, thinning types used and the degree of mechanization machines enabled the identification of parts thinned the number of flexible adjustment of 3 to 5 per machine mechanics. When the automatic machine requires only adjustment for flexible parts.

4. RELATIONS CALCULATION OF NORM TIME FOR OPERATION THINNING EDGE PARTS

Relationship standard is calculated as the thinning operation is not established, it is calculated proceeding from the standard production / productivity machine, or take the technical documentation developed in the 1980s by Russian specialists. Literature presents normative values for the time and basic auxiliary. The calculation formula No. **4** time helper does not consider that a part can contain from 3 to 5 different profiles. Therefore, it is proposed the following amendment of the relationship:

$$t_a = t_{a1} + t_{a2} + t_{a3} + t_{a4} * n_r + t_{a5} \quad \textbf{(5)}$$

where: n_r - number of adjustments to the machine.

After analyzing the literature, but also the calculations made by the authors propose the following equation for calculating the standard time for the operation analyzed:

$$N_t = K_1 * K_2 * T_{op} \quad \textbf{(6)}$$

where: K1 is a constant for thinning operation of 1,0549; K2 - a constant that depends on the degree of automation of the machine.

We know the following degrees of mechanization: manual (m), mechanical (M), automated (A). Was calculated for each analytical value was thus obtained the following coefficients or Km – 1,0833; KM – 1,0460; KA – 0,0785.

5. CONCLUSIONS

After analyzing the literature has proposed a new relationship for calculating the standard time for thinning operation also was established value of two coefficients K1 and K2. K1 is a constant coefficient for thinning operation of 1,0549; and K2 - a constant that depends on the degree of automation of the machine. Since in relation No. **4** Calculation of Time helper is not it considered that a part can contain from 3 to 5 different profiles, it was proposed that it be included in the relationship, so we obtained a new relationship number **5** calculation.

Proper use of normative values, taking into account the type of machine, but also knowing their calculation methodology allow us to identify the following positive effects on the company's footwear: reducing workload; achieving balanced labor standards; saving human effort; reducing worker fatigue etc.

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ANNALS OF THE UNIVERSITY OF ORADEA
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STUDY REGARDING THE PATTERN DESIGN FOR FOOTWEAR WITH AND WITHOUT PREMOULDING OF THE VAMP

MĂRCUȘ Liviu[1], ISCHIMJI Nicolai[2]

[1] Technical University "Gh. Asachi" Iaşi, Faculty Textile Leather and Management Industry, bd. Dimitrie Mangeron nr.28, postal code 70050, Iasi, România, email: liviumarcus@yahoo.com

[2] Technical University of Moldova ,Faculty Light Industry Chisinau, Moldova, email:ischimjinicola@yahoo.com

Corresponding author: Mărcuș, Liviu, E-mail: liviumarcus@yahoo.com

Abstract: *When it comes to footwear design, independently from the type of shoe that is to be designed (pumps, boots, ankle boots), there are different situations where the vamp is brought up to the leg. Specific for this choice of asemblance, is that the vamp can have two or three symetry axes. Therefore, the pattern is to be transformed into a single simetry ax guideline.This paper analyses ways to obtain the pattern of the vamp, by using the method of successive rotations and previous perforations of the material. This paper does not propose to analyze the existing methods, which are more or less accurate, but based on the authors' experience in designing footwear, we propose two methods of cutting the vamp, leading to an spatializing during installation and also saving material during the operating of re-cutting the premoulded pattern after preforming. Most times, the preformation pattern is drawn approximately, during the second cut resulting huge waste, thus affecting the leather consumption. Based upon a theoretical approach and a graphical construction, we managed to obtain a reduction of the wastes during the second cut, and for certain models to completely eliminate this operation. In comparison to the used methods, which as we showed before are very inaccurate, using the presented algorithm we can obtain a material economy of up to 15-20%.*

Key words: *footwear design, preformed, simetry axe, recutting, premoulding.*

1. INTRODUCTION

In the composition of different footwear models, regardless of assortment (shoes, boots, ankle boots), we can encounter different constructive variants for the vamp, the most frequent one being the variant where the vamp is prolonged above the ankle joint.

In order to achieve this landmark, which during assembly receives a gap, there are two possibilities:

- To obtain the vamp by successively rotating it in certain positions;
- To obtain an approximate pattern of the vamp, to tailor and preform the profile of the shoe given by the conformation of the last and of the basic design.

The literature proposes different solutions to achieve these milestones, each author having a subjective approach, purely theoretical. [1]

This paper does not propose to analyze the existing methods, which are more or less accurate, but based on the authors' experience in designing footwear, we propose two methods of

cutting the vamp, leading to an spatializing during installation and also saving material during the operating of re-cutting the premoulded pattern after preforming.[2,3]

We chose the same boot type as an example, having into consideration the fact that the producer owns a preforming machine. Most times, the preformation pattern is drawn approximately, during the second cut resulting huge waste, thus affecting the leather consumption. [4]

Based upon a theoretical approach and a graphical construction, we managed to obtain a reduction of the wastes during the second cut, and for certain models to completely eliminate this operation. The median line of the top of the boot is drawn from the intersecting point with the vamp. The higher point of the vamp S is connected with point B, situated on the tangent line in the top are resulting BS line.

ll_1, tangent to the curve BS. The intersecting point is E. In E the perpendicular on BS results point E_1.fig.4..

2. OBTAINING THE VAMP PATTERN BY SUCCESIVELY ROTATING IT IN CERTAIN POSITIONS

The most conclusive example is cutting the vamp, which is shaped like a saddle. A good example for this is the boot model in Fig 1.

Fig. 1: *Model of boots with prior vamp preforming*

We go through all known stages for obtaining the basic design by adapting the anthropometric parameters given for the calf and the dorsal side of the foot.

Particular attention should be paid to the manner in which the copy of the last on which the chosen model has been drawn on is flattened.[5]

The choice of the vamp midline is also a basic element.Fig.2 .

Fig.2: *The basic design for boots with vamp preforming*

In order to determine correctly the correspondence between the vamp line and the top of the boot, we proceed to fixing the medium copy on the last, after previously cutting the upper part, which by installation spatializes. Fig 3 a and b.

Fig3.a: *Fixing the basic design on the last*

Fig3.b: *Setting the medium line at vamp*

We can observe that by successively rotating the vamp, using the methods which are proposed by the literature, we obtain different contour lines. The advantage of this method is that the landmarks can be cut immediately, without needing any supplementary corrections.

3.DRAWING THE VAMP PATTERN FOR BOOTS WITH PRIOR VAMP PREFORMING

We chose the same boot type as an example, having into consideration the fact that the producer owns a preforming machine.

Most times, the preformation pattern is drawn approximately, during the second cut resulting huge waste, thus affecting the leather consumption.

Based upon a theoretical approach and a graphical construction, we managed to obtain a reduction of the wastes during the second cut, and for certain models to completely eliminate this operation. The median line of the top of the boot is drawn from the intersecting point with the vamp. The higher point of the vamp S is connected with point B, situated on the tangent line in the top are resulting BS line.[6]

ll_1, tangent to the curve BS. The intersecting point is E. In E the perpendicular on BS results point E_1.fig.4..

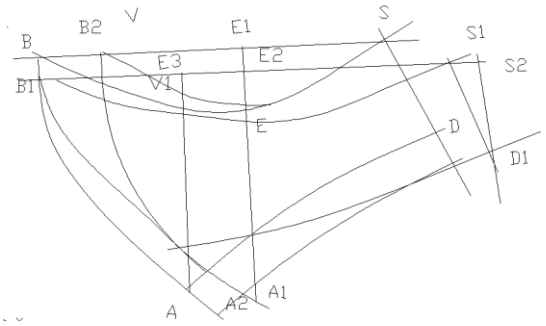

Fig.4: *Drawing the vamp pattern for boots with prior vamp preforming*

In point E_1 we measure E_1 A_1, which is the vamp width.

E_1 E_2= 0,33 E_1 E
From E_2 we draw a parallel to BS, intersecting with the vamp contour B_1.
B_1 S_1= K_s BS= B_1 S_2= the vamp median line
K_s=1,04 for leather
Din A perpendicular on B_1 S_1 results E_3
E_3 A_2=0,996K_s EA_1+ 0,34EE_1

We determine the upper pattern line S_1 D_1, as follows:
From S on SB we draw the distance SV.
SV=1,37 SE_1

The perpendicular from V on B_1 S1 gives the vamp rotation point V_1.

The initial pattern is superposed with point S in S_2 and is rotated until it intersects with point V_1 (see the printed line).

We mark the obtained points B_2 A_2 D_1 S_1, and obtain the pattern for preforming. We aim to have a straight angle in point S_2.

When the vamp is preformed using the preforming machine, we can obtain deformations of up to 3-5 mm. This is why in S_1 D_1 and D_1 A_2 we add 5-7 mm.

To this we can 2- 3 mm.

The resulting pattern we use for cutting.

In comparison to the used methods, which as we showed before are very inaccurate, using the presented algorithm we can obtain a material economy of up to 15-20%.

3. CONCLUSIONS

The two methods for getting the pattern of vamp are different from the methods proposed in the literature.

For getting the pattern of vamp we need to set the last of the basic pattern and that it is the author's own conception.

By making construction graphic patterns for preforming and neckline, on the basis of practical measurements , we have found a saving of material about 15-20%.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

A STUDY ON USING 3D VISUALIZATION AND SIMULATION PROGRAM (OPTITEX 3D) ON LEATHER APPAREL

Ork Nilay[1], MUTLU Mehmet Mete[1], POPESCU Georgeta[2], MOCENCO Alexandra[3]

[1] Ege University, Engineering Faculty, Leather Engineering Department, 35100 Bornova, Izmir, Turkey, mete.mutlu@ege.edu.tr
[2] National Research and Development Institute for Textile and Leather, 030508, Lucretiu Patrascanu 16, sector 3, Bucharest, Romania, georgeta.popescu@certex.ro
[3] Greta Oto Design, Via Alessandro Massaria, 36100, Vicenza, Italy, alexandra_mocenco@yahoo.com

Corresponding author: Mutlu, Mehmet Mete, E-mail: metemutlu@gmail.com

Abstract: *Leather is a luxury garment. Design, material, labor, fitting and time costs are very effective on the production cost of the consumer leather good. 3D visualization and simulation programs which are getting popular in textile industry can be used for material, labor and time saving in leather apparel. However these programs have a very limited use in leather industry because leather material databases are not sufficient as in textile industry. In this research, firstly material properties of leather and textile fabric were determined by using both textile and leather physical test methods, and interpreted and introduced in the program. Detailed measures of an experimental human body were measured from a 3D body scanner. An avatar was designed according to these measurements. Then a prototype dress was made by using Computer Aided Design-CAD program for designing the patterns. After the pattern making, OptiTex 3D visualization and simulation program was used to visualize and simulate the dresses. Additionally the leather and cotton fabric dresses were sewn in real life. Then the visual and real life dresses were compared and discussed. 3D virtual prototyping seems a promising potential in future manufacturing technologies by evaluating the fitting of garments in a simple and quick way, filling the gap between 3D pattern design and manufacturing, providing virtual demonstrations to customers.*

Key words: *Leather, Leather apparel, 3D, Simulation, Physical properties*

1. INTRODUCTION

Virtual prototyping is a technique used in the process of garment development that involves application of computer aided design intended for garments development and virtual prototyping of them. Its aim is to integrate all specific characteristics of the garment into the virtual prototype that fits the virtual human body model [1].

The application of computer aided design (CAD) intended for garments development and their virtual prototyping has become an obvious trend in many of industries recently. Nowadays, the virtual prototyping allows us an accurate and rapid development of garments, as well as adaptable and quickly changeable garments [2-3].

Virtual garment simulation is the result of a large combination of techniques that have also dramatically evolved during the last decade. The cloth is by nature highly deformable, therefore the mechanical representation should be accurate enough to deal with the nonlinearities and large deformations occurring at any place on the cloth, such as folds and wrinkles [4]. With application of the 3D virtual garment prototyping the garment's patterns can be placed and draped on the virtual

human body. When the virtual prototyping is accurate the garment fitted to the body model reflects and combines characteristics of the garment style, garment pattern design, virtual body model and mechanical properties of textiles [5]. The success of 3D virtual garment prototyping programs closely depends on definition of the used material properties to the program. Present softwares contain selection of many fabric types within the program. However lack of detailed leather types in the software hinders usability of these programs in leather garment manufacturing.

3D virtual garment prototyping programs have advantage of time, labor and material saving by fitting designed garment models and patterns on virtual mannequins. Leather jacket production requires numerous inputs. The major cost of a jacket, which is more than 74%, is the leather cost followed by the labor cost which accounts for about 21% [6]. These figures show the importance of material and labor cost.

In this study, a dress was designed and produced by using textile and leather materials both virtually and in real. The first one was a leather dress, where individual mechanical and physical properties of the leather were defined to the program. The second was a cotton fabric dress, where fabric properties of the material were selected from the OptiTex database. Similarities and differences were compared between virtual model and real production.

2. MATERIAL AND METHOD

2.1. Material

9 chromium tanned leathers, Cotton fabric (97% Cotton / 3% Spandex), Polyester lining, Gauge for thickness measurement Sylvac S229 (textile) and Pellizzato (leather), Hounsfield H10 dynamometer and Louis Schopper tensile strength testing instruments, Analytical balance Acculab 302, 3D Scanning VITUS Smart XXL (Human Solutions GmbH, Germany), 3D visualization and simulation program OptiTex 3D, LECTRA cutting machine VECTOR FASHION FP, Industrial sewing machine, Brother S 7200B-403/EFL one needle direct drive with thread trimmer, Polyester close-end zipper, No.50 polyester thread, Adhesive for leather apparel

2.1. Method

Samplings of all leathers for the tests were done according to TS EN ISO 2418. The test samples were conditioned according to SR EN ISO 2419:2003 [7]. Thicknesses of test samples were measured according to SR EN ISO 2589:2004 [8]. Physical properties of samples were determined following standards: SR EN ISO 3376: 2012, ISO 13934-1, SR 5045:2008, IRS SR 6144-86(A) and TS EN ISO 17235 [9-13]. The surfaces of leather and cotton fabric were scanned by a scanner. 3D body scanning of selected person was performed using the Human Solutions 3D body scanner at National Research and Development Institute for Textile and Leather (INCDTP) Bucharest, Romania. The scanner consists of 4 laser sensor and 8 photo cameras with CCD sensor. The 3D scan object has a density of points of 300 points/cm^2. After that, the body measures were taken using the program package VITUS Smart XXL. 151 different body measurements were obtained as one example: body height is shown in Fig. 1.

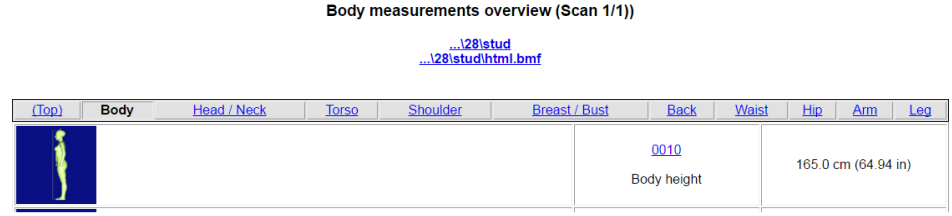

***Fig. 1**: Body height 3D scanning*

The 3D body scanning system used is a mobile system efficient in serial measurements, which consists in a very precise body scanner and powerful software, Anthroscan. The VITUS Smart XXL scanner is based on the most precise optical triangular method with laser, for the 3D image capture, in conformity with EN ISO 20685:2005 [14]. The system combines the efficiency and flexibility of an automate capture of the body sizes, providing the user the possibility to define individual measuring rules perfectly fit to his/her own requests. The parametric 3D body model of selected female was built by using OptiTex PDS program and the body measures obtained from the scanner. These body measures were: body height, neck, bust, over-bust and under-bust, waist, hips, upper arm, wrist, thigh and high thigh, knee, neck, arms, waist to hips, waist to floor and many others with the aim to achieve more realistic appearance of the virtual body model (Fig. 2).

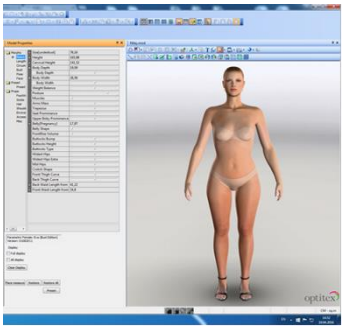

***Fig. 2**: 3D body model on OptiTex PDS*

A dress model was designed as shown in Fig. 3. Many different pattern making systems are used in the apparel industry, developed according to the nation's anatomy and changes in the pattern preparation steps with respect to different systems [15]. In this study, the dress patterns were designed by using OptiTex 2D system in conformity with German pattern drafting system M. Müller & Sohn (Fig. 4). The carton drawing and cutting of patterns were made by Lectra cutting machine.

***Fig. 3**: Design of dress model*

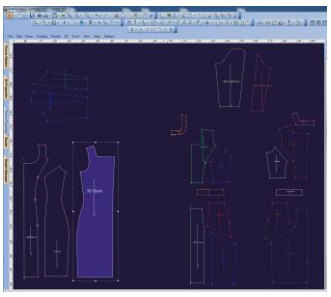

***Fig. 4**: Screenshot of patterns on OptiTex 2D*

The leathers and fabric were cut by placing dress patterns on them and the pieces were laid on a table individually (Fig. 5-6). Linings were cut by placing dress patterns on them and the pieces were laid on a table individually (Fig. 7).

***Fig. 5**: Leather pieces*

***Fig. 6:** Cotton Fabric pieces*

***Fig. 7**: Lining pieces*

The leather and fabric pieces of the dresses were sewn by using BROTHER S 7200B-403/EFL sewing machine. The dresses were finished and fittings were done. For the leather dress some adjustments were done in order to improve the fitting because the leather was flexible and 1 cm on the hip line was cut to tight the dress around hip line (Fig. 8). Then, last fittings were done.

***Fig. 8**: Fitting of leather and cotton fabric dress*

3. RESULTS

The surface images of leather and cotton fabric are shown in Fig.9-10. These images were transferred to the program to observe the details of material texture in the 3D simulation.

***Fig. 9**: Surface of leather*

***Fig. 10**: Surface of cotton fabric*

Physical tests were applied to both leather and fabric samples according to leather and textile official test methods. The obtained test results are given in Table 1. Acceptable quality standards recommended by UNIDO for chromium tanned garment leathers are 10 N/mm2 for tensile strength and 15 N/mm for double edge tear load [16]. BASF Leather Pocket Book has a recommendation of less than 60 % elongation at break value for chromium tanned clothing leathers [18]. When the data given in Table 1 are considered in terms of strength and elongation; and compared with the recommended standards; it is seen that the leather has met the standards for tensile strength and elongation % for tests done according to leather standards. Single edge tear, is getting importance in last years, thus there is no recommendation in old standards. Additionally it was observed that the tensile properties of fabric were higher than the leather when tested within the same standards; however textile fabric had less elasticity and percentage elongation.

Similar tests were done again to same samples by using textile testing standards. Again tensile strength of fabric was found higher than leather; and percentage of elongation was found lower than the leather sample. Another finding is that although the names and principle of the physical tests used in leather and textile are similar, they have different methods, patterns, sample measures which leads to obtain differences in results as seen in Table 1. So it is advised to measure the properties of materials either only by using leather methods or only textile methods, but not to compare results of separate methods.

Table 1: *Physical test results*

Test	Leather Standards		Leather	Fabric
Tensile	Thickness (Mean) (mm)		0.48	0.30
	Strength(N/mm^2)	Mean	15.53	37.70
	Elongation (%)	Mean	49.33	27.66
Single Edge Tear	Thickness (Mean) (mm)		0.61	0.31
	Strength (N/mm)	Mean	5.66	48.10

Test	Textile Standards		Leather	Fabric
Tensile	Thickness (Mean) (mm)		0.56	0.43
	Strength (N/mm^2)	Mean	22.55	26.33
	Elongation (%)	Mean	86.53	21.40
Single Edge Tear	Thickness (Mean) (mm)		0.56	0.43
	Strength (N/mm)	Mean	7.48	36.16
Weight	Mean (g/m2)		302.44	177.36

OptiTex 3D software demands some properties as bending, stretch, shear, friction, thickness and weight. The results obtained from physical analyses were interpreted to the 3D program considering physical and organoleptic tests, and then the data were entered in the 3D program and after, the dresses were simulated. The real and virtual dresses are shown on the Fig. 11-12.

Fig. 11*: Real and visual leather dress*

Fig. 12*: Real and visual cotton fabric dress*

In 3D program clothes are virtually sewn on the avatars, but clothes should be physically worn by human in real life after sewing. That's why 3D programs sometimes couldn't simulate wearing comfort in the reality. In this study, the dress was not designed with long sleeves because leather and cotton fabric are not elastic like some fabrics. Thus, this dress can be worn comfortably by human. And for the same comfort reasons, the dress was designed with a zipper from back of the neck to the hip. Then the virtual and the manufactured dresses were compared and done critics by experts. It was concluded that the virtual and real appearances were very similar. But the most important thing is defining the material properties right. Leather is an anisotropic material, the strength and stretch properties change directionally and locational over the area of the leather [18] and one to the other even from the same batch. The parameters of the program in which are available for standard textile fabrics should be adjusted in accordance with the leather type and properties.

5. CONCLUSIONS

In this study, which we presented the process of 3D virtual prototyping of dress based on a 3D body scan model and then the real and virtual models were compared to each other, the following conclusions were came out as outputs:

- The success of apparel begins with right body measurements. Using a 3D body scanning system provides possibility to obtain individual measures perfectly to match with dress measures.
- 3D body scanning systems make it possible to create realistic avatars in short time with precision.
- 3D Visualization and Simulation programs need and have a rich material database. However the variety of leather material is not defined enough.

- It is possible to interpret new material properties to 3D programs by using some data as bending, stretch, shear, friction, thickness and weight. Some physical tests can provide related information.
- Although the names and principle of the physical tests used in leather and textile are similar, they have different methods, patterns, sample measures which leads to obtain differences in results.
- It is possible to obtain realistic simulations comparable to in real world examples by interpreting the right material data.

As a final conclusion 3D virtual prototyping seems a promising potential in future manufacturing technologies by evaluating the fitting of garments in a simple and quick way, filling the gap between 3D pattern design and manufacturing, providing virtual demonstrations to customers and maybe for e-tailoring chains, but material properties and interpreting to software should be studied in detail.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

SEWABILITY PROPERTIES OF GARMENT LEATHERS TANNED WITH VARIOUS TANNING MATERIALS

ORK Nilay[1], MUTLU Mehmet Mete[1], YILDIZ Esra Zeynep[2], PAMUK Oktay[3]

[1] Ege University, Faculty of Engineering, Leather Engineering Department, 35100, Izmir, Turkiye, mete.mutlu@ege.edu.tr

[2] Ege University, Emel Akin Vocational Training School, 35100, Izmir, Turkiye, esra.zeynep.yildiz@ege.edu.tr

[3] Ege University, Faculty of Engineering, Textile Engineering Department, 35100, Izmir, Turkiye, oktay.pamuk@ege.edu.tr

Corresponding author: Yildiz, Esra Zeynep, esra.zeynep.yildiz@ege.edu.tr

Abstract: *Chromium tannage is the most used technology in processing of garment leathers. Due to environmental requirements and demands on natural products there is an increasing interest on alternatives to chromium tannage especially on vegetable tanned leathers. Leather properties vary in a very wide range depending on the animal type it is obtained from and the process type and chemicals used in the manufacturing. In this study, the effect of various tanning materials to the sewability of garment leathers was investigated. For this purpose, vegetable, chromium and chromium-vegetable combination tanned garment leathers from the same animal origin were supplied from a garment leather manufacturing factory. Needle penetration force and the sewability values of these leathers were determined by using L&M Sewability Tester. It was found that material properties and sewing properties showed differences regarding to the tanning material used even in same type of raw material. Chromium tanned leathers had sewability values of 13.4% horizontal and 14.2% vertical which are considered good to fair. Vegetable tanned leathers and chromium-vegetable tanned leathers had sewability values of 38.2% horizontal, 49.2% vertical and 98% horizontal, 98.5% vertical respectively which are considered poor. The results of the study conclude that, there is a big difference in material properties when the tanning technology and material is changed which also affects the sewing properties.*

Key words: *Leather, Sewability, Garment, Tanning materials.*

1. INTRODUCTION

Leather processing can simply be defined as, modification of hides/skins by a sequence of chemical and physical treatments. Although leather processes and the preferred chemicals have big contribution to designation of final leather characteristics, the type of the raw material, type and amount of tanning material used, have the most important effect [1]. Modern tanning chemistry can be classified by mineral, vegetable, oil, aldehyde, and organic tanning and syntans [2].

Chrome tanning is one of the most popular tanning systems because of the excellent qualities of chrome tanned leather such as high hydrothermal stability, good dyeing characteristics and softness [3]. Although vegetable tanning materials are generally used in production of saddlery, harness, belt, shoe upper and sole leathers requiring less elasticity, high shape retention and firmness; their use in garment leather production has increased due to natural look and feel they

confer to leathers and high demands on natural products in last decades. The vegetable tanning process is flexible, and can produce leathers with a very wide range of characteristics [4]. Besides, combination of various tanning materials and chemicals provide a possibility to combine their characteristics or even to enhance properties with their synergistic effect. This can lead to produce leathers with better properties than the leathers tanned with a single type of tanning material.

Leather clothing differs in its origin, tannage and mechanical or physical properties. It is necessary to distinguish between pig, goat and sheep leather, and cowhide, which differ both in their properties and in their surface appearance. Leather clothing is affected both by its basic mechanical properties and usage characteristics and by the manufacturing features of the leather [5].

Apparel making is the process of making shell structures from flat fabrics or leathers to match the shape of human body. During this process, leathers are subjected to various types of mechanical stresses, which are indispensable for the garment appearance [6]. In garment manufacturing, a two dimensional structure is converted into a three dimensional structure. During the process of sewing, the needle is subjected to repeated tensile stresses, heat, bending, pressure and wearing. These stresses repeatedly act on the thread as a result of which leather is subjected to various types of mechanical stresses which are low stress in nature [7].

The term sewability can be defined as the ability and the ease with which the 2-D fabric components can be qualitatively and quantitatively be seamed together to 3-D garment [8]. Better sewability means greater ease of formation of shell structures and styles with the absence of fabric distortion and seam damage. The appearance and durability of seams form an important component of the quality of the finished product [9]. Damage of the structure of the fabric occurs when the fabric is penetrated by the needle. The needle can penetrate at any point in the fabric. The structure of the fabric can be deformed beyond its elastic limit or can literally be destroyed [10].

The sewing needle penetration force which is one of the most significant technical parameter in the sewing process is the quantitative measure of the damage that appears in a garment as the result of the sewing process [11]. A high penetration force means a high resistance of the fabric and thus a high risk of damage [12]. The sewing needle penetration force is affected by various factors such as type and amount of layers of the sewing material, needle size, shape of needle point, stitch speed of the sewing machine, and treatment of the sewing material, among others [13]. The fabric should withstand the needle penetration without any damage to the fabric [10].

Although many sewability studies have been carried out on textile fabrics, there is not much study related to sewability of garment leathers. It is accepted that leather as a material needs more penetration force for the needle. However leather properties vary in a very wide range depending on the animal type it is obtained from and the process type and chemicals used in the manufacturing. The present work aims determination of the sewability properties of garment leathers tanned with various tanning materials which are chromium, vegetable and chromium-vegetable combination. Sewability of these garment leathers were compared with each other in terms of the average needle penetration force (gf) and the sewability value (%). A good seam is a measure of quality in leather garments. The results of this study will give data to be considered in sewing to obtain better seams for manufacturing of high quality leather garment products.

2. MATERIAL AND METHOD

2.1 Material

In this research 3 chromium, 3 vegetable and 3 chromium-vegetable combination tanned garment leathers (English origin sheep skins) obtained from a garment leather manufacturing factory were used. The samples were analyzed by using L&M Sewability Tester as three parallels vertically and horizontally.

2.2. Method

Sampling of leathers were done according to TS EN ISO 2418. The tests were carried out at the same conditions according to TS EN ISO 2419. The thicknesses of test samples were measured according to TS 4117 EN ISO 2589. Apparent density of leathers was calculated according to TS 4121 EN ISO 2420 [14-17].

Fig.1: *L&M Sewability Tester*

The sewability properties of the leathers were determined by using L&M Sewability Tester (Fig. 1). It enables consecutive readings of force for penetration of the fabric by a selected needle to be measured on a small sample of fabric at a rate of 100 penetrations/min [18]. This device measures the penetration force exerted by a sewing needle on the fabric. A strip of fabric passes through a zone in which a sewing needle operates. A nominal value (threshold) of penetration force is determined based on the fabric mass per unit area according to the fabric type, and then the number of times this value is exceeded is recorded. Fabric sewability corresponds to the number of points that exceed the threshold previously set, related to the over-all tested points and expressed as a percentage. The sewing operation will be more difficult as the sewability parameter increases [19].

In this study the device setting was maintained constant for all the tests; the total count per leather was 100; the force range chosen was 500gf, and the threshold value for sewability determination was 150gf. The number of high recordings which exceed the threshold value, which is called the "sewability value", was also recorded.

3. RESULTS AND DISCUSSION

The weight and thickness properties of garment leathers tanned with chromium, vegetable and chromium-vegetable combination were determined and are given in Table 1. Vegetable tanned leathers are known to give denser and thicker leathers; contrary chromium tanned leathers are famous with their light, soft and thinner character. Apparent density of chromium tanned leathers and vegetable tanned leathers vary between (0,680 - 1,000 g/cm^3) and (0,780 - 1,150 g/cm^3) respectively [20]. When the apparent density figures in Table 1 are considered, they are in accordance with the reference limits. Although thickness of leathers are adjusted by mechanical operations to give a uniform distribution across the whole area; vegetable tanned leathers were found thicker than chromium-vegetable combination tanned leathers and chromium-vegetable combination tanned leathers were found thicker than chromium leathers.

Table 1: *The properties of garment leathers.*

Leather type	Weight (g/m^2)	Thickness (mm)	Apparent density (g/cm^3)
Chromium	*290,62*	*0,52*	*0,71*
Chromium-Vegetable combination	*363,96*	*0,59*	*0,79*
Vegetable	*420,95*	*0,61*	*0,87*

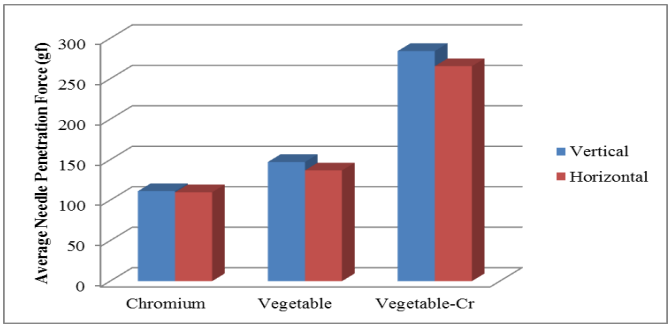

Fig. 2: *Average Needle Penetration Force of Different Tanned Leathers.*

As it can be seen from **Fig. 2**, the values of needle penetration force were varied between 111 gf and 284 gf.

Vegetable tanned leathers had higher needle penetration force and sewability values than chromium tanned leathers. However semi-vegetable leathers had the highest needle penetration force and sewability values in both directions. These findings could be related to physical properties of the used leathers. Ork et al. (2014) also found that semi-vegetable tanned leathers came into prominence with their high strength and low extension set properties which are important for garment leathers. When physical test results of leathers tanned with different tanning types were statistically evaluated, it was concluded that tanning type has important effect on the physical properties of leathers even from the same origin. Physical properties of the leathers were varied due to the tanning material used in their production [1].

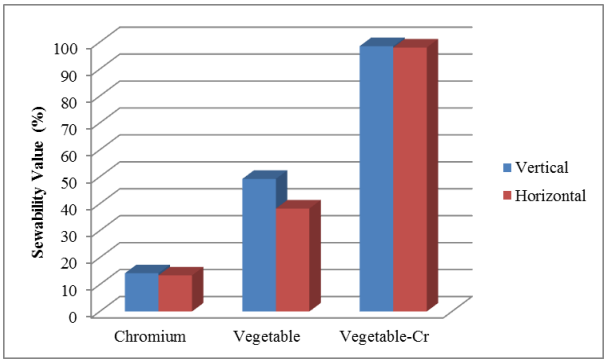

Fig. 3: *Sewability values of Different Tanned Leathers*

When sewability values ranged between 0 and 10%, the fabric sewability was considered good; between 10 and 20% sewability was considered to be only fair even though no great difficulties arose during sewing [21].

As it can be seen in **Fig. 3**, sewability values of chromium tanned leathers were found 13.4% horizontal and 14.2% vertical which could be accepted a fair value close to good. However vegetable tanned leathers and chromium-vegetable combination tanned leathers had sewability values of 38.2% horizontal, 49.2% vertical and 98% horizontal, 98.5% vertical respectively. So the sewabilities of these samples are considered poor. This means that an extra attention is required to obtain seam quality in production of garment leathers tanned with vegetable or vegetable-chromium combination tannage.

Ork et al. (2014) found stitch tear values of chromium, vegetable and chromium-vegetable tanned leathers as 334 N/cm, 518 N/cm and 786 N/cm respectively [1]. Although stitch tear resistance test is a static test which is done in tensile testing equipment and sewability test is a dynamic test done with L&M sewability tester, there seems a consistent relation between the results as seen **Fig. 4**.

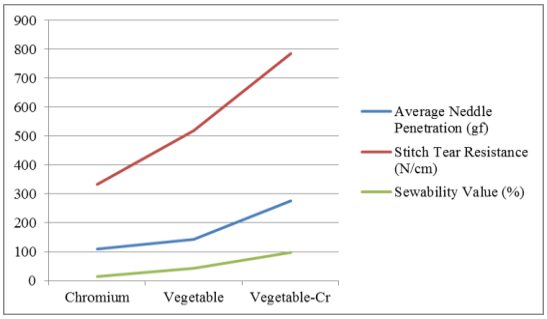

Fig. 4: *Average Needle Penetration, Stitch Tear Resistance and Sewability values of Leathers*

5. CONCLUSIONS

In the last decades there is a demand on natural products in leather industry as in many industries. Vegetable tannins which are known to give heavy, strong and durable leathers are now being used in the production of soft, light and elegant garment leathers either alone or in combination with mineral tanning materials. Undoubted, tanning materials have a significant effect on the material properties of leathers produced. In this study, sewability of garment leathers tanned with chromium, vegetable and vegetable-chromium combination tanning agents has been determined and the following conclusions have been found:

- Chromium leathers were found having the lightest weight, the thinnest and the less apparent density followed by chromium-vegetable combination and vegetable tanned leathers. Vegetable tanned leathers had come closer to the characteristics of chromium tanned leathers; however there are still some differences in properties.
- Average Needle Penetration Force was found lowest for chromium tanned leathers, followed by vegetable and chromium-vegetable tanned leathers in order. That means chromium tanned leathers can be sewn with a less needle force, and more needle force is required for vegetable and chromium-vegetable tanned leathers.
- Chromium tanned leathers had sewability values of 13.4% horizontal and 14.2% vertical which are considered good to fair. Vegetable tanned leathers and chromium-vegetable tanned leathers had sewability values of 38.2% horizontal, 49.2% vertical and 98% horizontal, 98.5% vertical respectively which are considered poor.
- When the results of dynamic sewability test are compared with static stitch tear test, the relation among the data was found consistent, even the tests have totally different principles.

Leather is a luxury product due to limited supply, high cost of material and labor. This luxury product should maintain all the quality and environmental requirements. Besides; garment design and manufacturing quality have also big importance. The design should meet the fashion, comfort, aesthetic expectations of the consumer. Leather garments contain many joining and ornament seams due to small patterns related to animal size. These seams should be proper to meet the quality aspects. The results conclude that, there is a big difference in material properties when the tanning technology and material is changed which also affects the sewing properties.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

POTENTIAL USE OF COLLAGEN HYDROLYSATES FROM CHAMOIS LEATHER WASTE AS INGREDIENT IN LEATHER FINISHING FORMULATIONS

POPA Emil[1], BĂLĂU MÎNDRU Iulia[1], PRUNEANU Melinda[1], BĂLĂU MÎNDRU Tudorel[1]

[1] "Gheorghe Asachi" Technical University of Iaşi, Romania, the Department of Chemical Engineering in Textile – Leather, Faculty of Textile Leather and Industrial Management, 53 Dimitrie Mangeron Avenue, postal code 700500, Iaşi, Romania

Corresponding author: Bălău Mîndru Iulia; E-mail: ibalau@tex.tuiasi.ro

Abstract: *The aim of this paper is the obtaining of value-added products from the dust resulted from chamois leather buffering, a solid waste that raises serious disposal problems, due to its physical state and complex chemical composition. Starting from leather waste, an alkaline hydrolysis was performed followed by the chemical modification of the polypeptyde hydrolysate by polycondensation with dispersions of copolymers of vinyl acetate with acrylic esters and reticulation with glutaraldehyde in order to improve its hydrophobicity. The resulted product can be used/was tested as an ingredient in leather finishing formulations, as binder or carrier agent. In this paper, new finishing mixtures were prepared using pigments and obtained polypeptide hydrolysates as a substitute for casein in pigment pastes. By this method, there were obtained two experimental variants of brown and black pigment pastes which were compared to the pigment pastes with casein binder. Natural grain Box bovine leather samples coated with such admixtures were subjected to physico-mechanical resistance tests, in accordance with the standardized methods. Specific tests carried on finished leather – tensile strength, tear resistance, resistance to grain cracking, dry and wet rubbing fastness, flexural fatigue strength test, etc – showed values of this characteristics comparable to those obtained with casein conventional finishing.*

Key words: *alkaline hydrolysis, polypeptide product, crosslinking, binder agent, coatings.*

1. INTRODUCTON

Collagen-based wastes coming from tanneries/leather processing are the subject of numerous research works, due to the different recovery posssibilities, by processing into useful products, with applications in: production of chemical auxiliaries for leather processing [1-3], cosmetics industry [4], health care [5], pharmaceutics [6], electronics [7], building materials [8,9], agriculture [10], bioplastics [11]. In leather industry for example, simple and modified collagen hydrolysates from leather waste, act as filler in re-tanning operations of leather processing [12] or can be a very good finishing agent for leather finishing [13,14].

It is the aim of this paper to obtain an alkaline hydrolysate starting from leather waste resulted from the buffing of chamois leather, in the following conditions: autoclaving with ammonium hydroxyde (NH_4OH) solution with pH 11, at 3 atm pressure, for 6 h. Heating the reactants dramatically accelerates hydrolysis. The same way as proteins, lipids were depolymerized or unbound by hydrolysis.

Alkali treatment, in the form of hydroxide solution, is used for rapid dissolution and then for hydrolysis of the proteins into small peptides and amino acids in the form of their ammonium salts. These salts can be removed by using membranes that retain the amino acids and peptides, by a dialysis process. Alkaline hydrolysis leads to the random breaking of nearly 40% of all peptide bonds in proteins. The vast majority of the products of the hydrolysis are single amino acids or small

peptides in the 2-5 residue range (nearly 98% of the hydrolyzate). The hydrolysis process results in reducing the collagen proteins of about 30 KDa into small peptides having an average molecular weight between 2 and 5 kDa. [15].

The polypeptyde hydrolysate was isolated/separated from the reaction mass and chemically modified by polycondensation with dispersions of copolymers of vinyl acetate with acrylic esters followed by reticulation with glutaraldehyde to improve its hydrophobicity [16,17,18].

The operation of leather finishing also implies conferring an adequate ergonomic aspect with the help of certain film coatings with characteristic hygienic and physico-mechanical properties. The main substance in coating varnish and paints from the pigment paste is casein, a micellar phosphoproteide, extracted from cow milk, which tends to be replaced by other chemically modified compounds [19].

In this paper, new finishing mixtures were prepared by using pigments and afore mentioned hydrolysates as a substitute for casein in pigment pastes. Films and leather samples coated with such admixtures were subjected to physico-mechanical resistance tests, in accordance with the standardized methods.

2. MATERIALS AND EQUIPMENTS

a) Chamois powder wastes from/provided by S.C MESSY DANNY DAY tannery, with the following composition: total ash: 11,8 %; extractable fats (in trichloroethylene): 9,8 % [UNI EN ISO 4048 2000]; water soluble matter: 4,8 %; and pH: 10,5.

b) Chemical reagents and chemical auxiliaries: trichloroethylene, NH_4OH, NaOH, sulfated castor oil, glutaraldehyde, vinyl acetate, acrylic resin, nonionic surfactants (Boron), Casicolor Brown R Casicolor Black.

c) Equipment: Velp Sctientifica Vortex Mixer, AT 510 Kyoto Electronics for unionized α-amino groups determination, VESLIC - C4500 and IUP 450 for color resistance to friction, Bally Flexometer for flexing resistance, VELP Scientifica UDK 132 with semiautomatic Distillation unit for total nitrogen determination, Dialysis membrane cut off 800-100 Da, Krebs Viscometer.

3. EXPERIMENTAL

In a first stage leather waste was subjected to alkaline hydrolysis; the chemical process was carried out in a batch reactor provided with a pressure manometer and automatic temperature control. Thus 250 g chamois waste powder was treated for wetting/ swelling and partial degreasing process with a mixture of ammonium hydroxide and emulsion of nonionic tenside/trichloroethylene (1p/5p) at 20^0C, for 24 h. Then the mixture was placed in a stirrer-equipped autoclave at 250% fleet ratio, and heated at 130°C, 3 atm pressure, for 6 h. The resulted mixture was then cooled down to 20°C and the undissolved residue was separated by decantation-centrifugation at 6000 rpm, for 30 min, followed by filtration.

The operations for obtaining polypeptide alcalin hydrolysates are shown in Figure 1.

In order to extract fats from the liquid phase, a mixture of polypeptide filtrate and trichlorethylene was placed in extraction vials and continuously stirred at room temperature in a Velp Sctientifica Vortex Mixer shaker, vibration type, for 4 hours. The resulting fats were then removed by separation in a separating cone.

The characterization of the alcalin hydrolysate was performed by classical analyses (total solids, total solubles, ash, total nitrogen contents by Total Kjeldahl Nitrogen method, fat acids, soaps, pH and hydrolysis yield). The following results were obtained:

- total solids: 9,78%;
- total solubles: 25,12 g/l;
- ash: 7,9%;
- total nitrogen: 18%;
- fat acids: 2,94 g/l;
- soaps: 14,21 g/l: pH 8;

- hydrolysis yield: 67,65%.

The soluble molecular weight by dialysis process was: 800 -1000 Da. This value shows a strong fragmentation of the protein and formation of amino acid fragments.

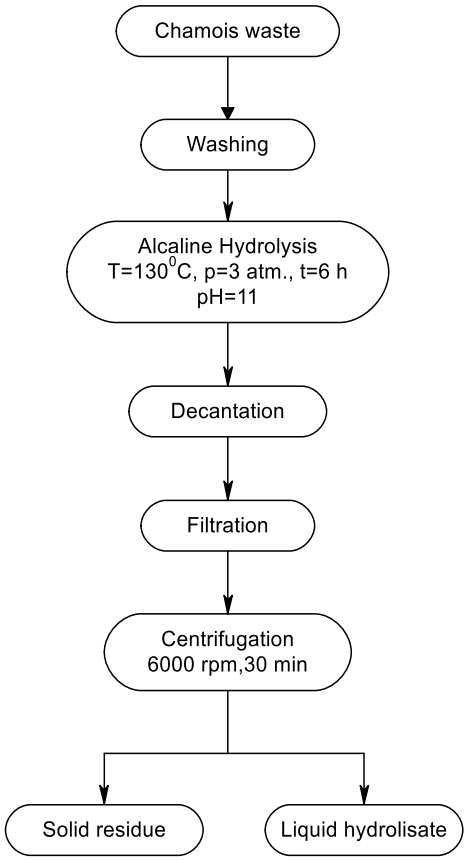

Fig. 1: *The operations for obtaining polypeptide alcalin hydrolysates*

In a second stage, the alcalin hydrolysate was chemically modified by polycondensation with dispersions of copolymers of vinyl acetate with acrylic esters at pH 8.5-9.0.

The resulted hydrogels were then brought to a final pH of 7-7.5 having the following characteristics:

- appearance: brown transparent solution;
- pH: 7 – 7,5;
- ash: 0,7%;
- dry matter: 17-25 %;
- total nitrogen: 16,5-17,8 %;
- proteic content: 85-97%;
- viscosity at 25°C: 50-100 CP.

In order to obtain the carrier agent, the afore mentioned hydrolysates were treated with glutaraldehyde as crosslinking agent which consumes the free unionised α-amino groups, at a pH of about 9 -10 (adjusted with 10% NaOH solution).

Starting for these chemically modified polypeptydes, new coatings based on inorganic pigments were obtained.

3.1. The obtaining of pigment pastes

In order to obtain pigment pastes with new chemically modified carrier, powder pigment was mixed with polypeptide product, wax emulsion and nonionic emulsifier followed by dispersing

composition into acrylic binder, oil, antibacterial agent and water. The resulting dispersion system was subjected to mechanical stirring (50-80 rpm/min) at 25-30°C for 2-4 hours.

By this method, there were obtained two experimental variants of brown and black pigment pastes (Table 1) which were compared to the pigment pastes with casein binder (control sample).

Table 1: *Experimental variants of pigment pastes compared to the pigment pastes with casein binder*

Variant / Composition (%)	**Casicolor Brown R (control sample)**	**Variant 1 (Brown R)**	**Casicolor Black (control sample)**	**Variant 2 (Black)**
Pigment	10	10	10	10
Acrylic binder (resin)	35	35	40	40
Casein	5	-	5	-
Chemically modified polypeptyde product	-	5	-	5
Wax emulsion	2	2	2	2
Oils	10	10	10	10
Nonionic emulsifier	0,5	0,5	0,5	0,5
Antibacterial agent	1	1	1	1
Water	36,5	36,5	31,5	31,5

The new pigment paste had the following physico-chemical characteristics:

- dry matter: 40-45%;
- pH (1:10 solution): 6.5-8.0;
- stability over time without deposits or phase separation;
- uniform film deposition on the surface (glass plate).

These results are comparable to conventional pigment pastes based on casein (control samples: Casicolor Brown R, Casicolor Black- TFL Elvetia, pH: 7,5-8,5).

3.2. Finishing natural grain Box bovine leather using the new pigment pasta

The finishing technology with brown and black coatings of natural grain Box bovine leather is shown in Table 2.

Table 2: *Finishing technology with coatings* of *natural grain Box bovine leather (brown and black)*

Operations	**Recipe**
Application of the first coat (disperse solution)	- Solution preparation according to the recipe: 100 g/l pigment paste(brown, black) 30 g/l wax emulsion 300-400 g/l acrylic binder 470-570 g/l water - Spraying solution 1, 2 coats.
Intermediate ironing	- Performed on hydraulic press with mirror plate: temperature: 50-60°C; pressure: 50 atm.
Application of first coat (disperse solution)	- Spraying solution 2 coats.
Application of second coat (starch finish)	- Solution preparation according to the recipe: 700 g/L acrylic water emulsion 20 g/L wax emulsion for touch 280 g/L water - Spraying solution 2 coats.
Final ironing	- Performed on hydraulic press with mirror plate: temperature: 60-70°C; pressure: 50 atm.

The leather samples coated with the new finishings were subjected to physico-mechanical resistance tests, in accordance with the standardized methods (table 3).

4. RESULTS AND DISCUSSIONS

Table 3 presents the results obtained for physico-mechanical characteristics of natural grain Box bovine leather finished with the new coating pastes compared to the casein pigment pastes.

Table 3: *Physico-mechanical characteristics of natural grain Box bovine leather*

Physico-mechanical characteristics	**Brown natural grain Box [1-1,2 mm]**				**Black natural grain Box [1-1,2 mm]**				**According to standard**
	Casicolor Brown R (control sample)		Sample 1		Casicolor Black (control sample)		Sample 2		
Tensile strength [N/mm^2]	18		16		23		22,7		SR EN ISO 3376: 2003
Tear resistance [N/mm]	43,8		43,2		46,8		45,7		SR 5045 : 1999
Resistance to grain cracking [N/mm^2]	12,8		12,6		12,9		12,7		SR ISO 3378:2003
Elongation at 10 N/mm^2 stress [%]	27		26		28		27		SR EN ISO 3376 : 2003
Dry and wet rubbing fastness [Note: 1-5]	wet	dry	wet	dry	wet	dry	wet	dry	SR EN ISO 11643:2002
	4/3	5/4	4/3	5/4	4/3	5/4	4/3	5/4	
Flexural fatigue strength test (Bally) [no.]	200 000		180 000		200 000		190 000		SR EN ISO 5402: 2003

These results show characteristics of the new finishing pastes comparable to those obtained by casein based conventional finishes.

5. CONCLUSIONS

1. The polypeptide product obtained by alkaline hydrolysis/chemical modification allowed its use as a carrier to obtain pigment pastes.
2. This new hydrolysis product has been used as a substitute for casein in pigment pastes with characteristics comparable to conventional pigment pastes based on casein.
3. The new coatings for leather finishing show physico/mechanical resistance values in the limits imposed by current standards.
4. The applied method allows the obtaining of value-added products from the dust resulted from chamois leather buffering,

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

THE EVOLUTION OF CORPORATE SOCIAL RESPONSIBILITY REPORTING IN THE EUROPEAN UNION

ANDREESCU Nicoleta Alina[1], POPOVICI Mihaela[2]

[1] University of Oradea, Faculty of Energy Engineering and Industrial Management,
Department Textiles-Leatherwork and Industrial Management,
Str. B.Şt Delavrancea nr.4, 410085, Oradea, Romania,
E-Mail: nandreescu@uoradea.ro

[2]Liceul Tehnologic Ioan Bococi Oradea, Romania, Tudor Vladimirescu 42, Oradea, Romania,
E-Mail: mihatex@yahoo.com

Corresponding author: Nicoleta Alina, Andreescu, E-mail: nandreescu@uoradea.ro

Abstract: *Modern society is confronting with problems such as global warming, pollution, contamination of the soil. As a response to these problems, organizations are implementing corporate social responsibility programs, as a way of dealing with these new challenges.*
CSR reporting began in the 90's in the USA, but in the last twenty years, EU companies have shown an increasing involvement to a point in which today European CSR reports ammount to 38% of the total reports worldwide. The Global Reporting Initiative is a nongovernmental organism that provides companies which wish to create CSR reports, a set of guidelines and databases what contain CSR reports from 1999 to the present day. As an answer to the need of companies to report their CSR activities, in November 2014, the European Union published Directive 2014/95/EU regarding the obligation of large companies to anually report a series of nonfinancial aspects and information. A priority of the European Comission is to align the CSR reporting method of the member states to the global methods. The comission has evaluated in 2013 the progress of member states and reached the conclusion that member states have chosen different pahts: some have taken only small impact decisions – such as informative and promotional actions for CSR – while other states have taken legislative measures to support corporate social responsibility.

Key words: *Corporate Social Responsability, organization, reporting.*

1. INTRODUCTION

In the last decades, the interest of European Union companies towards the CSR (Corporate Social Responsibility) concept has increased. If the first signs started to appear in the UK during the 80's, when the Business in the Community (BITC) coalition started, in the 90's the European Union raises the problem of implementing CSR in its member states.

The first CSR reports started to appear in North America, being created by large companies from the chemical and oil industries, which were obliged by a law called "the right to know Law" to publish their data regarding emissions and soil impact. [1] In the United States of America, these reports started to appear as an answer to the pressure created by environmental organizations on large companies in an effort to make them become more transparent and explain their impact on the

environment, while today the pressure comes from the investors, the employees and the local communities. In Europe, CSR reporting began 20 years ago and today it is still on the rise.

The economic crisys and its social consequences have had a negative impact on consumers' trust in business. They have diverted their attention to the ethical and social performance of companies. The European Comission wanted that through the renewal of its efforts in promoting CSR, to create favorable conditions for a sustainable economic development and a responsible behavior of the companies.

2. ASPECTS OF CSR REPORTING IN THE EU

The European Councill and European Parliament have invited the European Comission to develop a CSR policy for the European Union. In the Europe 2020 strategy, the Comission has taken the role of renewing the EU strategy for promoting CSR. In the 2010 press buletin, in regards to industrial policies, the Comission has expressed its intention on creating a new CSR policy.

In October 2011, the European Comission presented its strategy and action plan by which it proposed to encourage the adoption of CSR principles in the European space, in the 2011-2014 period. [2]

Through the Directive of 2014, the European Commission deems necessary to coordonate internal judicial dispozitions regarding nonfinacial information presentation, as this is of major interest to large companies, their shareholders and other interested parties. Coordonation in this field is necessary because most of these companies operate in several member states. [3] Also, it is necessary to set certain minimal judicial requirements as to what the level of information that needs to be givent access to the public and authorities, by companies from accross the Union. [3]

In November 2014, the European Union published Directive 2014/95/UE [4] regarding the obligation of large companies to report anually a series of nonfinacial aspects and information regarding diversity (CSR /sustainability reports). [1] This Directive was adopted in its final form by the European Parliament and the Eurpean Union Council in September 2014, coming to complete and modify another European Union Directive – more specifically, 2013/34/UE relating to finacial reporting done by companies.

Directive 2013/34/UE obliges "public interest companies" with over 500 employees to publish a nonfinacial declaration which contains "information relating to environmental, social or personal aspects, human rights and fighting against corruption and bribery". [5]

According to the normative act, in article 2 the public interest companies are defined: "companies that are tradeable on the stock market, credit companies, insurance companies or any other company that, by its nature, size or status, represents a significant public interest". [5] Companies that fall under this describtion must publish on a yearly basis, begining with 2017, a declaration that contains: a short describtion of their business model, a describtion of adopted policies in regards to mentioned nonfinancial aspects, the results of said policies, the main risks related to the aforementioned aspects which are a part of the company's operations and the way in which the company is handling the risks that may appear as a result of those operations, as well as relevant performance indicators for the field of work of the company. [5]

A priority of the European Comission's action is to allign the European and global CSR. This means solicting EU companies to make an effort in conforming and acting in acordance with the internationally recognized guides and principles: the Organisation for Economic Co-operation and Development Guide for multinational companies, the Ten United Nations Global Compact Principles, the Directing Principles of the United Nations regarding business and human rights, the Tripartheid Declaration for setting principles regarding multinational companies and social policies of the International Work Organization, ISO 26000 Social Responsability Standard,

or other internationally and EU recognized institutions, as well as the EMAS – Environment Management and Audit System. [5]

In this way, member states need to make sure they have efficient national procedures to impose the respecting of the obligations set though the directive, as well as that these procedures are accesible to all natural and legal persons that have a legitimate interest according to the national rights, as to respecting the dispositions of the directive. National legislations regarding consolidated management reports should then be coordonated to fullfill the informational comparability and coherence objectives that companies should publish in the Union. [3]

The comission has monitorized the involvement of companies in applying these rules and international CSR guides.

The comission has evaluated in 2013 the progress of member states and reached the conclusion that countries have chosen different pahts: some have taken only small impact decisions – such as informative and promotional actions for CSR – while other states have taken legislative measures to support corporate social responsibility. [6]

In June 2014, 15 member states already had national action plans for CSR (Belgium, Bulgaria, Cyprus, Czech Republic, Germany, Denmark, Estonia, Finland, France, Italy, Lithuania, Holland, Poland, Sweden, UK). In 5 other countries these plans were nearly finished (Austria, Ireland, Hungary, Malta, Spain) and in 7 more (Croatia, Grece, Lithuania, Portugal, Romania, Slovenia, Slovakia) the plans were still in their development phases. [6]

3. THE EVOLUTION OF CORPORATE SOCIAL RESPONSIBILITY REPORTING IN THE EUROPEAN UNION

Member states of the EU have begun to produce CSR reports according to Global Reporting Initiatives (GRI) Standards begining with 1999. If in the first year, only nine reports have been filed, this number increased yearly so that in 2014 a number of 2005 reports were filed. In total, 12.562 reports. In the chart and table, the evolution of the number of reports in the EU is presented, based on infromation rom the GRI.

Table 1:*Evolution of no of CSR reports from 1999-2015*

Crt. No.	Year	No. of reports	Crt. No.	Year	No. of reports
1.	1999	6	10.	2008	594
2.	2000	22	11.	2009	803
3.	2001	58	12.	2010	1037
4.	2002	59	13.	2011	1371
5.	2003	83	14.	2012	1644
6.	2005	157	15.	2013	1752
7.	2005	228	16.	2014	2005
8.	2006	307	17.	2015	1923
9.	2007	434	18	2016	79

Source: made by the author according to the GRI database

We consider this as being an evolution determined by several factors: the society became more aware of the role which the companies play in our daily lives, which in turn led to changes in laws that later were implemented by companies. In this way, the companies had to adapt to be able to face the competition. The economical crisis had a major impact on society in general, as well as on companies. Based on the data from table 1, we can see that after 2011, there has been a great increase in the number of CSR reports filed by the companies (a 32% increase when compared to 2010). [8]

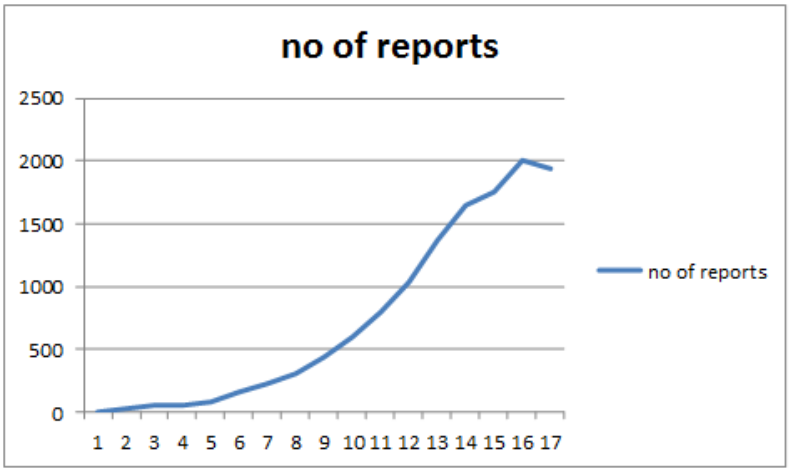

Fig. 1: *Evolution of no of CSR reports from 1999-2015*
Source: made by the author according to the GRI database

4. CONCLUSIONS

By creating CSR reports according to international standards, companies, have a series of advantages such as a better world visibility, their inclusion in the circle of companies that care about the environment and society. For the stakeholders, these reports represent the interest the company takes in its impact in the community. We consider that in the next years, the number of companies interested in creatind CSR reports will increase, also because of the norms imposed by the EU, once Directive 2014/95/EU comes into force, but also because companies are becoming more aware to the role they have in society.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

DE LEGE FERENDA PROPOSAL FOR THE COMPLETION OF THE LEGAL FRAMEWORK REGARDING THE TEXTILE PRODUCTS, IN THE CONTEXT OF A SOCIAL RESPONSIBLE MANAGEMENT

MUREȘAN (POȚINCU) Laura[1], MĂRĂSCU-KLEIN Vladimir[2]

[1] Transilvania University of Brasov, Faculty of Economic Sciences and Business Administration, Department of Management and Economic Informatics, 1 Colinei Street, 500084, Brasov, Romania, E-Mail: laurapotincu@yahoo.ro

[2] Transilvania University of Brasov, Faculty of Technological Engineering and Industrial Management, Department of Engineering and Industrial Management, 5 Mihai Viteazul Street, 500174, Brasov, Romania, E-Mail: klein@unitbv.ro

Corresponding author: Mureşan (Poţincu), Laura, E-mail: laurapotincu@yahoo.ro

Abstract: *In the case of this economic operator, manufacturing or trading textile products, the corporate social responsibility is a social must, and it consists of a set of objectives which must be implemented by the management of the economic operator in all departments. In order to understand the implications of a social responsibile management in the textile products domain, it is required to analise the juridical framework. Interesting is the choice in this area of the production and the marketing of textile products, to only adopt/use one regulation, not a directive or a legislative package consisting in a directive and a regulation. As a result of legal analysis performed, we support the maintenance of the use, as a legal instrument, of the European regulation type normative document, but we suggest the extension of the provisions of the European normative act and its transformation into a particular complex normative act, beyond the scope of the aspects concerning the labelling.*

Key words: *textiles, labeling, social responsible management, consumer's protection.*

1. INTRODUCTION

The economic operators acting from the perspective of the corporate social responsibility (CSR) develop the following essential management aspects differentiating them from the other economic operators:

A) establishing the vision and mission of the economic operator, which considers the optimization of the interests of the respective economic operator (materialized in the profit), as well as the consumer's interests (maximization of the value expected from the respective product or service) and the general interests of the community (by complying with ethical principles and assuming social responsibility);

B) conceiving specific marketing policies and strategies and marketing-mix (which also include strategies related to CSR);

C) adopting tactics specific to the socially responsible management vision;

D) using the management instruments for knowledge and researching the environment in which the economic operator acts;

E) other aspects especially related to strategic management.

The aspects related to social responsibility have been taken over by the Romanian economic operators, from the economic doctrine outside Romania [1], but also from the practice of the foreign economic operators which have opened branch offices or subsidiaries in Romania.

For the sake of a better highlighting of the previously presented theoretical aspects, we shall apply the elements analysed regarding the socially responsible management to the activity of an economic operator manufacturing or trading textile products. In the case of this economic operator, manufacturing or trading textile products, the corporate social responsibility is a social must, and it consists of a set of objectives which must be implemented by the management of the economic operator in all departments, not only the social responsibility department, even if such a department cannot be outlined. As we have previously mentioned, a socially responsible management implies not only respecting the law, but also a series of ethical norms. Thus, a manufacturer or a trader of textile products developing a socially responsible management must comply with the legislation regarding the purchase and use of raw materials, the legislation regarding its operation, the legislation regarding the protection of the employees, the legislation regarding the intellectual property, the fiscal legislation, **the legislation regarding the labeling** and the entire legislative framework required by the development of their managerial activity, only because it is socially responsible, and not for fear of the legal sanctions to which he would otherwise be subject.

2. CUSTOMER PROTECTION THROUGH LABELING THE TEXTILE PRODUCTS, ESSENTIAL ASPECT OF A SOCIALLY RESPONSIBLE MANAGEMENT

In order to understand the implications of a social responsibile management in the textile products domain, it is required to have an overview of the social responsibility concept. This way, it would be highlighted how important it is to really and completely integrate the requirements of the social responsibility into the management activity of the economic operators.

For many years, the objectives of the social development have been the philanthropy activities which have however been considered as separate from the objectives of the business activity, not as being fundamental for the latter. To do something correctly and to do the right things have been perceived as different separate purposes. However, this has changed. Several economic operators have learned that innovation and the competitive advantage could have their roots in the implementation of the social ensemble and the natural environment protection in the business strategies as far back as the beginning of their commercial activity. [2]

At present, the social responsibility of the economic operators must be regarded from a complex perspective. We consider [3] that the social responsibility of the economic operators is what the community expects from an economic operator ecologically, economically, legally, ethically and philanthropically. In our opinion, the social responsibility includes all these types of responsibilities: ecological responsibility, economic responsibility, legal responsibility and philanthropic responsibility.

The Romanian authors [4] dealing with the corporate social responsibility field include the social partners from the stakeholders' category. The "stakeholder" term derives from the following terms: stake meaning interest, and holder meaning owner, both English terms. Thus, stakeholders are those categories of persons which have an interest in developing the activity of the respective economic operator.

The social responsibility can also be characterized as being the firm obligation of an economic operator to act beyond the legal obligations or those imposed by economic restrictions, and to pursue long-term objectives to the use of the community. The respective economic operator is considered responsible not only towards their owners (shareholders) but also towards **clients**, providers, employees, governmental organisms, creditors, local communities, public opinion (**stakeholders**).

In this context, a manager of a socially responsible economic operator (including in the textile products field) has several categories of ethical and legal obligations. These obligations are divided into four directions, given four groups interested in the respective commercial activity, i.e.: the shareholders, the employees, **the clients (obligations regard high-quality products/services, guarantee of the use safety, information),** the community. [5]

The consumer is legally [6] defined as any natural person or group of natural persons constituted in associations, which purchases, acquires, uses or consumes products outside their professional or commercial activity. **The consumer protection** is a concept representing all the dispositions regarding the public or private initiative, meant to continuously provide and improve the observance of the consumers' or users' interests. [7]

3. THE ROMANIAN REGULATORY LEGAL FRAMEWORK, AS ROMANIA IS A MEMBER OF THE EUROPEAN UNION, REGARDING THE TEXTILE PRODUCTS' LABELING

The Civil Code establishes, in art. 5, that in the provisions regulated by this Code, i.e. the private law field – which includes the commercial or business law – the juridical norms included in the European Union law are primarily applied as compared to juridical norms provided by the internal law. This principle cannot in any way be restricted by the quality or status of the parties belonging to the juridical relation in question.

The two, most important and compulsory, category of normative acts used at European Union level and at the level of each member states of EU, are regulations and directives. The regulations are applied to all the persons that are in their applicability area.[8] The regulations create subjective rights in the favour of private persons, citizens of the member states, both individuals/natural, and legal persons. As compared to the regulations, the directives are mandatory only for each member state to which it appeals regarding the result to be obtained. These community normative documents (directives) cannot be invoked in the relations between private persons, but only against a member state to which they are addressed, because they cannot impose obligations to the persons, as the regulations can.[9]

3.1. Legal analysis of Regulation (EU) no. 1.007/2011 of the European Parliament and of the Council from 27th of September 2011 regarding the names of the textile fibers and appropriate labelling and marking of the fiber composition of textile products

As we previously mentioned, the regulations adopted at the level of the European Union are automatically applied to all the citizens of the European Union, both economic operators (legal persons) and consumers (individuals).

Therefore, the Regulation (EU) no. 1.007/2011 of the European Parliament and of the Council from 27th of September 2011 regarding the names of the textile fibers and the appropriate labelling and marking of the fiber composition of textile products is automatically applied to all the economic operators and consumers in all the Member States of the European Union.

Interesting is the choice in this area of the production and the marketing of textile products, to only adopt/use one regulation, not a directive or a legislative package consisting in a directive and a regulation. Practically, in this way, the process of harmonization is excluded, process which would have operated in the case of the adoption of a directive, and therefore - to a very large extent - the intervention of the Member States of the European Union is excluded. A regulation was adopted, and it had an immediate and complete applicability.

In our lege ferenda proposals which will be extended upon in the conclusions and proposals part of the work, we support the maintenance – as a good choice – of the use, as a legal instrument, of the European regulation type normative document.

At point 8, the thesis 2 and 3, in the preamble to the Regulation (EU) no. 1.007/2011, it is specified that the labelling or marking should not be misleading, this helping consumers to make an informed choice. In order to achieve this, it is necessary that this European instrument settles rules which establish the requirement to indicate the presence of non-textile parts of animal origin in the labelling or marking of the textile products containing such parts. Also, the labelling or marking of the fiber composition should be compulsory in order to ensure the availability for all the consumers in the European Union of correct and uniform information.[10]

At point 13 of the preamble to the Regulation (EU) no 1.007/2011, it is specified that the use of the names of the textile fibers or the descriptions for the fiber compositions which carry a special appreciation among consumers should be subject to certain conditions. Furthermore, in order to provide information to the consumer, it is necessary that the names of textile fibers are related to their characteristics.

An interesting issue is the possibility provided at point 23, which states that producers or other persons acting on their behalf, who want to add a name of a new textile fiber in the annexes to the Regulation (EU) no 1.007/2011, to include in the technical file, which should be submitted together with the application, available scientific information about allergic reactions or other adverse effects which the new textile fiber could have on human health, including the results of the tests carried out for this purpose, in accordance with relevant legislation of the Union. The health of consumers is thus addressed as a priority. Also, point 27 of the preamble and Article 25, specify that the European institutions, and in this case, the Commission, should undertake a study to assess whether there is a causal link between allergic reactions and the substances or mixtures of chemicals used in the textile products. On the basis of this study, legislative proposals should be brought and included in this European normative act, in the context of existing legislation of the Union.

In accordance with the letter g, paragraph 1 of Article 3, the term "labelling" is legally defined as representing the attaching of the required information, on the textile product, by the application of a label.

Article 14, 15 and 16 establish the following:

- □ the textile products shall be labelled or marked in such a way as to indicate their fiber composition whenever they are made available on the market;
- □ labelling and marking of textile products are durable, easily legible, visible and accessible and, in the case of a label, this is securely attached;
- □ the manufacturer ensures the provision of the label or marking and also the accuracy of the information contained in it, in the case of placing a textile product on the market. If the manufacturer is not established in the European Union, the importer shall ensure the supply of the label or marking and the accuracy of the information contained in it;
- □ from the moment in which a textile product is made available on the market, the descriptions of the composition of the textile fiber are indicated in the catalogs and commercial leaflets on packaging, on labels and on markings, in such a way as to be clearly legible and visible with ease and evenly printed, from the point of view of the characters, style and the size of the characters; information clearly visible to the consumer before purchase, including the case in which the product is purchased by electronic means;
- □ labelling or marking are available in the official language or languages of the Member State of the European Union within the territory of which the textile products shall be made available to the consumer, except for the case in which the Member State stipulates otherwise.

3.2. Legal analysis of the Romanian Government Decision No. 699/2012 regarding the establishment of certain measures for the implementation of the (EU) Regulation no. 1.007/2011 of the European Parliament and of the Council from 27th of September 2011, on the names of the textile fibers and the appropriate labelling and marking of the fiber composition of textile products

The Government Decision No. 699/2012 lays down the legal framework and institutional framework required for the direct implementation of the Regulation (EU) no. 1.007/2011 of the European Parliament and of the Council, by a brief supplement to the European provisions.

Therefore, by Articles 2, 3 and 5, the Ministry of Economy, Trade and Business Environment shall be designated as the competent national authority for coordinating the implementation of the provisions of the Regulation, together with the National Authority for Consumer Protection as competent authority responsible for monitoring the market of textile products intended for consumers (individuals) and identification of minor offenses and the application of sanctions.[11] Also through the Article 4, the values of the fines imposed, in Romania, a European Union Member, for failure to comply with the provisions of Regulation (EU) No. 1.007/2011.

It should be noted that the normative document adopted in Romania does not establish other aspects which might provide a higher degree of protection for the consumers, in respect of labelling the textile products manufactured or placed on the Romanian market, although the European normative act allows it.

4. CONCLUSIONS AND PROPOSALS DE LEGE FERENDA

Also, the Regulation adopted at the European Union level specifies, at the points 19, 20 and 21 of the preamble and in Article 24, the fact that its provisions are supplemented by the normative acts existing in the European Union - and at in the Member States, we'd like to add - governing:

- □ misleading commercial practices which involve the provision of false information which might determine consumers to make decisions which they wouldn't otherwise make;
- □ the need for the existence of transparent and consistent commercial rules, including with regard to the indication of origin, imposed by the legal institution responsible for the consumer protection;
- □ possibility that consumers are permitted access to full knowledge of the origin of the products that they buy in order to be protected from fraudulent, inaccurate or misleading statements with regard to the indications of origin;
- □ prohibition of counterfeiting, which poses the problem of both the infringement of intellectual property rights as well as the increased need of protecting and informing the consumers.

We, therefore, think that all these normative acts to which reference is made for the completion of the Regulation (EU) no. 1.007/2011 of the European Parliament and of the Council should, de lege ferenda, represent legal rules, components of the Regulation, applied exclusively to the field of production or marketing of textile products. Furthermore, as the Regulation stipulates, the evolution of electronic commerce and the future challenges of the market of textile products will have to be taken into account in the process of harmonization or standardization of other aspects concerning the labelling of textile products, also, not only of those provided for in this European normative act.

Another aspect that should be brought into use, by supplementing Regulation (EU) no. 1.007/2011, concerns the identification of the new labelling requirements which must be implemented at Union level, in order to facilitate the free circulation of textile products within the internal market and to ensure a high level of protection for consumers, throughout the territory of the Union. *In this way, in our opinion, the extension of the provisions of the European normative act*

and its transformation into a particular complex normative act, beyond the scope of the aspects concerning the labelling (or of the current mode of legal regulation of the labelling institution) and over the entire set of legal rules governing the production or marketing of textile products, represents the current necessity. This would enable the economic operators' access to fast and comprehensive information over the legal frame of production or marketing of textile products at European Union level, including Romania.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

COMPETITIVENESS OF THE PRODUCTS AND ITS IMPACT ON THE STRUCTURE OF EXPORTS - THE CASE OF ROMANIA

TRIPA Simona[1], CUC Sunhilde [2]

[1, 2] University of Oradea, Faculty of Energy Engineering and Industrial Management, Department of Textile Leather and Industrial Management, Str. B. Șt. Delavrancea, no. 4, 410058, Oradea, Romania, E-Mail:tripasimona@yahoo.com

Corresponding author: TRIPA, Simona, E-mail: tripasimona@yahoo.com

Abstract: *The paper analyse the evolution of the competitive advantages of the main products exported by Romania in the 2000-2014 period and the connection between this evolution and the current structure of Romanian exports. In the first part we calculated the Revealed Comparative Advantage Index (RCA) of Balassa, index for main groups of products exported by Romania the period 1990 to 2014 and we analysed the competitive advantage evolution. In the second part we presented the evolution of the structure of Romanian exports in 2010-2014 and we noticed that the recorded changes in structure of Romanian exports is in close correlation with the changing competitiveness of products exported by Romania. In this sense one of the most significant examples is given by the evolution recorded in exports of machinery and transport equipment that not only was raised every year but the sector succeeded and currently holds a competitive advantage in the market of these products - a market where it is knows is stiff competition. Although garment exports have recorded during the analyzed period the largest decrease, the advantages of the Romanian garment industry - labor force highly qualified endowing companies with machinery efficient, product quality achieved, flexibility and quick response to orders but also geographical position the country - still cause this sector recording still comparative advantages though its values are declining during the whole period analyzed.*

Key words: *international competitiveness, trade, specialization, exports, Romanian*

1. INTRODUCTION

The international context of the trade has changed dramatically in the last few years and will probably continue to do so under the impact of the global crisis, of the liberalization and globalization, which have determined a quickly delocalisation of the production and the capital, greater mobility of the factors of production, a reorientation of the trade flows in the international market and a great fragmentation and specialization of activities in the value chains. Due to the proliferation of global value chains, generated by the trying of the manufacturers to minimize costs and maximize profits, has become increasingly difficult to keep the value into the national economy.

International competitiveness is influenced by numerous and interdependence factors, which is why it is important to understand that competitive advantage can not come from protectionism, quotas or preferential market access but on the contrary all these causes doing stagnation, reducing the ability entrepreneurship and motivation for quality, innovation, efficiency and product development in private sector At European level the dinamic competitivity was given by the transition from GATT (The General Agreement on Tariffs and Trade) to OMC (Organisation Mondial of Comerce) when USA attacked the Community Common Customs Tariff; the argument

"for" common customs tariff was based on the construction of the Union as a distinct agent of international trade. [1]

In these conditions, international competitiveness has become increasingly dynamic and competitive advantages are more volatile and less durable. Nonetheless, competitiveness is fundamental to sustainable development and modern economies are trying to continually create and recreate competitive advantages.

In this context we considered opportune to analyse the evolution of the competitive advantages of the main products exported by Romania in the 2000-2014 period and the connection between this evolution and the current structure of Romanian exports.

The main aim of this paper is analysis of evolution of the competitive advantages of of the main products exported by Romania in the 2000-2014 period and highlight how it this evolution has influenced the current structure of Romanian exports.

Methods of the scientific research that have been employed in the paper are scientific analysis and summarizing of literature, mathematic calculations, comparative analysis of statistic indexes.

The paper is organized in tree parts: the first part present the theoretical basis of the RCA and we calculated the Revealed Comparative Advantage Index (RCA) for the main groups of products exported by Romania. In the second part it was presented the evolution of the structure of Romanian exports in 2010-2014. The final part draws some conclusions based on the findings.

2. COMPETITIVENESS OF ROMANIAN INDUSTRY

The evolution of trade specialization is a phenomenon that reflect structural changes in the entire economic system of a country and needs time, since the comparative advantages in trade cannot be achieved in a short time, especially since they are structurally by definition.

A great importance in the study of the performance trade has specialization profile, usually measured by using the comparative advantage. In this paper we used for analyzing comparative advantages the Revealed Comparative Advantage Index (RCA) of Balassa (1965). The index of revealed comparative advantage, suggested that country's revealed comparative advantage in the trade of a certain industry is assessed by the share of that industry in the country's total exports relative to the industry's share in total world exports of manufactures. [2] In a later work, Balassa restricted his analysis to manufactured goods only, as distortions in primary products, such as subsidies, quotas and special arrangements, would not reflect the real comparative advantage. RCA index represent post trade relative prices and a prevailing factor as well as product market distortions. [3] The RCA index is defined as the ratio of two shares. The numerator is the share of a country's total exports of the commodity of interest in its total exports. The denominator is share of world exports of the same commodity in total world exports.

$$RCAij = (Xij / Xit) / (Xnj / Xnt) \quad \textbf{(1)}$$

Where: X is exports, i is the country, j is the commodity/industry, n is the world or a set of countries, and t is all product groups.

On the basis of this index, a country is defined as being specialized in exports of a certain product if its market share in that product is higher than the average or, equivalently, if the weight of the product of the country's exports is higher than its weight of the exports of the reference area. A country reveals comparative advantages in products for which this indicator is higher than 1, showing that its exports of those products are more than expected on the basis of its importance in total exports of the reference area. There is some criticism of this method of analysis of competitiveness. The RCA has been criticized for taking only the exports into consideration while

ignoring the imports. Another objection is the fact that if the country has a "comparative disadvantage"the index ranges from zero to one, whereas if it has a "comparative advantage", the index ranges from one to infinity. [4]

A more detailed analysis, in order to demonstrate the power of international competitiveness, Balassa's RCA index can be classified into four stages [5].

***Table 1**: Classified of competitiveness functions of Balassa's RCA index*

RCA	Stages of competitiveness
$0 < RCA \leq 1$	no competitiveness
$1 < RCA \leq 2$	week competitiveness
$2 < RCA \leq 4$	moderate competitiveness
$4 < RCA$	strong competitiveness

Source: Hinloopen, J. (2001). On the empirical distribution of the Balassa Index. Review of World Economics, 137(1). 1-49

We calculated the Revealed Comparative Advantage Index (RCA) for main groups of products exported by Romania. The results are centralized in Table. 2.

***Table 2**: Evolution of Romanian RCA (Balassa index) for main groups of products exported in the period 2000-2014*

	Chemicals	Clothings	Machinery and transport equipment	Office and telecom equipment	Pharmaceu-ticals	Textiles	Total fuels and mining products
2000	0.64	7.32	0.46	0.34	0.14	0.79	1.11
2001	0.53	7.78	0.50	0.30	0.09	0.89	0.91
2002	0.45	7.48	0.54	0.30	0.06	0.95	1.01
2003	0.45	7.52	0.55	0.26	0.05	1.11	0.85
2004	0.52	7.13	0.62	0.22	0.05	1.13	0.82
2005	0.55	6.29	0.69	0.17	0.06	1.26	0.86
2006	0.55	5.36	0.83	0.20	0.06	1.44	0.81
2007	0.54	4.32	0.96	0.20	0.11	1.41	0.67
2008	0.59	3.65	1.09	0.44	0.18	1.34	0.63
2009	0.44	2.99	1.28	0.67	0.37	1.30	0.53
2010	0.52	2.69	1.27	0.78	0.52	1.24	0.48
2011	0.57	2.54	1.31	0.85	0.59	1.22	0.45
2012	0.62	2.53	1.30	0.53	0.72	1.28	0.43
2013	0.54	2.15	1.34	0.41	0.68	1.20	0.41
2014	0.48	2.04	1.31	0.38	0.56	1.17	0.45

Source: Calculated by the authors according to the WTO dates

Analyzing the competitive advantage evolution recorded by Machinery and transport equipment industry is observed constant increases from year to year, throughout the analyzed period and since 2008 the sector has a competitive advantage on the world market of these products. Although garment exports have recorded the largest decrease during the analyzed period, the advantages of the clothing sector in Romania - highly qualified workforce, endowing companies with efficient machinery, product quality achieved, flexibility and quick response to orders but also the geographical position of the country - has determined to still have comparative advantages this sector though its values are declining during the whole period analyzed.

The export of pharmaceuticals although it has significant increases in recent years, reaching at $ 1,127 millions, in 2014, still have competitive disadvantage in the global market of these products. Total fuels and mining products are significantly reduces, representing 9.05% out of total Romanian exports in 2014 compared to 14.64% it was represented in 2000. By point of view

competitiveness is observed the continued decrease the value of RCA - values that indicate an export disadvantage with this products.

Agricultural exports holds the second in the top of Romanian exports in 2014, this one being $ 8,847.39 million. Nonetheless Romania still has competitive disadvantage at export food products to the world market.

The export of chemicals retains its the share in Romanian exports and is still a field that does not have competitive advantage on the world market of these products.

3. THE EVOLUTION OF THE STRUCTURE OF ROMANIAN EXPORTS

By comparing the structure Romanian exports from 2014 to that in 2000 stands out increasing the share in total exports of agricultural exports from 7.99% in 2000 to 12.69% in 2014, the share of exports of machinery and transport equipment from 18.91% at 42.01%, reaching in 2014 to have the largest share of total exports of Romania and increasing the share of exports of pharmaceuticals from 0.23% to 1.87% in 2014. In contrary have evolved shares of owned garment exports which registered the largest decrease from 22.41% to 5.20% and exports of fuels and mining products which significantly reduces reaching 9.05% in 2014 compared to 14.64% as represented in 2000. For the remaining product categories were not recorded significant changes in shares held in total exports. (See fig. No. 1)

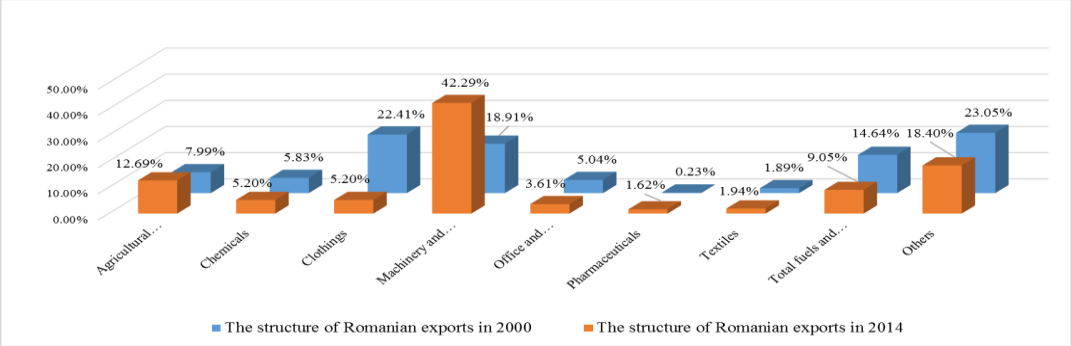

Fig. 1: *The structure of Romanian exports in 2000 and 2014*

Because the biggest changes were recorded in domain of the Machinery and transport equipment and in the garments domain, these fields were analyzed in detail in the following.

Machinery and transport equipment ranks first in Romanian exports in 2014, with $ 29,492 million. This position is due mainly to the applied technologies, high technological level, increased productivity, the big specialization degree and not least the high level of quality products - demonstrated by undoing on the EU markets (mostly exports from section SITC 7 being EU market- see fig. 2)

Fig. 2: *Evolution of Romanian exports of section 7 SITC - intra and extra EU markets*

As it can be seen from the figure 3 and 4, the main growth on the EU market and Extra EU market is registered in division 78 - ROAD VEHICLES (INCLUDING AIR-CUSHION VEHICLES). A important increase was also registered in exports of Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (including non-electrical counterparts, n.e.s., of electrical household-type equipment) on the EU markets (SITC 77)

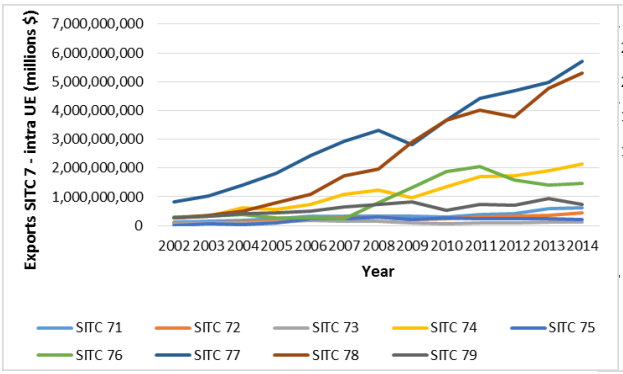

***Fig. 3**: Evolution of Romanian exports on divisions of section SITC 7 - intra EU market*

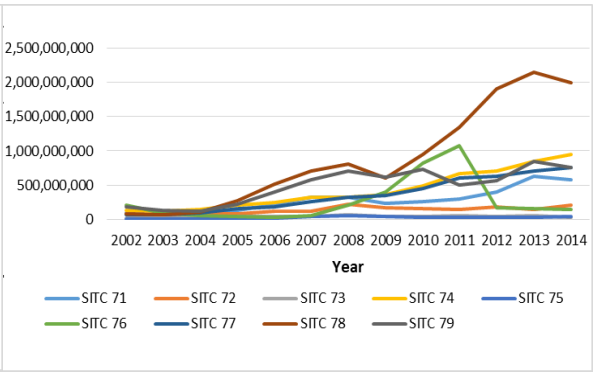

***Fig. 4**: Evolution of Romanian exports on divisions of section SITC 7 - extra EU market*

Garment exports have recorded during the analyzed period the largest decrease, down from the first place - in 2004, when they represented 20.08% of total exports on the 6th place in 2014, when it represents only 5.20% of total exports. (See fig. No. 5) Dynamics of exports this subsector, from year to year, was influenced by a number of factors such as liberalization of trade in 2005, reducing production type Lohn, changing consumer demands etc. These have determined structural changes in this sector and have led to a reorientation of Romanian producers on the domestic market and to development some autochthonous brands recognized worldwide.

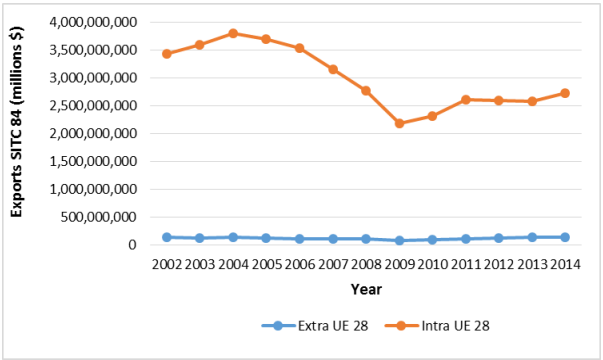

***Fig. 5**: Evolution of Romanian exports of division SITC 84 - intra and extra EU markets*

The main types of exported products of this section are during the whole period analyzed, products of the type coats, capes, jackets, suits, blazers, trousers, shorts, shirts, underwear, nightwear and similar articles of textile fabrics, not knitted or crocheted - for men's or boys and women's or girls, products belonging to groups 841 and 842 - according to SITC Rev. 4, as the market intra and extra EU. (See fig. No. 7 and 8)

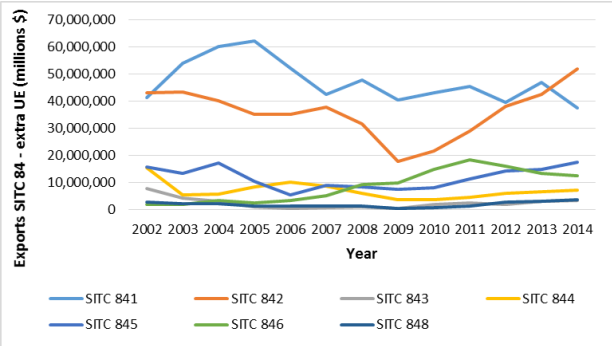

Fig. 6*: Evolution of Romanian exports on groups of division SITC 84 - extra EU markets*

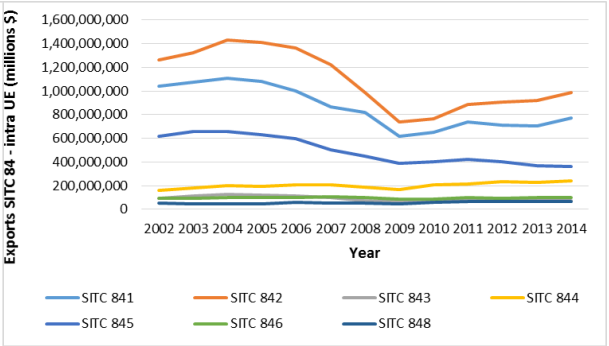

Fig. 7 *: Evolution of Romanian exports on groups of division SITC 84 – intra EU markets*

From of the above it is apparent that the dominant characteristic of the evolution of Romanian trade in the last two decades was dynamic growth of trade flows with processed products and a growth the share of this in total trade.

4. CONCLUSIONS

Recorded changes in structure of Romanian exports is in close correlation with the changing competitiveness of products exported by Romania. In this sense one of the most significant examples is given by the evolution recorded in exports of machinery and transport equipment that not only was raised every year but the sector succeeded and currently holds a competitive advantage in the market of these products - a market where it is knows is stiff competition.

Although garment exports have recorded during the analyzed period the largest decrease, the advantages of the Romanian garment industry - labor force highly qualified endowing companies with machinery efficient, product quality achieved, flexibility and quick response to orders but also geographical position the country - still cause this sector recording still comparative advantages though its values are declining during the whole period analyzed. A special attention will be given to this sector who no longer can be based on the advantages presented above and will have to find new solutions in the future to face the increasing competition coming especially from the underdeveloped countries.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

NOVEL ECOMMERCE TECHNOLOGIES FOR THE CLOTHING INDUSTRY: FASHIONPHORIA-A SOCIAL FASHION PLATFORM

VYNIAS Dionysios[1], BARMPARIS Demetrios[1], PRINIOTAKIS Georgios[2], DOBLE Liliana[3], NIKOPOULOU Katerina[4]

[1] Fashionphoria SA, Athens, Greece

[2] Department of Textiles, Technological Educational Institute of Piraeus, Aigaleo, Greece[4] Choice-N-Vote , Thessaloniki, Greece

[3] University of Oradea Department of Engineering and Industrial Management in Textiles and Leatherwork

Corresponding author: Vynias, Dionysios, E-mail: ceo@fashionphoria.com

Abstract: *Fashion industry is one of the most vibrant and creative sector in Europe. Having over 5 million people directly employed in the fashion value chain and 850,000 companies established, this industry provides an important contribution to the EU economy with an annual turnover of EUR 525 billion. Despite the global competition, European retailers have managed to be competitive by moving to high- added value products, serving niche markets and investing on technology and novel ecommerce tools.*
Fashion is in a transition phase where digital brands and eshops try to engage more shoppers, provide unique experiences and increase revenues. However, conversion rates are still low, competition is fierce and novel products and services are required in order to capture the attention of the consumer. More customer behaviors regarding fashion preferences of the users are needed and new advertising techniques have to be implemented in the sector.
In this paper, the market trends regarding clothing and eCommerce in Europe are provided. In addition, a market research is presented that reveals the need for a social fashion platform in Greece coupled with the expectations that an shopper has for a fashion aggregator. The basic functionalities of Fashionphoria, a novel social fashion platform are presented and the benefits for the fashionistas and the brands are outlined.

Key words: *ecommerce, technology, gamification, digital advertising*

1. INTRODUCTION

1.1. Market opportunities in E-commerce

Although Greece has been heavily struck by the economic crisis, e-commerce is still growing [1]. The reasons behind this statement are two significant factors:

(a) The transformation of the retail industry to a digital one that will continue to generate economic activity;
(b) The crisis has been a catalyst to accelerate creativeness, new and more effective practices, where digital retailing replaces old, inefficient practices of traditional retailing and logistics.

Consequently, more buyers are questioning the products they need and turn to a more efficient way to shop (on-line) than they would have without the crisis. According to Eurostat, Greece has the lowest turnover in E-commerce sales (2%) among the 28 member states, Fig. 1 [1].

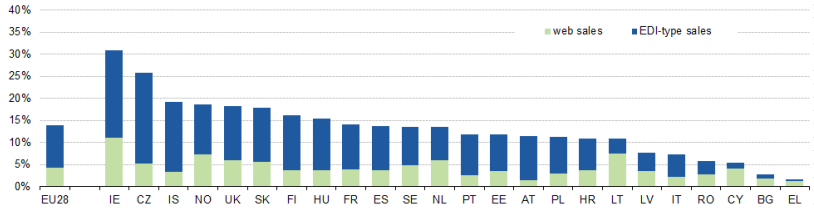

Fig. 1: *Turnover from e-commerce broken down by web and EDI-type sales, 2012 (% total turnover) in EU countries [1]*

For investors, this information is of high significance since it is evident that the E-commerce market is not yet mature and there is a big potential for market penetration in this area of interest. In addition, electronic transaction sales in Greece are among the lowest in EU countries (with Cyprus, Lithuania and Bulgaria), Fig 2, indicating that recent developments in payments infrastructure (simplified electronic communications systems) will change the Greek E-commerce field for the years to come.

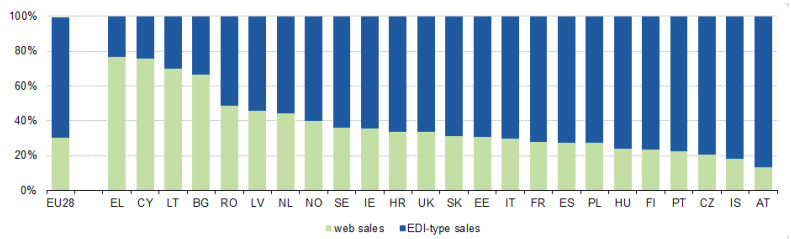

Fig. 2: *Web sales and EDI-type sales in EU countries 2012 [1]*

2. THE EXPERIMENTAL PART

2.1. E-commerce in Greece: a sector that gains ground

Greece has around 1.9 million e-shoppers and 6.09 million people use the Internet. Interestingly, despite the crisis, for five consecutive years from 2008 to 2012 E-commerce in Greece has increased to 18.5% [3], indicating a market that shows fast growth pace compared to other European e-commerce regions. B2C development in Greek E-commerce is considerably high with 1.9 million Greeks having bought on-line products of total value of 2.9 billion Euros with an average spend per e-shopper reaching 1.347 Euros, Fig 3. This value is among the highest amounts of money spent in EU according to Eurostat statistics.

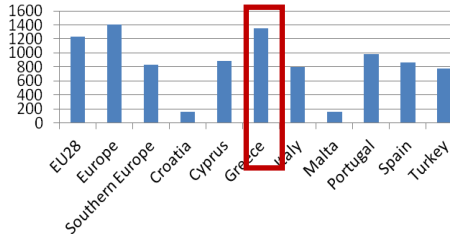

Fig. 3: *Average spend per e-shopper in EU countries*

E-commerce sales forecast for 2013 are to rise from 2.56bn to 3.5bn, with the number of e-Greek shoppers being 2.5 million [4] with 15.000 SMEs being involved in B2B transactions.

2.2. Why investing in Clothing, Footwear and Sports?

E-clothing: the King is back

Among the five purchased goods and services by percentage of users, clothing, footwear and sports are ranked first, Fig. 4, where in previous years they were lower in ranking and with lower market share.

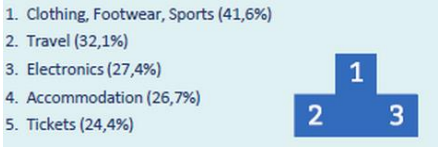

Fig. 4: *Top five online purchased goods and services by percentage of users*

2.3. The on-line behavior of Greek consumers

It should be noted that only 61% of the money spent by e-shoppers in Greece was carried out by Greek sites. In mature e-commerce markets in other EU countries an average of 80% of sales is attributed to national/local websites. Therefore, in the years to come, we expect the market share of Greek sites to increase and reach the average EU penetration. Greeks are still very reluctant to use the internet and purchase through the web. To our experience the most important factors are: firstly, the first assumption that can be made is that Greek consumers are very preoccupied with the safety of the on-line purchase. Secondly, they are concerned about possible product returns of the items purchased. Thirdly, they want to navigate through a simple and fast website. Lastly, they want the website to have an effective customer support. A transaction in which goods are paid for in full in cash or by certified check immediately when they are received by the buyer is the dominant payment method in Greece. This tendency demonstrates the distrust of the Greek consumer in the e-commerce. However, this behavior will change in the future, since generation Y has fully embraced the technology and in the years to come the shopping mentality will drastically change.

Credit cards and Paypal are ranked second and third respectively, whereas debit cards and money deposits in bank accounts complete the puzzle of payment methods. Lately, the capital controls have altered the shopping behavior with an increase in e-payment being reported.

2.4 . The problem: Greek e-shops fail to monetize

Although the number of e-shops has significantly increased over the past years, their on line sales and their conversion rate is low. A number of reasons are responsible for these observations:

(a) E-shops have failed to promote the idea of a safe environment for transactions and therefore a high number of shoppers are very reluctant to purchase on-line despite their high average spending. One in three Greeks does not trust the Electronic Data Interchange (EDI);

(b) The delivery dates are long, their stock is limited;

(c) The high prices of logistics in Greece are added up to the prices of the items advertised making the competition between e-shops fierce;

3. METHODOLOGY

3.1. Our Market Research for product-market fit

We performed a market research in order to investigate the behavior of the consumer and find answers to the following questions:

- Is the consumer visting online fashion eshops and aggregators?

- Which factor affect her purchase decision?
- What products does she buy?
- Which are the products that she likes to purchase?
- Which are her expectations from a novel fashion platform?

We performed a nationwide quantitative research that was designed in an open source software[4]. An online questionnaire was used that was uploaded on our website with a random sampling of 290 females. Men were excluded from the survey for the this survey since our product is focused on women.

4. RESULTS

4.1 Key demographics

Women between 16 to 45 years of age participated in the survey with all of them coming form different regions of Greece such as Attica, Macedonia rural areas and islands.There was a significant response rate (19.3%) collected from girls between 18 and 24 years with the highest percentage (43.8%) of our sample observed for women between 25 to 34. The percentage of women aged between 35 and 44 reached approximately 30%. Regarding the geographical distribution it was revealed that 69.7% of the respondents reside in the region of Attica. However, a percentage of 14.5% was found to reside in the region of Macedonia (Western, Central and East-Macedonia and Thrace) and an equal percentage (14.5%) was reported for the remaining perfectures of Greece. Therefore, a representative sample was used in order to carry out this research. Our initial question was whether women visit fashion websites or not. As expected, the majority of the sample responded positively with only a small percentage of 3,8% stating not using the internet. A significant percentage uses the internet to explore products and purchase (59,7%) whereas a small percentage (1,4%) goes online for dedicated and scheduled purchase. This finding demosntrates the importance of user experience and interaction in fashion sites and the need for content since users desire to explore and get informed on products prior to purchase.

4.2 Online product purchase frequency

When the purchase frequency was asked, approximately 75% of the participants responded that they puchase “sometimes”, “often” and “very often” items from the internet. Therefore it can be assumed that the purchase behaviour of consumers is changing, the internet is influencing our purchase decisions and the number of people rarely buying or never buying products is reduced and has become a minority.

4.3 Popularity of the fashion websites in Greece

The purpose of this question was to identify which websites are more prominent to the user’s mind regarding fashion. Our findings, indicated that ASOS (www.asos.com) is the most renowned fashion website regarding fashion with a percentage of 34,8%. This is not a surprise since ASOS is one of the major fashion aggregators in Europe and overseas. However, an observations has to be outlined in this finding. The majority of Greek women has not related in her mind fashion with a specific website (42,8%). As a result, there is a gap in the market that has to be fulfilled with a fashion platform that will be the flagship of fashion and will promote style in Greece. A brand platform is required that will be related to fashion and sophisticated style. That gap in the market we plan to fullfill with the **Fashionphoria**, a representative fashion platform synonymous to style[5]. In addition, an encouraging finding was revealed when participants were asked whether they purchase items (clothing, shoes or accessories) online. A vast majority replied positive that purchases on the

internet clothes shoes and accessories which indicates that the online fashion market is present and active in Greece.

4.4 Factors influencing purchase decision of the consumer

Our purpose was to identify the priorities of the consumer prior to purchase and investigate the dynamics that influence her final decisions. Therefore, we asked participants to select those factors that they consider important prior to purchasing a fashion product. The findings suggested that the Greek consumer in fashion industry is very demanding, looking for products that are cost effective, comfortable, of high quality and match her style. Interestingly, when the brand name is questioned, the majority of participants responded that it is of neutral importance to them.
In addition, when the finding was further analyzed by segmenting the age distribution groups, the same tendency was observed for all age groups examined.

4.5 Factors that influence online purchases of clothes, shoes or accessories

A number of factors that affect purchase of fashion items such as special offers, saving time, variety of products, size and quality of the product and delivery speed were examined in our survey. The big winners in this study were the special offers, saving time and product variety. Although the customer appreciates the product quality and are concerned for the size of the cloth, these factors coupled with the delivery speed are not of significant priority when purchase decision is formulated.

4.6 User's expectations for a novel fashion platform

We asked users their expectations for a new fashion platform. We were interested in identifying which features in a fashion platform are highly appreciated in order to develop our product accordingly and adapt to the arising opportunities. The results demonstrated that the update on new fashion items seems to be a very important aspect for the fashionista. Value for money purchases and the creation of the "Set" are also important features of the users, however, they should be considered at a subsequent stage.

5. DISCUSSION

5.1 The need for a Social Fashion Network

Based on the above observations regarding the low number of sales for Greek e-shops, it is evident that a new and intriguing environment is required in order to achieve the following challenges:

For the e-shopper the platform will:

- Provide the consumer with new shopping experiences;
- Assist the user in participating in the fashion industry-be proactive;

For the brands the platform will help them to

- Increase their sales utilizing a number of advertizing tools;
- Allow them to have an insight on users' preferences and adapt their advertising campaign accordingly;

5.2 Activities of a FashionPhorian user

- Update her status and comment on other users' status or Sets;
- Create a "Set", comment on it and share it on Social Media;

- Discover new products after having saved the "Set" and navigate to the corresponding webistes

6. CONCLUSIONS

Although there are a number of fashion aggregators in the global market [6, 7, 8], Fashionphoria is a unique social fashion network. It enables users:

1. to create their own outfits from (a) *clothing*, (b) *accessories* and (c) *shoes* that they find online;
2. to socialise with other users in topics such as style and fashion;

Added value of the product

The added value of the site, the core idea, is that the user can create a collage by using the products offered by brands and fashion e-shops. As a result, by mixing a matching products the user creates the so called "Set" and becomes a stylist, Fig. 6.

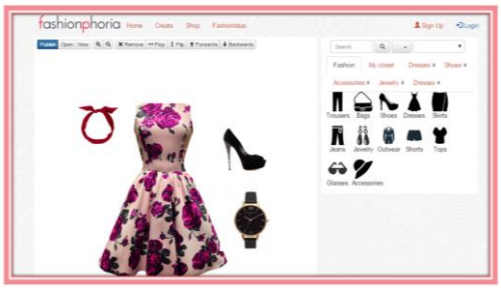

Fig. 6: *Creating a Set in the site*

The fashionista can select the background she prefers, add text, colors and other features with a scope to create a piece of style. Then, she can save the Set to the site or publish it directly to her blog or other social media such as Facebook, Twitter or Pinterest. When the Set is published on the site, the products that form the collage are displayed on the screen underneath the Set, with their image, price and the corresponding site for potential purchase. In case the user likes the product and decides to purchase or seek for further product details in the e-shop, she clicks on the button "Buy at" and gets transferred to the landing page of the brand or the e-shop. By this transfer Fashiophoria get paid by pay per click, helping the e-shop to attract more on-line customers and obtain revenue.

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[7] www.lyst.com

[8] www.clothia.com

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