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ALTERNATIVE AESTHETIC DIVERSIFICATION OF CLOTHES USING PRINTING

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Abstract: *The fast pace evolves surrounding world reflects on achievement technologies and decorating clothes. The most common, by far, the technique of personalization and printing of textiles and clothes is screen printing technology. Nevertheless, screen printing method limits the printing area and the number of printed colors.*
Screen printing technology is a traditional method to obtain surface images of textiles and since it involves a lengthy process of transition from one model to another great time to adjust equipment it is necessary modernization. Modernization implies the gradual replacement of screen printing technology with digital printing. Digital printing technology is directly applicable on computer to textile raw or cut the selected image using only a special printer using special inks. This new technique provides designers almost unlimited creative freedom and an advantage for all industrial and commercial process in the production system.
The purpose of this study aims to analyze the possibilities of using technological alternatives clothes printing, namely digital printing technologies directly or indirectly.
There were samples subjected to laboratory tests for textile printing by the traditional method – screen printing, and three samples of textile printed by a digital printing method in order to identify different characteristics of resistance to dry friction and drapery prints, vapor permeability zone print, hydrophilicity.
Printing patterns on textiles, which were not feasible in the past – no color limits are now available to everyone through digital printing technologies. It is a superior alternative to screen printing, denoting several strong elements: quickness, effectiveness, economic constraints related to complex manufacturing process and the minimum number of copies, myriad of colors, resistance to washing and ironing.

Key words: *inks, textiles, digital printing directly, digital printing indirectly, technologies.*

1. INTRODUCTION

Prints are one of the elements in vogue fashion trends in clothing products. It has also stimulated interest in the development and modernization of technologies of printing on textiles and knits. The most commonly used method of printing on textiles and knits up to this point has been screen printing. This includes the application of an ink layer by a screen using attached to the frame and a scraper, in order to obtain the desired image on the surface of the fabric. This technology involves a lengthy process of transition from one model to another application time and high technical configuration of the means of production. The development of digital technologies has enabled the expansion of printing on textiles and knits as media. Digital technology has seen a rapid spread since it includes several methods of achieving that exclude many technological steps such printing process is reduced only to the creation of original - layout electronic file and make prints itself.

The purpose of this study aims to analyze the possibilities of using technological alternatives textile printing and digital printing technologies namely direct and indirect with subsequent analysis of the advantages offered by them.

2. GENERAL CONSIDERATIONS ON DIGITAL TEXTILE PRINTING

Field of the digital textile printing (figure 1a, b, 2) can be sized large segment:
1. Printing on polyester textiles;
2. Printing on textiles of natural fibers and synthetic fibers other than polyester, such as:
    - natural textiles - 100% cotton, bleached and / or mercerized;
    - natural cotton or viscose content;
    - 100% natural textiles bleached
    - 100% silk;
    - containing silk cotton, wool and cashmere;
    - natural wool (only thin fabric);
    - viscose (there are technological limitations).

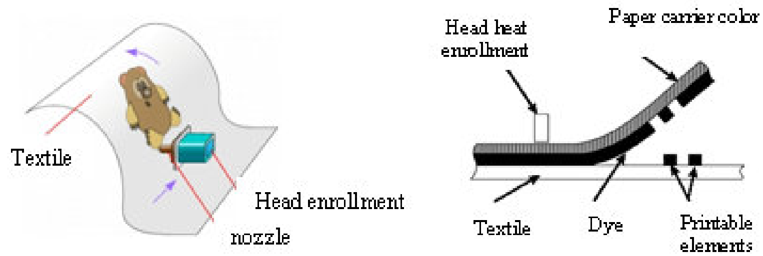


Fig. 1: *Printing digital technology [8]*
a - direct printing;
b - by indirect printing.

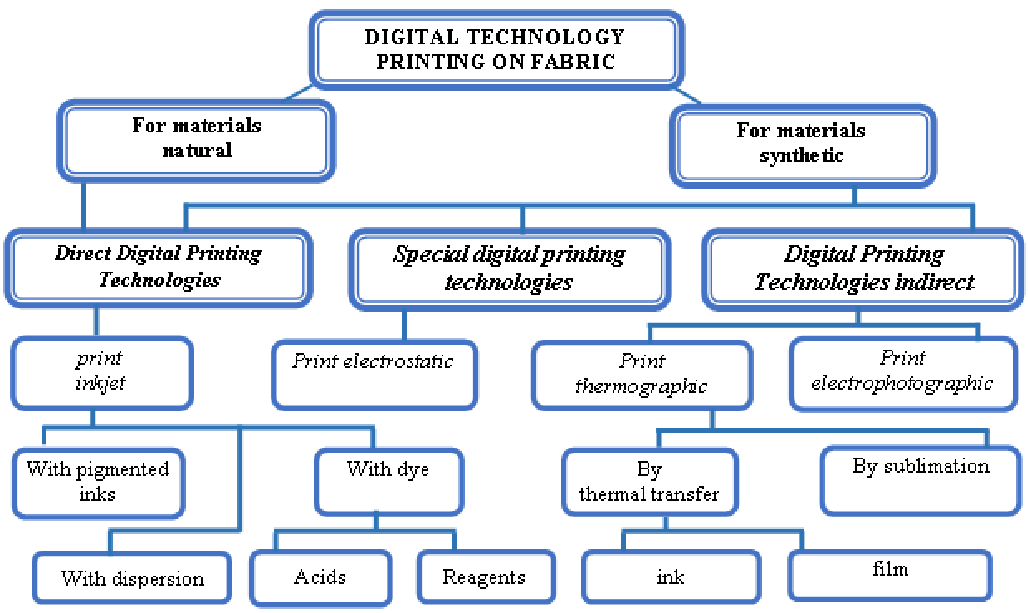


Fig. 2: *Digital technologies achieve prints on textiles*

For digital printing on textiles polyester using sublimation inks, most commonly water based. The pigments in the ink by heat (180-210 °C) going from the solid phase and gas phase entering the polyester fiber. This allows for: vivid colors, a good double sided penetration, high resistance to washing and UV radiation, the material keeping the flexibility and features original perceived tactile touch [1, 4].

For printing on textiles from natural fibers (cotton, silk, viscose, etc.) using reactive inks and acid inks. Attachment to a material requires post-treatment steam [1].

Digital printing on textiles requires the involvement of a minimum consumption of material and equipment (figure 3), customizing the following advantages:
- economic (buying a single machine and pay a single operator);
- technological (maximum precision inking);
- ecological (various chemical solutions used in traditional printing process pollute the environment);

• space (eliminating pre-press equipment, we have more space);

• temporals (making the graphical layout to produce the final product is only a few hours) [2, 3, 5-7].

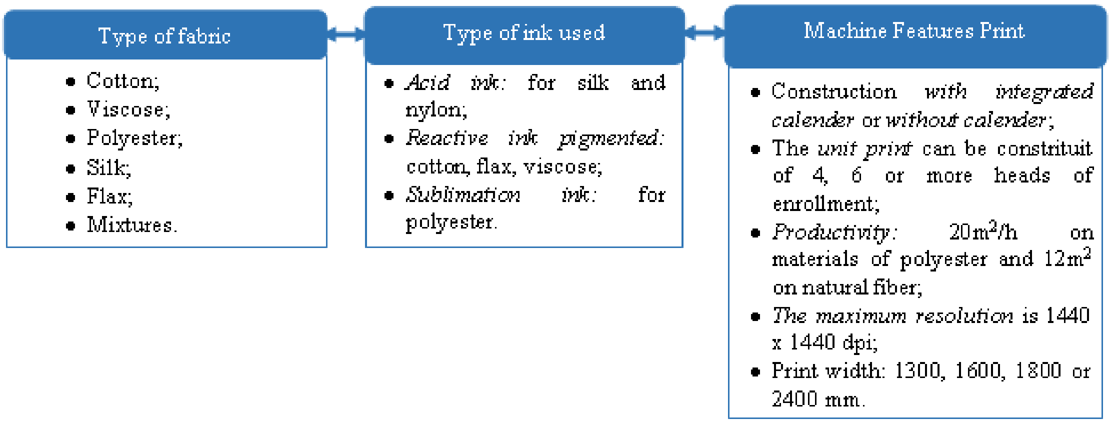


Fig. 3: *Peculiarities digital printing on textiles*

Analysis of the advantages of digital technology and traditional textile SWOT method is shown in figure 4 through specific elements common to both technologies.

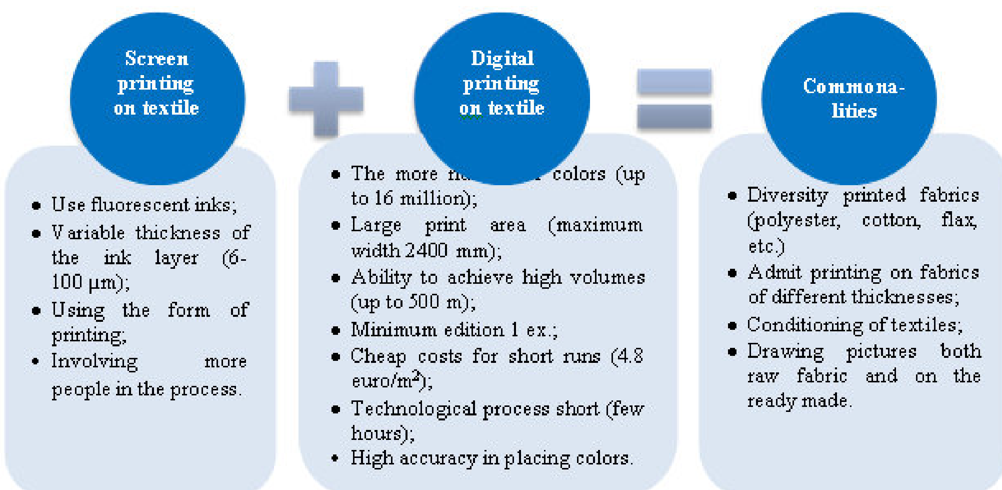


Fig. 4: *Specific and common aspects of screen printing and digital printing on textiles*

For digital printing, the process is much shorter, the aesthetic concept development (design) and to obtain printed fabric needed a few hours. The customer brings the file to the printer model in vector or bitmap format, and possibly material if it is to work with your own material. Make a test, and then after the confirmation date of the beneficiary, go to achieve the entire order. It is recommended to power the coil material previously treated, ensuring hydrophilicity required for better absorption. Subsequently, the material is treated with different substances for better adhesion of the ink. Finally, the fabric is printed like paper. Due solution which was treated material, it allows the ink to enter the fiber and a stain to get some clear, sharp images. After printing, followed by heat setting process, as well as conventional printing [2].

3. EVLUATION STRENGTH CHARACTERISTICS OF TEXTILE PRODUCTS TO VARIOUS REQUESTS

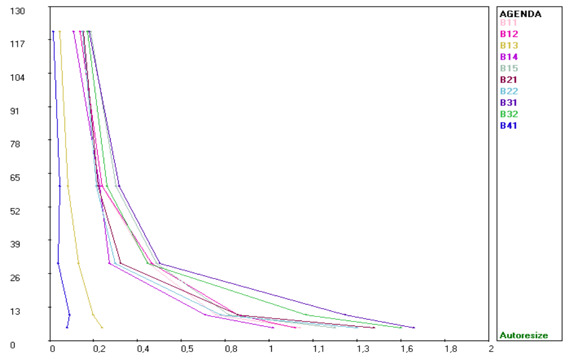
To assess the strength characteristics of printed textiles screen printing and digital technology were prepared by 10 types of materials (table 1, figure 5) for each printing method, with dimensions of 350×450 mm. Tests in laboratory analysis assumed vapor permeability zone print, hydrophilicity, resistance to dry friction and drapery prints.

Table 1: *Identity features cotton-containing fiber materials*

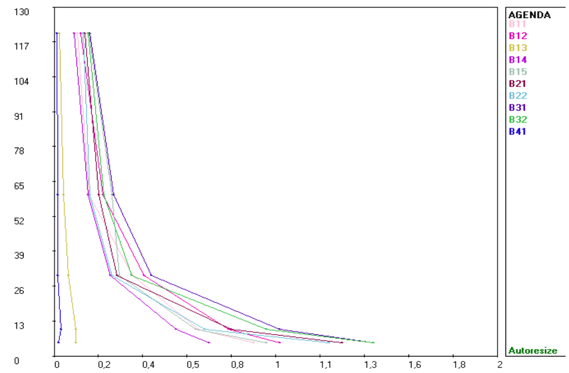
Marking	Coding	Fiber composition	Thickness (mm)	Mass, (g/m^2)	Density (threads/10cm)		Link	Width (cm)
					U	B		
110	**B 1.1**	100% C_0	0,21	101,59	290	260	canvas	152±2
190	**B 1.2**	100% C_0	0,27	141,87	290	250	canvas	152±2
750	**B 1.3**	100% C_0	0,22	118,73	260	220	canvas	152±2
350	**B 1.4**	100% C_0	0,245	132,93	290	250	canvas	152±2
230	**B 1.5**	100% C_0	0,23	129,67	280	250	canvas	152±2
550	**B 2.1**	98% C_0 2% LY	0,99	305,75	300	280	canvas	152±2
650	**B 2.2**	98% C_0 2% LY	0,85	287,32	280	280	canvas	152±2
1149/329	**B 3.1**	98% C_0 2% ES	0,61	264,20	400	160	canvas	152±2
1149/331	**B 3.2**	98% C_0 2% ES	0,31	124,50	380	140	canvas	152±2
932/257	**B 4.1**	70% C_0 30% PES	0,4	241,96	270	250	canvas	152±2

Table 2: *Vapor permeability (PV) materials-cotton*

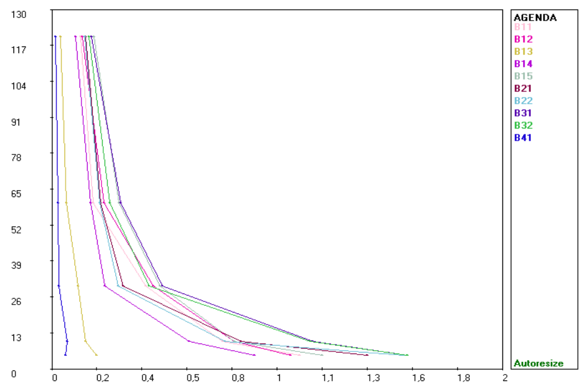
Encoded material	Type of measu-rement	Coefficient of vaporization, μ, $g/m^2 \cdot h$					
		absolute, μ			relative, μ_0		
		μ_1	μ_2	μ_3	μ_{01}	μ_{02}	μ_{03}
B 1.1	1	1,27465	1,48403	1,56498			
	2				12,89353	13,73037	14,86610
B 1.2	1	2,15555	1,82615	1,60318			
	2				20,64216	18,19784	16,12809
B 1.3	1	1,51846	1,54415	1,45281			
	2				15,34210	15,38877	15,95085
B 1.4	1	1,86332	2,03112	1,83979			
	2				20,45928	22,66205	20,77736
B 1.5	1	1,57113	1,63045	1,27386			
	2				16,87791	17,85899	15,56217
B 2.1	1	1,27399	1,38594	1,83953			
	2				13,31625	13,97228	18,61219
B 2.2	1	1,27904	1,57190	1,79594			
	2				12,86243	15,84781	16,60413
B 3.1	1	0,97285	1,36283	1,43237			
	2				17,82751	19,25896	18,16196
B 3.2	1	1,50384	1,61748	1,77986			
	2				14,79539	15,94718	17,39672
B 4.1	1	1,57976	1,61003	1,54344			
	2				12,99709	14,53655	14,02254



a)



b)



c)

Fig. 5: *Hydrophilicity of cotton-type material*
a) in the warp direction;
b) the weft direction;
c) orientation under 45^0.

Table 3: *Attrition behavior by friction of materials-cotton*

Encoded material	**Initial mass of the specimen, $m_{0,\,g}$**	**Initial thickness, $g_{0,\,mm}$**	**Number of rubbing cycles / min**	**Mass of the specimen after 20 min of friction, m_1 g**	**The thickness of the test specimen after 20 minutes of rubbing, $g_{1,\,mm}$**	**Loss of mass, P_m, g**	**Loss of thickness P_g, mm**
B 1.1	7,177	0,217	60	7,072	0,112	1,4629457	48,3870968
B 1.2	10,231	0,273	60	10,116	0,212	1,1230464	22,3443223
B 1.3	8,388	0,225	60	8,282	0,197	1,2660642	12,4444444
B 1.4	9,392	0,245	60	9,278	0,172	1,2138636	29,7959184
B 1.5	9,161	0,232	60	9,069	0,185	1,0053378	20,2586207
B 2.1	21,597	0,991	60	21,396	0,721	0,9306848	27,2452069
B 2.2	20,299	0,857	60	20,127	0,795	0,8473324	7,2345391
B 3.1	18,665	0,613	60	18,544	0,573	0,6482722	6,5252855
B 3.2	8,795	0,314	60	8,670	0,288	1,4212621	8,2802548
B 4.1	17,094	0,452	60	16,959	0,407	0,7897508	9,9557522

4. CONCLUSIONS

Models of textile prints that were not possible in the past are now made available to everyone through avoiding demarcation color digital printing. Digital printing on textiles and knits are a superior alternative to screen printing, denoting several strong elements:

1. Quickness – from product design on calculator to the finished product is only one click.
2. Effectiveness – incredible customizations done on any difficulty level graphics.

3. Economic constraints related to complex manufacturing process (eg, site of each color) and the minimum number of copies (after all is not just a picture on the computer that is sent to print as many copies as necessary).
4. Myriad of colors - every ton of the color is achieved.
5. High vapor resistance, high hydrophilicity, medium strength dry friction.

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STRENGTH OF A WAX COATED SILK YARN UNDER PERSPIRATION SOLUTIONS

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Abstract: *Medical products play an importan role in our society. Textile structures offer a wide variety of products which can be used in a wide variety of medical apllications. When treating a deep wound, it needs to be sewed with some yarns in order to stick both sides in the wound. It recquires the yarn to be in contact with the skin and depending on the place the wound is located, it is soaked on corporal fluids such as perspiration, saliva, blood, etc. The aim of this work is to determine if silk threads can be damaged by perspiration and lose some properties. Yarns with different conditions have been treated for 10 days with perspiration solutions and results showed that traction resistance decreases for some of the studied yarns and that microorganisms grow on the yarn surface. Despite the fact that some yarns show antimicrobial treatments, this test showed that wax coated is not enough to prevent the presence of microorganisms on the yarn. This is an important fact as the yarn is in directly in contact with the wounded area and it can implie infections for the patiente. Results evidence that perspiration solutions can reduce the yarn´s resistance and it can be a problem if the yarn lasts longer than 10 days. Obbiously, the test was conducted at room temperature, about 22º C, and patiente´s bodys is at higher levels 36.5-37º C. Thus, further studies should be conducted in order to test temperature or even though fineness influence*

Key words**:** *Yarn, wound, traction resistnace, perspiration, and microrganisms.*

1. INTRODUCTION

Nowadays, medical products play an importan role in our society. They have increased its demand considerably [1]. Its increasing interest and the presence of infectious–contagious diseases has contributed to accelerate the development of new materials in order to answer the recquirements and specifications of helath care services. [1-2]

Textile structures offer a wide variety of products which can be used in diverse medical aplications. When treating a deep wound, it needs to be sewed with some yarns in order to stick both sides in the wound. It recquires the yarn to be in contact with the skin and depending on the place the wound is located, it is soaked on corporal fluids such as perspiration, saliva, blood, etc.

Despite the fact that some publications show the interes in developing new products based on avoiding suture by different methods [3], the use of yarns is far from being forgotten. Some yarns are made of biocompatible or absorbable materials [4-6]. Depending on the place the bound is located the thread material recquires some properties, but absorbable is not allways compulsory.

The aim of this work is to determine if silk threads can be damaged by perspiration and loose some properties. Yarns with different fineness have been treated for 10 days with perspiration solutions and results showed that traction resistance decreases for some of the studied yarns.

2. EXPERIMENTAL

2.1 Materials

One yarn 3.5 metric has been tested. Yarns were labelled as “Wax coated Braided Silk”.

2.2 Perspiration text

Perspiration fluid can be prepared by two different recipes depending on the pH of the solution. The test was conducted with two different solutions, acid perspiration or alkali perspiration. Throughout this paper the term “A” will refer to acid and the term “B” will refer to alkali. Solutions were prepeared according to Standard UNE EN ISO 105 E04. Textiles. Test for colour fastness. Part E04: Colour fastness perspiration.

Samples of 200 mm were immersed into 100 mL of solution and they remained on fluid at room temperatura for 10 days and 30 days.

Thus, different references were obtained depending on the pH from the solution and the number of days they had been inmersed on the solution. In this dissertation acronyms have been used. Table 1 Shows the abbreviation for each experiment considering the test conditions.

Table 1: *References for conducted tests*

REFERENCE	SOLUTION	TIME (days)
Y3.5	NONE	0
Y3.5_A10	ACID	10
Y3.5_B10	ALKALINE	10
Y3.5_A30	ACID	30
Y3.5_B30	ALKALINE	30

2.3 Traction Resistance

We evaluated the modification in the traction resistance for the treated yarns and compared with results for the yarn without any perspiration treatment. Traction resistnace test was conducted according to the standard “Textiles. Seam tensile properties of fabrics and made-up textile articles. Part 1: determination of maximum force to seam rupture using the strip method (ISO 13935-1:1999)”.

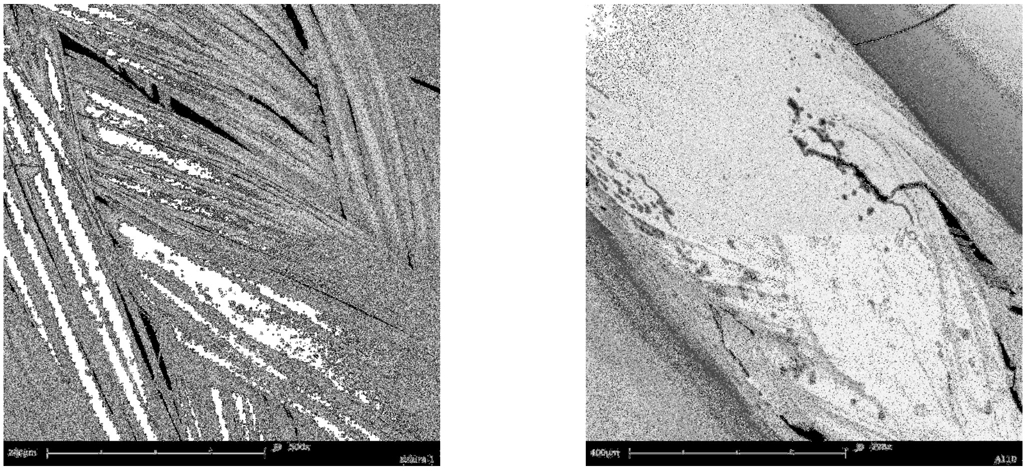
2.4. SEM microscopy.

Yarn surface was obserbed by SEM microscopy. A scanning electron microscopy (Phenom Microscope FEI Company, Hillsboro, OR, USA) was used. Each sample was fixed on a standard sample holder and sputtered with gold and palladium accurately in order to convert the sample into a conductive one so as to be observed properly.

3. RESULTS AND DISCUSSION

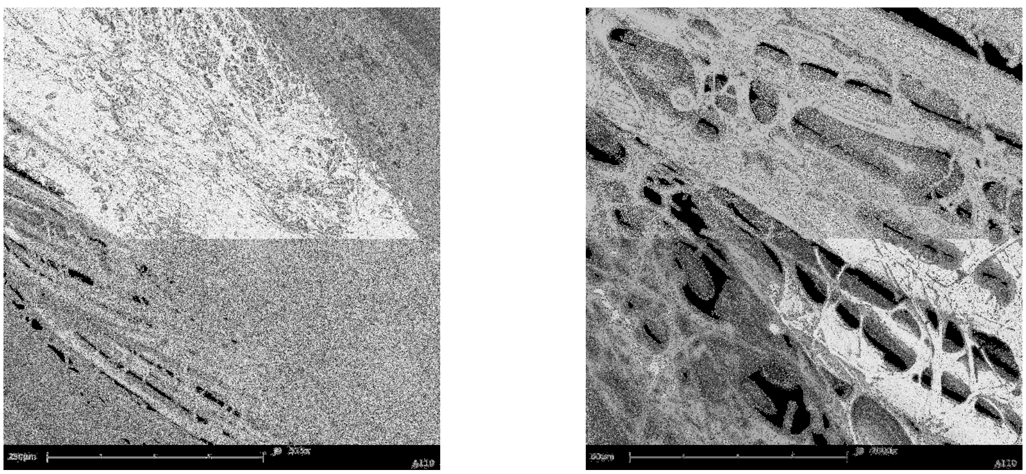
Surprisingly, on the 4th day of treatment some samples innmersed on acid solution showed some white spots on the yarn surface, simmilar to a nonwoven from electrospinning, which implied the grow of microorganisms. It must be pointed out that day-by-day spots appeared in almost every sample, mainly the ones which lasted 30 days.

Figure 1a shows the appearance of the yarn without any treatment, and figure 1b the extent of the microorganisms net on the yarn surface which seems to cover the yarn surface compleately. Figure 2 corresponds to the image from 1b enlarged so that it could be appreciated the net structure of the coating.



a) *b)*

Fig. 1: *Tested yarn. a) Without treatment. b) immersed on acid perspiration solution for 30 days.*



a) *b)*

Fig. 2: *Tested yarn immersed on acid perspiration solution for 30 days.. a) enlarged X500. b) enlarged x2000*

Knowing the presence of microorganisms on the fibres surface, the yarns were thoroughly rinsed with cold water previously to test its traction resistnace. SEM images showed that all the microorganisms net had been removed.

Traction resistance text showed that regarded the was coating on the fibres, the perspiration solution can affect its resistance as it can be observed in table 2.

Table 2: *Traction resistance results*

REFERENCE	HIGH FORCE-FH (N)	ELONGATION (%)
Y3.5	54,26	18,09
Y3.5_A10	54,02	18,01
Y3.5_B10	52,04	17,35
Y3.5_A30	46,68	15,56
Y3.5_B30	45,62	15,21

This study was interpretative in nature, as it could be appreciated from table 2 that the yarn´s traction resistance and elongation was reduced because of its contact with perspiration solutions. As it cpuld be expected, the treatment for 30 days shows a higher reduction than the yarns exposed for 10 days. However, the recution is about 15 % for 30 days.

4. CONCLUSIONS

The reader should bear in mind that the study is based on a small sample, one yarn and two corporal fluids at room temperature. However, some conlusions could be extracted which originate new variables to be studied.

Despite the fact that some yarns show antimicrobial treatments, this test showed that wax coated is not enough to prevent the presence of microorganisms on the yarn. This is an important fact as the yarn is in directly in contact with the wounded area and it can implie infections for the patiente.

Results evidence that perspiration solutions can reduce the yarn´s resistance and it can be a problem if the yarn lasts longer than 10 days.

Obviously, the test was conducted at room temperature, about 22º C, and patiente´s bodys is at higher levels 36.5-37º C. Thus, further studies should be conducted in order to test temperature or even though fineness influence.

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BENDING BEHAVIOR OF RAYON AND WOOL TYPE POLYESTER FIBERS THERMAL TREATED

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Abstract: *Given the fact that bending rigidity influences to a great extent the product handle and considering that the market demands products with a soft, pleasant handle, one must pay a special attention to these characteristics and especially to the treatments that modify the bending rigidity.*
It was found that any mechanical or thermal treatment brings modifications of the bending rigidity, in terms of the fibers nature and treatment conditions.
In most of the methods meant to determine the bending rigidity one must measure the amount of deflection of the fibers end in constant cross-section either under the action of the weight.
The textile products are subjected to flexion, to repeated and frequent bending due to knotting and kinking during both the processing and exploitation. All these result in the appearance of stresses of various natures depending on the fibers type. The strains and fiber destruction as the result of these stresses depend on a series of factors related to the fibers composition and intermolecular and intra-molecular structure, their yarn count, elastic modulus, fiber flexibility, finishing procedures or products texture, etc.
Following the performed measurements, we calculated the bending rigidity for the witness samples and for thermally cured fibers; then we divided them in classes and we graphically represented their distribution in terms of the bending rigidity.

Key words: *bending rigidity, flexion, wrapped fiber, deflection*

1. INTRODUCTION

Among the methods used to determine the bending rigidity, we can specify:
Cambridge Method: the device measures either the force necessary to produce a constant deflection, or the deflection corresponding to a force of a conventional size [1], [2].

$$R_i = \frac{F \cdot l^3}{48 \cdot f} \quad \textbf{(1)}$$

where f - maximum deflection;
F- force that produced the bending;
l - fiber length, mm

Peirce Method**:** the determinations can be performed either on a fiber or a bundle of fibers shaped as a loop.The loop elongation is measured in percentages or in absolute value.The bigger the loop elongation, the smaller the bending rigidity [3], [4], [5].

$$R_i = \frac{F \cdot L^2}{z} \quad \textbf{(2)}$$

where: z = d/L;
d- loop deformation;
F- tensile strength, cN;
L-bending length, mm

***Suthrie Method*:** the deflection is measured for a fiber or a bundle of fibers embedded at one end, while a conventional force is acting at the other end:

$$f = \frac{F \cdot l^3}{3 \cdot E \cdot I} \quad \textbf{(3)}$$

where: f maximum deflection (arrow);

F- tensile strength;

l - fiber length, mm;

I- inerta moment;

E- Young's modulus.

Bending rigidity can by calculated using the following relation:

$$R_i = \frac{F \cdot l^3}{3 \cdot f} \cdot E \cdot I \quad \textbf{(4)}$$

Method proposed by Prof. I. Vlad has as a principle winding the fibers round a plate of known perimeter, with a standard stress (0.5 cN/tex), thus producing turns whose radius of curvature will be the higher, the bigger the fiber flexion.

Taking as reference the perimeter of the winding cross-section, given by the formula:

$$P = 2(a + b) \quad \textbf{(5)}$$

$$P = l \cdot r \quad \textbf{(6)}$$

a **-** plate thickness

b - plate width,

the bending rigidity is calculated with the formula:

$$R_i = \frac{P}{l_s} \cdot 100 \quad (\%) \quad \textbf{(7)}$$

l_s – mean length of the turn wound on the plate

$$l_s = \frac{N_s}{l_f} \quad \textbf{(8)}$$

l_f – initial fiber length

N_s – number of wound turns.

The bending rigidity is determined as follows:

- determine the initial fiber length (l_1);
- wrap a round number of turns (n) on a plate;
- determine the difference of unwrapped length;
- calculate the length of the wrapped fiber corresponding to the number of turns n;

$$l_{ns} = l_1 - l_2 \quad \textbf{(9)}$$

- calculate the length of a turn:

$$l_s = \frac{l_{ns}}{n} \quad \textbf{(10)}$$

- calculate the bending rigidity with the formula:

$$R_i = \frac{l_r}{l_s} \cdot 100 \qquad (\%) \quad \textbf{(11)}$$

In the case R_i = 100%, the fibers have the smallest rigidity, i.e. this is the ideal case.

2. EXPERIMENTAL PART

In order to analyze the fibers bending rigidity we performed studies on a rayon fiber and a synthetic fiber: wool type polyester.

Following the performed measurements, we calculated the bending rigidity for the witness samples and for thermally cured fibers; then we divided them in classes and we graphically represented their distribution in terms of the bending rigidity.

From Table 1 can be notice for the polyester fibers that very close values of bending rigidity were obtained.

The polyester fiber suffered small stiffening. This can be explained by the fact that the polyethylene terephtalate absorbs a very small amount of water and resists very well to thermal cure up to 150°C.

Structural modifications can appear due to the mobility of molecular segments in non-crystalline zones.

With the increase of the treatment temperature and duration, the packing density increases, this being ascribed to a corresponding increase of crystallinity.

Since, according to the measurements, the results obtained for rayon fibers were contrary to those for polyester fibers, namely after the thermal cure the fiber does not get stiffer but softer, we ascribed this to the non-uniformity of fiber diameter.

Table 1: *Bending Rigidity and Coefficient of Variation Values*

No.	Fiber denomination	Bending rigidity (R_i) (%)	Coefficient of variation (CV) (%)
1.	Polyester 4 den/76 mm, untreated	87.39	2.02
2.	Polyester 4 den/76 mm, treated (dyed)	87.19	1.59
3.	Rayon type L 15 den/100 mm untreated	90.86	1.22
4.	Rayon type L 15 den/100 mm, heat treated for 10 minutes	90.74	1.17
5.	Rayon type L 15 den/100 mm, heat treated for 20 minutes	90.71	1.10
6.	Rayon type L 15 den/100 mm, heat treated for 30 minutes	90.64	1.10
7.	Rayon type L 15 den/100 mm, heat treated for 40 minutes	90.62	1.22

We performed a new series of measurements, determining at first the diameter of each fiber and then the corresponding rigidity. We noticed that the diameter does not influence too much the rigidity and indeed, after the thermal cure, the wool-type rayon fiber has a softer handle. The coefficient of variation (CV) refers to a statistical measure of the distribution of data points in a data series around the mean. It represents the ratio of the standard deviation to the mean. The coefficient of variation is a helpful statistic in comparing the degree of variation from one data series to the other, although the means are considerably different from each other [6].

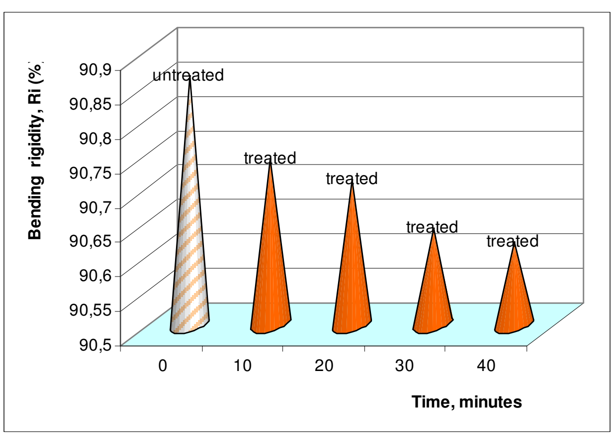

Fig.1: *Distribution in terms of the bending rigidity*

This is due to the fact that viscose has a very non-uniform structure with a core/coating structure having a different degree of orientation and crystallization.

3. CONCLUSIONS

Viscose presents an important diminution of resistance in wet condition, due to swelling and sliding of molecular chains as the result of intermolecular chains breaking.

The hydroxyl groups of cellulose, which became free during water absorption, are not completely able to re-form the initial bonds. One should add to this a certain rigidity of the large cellulose macromolecules which, due to their inertia, obstruct the return of fiber structural elements to their initial position; this results in a looser structure, less rigid to bending.

By analyzing the polyester fibers, one can notice that the variation range is much narrower, and the variation coefficient is much smaller. After the thermal cure, polyester does not change its bending rigidity; being a fiber very resistant to high temperatures, it is not very affected by the treatment to which it is subjected during dyeing.

The rayon fiber does not satisfy the statements made in the case of polyester, such that, following the thermal cure, as the cure duration increases its bending rigidity decreases. This can be explained by the fact that during the thermal cure in wet medium the cohesion forces between molecules decrease and the fibers have a looser structure and, as new cohesion forces can not appear, their softness increases.

A characteristic of the rayon is that there are two maxima in its distribution curves, probably due to the variation of the fiber diameter. The variation range is quite wide, but the coefficient of variation has still quite small values.

It results that during fibers and products manufacturing, as well as during the exploitation of textile products, one should pay a very great attention to both the temperature and duration of exposure to these temperatures. If it is not possible to carry out the process at high temperatures, it should be correlated with durations as short as possible, in order to avoid fiber destruction that can down-grade the corresponding products.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

INFLUENCE OF THE AMOUNT OF THE BTCA ON THE EFFECTIVENESS CROSSLINKING

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Abstract: *Cellulosic textiles mainly cotton fibres, are finished in order to improve their properties, dimensional stability and crease resistance play a considerably important role. These properties can be satisfactory achieved by crosslinking agents, which react with hydroxyl groups of cellulose fibers. Esterification between polycarboxylic acids and cotton cellulosic has been investigated since long ago. Over the past few years, there has been an attention on application of nanoparticles with crosslinking agents to impart other properties to the fabric, such as antimicrobial, flame retardant, water repellency or UV protective. The present study is aimed at imparting polyfunctional finishes on cotton fabrics using polycarboxylic acids (PCAs) which are able to crosslinking with cellulose. 1,2,3,4-butane tetra carboxylic acid (BTCA) have been selected and applied using different concentration on 100% cotton fabrics using pad-dry-cure process. This work is focused on studying the influence of the BTCA concentration on the wrinkle recovery and flexural rigidity behavior. We studied the modification, the wrinkle recovery angle and flexural rigidity. The results of each sample have been compared with the results of the untreated fabric and, as expected, it could be observed differences in behaviour depending on the concentration used. Results from instrumental techniques, showed that the treated sample with 80 g/L BTCA and 40 g/L NaH_2PO_2 is the best effectiveness of all treated fabrics.*

Key words**:** *cotton, BTCA, cosslinking agents, flexural rigidity, wrikle recovery.*

1. INTRODUCTION

Cotton fabrics require several functional finishes to make them confortable during wear. Dimensional stability, feel, appearance, wrinkle recovery, flexural rigidity and soil release property are some of the functional areas which require chemical treatment to improvement. Crosslinking of cellulose molecule renders wrinkle resistance, smooth drying and crease retention properties in cotton fabrics. Majority of easy care finishes used by the textile industry are formaldehyde based resin precondensates. Dimethylol dihydroxyethyleneurea (DMDHEU) is popular among them, as it is more efficient and cost effective. However, the health risk associated with formaldehyde emission has caused increasing concern worldwide. [1]

In recent years, extensive efforts have been made to develop polycarboxylic acids as new crosslinking finishing agents for cotton fabrics to replace the traditional reagents [2, 3]. 1,2,3,4-butane tetra carboxylic acid (BTCA) is found to be the most promising polycarboxylic acid for easy care finishing of cotton fabrics [4-6].

In this research BTCA was applied in 20, 40, 60 and 80 g/L concentration with 10, 20, 30, 40 g/L of sodium hypophosphite as catalyst in each case and cured at high temperatures. We evaluated the influence of concentration of BTCA used on the effectiveness crosslinking. For this, flexural rigidity and wrinkle recovery angle of each treated samples were analyzed.

2. EXPERIMENTAL

2.1 Materials

A 100% bleached cotton fabric with the weight of 115 g/m^2 was used.

The fabrics were impregnated with solutions containing the polycarboxylic acid, using 1,2,3,4-butane-tetracarboxilyc acid (BTCA) and sodium hypophosphite monohydrate ($NaH_2PO_2 \bullet H_2O$) (SHP), which was used as catalyst for the reaction of cellulose with BTCA. Different concentrations were used in each treatment.

2.2 Crosslinking Procedure

The formulations with different acids and conditions of crosslinking are shown in Table 1.

Table 1: *The content of the policarboxylic acids in the reaction bath and the conditions of crosslinking.*

Polycarboxilyc acid	BTCA
Concentration acid (g/L)	80, 60, 40, 20
Concentration NaH_2PO_2 (g/L)	40, 30, 20, 10
Cured temperature (ºC)	170

The samples were immersed in the aqueous solution and then were passed through squeeze rolls to give a specified pick-up, we obtained around 70%.

2.3 Instrumental techniques

We evaluated the modification in the flexural rigidity and wrinkle recovery angle (WRA) of the treated cotton fabrics. It was measured according to UNE 40-392-79 and UNE EN 22313, respectively. The results obtained were the average of 10 measurements taken along the warp and weft directions.

3. RESULTS AND DISCUSSION

The table 1 shows the results of the modification on the flexural rigidity of the treated cotton fabrics. The results of each sample have been compared with the results of the untreated fabric where we can see the percentage increase in warp and weft (Rt).

Table 1: Results of flexural rigidity

	Fabric 110 g/m^2					
	Untreated fabric		**Treated fabric**		**Treated and cured fabric**	
	Weft	Warp	Weft	Warp	Weft	Warp
mg/cm	57,39	80,78	65,50	85,55	77,70	124,26
% Increase			**14,13**	**5,90**	**35,40**	**53,82**

These results for every sample are shown in figure 1, where we can see at a glance behaviour modification after the treatment.

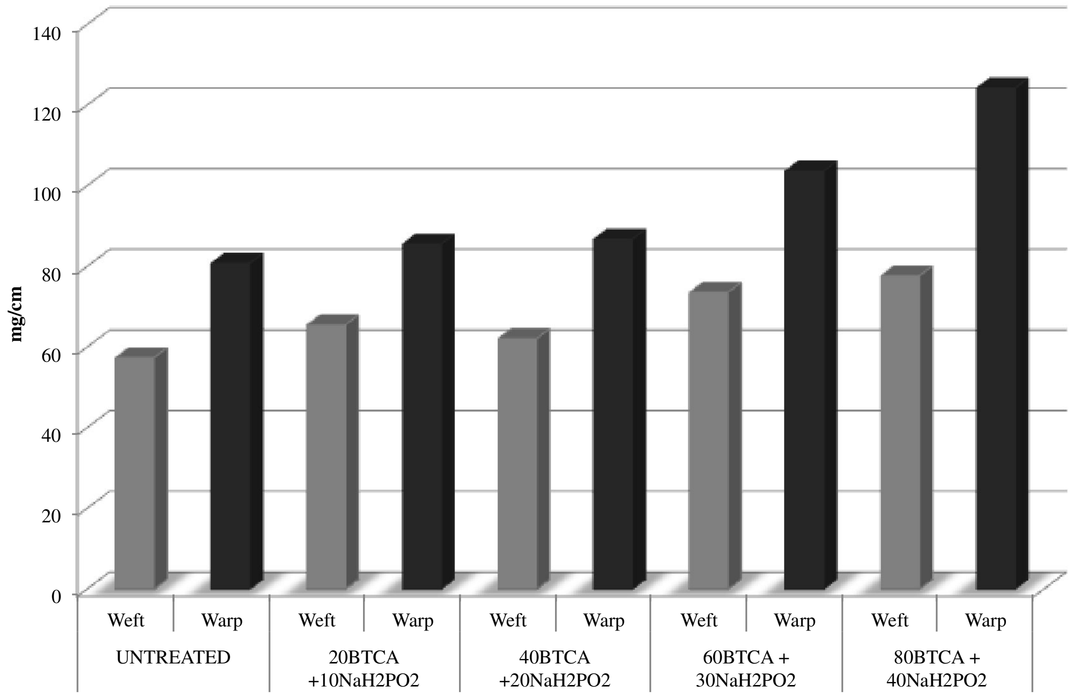

Fig.1: *Flexural rigidity results of samples treated with different BTCA and NaH_2PO_2 concentrations*

The flexural rigidity behavior improves in all of treated sample, as expected, greater amount of BTCA is used, lower flexural stiffness show the cotton fabric.

The figure 2 shows the results of the modification on the wrinkle recovery angle of the treated cotton fabrics. The results of each sample have been compared with the results of the untreated fabric.

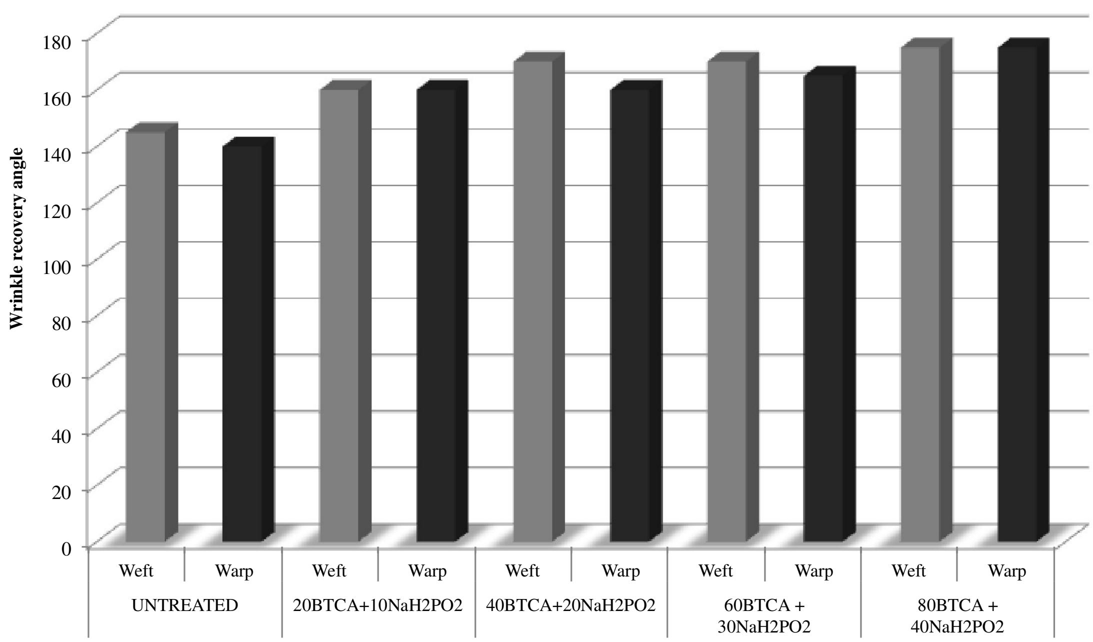

Fig. 2: *Wrinkle recovery results of samples treated with different BTCA and NaH_2PO_2 concentrations.*

The figure shows the results of the modification on the wrinkle recovery angle of the treated cotton fabrics using different BTCA concentration. The results of each sample have been compared with the results of the untreated fabric where we can see the increase in warp and weft.

It could be observed differences in behavior depending on the concentration used. The samples of lower amount of BTCA obtain less wrinkle recovery angle in warp and weft. In all of these fabrics the results are better than untreated sample.

4. CONCLUSIONS

In this work we have impregnated with BTCA cotton fabrics, and we dried the samples at 85ºC, then these fabrics were cured at high temperature. We obtained different behaviour depending on the crosslinking agent concentration have been used.

In this study the influence of polycarboxylic acid concentration on crosslinking efficiency of cotton cellulose crosslinked with 1,2,3,4 buthanetetracarboxylic acid (BTCA) was evaluated. In order to get those evidences, we studied the modification the wrinkle recovery angle and flexural rigidity. The results of each sample have been compared with the results of the untreated fabric and, as expected, it could be observed differences in behaviour depending on the concentration used. In both instrumental techniques, the treated sample with 80 g/L BTCA and 40 g/L NaH_2PO_2 is the best effectiveness of all treated fabrics.

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SEAM PUCKERING EVALUATION METHOD FOR SEWING PROCESS

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Abstract: *The paper presents an automated method for the assessment and classification of puckering defects detected during the preproduction control stage of the sewing machine or product inspection. In this respect, we have presented the possible causes and remedies of the wrinkle nonconformities. Subjective factors related to the control environment and operators during the seams evaluation can be reduced using an automated system whose operation is based on image processing. Our implementation involves spectral image analysis using Fourier transform and an unsupervised neural network, the Kohonen Map, employed to classify material specimens, the input images, into five discrete degrees of quality, from grade 5 (best) to grade 1 (the worst). The puckering features presented in the learning and test images have been pre-classified using the seam puckering quality standard. The network training stage will consist in presenting five input vectors (derived from the down-sampled arrays), representing the puckering grades. The puckering classification consists in providing an input vector derived from the image supposed to be classified. A scalar product between the input values vectors and the weighted training images is computed. The result will be assigned to one of the five classes of which the input image belongs. Using the Kohonen network the puckering defects were correctly classified in proportion of 71.42%.*

Key words: *Seams, pucker, image processing, neural network, Discrete Fourier Transform.*

1. QUALITY AND AUTOMATION IN THE TEXTILE INDUSTRY

The textile industry is one of the traditional and dynamic sectors where the customer quality requirements are constantly changing as a result of trends in fashion and the development of production tools. In order to satisfy clients demands, the variables that affect product quality must be kept under control during the production cycle: design, manufacturing, delivery and maintenance.

The evaluation process of a sewn product relating to appearance and performance have to rely on a holistic perspective that includes both fabrics and sewing threads assessment, but also consider their interactions during sewing, wearing and maintenance of the product. Throughout the manufacturing process, the woven, non-woven or knitted fabrics are controlled from two to more than six times in order to detect the defects which may occur, followed by their classification and if possible, remedying. A good compatibility between sewing thread and materials will influence the product quality and productivity. Otherwise, during the sewing process, the fabric is damaged or the machine stops at unanticipated time intervals [1].

After execution, a correct seam need to be smooth and flat, without puckering, tuck developing or seam damage, having an appropriate behavior during pressing and cleaning. There are several standard test methods for evaluating the interactions between the threads and fabrics after the execution of the seams and stitching. ASTM D1683 assess seam strength, slippage, failure, damage, pucker and jamming before and after cleaning. ISO 7770, AATCC 88 B and AATCC 143 standards use sets of images and rating scales in order to evaluate the appearance of seams, using grades from 1 (worse) to 5 (best quality seam). Inspectors should compare the stitching samples with the standard images, in different environments, which cause subjective results.

Due to long reaction time and fatigue of the human operator, an automatic inspection would be able to verify and classify the seams with a much higher speed and would eliminate the subjective factor. The system can be used both in the pre-production stage, for sewing machines adjustment, and also in product inspection. The ability to recognize flaws and stop production immediately after the occurrence of the defect is important for clothing manufacturers.

The automatic control system may use different technologies for image acquisition, containing mechanical components, computer software, video cameras, lighting and video equipment. In particular, an automatic defect detection is be based on an electro-optical device for fabric surface inspection using a two-dimensional scanner of the warp and weft directions, or on a complex of video camera and uniform illumination source connected to video acquisition system [2].

2. THE SEAM PUCKERING DEFECT: CAUSES AND REMEDIES

The seam puckering phenomenon is defined as a local defect of a clothing item in the form of large ridges of material beside the seam and is considered one of the most serious defects in garment manufacturing [3]. The complete elimination of this flaw during pressing operations is almost impossible, and therefore in practice, it is often to accept a lower grade as normal. Consequently, the objective assessment of seam puckering is essential, such that the final product will be acceptable to the client [4].

Seam pucker may also be described as a differential shrinkage that arises throughout the seam line and is caused by the instability of the seam. Usually, wrinkling appears due to improper selection of stitching parameters and material properties, leading to an inequality of fabrics lengths that are sewn together and affecting the appearance characteristics. In serious cases, puckering can appear as a wave coming from the seams. Since sewing operation is subjected to excessive tensions, it produces a stretching of sewing threads, leading to an extension over the whole surfaces of the fabrics.

Although sewing threads have usually a controlled elasticity, they are overstretched when large tensions are implied in process. After sewing, the threads tend to relax, trying to return to the original length. As the stitches shrink, wrinkles appear in the material and can not be detected immediately, but in a later stage. The threads used in sewn products must also have a good stability to washing and ironing, as differential shrinkage between sewing thread and fabrics may cause puckering.

Other fabrics characteristics which affect seam stability and puckering are fabric density and structure. By stitching, threads snap the fiber material into a new position, inserting into material structure and tending to change it. This phenomenon is more obvious when the fabric is made of fine, dense and low resistance to compression yarns. In the case of differences in fiber composition, fabrics structure, extensibility and stability, puckers may occur due to feeding failure. In order to avoid this situation, it is necessary to adjust the presser foot pressure to a minimum value. The feeding systems used in stitching control are: a positive or negative differential conveyor, consisting of two teeth elements in front and behind the needle with adjustable amplitude, and a simple oriented tooth feed.

In order to reduce puckering, sewing machine and stitching parameters are adjusted. In the case of the sewing machine, adjustments are made on the conveyor mechanism, tension control and needle selection. Regarding the processing parameters, the stitching step should be as small as possible, while the value of cutting and sewing angle must be correlated with yarn and fabric structure. Using a similar fabric fiber composition thread with thermo stability, low elongation and recovery, puckers can be decreasead or avoided.

3. AN OBJECTIVE SEAM PUCKERING EVALUATION METHOD

Subjective evaluation methods have the disadvantage a higher assessment time, differences between appraisals, partiality towards certain colors or models, and training needs. In the attempt of objectification, two SP synthetic indicators may be used for seam pucker description: related to width and to the length [5]. The hypothesis assumes that following wrinkled defect occurrence, the thickness of two layers sewn assembly increases, while the length decreases, comparing to the initial length of unraveled material. In these conditions, the following formula can be used:

$$SP = \frac{t_s - 2t}{2t} * 100\ (\%) \text{ or } SP = \frac{l - l_s}{l_s} * 100\ (\%) \quad \textbf{(1)}$$

where t_s = seam thickness, t = fabric thickness, l = length of unraveled fabric, l_s = length of sewn assembly. However, incoherence and time-consuming are noticed for these assessments.

Image processing techniques have been already applied in the textile industry. Research was carried out to investigate the cross section of fibers, yarn structure, yarn thickness [6], texture fault detection, seam pucker etc. Image processing is sometimes combined with a classification/recognition step achieved using neural networks. A large review paper on this field, including many textile applications, has been published by [7].

The assessment of seams is one of the research topics in the aim of textile industry automation. The foundations of this field start with a geometric modeling of puckering and a review of the methods and techniques available at that time, in the view of measurement [8]. In [9], the use of a k nearest neighbor classifier achieved an 81% rate of successful classification rate compared with human experts. This implementation is trying to improve a previous one from the same authors, presented in [10]. A wavelet based detectors of surface smoothness or wrinkles and puckering defects have been used by [11], joined with a 3D scanning system.

Our implementation was derived from [12] and involves a spectral image analysis using Fourier transform, and an unsupervised neural network, Kohonen Map to classify material specimens, which are the input images into five discrete degrees of quality, to grade 5 (best) to grade 1 (the worst). A similar approach was proposed using fractal theory [13]. The learning and testing stages are depicted in figure 1. The next paragraphs will present the basics of our processing scheme.

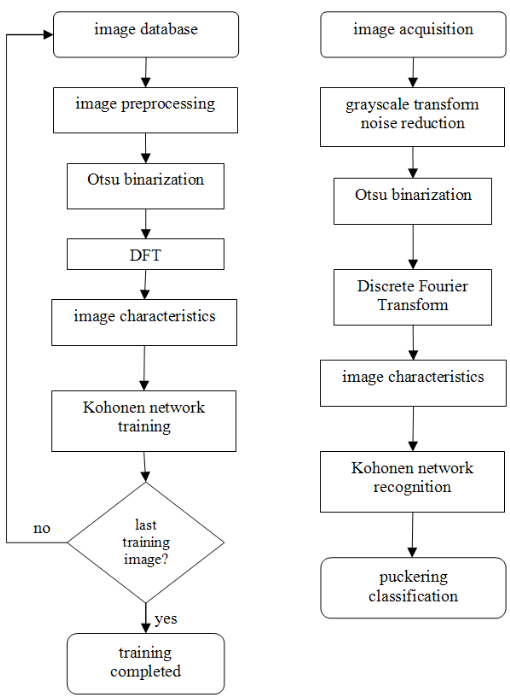


Fig. 1: *The proposed image processing framework.*

In image processing, the Otsu's method is used to perform image binarization, in order to separate objects from background. The algorithm assumes that the image to be segmented contains two classes of pixels (bimodal histogram) and calculates the optimum threshold to separate the classes. The frequencies of grey levels are established and the probabilities for each possible threshold level are computed. The variance of the pixels levels on either side of the threshold will be estimated, both for the object and the background region. Among all possible values, the threshold that minimizes the inter-class variance will be selected, being defined as a weighted sum of the two classes [14]:

$$\sigma_w^2(t) = w_1(t)\sigma_1^2(t) + w_2(t)\sigma_2^2(t) \quad \textbf{(2)}$$

where $w_{1,2}$ represents the probabilities of the two classes separated by threshold *t,* and $\sigma_{1,2}^2$ symbolizes the variance of the two classes. The average of each class is given by the weighted average of frequency intensities, with *L* the number of grey levels:

$$\mu_1(t) = \sum_{i=1}^{t} \frac{ip(i)}{w_1(t)} \quad \text{and} \quad \mu_2(t) = \sum_{i=t+1}^{L} \frac{ip(i)}{w_2(t)} \tag{3}$$

The individual variances of the classes are:

$$\sigma_1^2(t) = \sum_{i=1}^{t} [i - \mu_1(t)]^2 \frac{p(i)}{w_1(t)} \quad \text{and} \quad \sigma_2^2(t) = \sum_{i=t+1}^{L} [i - \mu_2(t)]^2 \frac{p(i)}{w_2(t)} \tag{4}$$

The Fourier Transform is an important tool in image processing, representing the input spatial domain image in the frequency field and therefore, each point in the output representing a particular frequency contained in the image. It is used in a wide range of applications, such as image analysis, image filtering, image reconstruction and image compression. In the context of the present paper, the Discrete Fourier Transform (DFT) will be used. The DFT is actually a sampled Fourier transform and will not contain all frequencies being present in the image, but only a set of samples large enough to describe the spatial domain image, as the number of frequencies corresponds to the number of pixels [19]. For an *N*x*N* image, the DFT is given by:

$$F(k,l) = \frac{1}{N^2} \sum_{m=0}^{N-1} \sum_{n=0}^{N-1} f(m.n) e^{-i2\pi\left(\frac{km}{N} + \frac{ln}{N}\right)} \tag{5}$$

where $f(m, n)$ is the spatial domain image. Each pixel value is multiplied with an exponential term, called the basis function, and summed over the domain. $F(0, 0)$ represents the continuous component of the image (ie the mean gray level), while $F(N\text{-}1, N\text{-}1)$ characterizes the larger frequency. In the same way, the DFT image can be retransformed in the spatial domain as an inverse transform:

$$f(m,n) = \frac{1}{N^2} \sum_{k=0}^{N-1} \sum_{l=0}^{N-1} F(k.l) e^{-i2\pi\left(\frac{km}{N} + \frac{ln}{N}\right)} \tag{6}$$

The DFT produces an output which can be displayed using two images: either the real and imaginary part or the magnitude and phase. In image processing, the amplitude values are usually employed since information about the geometrical structure of the image space is carried out. Nevertheless, in order to compute the inverse DFT after processing the frequency domain, both amplitude and phase array must be preserved and stored on wide representation variables [15].

The Kohonen networks are also known as "self-organizing maps", a special type of artificial neural networks trained using unsupervised learning in order to produce a discrete representation of the input space. Self-organizing maps are different from other neural networks as they use a function to preserve neighborhoods topological properties of the input space. Therefore, Kohonen maps are used to approximate the distribution of input vectors, the dimensionality reduction while maintaining data in the vicinity or for clustering.

Kohonen maps are organized in two layers. The first level of the network is the input layer, while the second is the competitive level, organized as an array. The two layers are fully interconnected; each input node is connected to all nodes in the competitive layer [16]. Each connection has an associated weight. In the initial state, the network weights have random values in the range [0, 1]. The input pattern is an *n* dimensional vector. As a result, the input models are uniformly distributed over a square. The first step in the operation of Kohonen maps is to compute a matching value for each node in the competitive layer. This value measures the extent to which the weight of each node corresponds to the input node. The matching value is the distance between *X* (inputs) and *W* (weights) vectors:

$$\|X - W_i\| = \sqrt{\sum_j (x_j - w_{ij})^2} \tag{7}$$

The node with the best match wins the competition. This node is set as follows:

$$\|X - W_c\| = \min_i \{\|X - W_i\|\} \tag{8}$$

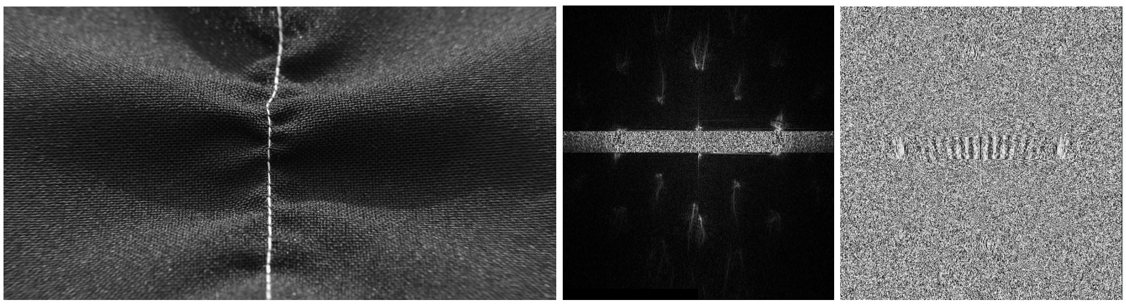
where *c* is the best node. After the winning node has been identified, the next step is to identify its neighborhood, as those nodes in a square centered on the winning node. The weights are updated for all neurons that are in the neighborhood of the winning node. In summary, the basic rules of the Kohonen network can be described as follows [16]:

- Locate the unit in the competitive layer whose weight fits best with the input,
- Update the weights of the selected unit and its neighbors, thus increasing the level of matching,

- Decrease the neighborhood size and adjust the weights during the iterations of the learning process

4. RESULTS

The input image is represented by a sewn sample image with puckering. At the beginning of the learning or testing framework, a preprocessing block was introduced, due to his main role in filtering. As in seam defects detection, color is not necessary; the acquired images are transformed to grayscale (figure 2 a).



a) *b)* *c)*

Fig. 2: *Grayscale image of a sewn presenting puckering, DFT amplitude b) and phase c) result*

The result of a DFT is represented by the amplitude and phase of frequency components of the input image. The amplitude shows how much of a particular frequency is being presented in the image, while the phase represents how the signal is offset from the origin, or particularly, how much the sinus wave is shifted to the left or the right, as shown in figure 2 b) and c).

Fig. 3: *The training set.*

Our classification approach of puckering is based on series of samples that have been categorized accordance to some human experts. In this sense, the puckering features presented in the learning and test images have been pre-classified using the seam puckering quality standard. In the case of the proposed framework, the image features are extracted using spectral analysis by Fourier transform and the results stored in an array. We have down-sampled the corresponding array, in order to fit into the low resolution Kohonen Map, of a 100x100 size. The network training stage will consist in presenting five input vectors (derived from the down-sampled arrays), representing the puckering grades. The network learning stops when the error falls below a value that is very close to zero. The puckering classification consists in providing an input vector derived from the image supposed to be classified. A scalar product between the input values vectors and the weighted training images is computed. The result will be assigned to one of the five classes of which the input image belongs.

This method requires the image acquisition of samples in special conditions. An oblique light is applied on the material and, due to the wrinkled material appearance, the shadows will highlight the nonconformities of the fabric surface.

The investigation was performed on 26 samples of 100% polyester plain woven fabric, with 21 cm^{-1} warp and weft density, and 170 grams/sqm specific weight. Specimens were cut into 10x10 cm sizes and midst sewn in pairs using 301 type lockstitch and a 4 cm^{-1} seam density. Two colors of sewing thread were used: white to the needle and red to the bobbin, with 80 Nm sewing thread count, 100% PES.

The network was trained using the features images from figure 3, extracted using the DFT. In order to test the functionality of the network another set of 21 test images was used. These images were originally classified subjectively using visual information. The classification results using the Kohonen network are as follows:

• 71.42% of the images were classified correctly.
• 28.58% of the images were misclassified.

5. CONCLUSIONS

The applicability domain of the presented framework is in the textile industry, namely seams quality control and sewn assemblies classification in terms of visual quality. Various algorithms have been applied on the acquired images in order to improve their processability. Currently, defect detection is done using input images containing only horizontal seams. For further development of the application, fault detection will be completed on several types of stitches and seam shapes, for example, circular.

The image classification is done using visual information, based on subjective standard images. We have created five quality classes using puckering images, used in the training of the neural network. By processing a large number of samples, classification could be redefined and improved. The detection of seams defects will be further investigated using three images categories, containing horizontal seams from clothing manufacturing, airbag assembly and automotive upholstery.

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THE INFLUENCE OF RAW MATERIAL ON THE LIQUID MOISTURE TRANSPORT THROUGH KNITTED FABRIC

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Abstract: *The comfort is undoubtedly the most important human attribute depends upon the moisture transport which in turn depends on the moisture transport behavior of the knitted fabric. Moisture transport is the transfer of liquid water capillary interstices of the yarns and depends on the wettability of fiber surfaces, as well as the structure of the yarn and fabric. Because of its good water absorption property, cotton is often used for next-to-skin wear such as t-shirts, underwear, socks.*
All these are known as ``moisture management`` which means the ability of a textile fabric to transport moisture away from the skin to the garment's outer surface in multi-dimensions and it is one of the key performance criteria in today's apparel industry since it has a significant effect on the human perception of moisture sensations.
In order to study, plated knitted fabric for socks were knitted as plated single jersey in the same production conditions, from different types of yarns, produced in different yarn counts (Ne 20, Ne 24, Ne 30) and different raw material. (cotton, bamboo, soybean, polyester, viscose). Were chose two different density on circular knitting machine.
The liquid moisture management of the samples was measured in order to determinate moisture transport index. Was study also the influence of raw material and fabric structure related to the moisture transport index. According to the obtained results, it was found that some of the knitted fabrics used in this study have good moisture management capability.

Key words: *comfort, moisture, plated single jersey, yarns*

1. INTRODUCTION

The moisture transfer is limited by the maximal quantity of humidity witch can be transfer from the body to the enviroment thru the clothing [1], [2], [3], [4], [5], [6], [7].

In order to ensure the wearing confort during a moderately sweat, the first textile layer (next to the skin), must maintain the microclimate as dry as possible. In the same time it should have a high capacity of the water vapours transfer, and a good humidity buffer. The buffer effect must match to the humidity flow and stay below to the absorption capacity [1], [2], [3], [4], [5], [7], [8], [9].

The most recomanded knitted fabrics, in the case of the person who in intesily sweting, are those with doble layers, one of them made by sintetic fibers and the second one made by natural fibers.

This knited fabrics, (figure 1.) offers a new value for the users as well as new functional characteristics, wich can not be found in the single layers knited fabrics, especially by those knitted by cotton yarns [2], [3], [4].

The double layer knitted fabrics made out of different fibres, the layer wich comes in the contact with the skin, (the back side), it is a hydrophobic layer also known as conductive layer and is made by syntethetic fibres [1], [2], [3], [4], [5], [6], [7].

The front part of the knitted fabric is the hidrophilic layer, made from natural or mixed fibres, with a high capacity of absorption and is called absorbant layer or sorption layer [2], [3], [4], [10], [12].

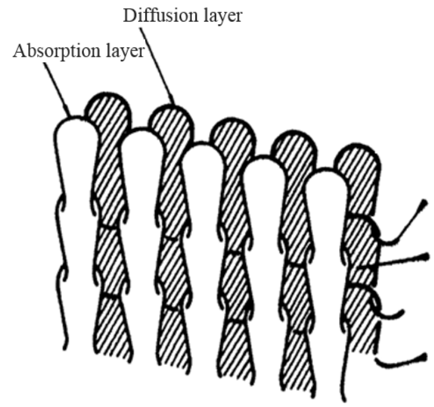


Fig. 1: *Double layer fabric structure [2], [3], [4]*

2. THE SAMPLES FOR TESTS

Were used different types of yarns (table 2) and codification of knitted fabric (table 1) according to the following parameters: knitted fabric geometry and density.

2.1. Knitted fabric geometry (figure 2):

The following patters were knitted: GV1 = plated single jersey, fabric density I (Do=50 wales/50mm, D_v=60 courses/50mm), GV2 = plated single jersey, fabric density II (Do=40 wales /50mm, Dv=50 courses /50mm) [11].

Were tested the samples plated jersey. In order to produce the fabrics 14 types of ground threads were used and plating thread was polyamide 6, 44/12x2 dtex. Samples were knitted in two variants of density: I and II (table 1).

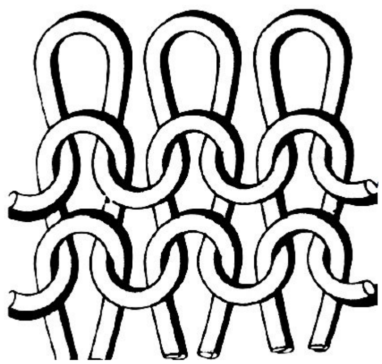


Fig. 2: *Knitted fabric geometry (plated single jersey)*

2.2. Knitted fabric density:

In the table 1 are displayed the density of samples knitted by ground yarn 1MDX cotton 34/1Nm (Table 2) and plating yarn Polyamide 6, 44/12x2 dtex.

Table 1: *Samples density*

Samples codification	Density code	Wale density and course density
GV1.1MDX	I	Do=50 wales/50mm, D_v=60 courses/50mm
GV2.1MDX	II	Do=40 wales /50mm, Dv=50 courses /50mm

Note: Do = horizontal density; Dv = vertical density.

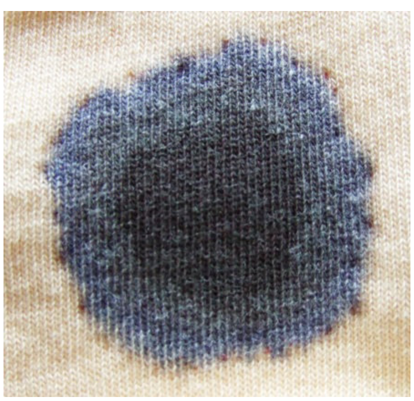
Table 2: *Raw material – fineness and codification [11]*

Code	Raw Material	Fineness	
		Ne	Nm
1MDX	Cotton 100%	20 / 1	34 / 1
2MDX	Cotton 100%	24 / 1	40 / 1
3MDX	Cotton 100%	30 / 1	50 / 1
1DC	Organic Cotton 100%	20 / 1	34 / 1
3DC	Cotton 100%	24 / 1	40 / 1
4DC	Cotton 100%	30 / 1	50 / 1
6DC	Cotton + soybean, (50% + 50%)	20 / 1	34 / 1
7DC	Polyester + Viscose, (52% + 48%)	20 / 1	34 / 1
8DC	Polyester + Viscose, (52% + 48%)(different supplier)	20 / 1	34 / 1
9DC	Tencel®	20 / 1	34 / 1
10DC	Bamboo + Viscose, (50% + 50%)	20 / 1	34 / 1
11DC	Viscose + Silk, (90% + 10%)	20 / 1	34 / 1
12DC	Polyester 100%, (Recycled)	20 / 1	34 / 1
13DC	Polyester 100%	24 / 1	40 / 1
2DC	Polyamid 6 (plated yarn)	44/12x2	40/12x 2

3. TESTS METHOD

The index of liquid moisture transport $\mathbf{i_u}$ [%] can be determined for the double layer textiles in order to demonstrate that this materials behave like an absorbent paper. 1 ml of water (mixed with dyer, wich does not interferes with the behavior of the material in humid enviroment) it is drop by drop from a distance of 10 cm on the conductive layer of the fabric [2], [3], [4].

According to patern characteristics of knitted fabric, the water drops are dispersed like different sizes spots on the sorption layer [2], [3], [4]. Photos will reveale the differences of the sizes of the spots on both layers (sorption layer (a) and conductive layer (b)) (figure 3) [2], [3], [4].



a)

b)

Fig.3: *The shape of the spot on the sorption layer (a) and the conductive layer (b) – plated fabric [11]*

The surfaces of the spots are marked with Sc for the conductive layer (b) and with Ss for the sorption layer (a) and then they are planimetred.

Using the values obtained after the planimetry we can calculate the index of the humidity transport, marked as $\boldsymbol{i_u}$ and calculate folowing equation 1 [2], [3], [4]:

$$i_u = \frac{S_c}{S_s} \cdot 100\ [\%] \quad \textbf{(1)}$$

Where:
Sc = surface of spot on conductive layer (cm^2),
Ss = surface of spot on sorption layer (cm^2).

4. TESTS RESULTS

The average values of the tests results obtained for 3 tests of each type of knitted fabrics are displayed in the folowing tables [11]:

Table 3: *The values of humidity transport index in case of plated single jersey, density I*

SAMPLES	Conductive layer (skin contact)		Sorption layer (face of the fabric)		Index of the humidity transport iu
	weight [g]	Surface Sc [cm²]	weight [g]	Surface Sc [cm²]	
GV1.1MDX	0.056	7.4	0.050	6.6	112
GV1.2MDX	0.050	6.6	0.046	6.1	109
GV1.3MDX	0.089	11.7	0.087	11.4	102
GV1.1DC	0.189	24.9	0.179	23.6	106
GV1.3DC	0.075	9.9	0.073	9.6	103
GV1.4DC	0.160	21.1	0.160	21.1	100
GV1.6DC	0.131	17.2	0.137	18.0	96
GV1.7DC	0.155	20.4	0.155	20.4	100
GV1.8DC	0.175	23.0	0.175	23.0	100
GV1.9DC	0.140	18.4	0.140	18.4	100
GV1.10DC	0.163	21.4	0.157	20.7	104
GV1.11DC	0.143	18.8	0.138	18.2	104
GV1.12DC	0.296	38.9	0.287	37.8	103
GV1.13DC	0.277	36.4	0.277	36.4	100

Table 4: *The values of humidity transport index in case of plated single jersey, density II*

SAMPLES	Conductive layer (skin contact)		Sorption layer (face of the fabric)		Index of the humidity transport iu
	weight [g]	Surface Sc [cm²]	weight [g]	Surface Sc [cm²]	
GV2.1MDX	0.059	7.8	0.059	7.8	100
GV2.2MDX	0.047	6.2	0.047	6.2	100
GV2.3MDX	0.091	12.0	0.091	12.0	100
GV2.1DC	0.165	21.7	0.157	20.7	105
GV2.3DC	0.059	7.8	0.059	7.8	100
GV2.4DC	0.112	14.7	0.109	14.3	103
GV2.6DC	0.126	16.6	0.119	15.7	106
GV2.7DC	0.163	21.4	0.154	20.3	106
GV2.8DC	0.181	23.8	0.166	21.8	109
GV2.9DC	0.123	16.2	0.115	15.1	107
GV2.10DC	0.108	14.2	0.114	15.0	95
GV2.11DC	0.145	19.1	0.148	19.5	98
GV2.12DC	0.312	41.1	0.312	41.1	100
GV2.13DC	0.203	26.7	0.217	28.6	94

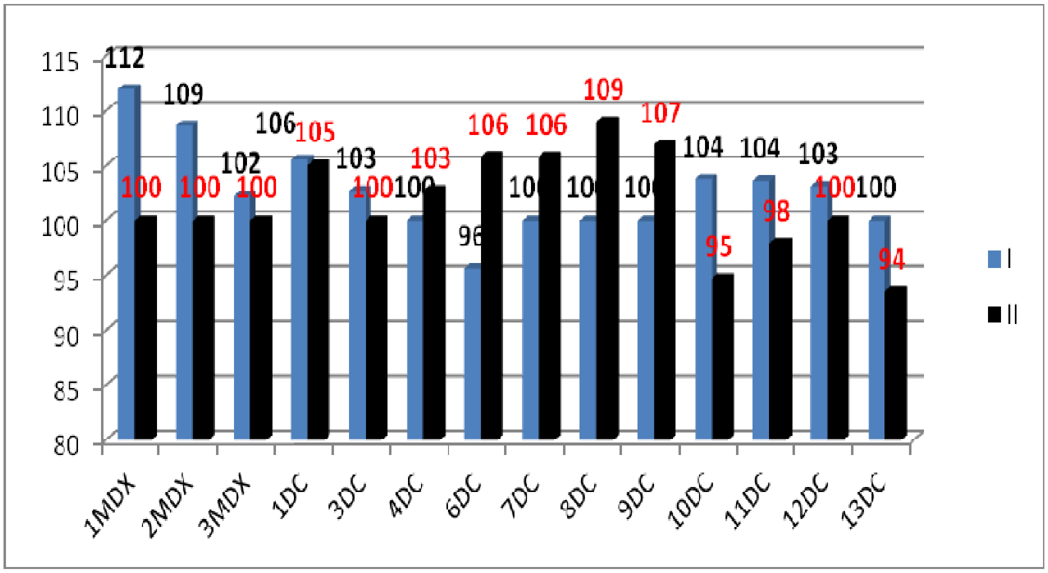


Fig.4: *The influence of the fabric density and the thread type on the humidity transport index for the plated jersey samples [11]*

5. CONCLUSIONS

The GV1.1MDX type of kitted fabrics, has the best humidity (liquid status) transport index for density I, and the GV1.8DC type for density II. (table 3, figure4).

For the knitted fabrics GV1.1MDX, GV1.2MDX, GV1.3MDX made from cotton 100% + polyamide 44/12x2 dtex, the humidity transport index increases with 6,86% when the ground yarn 50/1 Nm is replaced by yarn 40/1 Nm. In case of using ground yarn 34/1 Nm the humidity transport index increases with 2,75% comparing with knitted fabrics made from ground yarn 40/1 Nm.(table 3., figures 4)

For the GV1.7DC și GV 1.10DC types of fabric made by mixture of fibers, the percentage of 52 % polyester decreases the humidity transport index by 4%. (table 3, figure 4).

Comparing the GV1.12DC and GV1.13DC fabrics made from polyester yarns, the humidity transport index is higher with cu 3%, for the GV1.12DC type.

Comparing the GV1.1MDX și GV1.6DC knitted fabrics, the percentage of 50% soya, decreases the humidity transport index with 16,66 %. (table 3., figure 4)

The GV1.1MDX type knitted fabric (regular cotton) has a humidity transport index 6,66% higher than the GV1.1DC type one (organic cotton). (table 3., figures 4).

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BEAUTY, HEALTH AND WELL-BEING WITH COSMETOTEXTILES

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Abstract: *The concept of cosmetotextiles, as another aspect of new beauty and health marques a growing success. This hybrid fabric, is definite as a textile article that contains a substance that is release sustainable on the human body skin pointed to perfume, change of appearance, maintenance in good condition, protection, or correction of body odors. Cosmetotextiles are created by microencapsulating different substances for body care or health, that are gradually transfer to the skin, by movement, pressure or the effect of the skin's natural warmth and enzymes. The paper presents some elements regarding to the microencapsulating process (the major components of them general structure, the major advantages compare to usual presentation of cosmetic substances, some of the used active ingredients and them specific cosmetic and health benefits) and the new generation of cosmetotextiles that bring together the latest innovations in fiber and textile structures and products. So, one of the manufacturing processes of a cosmetotextile is based on functionalisation of fibers by fixing microcapsules in them structure, resulting fibers as Novorel, Tencel C, Nilit Breeze, Emana, or by the functionalisation of fabrics, so of products made by these fabrics, where microcapsules are fixed on the external surface of the fabric, resulting in revolutionary "fabrics' treatments" for beauty, health-care and well-being. Among these cosmeto fabrics and products are Sensitive Ultra Light Firming fabric, Sensitive Fabric Body ware, textile fabrics with the revolutionary Quiospheres technology, Doubleskin and different cosmeto-knitted products including specific placed areas with microencapsulated ingredients, depending on them destinations (slimming, anti-cellulite treatment, corrective effect).*

Key words: *microcapsules, active ingredients, cosmeto fibers, cosmeto products*

1. INTRODUCTION

In recent years, the customers request for apparel and home textiles containing not only their original basic characteristics, such as comfort, but also extra functions such as health and beauty care. Textiles materials found new applications in the cosmetic field, served by the rapid development of sciences and technologies. Because the quest for well-being and health, in our modern societies, is not simply a fashion, but a serious underlying trend, the market offers numerous opportunities for such functional textiles. Cosmetotextiles are designed to transfer, on contact with human body, an active substance for cosmetic purposes, by example the transfer of skin moisturizing substances. To achieve well-being and health functional effects, the cosmetic and pharmaceutical ingredients are imparting into the fabric of the clothing, and with the natural movements and warmth of the body, the skin receives slowly these ingredients. In odder to prolong the functionality of cosmetic textiles and provide satisfactory performance with increase durability, is necessary to control, the release properties of active ingredients, by microencapsulating technology.

2. MICROENCAPSULATION PROCESS

The microcapsules, produced by depositing a thin polymer coating on small solid particles or liquid droplets, include in them general structure two major components (**Fig. 1**):

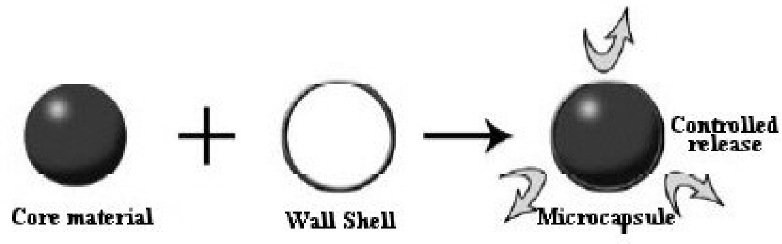


Fig. 1: *Structure of a microcapsule*

a) *active ingredient* (named too: core material, internal phase), which is a substance that may be in liquid or solid form;
b) *wall shell*, a natural, semi-synthetic or synthetic polymer coating, (also called: external phase, membrane, matrix), that surrounds the active ingredient.

Each microcapsule holds a specific amount of cosmetic substance which is the same as conventional cosmetic, but in a concentrated formula (without water). The major advantages, offered by using microcapsules, are:

- the ability to protect the active ingredient from hazardous environments (heat, acidity, moisture, evaporation);
- controlled release properties, under controlled conditions, resulting in increasing efficiency, performance and durability.

The release of core content may be by friction, pressure, change of temperature, diffusion through the polymer wall, biodegradation, etc., depending on the selecting of wall materials and more, on the textile end uses.

Microcapsules with specific active ingredients are used to obtain different cosmetic and health benefits:

- for slimming – the shaping textiles include seaweed (Fucus, Gelidium cartilagineum – for burn of feat, anti-orange peel, firming) and vegetal oil (Safflower seed oil and Sunflower seed oil – for moisturizing and nourishing);
- for refreshing (anti-fatigue, soothing, revitalizing) – are used Menthol and Ivy extracts;
- for anti-perspiration – is used Aloe Vera;
- for relaxing – are used Ylang-Ylang, Neroli Essential oil, Grape seed oil;
- for hair care – by using an sponge towel micro-fibers [1] (**Fig. 2**), impregnated with different ingredients:

Fig. 2: *Sponge towel with hair care ingredients*

- o for care & sheen. Because the dryness of the hair is linked to the altered hydrolipidic film, which no longer fulfils its barrier function against external aggressions, for nourishing, moisturizing and regenerating the hair the necessary active ingredients are the Apricot stone oil organic (rich in vitamin A, in omega 6 and 9) and Macadamia oil organic;
- o for anti-dandruff the natural active ingredients are Bertholletia seed oil, rich in selenium (the deffiency of selenium on the body cause increase of the desquamation process in the scalp) and Copaifera officinalls – rich in Beta-caryophylene, a natural bactericide, that helps to reduce of inflammatory process in scalp;
- o for prevention of hair loss are used three ingredients: Inula Crithmoide Extract – for a better protection and hair restructuration, Sea Buckthorn berry oil – to provide hair from sun damage and Ginger extract oil – for stimulate micro-circulation of derma papillary.

3. COSMETOTEXTILES

Today, a new generation of cosmetotextiles has appeared which bring together the latest innovations in fiber and textile structures and products.

3.1. New fiber for cosmetotextiles

One of the manufacturing processes of a cosmetotextile is based on functionalisation of fibers by fixing microcapsules in their structure:

- NOVOREL nylon microfiber [2] (patented in 2006 by Nurel), incorporates the microcapsules into the polymer of their nylon yarn, before extrusion;
- TENCEL C, from Lenzing, contains microcapsules of chitosan (a substance made from the shells of shrimps) in the realm of the spun cellulosic that reinforce the skin's barrier by up to 50%, maintaining optimal moisture content and stimulating cell renewal;
- NILIT BREEZE – a new fiber from Nilit [3], that through a combination of a flat cross section structure, a unique polymer with inorganic micron particles, and a special texturizing process, ensure the lower of body temperature;
- EMANA, a bioactive yarn from Rhodia [4], is created by the combination of polyamide 6.6 and a polymer with added bioactive crystals of bio ceramic. These crystals are built into the DNA of the fiber itself. The fibers reflect the far infrared rays emitted by the body back into the skin, helping to regulate the body's temperature, reducing the accumulation of lactic acid, and improving skin tone. The advantages of EMANA over other fiber technologies are:
    - comfort and maintenance – the garments are as comfortable as those made with normal polyamide, they have the same maintenance requirements as a regulate polyamide microfibre, and no special care is needed while handling or washing the garment. Because the special properties are intrinsec to the yarn, the effectiveness of fiber remain unaltered over time despite frequent washes, with the recommendation to wash only by hand;
    - hypoallergenic – the interaction between the fiber and the skin is exclusively physical in nature because there is no need for additives to be applied to the finished garment, that are harmful to the body;
    - easy care and eco-friendly – the products manufactured with Emana are easy to wash and dry, and do not need ironing. The production process of Emana produces no waste, therefore being an environmentally friendly "green" fiber.

3.2. Cosmeto fabrics and products

Another method to manufacture cosmetotextiles is the functionalisation of fabrics, so of products made by these fabrics. In this idea, microcapsules are fixed on the external surface of the fabric, resulting in revolutionary "fabrics' treatments" for beauty, health-care and well-being.

- ***Eurojersey*** (an italian warp knitter) created [5]:
    - *Sensitive Ultra Light Firming* fabric, which includes 'firming active ingredients' - that improve the elasticity and brightness of the skin;
    - *Sensitive Fabric Bodyware*, that offers a treatments program for optimal hygiene and better control of perspiration. To keep the wearer feeling fresh all day long increasing comfort in all conditions, the fabric includes a silver based solution that inhibits the growth of odor-causing bacteria helping your clothes to stay fresher, more comfortable and in better condition for much longer. Moreover, due to an innovative polymer applied on this fabric, it changes properties in response to body's temperature: at low temperature it captures moisture, keeping the body drier and warmer, as temperature increases, it cools the body.
- ***Clariant*** (a global specialist in chemicals for the textile industry) and Lipotec (a creator of cosmetic ingredients) developed a new technology called Quiospheres® based on microcapsules which react with natural skin enzymes to release and deliver their cosmetis ingredients, and a homogenous, durable application of these capsules to knitted, woven, and non-woven textiles [6], [7]. Quiospheres® technology can be applied to any textile fabric, such as cotton and nylon. It said, the cosmetic benefits are released onto the skin through a two-step technology(**Fig. 3**):

- first step AFFINITY (= Attraction) - is the “transphere” of the microcapsules which, thanks to the special design of Quiospheres®, confers them a high affinity for the skin;
- second step GRADUAL RELEASE (= Reaction**) -** the cosmetic ingredients, encapsulated in a fully cosmetic and biocompatible shell, interact with the body skin enzymes, allowing the ingredients to be delivered to the skin. Lipotec’s ingredients (such as peptides) have been proven to be biologically active and they are gradually released while the finished garment or product is worn. The release of the ingredients is scientifically measured and continues for an extended period of time. Not only are ingredients long lasting but the fabric has good wash resistance and the microcapsules remain effective through 20 wash cycles.

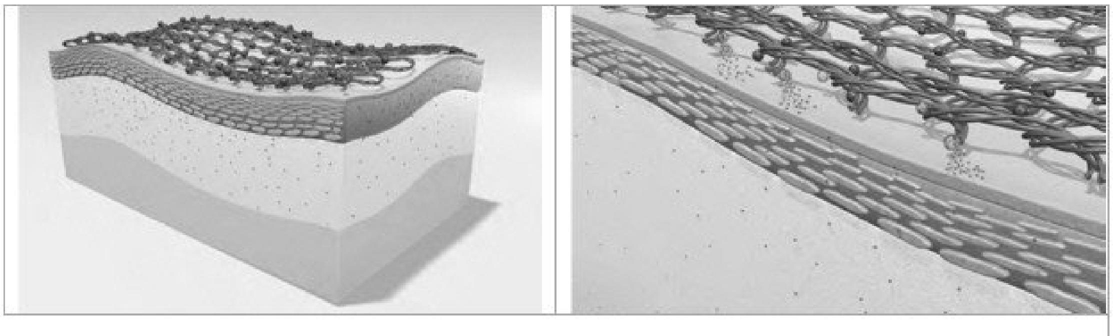


Fig. 3: *The two-steps of Quiosphere Technology: attraction and reaction*

Advantages:

- Quiospheres® withstand around 20 or more washes, depending on the how the textile is worn and laundered;
- Quiospheres® microcapsules are protected and are unaffected by the impact of handling, mechanical stress and high temperature throughout the textile production process. Garments can be made up, pressed, ironed and steamed at warm temperatures up to 120°C (for 1 minute);
- Quiospheres® technology can be applied to any textile fabric, such as cotton and nylon;
- Quiospheres® properties enable to encapsulate virtually all kind of cosmetic ingredients, even water soluble compounds;
- Quiospheres® microcapsules are based on high technology actives or peptides and actually work with the layers of the skin. They are designed to work continuously over an extended period of time through gradual release (as opposed to a one-off hand applied application of a cosmetic cream);
- garments incorporating Quiospheres® can be tumbled and ironed at warm temperatures up to 70°C.

❖ ***Doubleskin*** [4] is a product including Emana fibers (that absorb the electromagnetic waves emitted by the human body, and then turns these waves around towards the body based on resonance (**Fig**. 4), is suitable for bioactive clothing because the interaction between the fabric and the skin offers a significant improvement in both microcirculatory blood flow (+92%) and of cellular metabolism. The augmentation of the microcirculatory blood flow deliver important benefits in terms of cosmetics and athletic performances:

- esthetic benefits:
  - **an improvement in collagen synthesis** – it results in an increase in the skin’s elasticity and softness.
  - **cellulite reduction** - An insufficient microcirculatory blood flow is the reason for the irregular distribution of the temperature of the skin. This insufficiency generates an accumulation of liquids that prohibits the lymph node from draining the body correctly. Consequently this causes the growth of fat pockets and modifies the appearance of the epidermis and gives it the “orange peel” effect. By stimulating microcirculation and lymphatic draining, the effects of cellulite are reduced, there is a prevention in the accumulation of fat, and an overall reduction in skin blemishes.
  - **more collagen synthesis** - Doubleskin stimulates collagen synthesis, turning your skin healthier and younger.
- athletic benefits:

- **better body thermoregulation:** the augmentation of microcirculatory blood flow produces a more uniform distribution of heat on the skin's surface - consequently the body disperses of heat faster and maintains a better thermal equilibrium during physical exertion.
- **increase in muscular efficiency and resistance:** by increasing microcirculatory blood flow there is a progressive reduction in the formation of lactic acid and a positive influence in the oxygenation of cells. Consequently there is an increase in physical performance, and muscle recovery time is reduced.

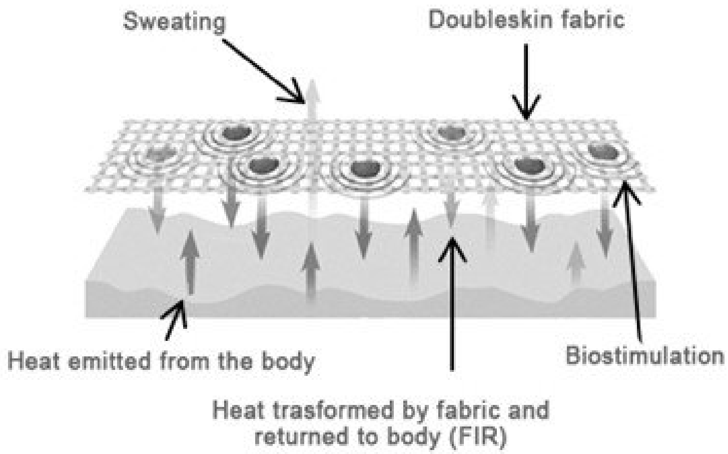
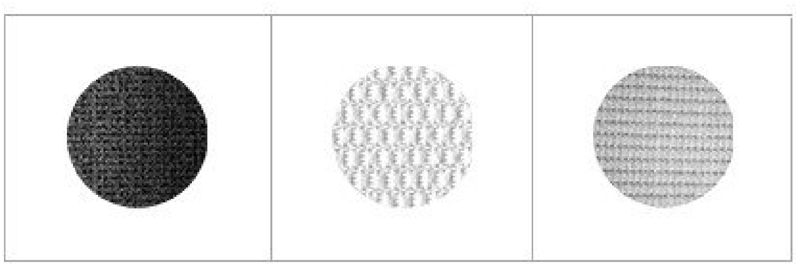


Fig. 4: *The work of Doubleskin*

Because Emana's special characteristics are activated by body heat, even the slightest amount of physical activity increase the garment's effectiveness.

To manufacture cosmeto–knitted products, depending on them end uses, in the whole garment or in different areas of it, are used specific structures [8]:

- *as a second-skin*, for wellness and slightly shaping - is indicated an elastic knitting, realized by polyamide and elastane microfibre (**Fig. 5a**);
- *for micro-massaging* – is used a double honeycomb knitting, realized by advanced technical yarns, which ensure the acceleration of blood circulation, resulting in a slimming action (**Fig. 5b**);
- *for corrective–shaping* – is used a mesh flexible compression knitting, placed in targeted areas, as hips, thighs, stomach, chest (**Fig. 5c**)



a b c

Fig. 5: *Knitted structures for cosmeto products*

Depending on them destinations (slimming, anti-cellulite treatment, corrective effect) there are different cosmeto-knitted products including specific placed areas [8] with microencapsulated ingredients (**Fig. 6**).

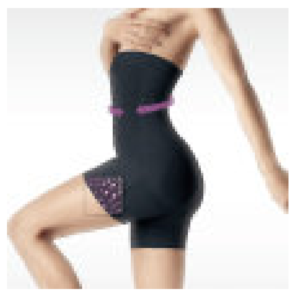
Slimming products		
		
Bike shorts	Capris	Legging
Anti-cellulite treatment products		
		
Bike shorts	Capris	Sleeves
Corrective effect products		
		
Belt panties	Shorty	Bra

Fig. 6: *Cosmeto-knitted products including specific placed areas with microencapsulated ingredients*

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ABSORBENCY CHARACTERISTICS OF PESHTAMALS: TRADITIONAL TURKISH WOVEN CLOTHES

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Abstract: *Absorbency of textiles is defined as the ability of taking in a fluid in the manner of a sponge. Absorbency is required for comfort properties in some clothes such as sportswear and underwear clothing, for drying properties in napkins, towels and bathrobes, for health concerns in some medical textiles such as bandages, gauze and absorbent cotton, and for cleaning properties in washclothes and mops. In this study five different fabric samples (three woven 100% cotton fabrics A, B and P respectively at plain, twill, and peshtamal weaving patterns and two 100% cotton terry towels T1 and T2) were tested. The absorbency properties of the samples were evaluated according to the droplet test, sinking time test and wicking height tests (pottasium chromate test). Peshtamal samples showed better absorbency results than plain and twill weaves and lower but close results to towel samples according to the droplet test, sinking time test and wicking height tests. The absorbency properties of peshtamals showed results close to towel samples. The void content of peshtamals is higher than plain and twill samples but closer and lower than towel samples. The good absorbency results of peshtamals might be due to the void content of peshtamals which is higher than plain and twill samples but closer and lower than towel samples. Peshtamals which are good in absorbency and light in weight might be used widespreadly in daily life for their high absorbency, and on travel for weight saving purposes.*

Key words: *absorbency, hydrophility, peshtamal, towel, porosity.*

1. INTRODUCTION

Peshtamals, having a specific weaving pattern, are traditional Turkish clothes that had been used in Turkish hammams during history for their absorbency properties until towels immerged. Peshtamals are still being used in homes and in Turkish hammams for their absorbency ability. Peshtamals are accepted as the ancestor of terry woven towels; peshtamals have long yarn floats, which resemble towel loops, on their weaving pattern.

Absorbency of textiles is defined as the ability of taking in a fluid in the manner of a sponge. Absorbency is required for comfort properties in some clothes such as sportswear and underwear clothing, for drying properties in napkins, towels and bathrobes, for health concerns in some medical textiles such as bandages, gauze and absorbent cotton, and for cleaning properties in washclothes and mops. There are studies on wettability of textiles and absorbency studies on textile materials which date as back as 1950s [1-9].

Buras et al (1950) offered a new absorbency testing method for fabrics which numerically evaluates rate of absorption and ultimate absorption values of fabrics, and also eliminates timing procedures. Uniform absorbency of textiles is necessary to have uniform printing and uniform dyeing during finishing processes of textile fabrics, due to the importance of absorbency in many textile products and production processes, the evaluation of absorbency is essential [1].

There are number of well-defined methods of testing textile absorbency and according to Ehrler et al (1983) the results obtained with different tests do not correlate with each other, and none of the tests has always provided all of the information needed. Textile fibers wetting behaviors are affected by their surface roughness, fiber type and blend ratios, liquid adsoption and surfactant adsorption. Wetting is the displacement of a fiber-air interface by a fiber-liquid interface [2].

Cary and Sproles (1979) compared several absorbency test methods for terry towels. They concluded that a towel does not need only a high rate of absorbency, but a towel has both a quick rate of absorption and a reasonable capacity of absorbency. Some absorbency tests were eliminated as they only measure capacity. Porous plate and sliding block tests are suitable for towel absorbency tests but the porous plate tends to clog by time due to lints of towels and the sliding block method is a very complex testing method. Testing methods have strengths and limitations in some senses for towel absorbency testing [3].

Ozturk et al (2011) evaluated the wicking properties of cotton-acrylic rotor-spun yarns and concluded that the increase in acrylic content increased the wicking ability of fabrics. The better wicking ability of acrylic yarns might be due to their lower moisture absorption of acrylic compared to cotton. Water diffuses into cotton fiber, and cotton fiber swells. On the other hand, water movement and absorption occurs only on the acrylic fiber's surface [4].

Hasan et al (2008) investigated the surface properties and wetting properties of plain and twill woven polyester fabrics. They investigated the relationship between the topographic structure of the fabrics and their wetting properties. They found that fabrics made of fibers at cruciform cross sections are more hydrophobic than the fabrics made of fibers with round cross sections [5].

According to Kissa (1981), wettability is a prerequisite for absorption. Wettability is defined as the initial behavior of the fabric, yarn or fiber when brought into contact with liquid. Wetting is the prerequisite for wicking. The contact angle is useful in determining the wetting tendency of fibers in a fabric, but the contact angle may be difficult to measure and hard to obtain accurate results due to the complex surface structure of fabrics [6].

Murphy and Macormac (1958) investigated the absorbencies of undyed towel samples against laundering. They observed an increase until 100 washing cycles in the ultimate absorptions [7].

Lord (1974) compared the wicking height and wicking volume of open-end yarns and ring yarns used in Terry towel production. Lord observed that open-end and ring yarns having same yarn counts and similar twist amounts have nearly the same ultimate wicking volume; and open-end yarns wick better and more evenly than ring yarns [8].

Miller and Tyomkin (1984) investigated the transplanar liquid uptake of fabrics and developed a gravimetric method to measure the total rate of transplanar liquid absorption [9].

2. EXPERIMENTAL APPROACH

In this study totally five different samples were evaluated according to their absorbency properties. Two terry towel samples T1 and T2 and three samples of woven fabrics A, B and P respectively at plain weave (1/1), twill weave (2/1 Z twill fabric), and peshtamal weaving patterns were used in this study.

2.1 Materials and Method

Woven fabrics A, B and P were woven on the same projectile weaving machine using the same weft and warp yarns to avoid absorbency differences due to material variance. The densities of the weft yarns and the warp yarns were kept same during production of fabrics A, B and P to eliminate effect of fabric composition. Samples A, B and P had the same number of weft and warp densities as well as the same weft and warp counts. Terry towel samples T1 and T2 were obtained from local towel producers. All the samples were greige goods and were desized and scoured. The fiber content, yarn densities, yarn counts, fabric weights and porosities of the fabric samples used in this study are given for woven samples and towel samples respectively in Table 1.a. and Table 1.b.

Table 1.a. *Properties of woven fabric samples used.*

designation of fabric	description of fabric	fiber content	yarns per cm		weight (g/m^2)	porosity (%)
			warp	filling		
A	Plain weave	100% cotton	15	14	161	83,5
B	Twill (2/1 Z)	100% cotton	15	14	162	88,7
P	Peshtamal	100% cotton	15	14	164	91,4

Table 1.b. *Properties of towel fabric samples used.*

designation of fabric	description of fabric	fiber content	yarns per cm			weight (g/m^2)	Porosity (%)
			terry warp	binder warp	filling		
T1	Terry towel	100% cotton	8	15	17	420	91,5
T2	Terry towel	100% cotton	8	17	20	500	94,8

The point diagrams of samples A, B and P are given in Figure 1.

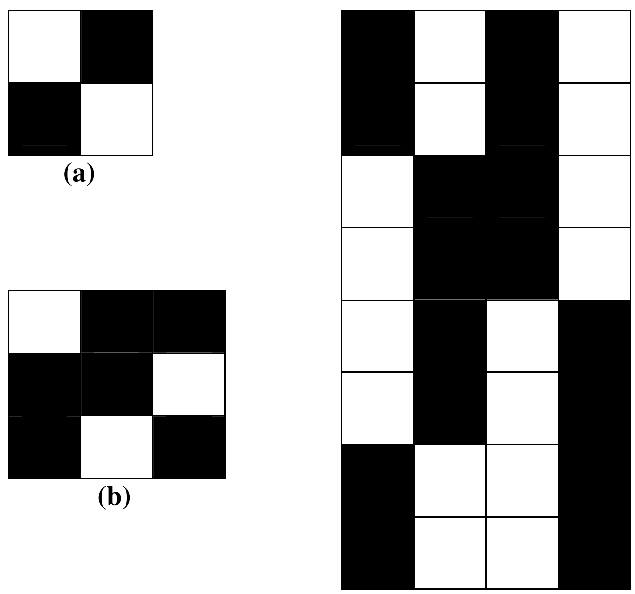

Fig. 1: *Point diagrams of samples (a) A, (b) B and (c) P.*

Ozturk et al concluded that fiber composition was the most important variable affecting yarn wicking, another statistically important variable affecting yarn wicking was yarn count [4]. Using the same weft yarns and same warp yarns, in this study we eliminated the effect of fiber composition and yarn count.

The porosity values of the samples, taking the specific density of cotton fiber as 1,54 g/cm^3, are calculated using the following equations 1 through 3:

$$porosity\ \% = 1 - pf \qquad (1)$$

$$pf = \frac{d_{fabric}}{d_{fiber}} \qquad (2)$$

$$d_{fabric} = \frac{w_{fabric}}{t_{fabric}} \qquad (3)$$

where:

$pf = packing\ factor$

$W = weight$
$t = thickness$
$d = density$

Absorbency tests of the samples were measured with three different methods: droplet test, sinking time test and wicking tests using the standard test methods respectively: TS 866, TS 866 and DIN 53924.

Droplet test was conducted according to Turkish Standard TS 866. In the droplet test, the textile product is attached to a hoop with a diameter of at least 15 cm in a stretched manner. Droplets are dropped one per 5 seconds from the burette above 1 cm of the sample. Time passed during the droplet disappears is measured using a chronometre. At least 10 measurements are needed and their arithmetic mean is taken as the result. For bleached cotton materials results from 0 sec to 2,5 sec is rated very good; results from 2,5 sec to 5 sec is rated as average and results above 5 sec is rated as low hydrophility degree.

Sinking time test was conducted according to Turkish Standard TS 866. In sinking time test the material is released from 10 mm height onto the water surface. As one side of the textile material touches to water surface, at that moment time is watched and the time passing until all the sample is wetted and immersed is noted. At least three measurements are needed. Results from 0 sec to 50 sec is regarded as very good, results from 50 sec to 100 sec is regarded as average and results from 100 sec to above results is regarded as low hydrophility degree.

The wicking tests (potassium chromate test) were conducted according to DIN 54924 standard, in which an edge of the test material is plunged into 1% potassium chromate solution. The distance covered by the solution in 10, 30, 60 and 300 seconds is determined by means of a ruler. Test is completed for both warp and weft directions for at least 5 samples and arithmetic mean is taken as result. If the wicking height result is less than 10 mm, hydrophility is noted as low; if height is between 10-30 mm, hydrophility is average and if result is above 30 mm, then hydrophility is regarded as very good.

2.2 Results

The absorbencies of the samples are tested according to droplet test, sinking time test and wicking tests. The droplet test results (TS 866) are given in Table 2, Table 3 and Table 4. According to droplet test results, sample A has low absorbency, samples B and P have average absorbency and T1 and T2 samples have good absorbencies.

Table 2. *Droplet test results*

designation of fabric	time (sec) ± standard deviation
A	5.13 ± 0.61
B	3.24 ± 0.26
P	2.96 ± 0.17
T1	1.02 ± 0.11
T2	0.86 ± 0.05

The absorbency results of sinking time tests given in Table 3 (TS 866) rate all the samples' absorbencies as "very good"; while the wicking test results given in Table 4a and 4b (DIN 53924) rate all the samples absorbencies as "low".

Table 3. *Sinking time results*

designation of fabric	Sinking time (sec) ± standard deviation
A	16.90 ± 3.36
B	16.78 ± 1.62
P	11.84 ± 0.30
T1	12.21 ± 1.81
T2	9.08 ± 0.30

Table 4.a. *Wicking results in warp direction*

designation of fabric	Wicking height in warp direction ± **standard deviation**			
	10 sec	30 sec	60 sec	300 sec
A	0.97 ± **0.15**	2.31 ± **0.23**	3.50 ± **0.19**	7.65 ± **0.64**
B	1.24 ± **0.20**	3.08 ± **0.12**	4.55 ± **0.22**	8.70 ± **0.12**
P	1.73 ± **0.20**	3.70 ± **0.36**	5.12 ± **0.38**	8.75 ± **0.24**
T1	1.04 ± **0.23**	2.78 ± **0.33**	4.08 ± **0.13**	7.41 ± **0.16**
T2	0.71 ± **0.12**	1.93 ± **0.42**	3.20 ± **0.42**	4.86 ± **0.48**

Table 4.b. *Wicking results in weft direction*

designation of fabric	Wicking height in weft direction ± **standard deviation**			
	10 sec	30 sec	60 sec	300 sec
A	0.37 ± **0.07**	1.82 ± **0.43**	3.12 ± **0.34**	7.04 ± **0.38**
B	0.56 ± **0.07**	1.70 ± **0.11**	3.01 ± **0.15**	7.00 ± **0.27**
P	0.68 ± **0.17**	2.05 ± **0.36**	3.48 ± **0.37**	7.61 ± **0.24**
T1	1.45 ± **0.48**	2.76 ± **0.71**	3.80 ± **0.37**	6.20 ± **0.18**
T2	1.31 ± **0.14**	2.77 ± **0.20**	3.67 ± **0.18**	5.25 ± **0.17**

3. CONCLUSIONS

According to droplet test results, plain weave has low absorbency, twill weave and peshtamal have average absorbency and towel samples have good absorbencies. The absorbency results of sinking time tests rate all the samples' absorbencies as "very good"; while the wicking test results rate all the samples absorbencies as "low". The water droplet method has validity problems in the manner of sensitive measurements for towels while the wicking height method is useful to make rough comparisons between towels. However, the wicking height method is not sufficient for research applications since the water rises only on the binder warp and this makes it hard to make sensitive comparisons between towels [3].

Although results of the three test methods don't correlate to each other, the rank in absorbency for samples is the same for all tests. Peshtamal samples showed better absorbency results than plain and twill weaves and lower but close results to towel samples according to all of the three testing methods.

Buras et al concluded that absorption was based mainly on the spaces within the fabric rather than on the fabric itself [1]. Hasan et al concluded that the plain weave has lower porosity and as a consequence a lower water absorption value [5].

Peshtamal samples have better absorbency results than plain and twill weaves and lower but close values to towel samples. This might be due to the void content of peshtamals which is higher than plain and twill samples but closer and lower than towel samples. Peshtamals which are good in absorbency and light in weight might be used widespreadly in daily life for their high absorbency, and on travel for weight saving purposes.

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INSURANCE OF KNITTED PRODUCTS QUALITY THROUGH THE ANALYSIS AND EVALUATION OF NON-QUALITY DURING THE OPERATIONS IN THE CUTTING ROOM

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***Abstract**: In a knitting- confection profile factory, any activity oriented toward evaluation, maintanence or improvement of products quality level is based on measuring and examining the product quality characteristics, in order to establish conformity to the quality specifications and/or naming the non-quality characteristics (establishing defects and fabrication deficiencies. We can consider non-quality as complementary to quality, although a definitive distinction cannot always be made between the two categories or states.*
Cutting holds a key role in insuring shape precision and pieces dimensions, determining the quality of the confectioning process, its structure and manual stages frequency.
The quality of the cutting operation, appreciated through the precision and aspect of cut contours, existence and precision of markings, is directly reflected in the finite product's quality, which entails knowledge of cutting instrument - fabric interactions.
Incompliance of the technological regime during the operations in the cutting room can determine: incorrect marking, spreading, sectioning or cutting.
Non-quality of intermediate products obtained in the cutting department can be evaluated and controlled through defectologic control methods.
The De – Ca – Re method (defect-cause-remedy correlation), applied in this paper, allows establising the most important causes that generate defects, as well as preventive and corrective actions to eliminate these causes.
This paper systematically presents the main defects that may occur during operations in the cutting room, causes that generate these defects, along with their preventive and corrective actions.

***Key words:** quality, non-quality, defects, marking, spreading, cutting.*

1. INTRODUCTION

Non-quality respresents a discrepancy or constant global aberration or real quality effectively obtained, instead of desired quality [1, 2]. We can consider non-quality as complementary to quality, although a definitive distinction cannot always be made between the two categories or states.

The **non–quality** of products can be evaluated and controlled through defectologic control methods.

If the applied method has as objective discovering the places and ways in which defect occur, it has a pronounced analytical character. Instead, when the method targets evaluating the quality level of products or product batches, it has a control character.

Professional literature [1, 2, 3, 4, 5, 6, 7] proposes a series of defectologic methods, which serve the purpose of describing as closely as possible defects and determining the perturbatory factors and their importance, in order to find solution to prevent and diminish the defects, as well as establising corective methods and remedies.

The methods can be structured on one or multiple criteria of defects classification and are divided in: analytical methods and graphic methods.

The De – Ca – Re method (defect-cause-remedy correlation) allows establising the most important causes that generate defects, as well as preventive and corrective actions to eliminate these causes.

The corrective action [2] begins with problem detection and implies taking measures in order to eliminate or minimize the possibility of problem reccurence. The corrective method is applied to both machines by adjustements and maintenance and products by fixing defects.

The preventive actions [2] have the role to diminish the risk of defects or abnormalities occurance. These imply inspection of engineering documentation, implementing measures for good management of working places, machine equipment, instruments and materials for proper performance as well as fulfilling the conditions regarding transport, packaging and product storage.

2. GENERAL INFORMATION

Cutting holds a key role in insuring shape precision and pieces dimensions, determining the quality of the confectioning process, its structure and manual stages frequency.

The quality of the cutting operation, appreciated through the precision and aspect of cut contours [8], existence and precision of markings, is directly reflected in the finite product's quality, which entails knowledge of cutting instrument – fabric interactions.

Cutting quality is dependent to a series of factors from which we may mention [8]:

- contour complexity;
- number of product pieces;
- machine and cutting device characteristics;
- textile fabric and spread characteristics (thickness, fibrous composition of the knitted, surface aspect etc.);
- technical documentation quality;
- competence and attention of the executants.

Incompliance of the technological regime during the operations in the cutting room can determine:

- ➢ incorrect marking;
- ➢ defective spreading;
- ➢ incorrect sectioning;
- ➢ cutting with deficiencies.

3. APPLICATION OF DE – CA – RE METHOD FOR THE OPERATIONS TAKING PLACE IN THE CUTTING ROOM

By corroborating the professional literature and personal experience, the defect types that could be generated by deficiency in the cutting room operation were established, in correspondence with the causes of their occurance. Simultaneously were predicted the preventive methods and defect remedies.

3.1 Application of De – Ca – Re method for the marking operation

In the industry, two types of marking are used:

- ➢ with outlines manually arranged on the first spread layer, according to the marking outline;
- ➢ by automatic drawing of the marker on a special paper that is placed on the first layer of the spread.

In order to perform the manual marking the following documentation is necessary:

- ✓ miniature outline of the markers needed for a certain product;
- ✓ demand (colours and sizes combination);
- ✓ assortement file (samples for all types of fabrics that are part of the product);
- ✓ outline sets for all the sizes that are to be marked on different types of fabrics that are part of the product;
- ✓ useful width of the fabric and other informations that contain positioning restrictions of the outlines.

The quality of manual marking is determined by the experience and proffesional training of the operator, and the necessary time for this operation is quite long.

In this case we may encounter errors caused by:

- positioning the outline without taking into consideration the nominal direction of the fabric;
- incomplete marking (pieces missing);
- usage of used outlines.

When using real scale outlines on special paper, the intervention of the operator is limited to gluing the paper on the surface of the spread. This way is reduced the risk of human errors, that generate inadequacies.

In table 1, the De – Ca – Re method is used for the marking operation.

Table 1: *De – Ca – Re method for the marking operation*

Types of defects cause by the marking operation	Causes	Preventive or remedial actions
Product pieces assimetry	Incompliance to the nominal direction of the stitch column in the knitted when placing the marker	Respecting the direction of the stitch column and the technological conditions at marking
Differences in aspect (nuance) between the product pieces	Incompliance of the placing direction of the product piece markers in the case of terry, fleecy or printed knitted etc. Incompliance to the direction of the spread layers	Correct placement of the markers in correlation with the light reflective patter of the knitted structure Respecting the direction of the spread layers
Incomplete marking of all the product pieces	Technological indiscipline *Observation*: In this case the omitted pieces will be cut separately which will result in : • additional fabric consumption; • additional working time; • increase of production costs; • possible nuance differences between pieces.	Respecting the technological regime

Observation: The outlines must be carried out on knitted with minimum width, in order to avoid dimensional variation of the pieces.

3.2 Application of De – Ca – Re method for the spreading operation

The conditions that must be applied during this operation are:

- the length of the spread is determined by the length of the marker (equal or multiple of it);
- the width of the spread is determined by the width of the textile fabric;
- the number of spread layers depends on the characteristics of the fabric, scale of demand and technical solution adopted for the cutting.

Besides the geometrical characteristics, when making the spread we must also take into consideration the distribution of the material according to the demand’s characteristics.

The characteristics of the material deteremine the optimum solution chosen for the spreading operation. For example:

- for the spreading of highly elastic materials (especially knitted) manual spreading is usually used; in the case or automatic spreading, there must be the possibility of adjusting the tension for successive layers of material;
- in the case of material with high sliding factor, the height of the spread must be smaller, and the fixation of the layers with clamps is mandatory; we can utilize spreading tables fitted with pneumatic installation;
- for thicker material spreads with fewer layers will be made;
- on uni circular knittings continuous spreading is preffered without cutting the edges;
- for fleecy textiles or fur imitation is recommended to cut the edges of spread layers and to place them front-up (so that the operator can track defects on this side).

In table 2 the De – Ca – Re method is applied to the spreading operation.

Table 2: *De-Ca-Re method for the spreading operation*

Defects cause by spreading	Causes	Preventive actions or remedies
Dimensions variation of the product pieces	Inadequate correlation between the marker dimensions and spread layers dimensions	Correspondence between the markers dimensions and spread layers dimensions
	Tensed placing of the spread layers - leading to spread contraction	Respecting the correct tension for the material
	Incorrect alignment of the spread edges (non-compliance to the perpendicularity of the longitude side of the spread on the working table) [9]	Ensuring the perfect allignement on one of the longitude edges of the spread so that eventual width variations of the spread layers will be restricted to one edge that could be sectioned.
	Not fixing the spread layers on the extremities that may cause relative position movement The edge of the spread is thicker that the middle – which implies difficulties of the marking and cutting operation because of these (rolled or fleecy edges)	Usage of clamps or other attachment methods for the spread layers Removal of the edges

Observations:

- ✓ Not conforming to the spreading conditions (alignment of spread layers, correct tensioning of the spread layers, attachment of the extremities) determines great loses of material (knitted);
- ✓ Critical defects in the knitted (that are inadmissible in any quality class) will be removed from the spread;
- ✓ The height of the spread depends on the thickness, surface aspect and friction coefficient of the knitted; the maximum admitted height of the spread must not exceed 12 cm.

3.3 Application of De-Ca-Re method for the sectioning and cutting operations

Taking into consideration the destructive effect, cutting the textile fabrics is particularly important for product quality. The shapes of pieces obtained through cutting, as well as outline aspect have a significant influence on esthetic, ergonomic and availability functions of products and respectively technological manufacturing esthetic.

Cutting has implications on specific consumption and occupies up to 25% of the time allotted for making a clothing product.

Cutting of textile fabrics usually contains two stages:

- sectioning of the spread;
- cutting of the pieces from the spread.

Sectioning the spread is realised with the help of mobile machines with circular knife (with disc) or vertical knife. When cutting pieces of high complexity are recommended mobile machines with vertical knifes.

Piece cutting is traditionally executed with fixed machines with continuous cutting blade. The cutting blade only moves in one direction – vertically while the executants moves the spread in the cutting zone.

The quality of cut pieces depends on their complexity, characteristics of the cutting blade and the degree of competence and skill of the executant.

The cutting operation of pieces from the spread was perfected by the emergence of automatic cutting systems. Their usage is justified by the integral automatization of all documentation execution stages, spreading and cutting of the pieces.

In table 3 the De – Ca – Re method is applied to sectioning and practical cutting operations (cutting according to outline).

Table 3: *De – Ca – Re method for sectioning and outline cutting operations*

Defects caused by sectioning and cutting	Causes	Preventive actions or remedies
Pieces with uneven contour lines	Incorrect handling of the mobile sectioning machines and incorrect handling of spread sections	Respecting the technological discipline
	Imprecise following of the outline contour, or not using outlines for cutting	
	Incorrect tension of the cutting band on the fixed cutting machine, caused by not correlating it to the fabric characteristics of spread height	Correct tensioning of the cutting band Respecting the optimal height of the spread
Inesthetics look of cutting lines of pieces contour	The cutting band of the fixed cutting machines isn't sharpened	Respecting the sharpening angle of the cutting band during the entire cutting
Control markings of inadequate dimensions	Imprecise guidance of the spread section in front of the cutting band	Respecting the technological discipline
	Incorrect documentation (used markers or markers incorrectly placed)	Replacing the incorrect (used) markers

The quality control of cut pieces is realized with control outlines, verifying for each piece, its integrity and markers position. Shape or dimensions abnormalities depend on the complexity of the contour lines. For uni knittings, the permitted aberrance is bigger, while for striped knittings they are minimal or void. For all textile materials, the maximum permitted aberrance from the nominal direction is 20 mm. [9].

In regards to pieces integrity is worth mentioning that defects tracking is necessary, assessing their gravity and eventually recutting of the pieces that present main defects of the knitted structure (highly frequent missed stitches, unrepared holes, unevenly distributed stripes) or critical cutting defects (dimensional variations above the admitted limits).

Observation: Before introducing the knitted in the fabrication line, it must be verified on the control ramp in order to appreciate its quality and registering knitting defects.

4. CONCLUSIONS

The quality of the operations taking place in the cutting room hold an essential role in insuring shapre precision and dimensions of cut pieces, determining the quality of the confection process and its structure, as well as the quality of the finite product.

The accuracy and correctitude of the cutting operation in its entirety, is appreciated through the precision degree and aspect of the cut contours, the existence and precision of markers and other important aspects that are directly reflected in the quality of the finite product.

The multitude of factors that influence these operations are punctually presented in this paper, this knowledge allowing the prevention of cutting defects and creating the premises that grant control over the process quality and implicitly product quality.

This paper systematically presents the main defects that may occur during operations in the cutting room of knitted products, causes that generate these defects, along with their preventive and corrective actions.

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ENHANCING PROFITABILITY OF A SPINNING

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Abstract: *Systematic control of the rheological behavior of the rovings in an installation facility dynamometer constant elongation gradient is proposed in this paper. It is an application for all types of spinning both short fibers as long fibers. Industrial experiments conducted show that this control drawing of the spinning frame is optimized, getting more regular yarns mass with greater industrial profitability. This work is applied to a spinning worsted manufactures fine yarns with high quality requirement The fundamental thesis of our work is that the rheological control of the roving, output from roving frame, either torsional or friction, helps to increase the profitability of the spinning frame and get higher quality yarns. Rheology is the science of movement of the fibers within a fibrous vein, ie a sliver or roving from the graph tribocharging-elongation another fundamental concept appears in our analysis: the isocarric elongation. Empirically, we defined this elongation as the difference between the elongation percentage corresponding to half the determined maximum tribocharge on the ascending and descending branches of the tribo-charging-elongation curve. The application of these techniques to former machines to roving frame in conventional wool process also allows us to adjust the machines with more speed, reducing the time and product (waste) required a change in manufacturing. To increase, for example, the feed of a gill, increase the difficulty for drafting in the following step. These difficulties are directly related to the value of the doubling and drafting that applies: the more doubling and drafting, the greater the difficulty in later steps.*

Key words: *Wool, tribocharging excision, isocharging elongation, roving*

1. INTRODUCTION

In the current market environment, it is very common in all types of spinning, produce very small lots, requiring machines and very flexible and versatile to be competitive processes. A few years ago, this feature was characteristic only of long fiber spinning, by imperatives of a highly selective fashion in small batches which were treated.

The current global situation of the cotton market also means working short series, with continued manufacturing changes. As is well known, although the trend in mechanical engineering is starting facilitate changes, these changes always represent wastage in the profitability of spinning.

Assessing the amount of fat that contains a wool content of spinning oils and antistatic additives in washing and carding, among other parameters, you could get an idea of the difficulty presented a wool fiber for processing into yarn.

The fundamental thesis of our work is that the rheological control of the roving, output from roving frame, either torsional or friction, helps to increase the profitability of the spinning frame and get higher quality yarns. Rheology is the science of movement of the fibers within a fibrous vein, ie a sliver or roving [1] [2] [3] [4] [5] [6].

Subjecting a roving to traction, in a constant gradient dynamometer working at a low speed elongation (mm/min), we obtain a load-elongation curve. Being a frictional load (from the Greek "tribo") interfibrillar, tribocharging denominate the traction force and tribocity the specific tribocharging, that is, the ratio of dividing tribocharging by its Kilotex mass (grams/meter).

Consequently, we will refer as excision tribocharging the charge necessary to produce the excision in the roving.

From the graph tribocharging-elongation another fundamental concept appears in our analysis: the isocarric elongation. Empirically, we defined this elongation as the difference between the elongation percentage corresponding to half the determined maximum tribocharge on the ascending and descending branches of the tribocharging-elongation curve (Figure 1) [1].

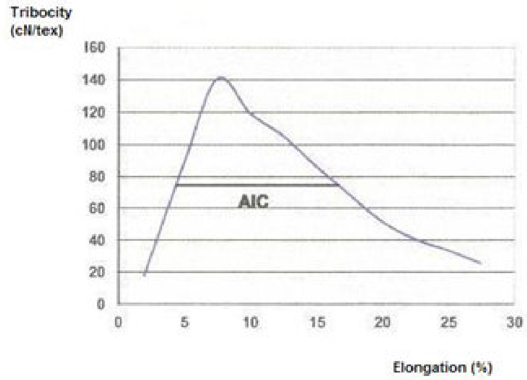

Fig. 1. *Determining isocarric elongation (AIC)*

2. EXPERIMENTAL PHASE

As already mentioned above, our approach is applicable to the spinning of short and long, natural, synthetic fibers and mixtures. In this paper we study for a process that produces wool yarn 60 metric number (Nm) with 700 turns/meter. The experiments were performed in a wool sector industry under very controlled environment conditions. It has always made the same thread, with the same parameters and quality standards, from wool, taken from an industrial point of view, the same characteristics of fineness, length, fat content and whiteness grade, but that have happened over time under various items made of batches of the same number, defined as the same characteristics.

To better understand our proposal we have selected two rovings of 0,3 grams/meter, obtained in the same industrial manufacturing process, but with significant differences in their degree of parallelism interfibrillar and especially in its excision tribocharging and isocarric elongation. For each of the rovings we have made sufficient evidences that makes results are significant from a statistical point of view.

The interfibrillar parallelism and excision tribocharging were determined by following a specific test methods tuned in Innotex Center/CTF of the Polytechnic University of Catalonia. In parallel, determine a weighted length corresponding to the arithmetic mean of the length L_1, in the sliver determined in the exit direction of the machine and the length L_2 in the other end fixed. As is well known, the fibrous structures have a marked structural asymmetry [4] [6]. Table 1 indicate the values found for the rovings, selected from a production batch of spinning, but extreme values in paralelism and excision tribocharging and isocarric elongation is concerned.

Table 1. *Parallelism interfibrillar of rovings of wool 0,3 grams/meter*

Reference	L_1	L_2	$L_{Average}$
Roving 1	47,2	53,7	50,4
Roving 2	50,0	55,6	52,8

In all experiments conducted, the length L_2 is greater than L_1, because the rear hooks of the fibers are removed when leaving them the combs from the drafting zone. It has also been demonstrated in our experience, in the gills of the preparation of fine, to decrease the weight of the roving, increase the length weighted in the two directions of analysis [2] [5] [6].

Excision tribocharging determining was performed on a dynamometer installation gradient constant elongation (Figure 2) working with samples of 200 milimeters between the jaws, to a low pulling rate (mm/min). Table 2 and Figure 3 indicate the results.

The rheological behavior in a dynamometer facility of two selected rovings and their interfibrillar parallelism, which from an industrial point of view were not significantly different, show a different behavior of the fibers of the roving into the draw zone of the ring spinning frame. The roving referenced as 2, has a higher parallelism and greater interfibrillar excision tribocharging (Figure 3).

Fig. 2. *Dynamometry gradient constant elongation installation*

Table 2. *Rheological behavior of the two wool rovings 0,3 g/m*

Elongation (%)	Tribocity (cN/tex)	
	Roving 1	Roving 2
2,5	18	26
5,0	89	84
7,5	141	144
10,0	120	156
12,5	106	124
15,0	87	111
17,5	69	97
20,0	52	89
22,5	41	75
25,0	34	64
27,5	26	39

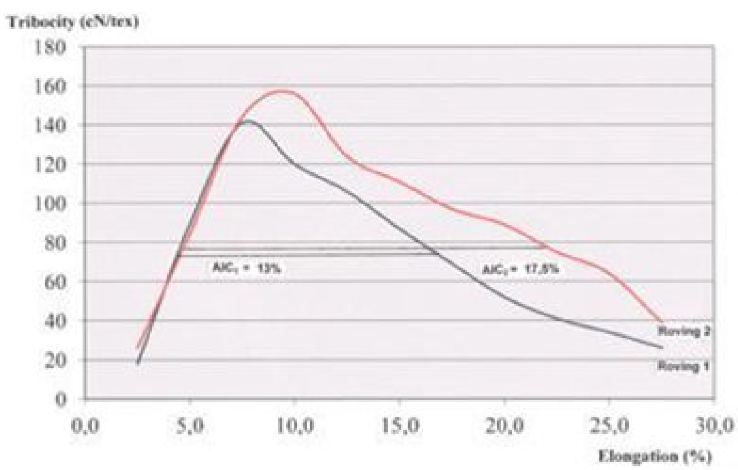

Fig. 3. *Excision tribocharging between the two rovings of wool*

All these differences are realized in different isocarric elongations. Our approach can detect structural differences in the rovings also go unnoticed in mass digital eveness tester. In the roving referenced as 1 have a isocarric elongation (AIC) 13% while in the referenced 2, the isocarric elongation rises to 17,5%. An increase in the AIC parameter implies an easier stretching of the wicks in the ring spinning frame, obtaining improved quality yarns [1]. This point is especially important for those industries that have an intermediate weight rovings that used to manufacture a wide range of yarns, varying only the draft and twisting the ring spinning frame.

With the respective rovings we obtained yarns of 60 metric number on the same spindles spinning frame and under the same environmental conditions. The objective of our proposal is that rovings of the same material, different items, prepared under the same conditions along the whole process of preparation and fine hair, can be differences in the quality of the thread if its rheological behavior is different. It has manufactured a yarn sample, under industrial conditions, sufficient for the results to be significant.Table 3 indicates the results of the quality of yarns obtained with both rovings.

Table 3. *Quality level of 60 metric number yarns produced from the two rovings of wool 0,3 grams/meter with different parallelism interfibrillar and different AIC*

Parameters	**Yarn obtained with the roving**	
	Roving 1	**Roving 2**
CV mass (%)	16,8	16,2
Thin places (-50%)	195,0	170,0
Thick places (+50%)	64,0	50,0
Neps (+200%)	16,0	12,0
H	5,7	5,2

The thin, thick and neps points are given over 1.000 meters of yarn. H hairiness index corresponds to the total length of the hairs of the yarn, in centimeters, in a measuring area of 10 mm in the hairiness tester.

In complementary work by the same author on these techniques, show adjust coefficient between the theoretical model and the industrial reality of the order of 0.989.

3. CONCLUSIONS

A systematic control of excision tribocharging of the rovings before being processed in the ring spinning processed into yarn, it may be appropriate to predict differences in the quality of yarns and, especially, the drafting capacity that each roving according to their isocarric elongation.

The application of these techniques to former machines to roving frame in conventional wool process also allows us to adjust the machines with more speed, reducing the time and product (waste) required a change in manufacturing. To increase, for example, the feed of a gill, increase the difficulty for drafting in the following step. These difficulties are directly related to the value of the doubling and drafting that applies: the more doubling and drafting, the greater the difficulty in later steps.

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THE DYEING PROCESS OF KNITTED FABRICS AT DIFFERENT TEMPERATURES USING ULTRASOUND

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Abstract: *The dyeing of knitted fabrics made from 100 % cellulose using on-line procedure vinyl sulfonic reactive dye, with or without ultrasound energy, is carried out in this paper. The impact of temperature has been observed. The dye exhaustion is monitored using the method of absorption spectrophotometry, and the quality control of the colorations is monitored using colour measurements. The acting of ultrasound on colouration consistency, as well as on some mechanical characteristics has also been examined. All examples of the ultrasound dyeing process show greater dye exhaustion in comparison to the conventional procedure. In addition, all the samples, which have been dyed with the ultrasound energy at 40°C, are significantly darker and have deeper colour in comparison with the referent sample. The temperature has a great influence on kinetic energy of the dye molecules, and therefore on the diffusion processes in the dyeing system. The exhaustion chart indicates that when the temperature is lower the exhaustion degree drops. However, all the samples dyed with the ultrasound energy have bigger exhaustion. Besides that, ultrasound energy contributes to warming up the processing environment, so the additional warm up with the electricity is unnecessary, unlike the conventional way of dyeing. Since the reactive dyes chemically connect themselves with the cellulose substrate and in that way form covalent connection, the dyed fabrics have good washing consistency. Analysis results indicate that the consistencies are identical regardless the applied dyeing procedure. In other words, the dyeing method using the ultrasound energy produces the dyed fabric of the same quality. After analyzing the results of breaking force and elongation at break of knitted fabrics, it is noticeable that there is no degradation of previously mentioned knitted fabrics features (horizontally and vertically) during the ultrasound wave's activity.*

Key words: *knitted fabrics, cellulose, micro fibres, dyeing, reactive dye, ultrasound.*

1. INTRODUCTION

The dyeing processes use the great amount of water as well as a lot of electricity and heat energy. It also require the appliance of chemicals as aids to speed up or slow down the diffusion processes which contribute to mass transfer from liquid environment towards the surface of the textile materials in reasonable amount of time. This mass transfer process, as well as the other chemical processes, is time and temperature dependent, and the production quality is gained by compromising these two factors [1-3].

Numerous non-traditional techniques that use operating frequencies, microwaves and infrared radiation have indicated the possibility to cut the processing time short and to decrease the energy consumption, and they have contributed in production quality improvement. In this respect, the ultrasound energy was especially interesting for textile processes. The idea to use ultrasound in textile processes is not new and it includes significant area in literature regarding improvement and acceleration of numerous textile-wet processes. The appliance of ultrasound for obtaining steady dispersions and cleaning of the materials and machine parts is particularly distinguished [4-7].

The goal of this paper is to apply ultrasound energy in dyeing process of cotton fabrics using vinyl sulfonic reactive dyes, as a way to improve the dyeing process. The knitted fabrics made of micro fibres is dyed with reactive dye of vinyl sulfonic type, with or without the influence of ultrasound oscillations, in order to show that the energy and time are saved by using the ultrasound, the chemicals are less used, dyeing is more profound, and processing conditions are better which is in accordance with the world tendency to preserve the environment.

2. EXPERIMENTAL PART

2.1 Used materials

Knitted fabrics made of micro cellulose with the following features is used: production form Nm 50/1, interlock weave, surface mass 220 g/m^2, degree of whiteness 85, for Berger criteria.

Dyeing process is done using the dye of vinyl sulfonic type C.I. Reactive blue 19.

2.2. Methodology

The previous processing of knitted fabrics that is, processing before dyeing is showed in Table 1.

Table 1: *Methods previous processing of knitted fabrics*

1 g/l Hostapol CV (detergent)	40°C, 30 min
3 g/l Na_2CO_3	
Hot rinse	80°C, 20 min
Cold rinse	20°C, 10 min
Neutralizing (0,5 g/l CH_3COOH)	20°C, 15 min
Cold rinse	20°C, 10 min
1 g/l Hostapol CV (detergent)	40°C, 30 min
3 g/l Na_2CO_3	

Dyeing is carried out in the following conditions: concentration of a dye 3 %, isothermal dyeing at 40, 50 and 60°C, 80 g/l NaCl and 5 g/l Na_2CO_3 (the dye and chemicals are added at the beginning of the process), the scale of the bathroom for dyeing R 30:1, mechanical mixing (for conventional dyeing process but not for ultrasound treatment), dyeing process time 100 and 80 minutes. The dyed samples have been washed at the end: 10 minutes at 30°C, 10 minutes at 70°C and 10 minutes at 100°C with 2 g/l Hostapol CV – non-ionic washing powder, the scale of the bathroom for dyeing R=30:1.

Ultrasounds waves, which have been derived by using ultrasound bath Sonic, Serbia, have been used for dyeing process. Ultrasound exciters are attached at the bottom of the bath, the frequency of the received ultrasound oscillations is 40 kHz, and the used power is 150 W.

2.3. Analyzing methods

- The degree of dye exhaustion analysis

The exhaustion degree was determined by spectrophotometric sampling in certain moments and measured on UV-VIS spectroscope, Spekol MA-9525, at wavelength of the dye solution absorption maximum (650 nm). The degree is expressed in %, and it is calculated based on the absorbance difference at the beginning and absorbance in time t, with respect to starting absorbance.

$$I = \frac{A_0 - A}{A_0} \cdot 100 \quad (\%) \qquad \textbf{(1)}$$

A_0 – absorbance at the beginning (dyeing process time t=0 min)
A – absorbance in time t.

- Analysis of reflective knitted fabrics features, spectrophotometer Upgrade Colour Eye 3000 (ICS-Texicon) is used as measuring instrument, PC with software package Super Match 6 intended for data processing.
- Analysis of colour consistency while washing at 40°C, by standard SRPS F.S3.216.

- Measurement of the mechanical properties of the knitted fabrics, according to standard SRPS ISO 5081.

3. RESULTS AND DISCUSSION

In the reactive dye system – cellulose, electrolyte is added in order to encourage dye exhaustion form the bathroom. The amount of the required amount of salt depends upon the dye concentration. According to dye manufacturer suggestion, it is necessary to add 80 g/l salt for the dye concentration of 3 %. According to the results (Figs. from 1 to 3), in comparison with conventional procedure, the alternative procedure with the appliance of ultrasound energy produces greater dye exhaustion. All examples of the ultrasound dyeing process show greater dye exhaustion in comparison to the conventional procedure.

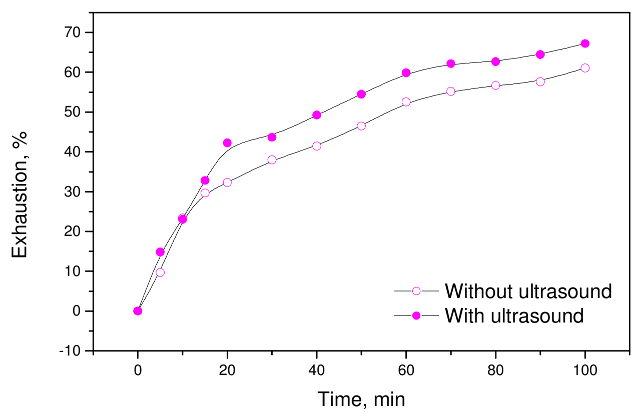

Fig. 1: *Dye exhaustion curve at isothermal dyeing at 60°C*

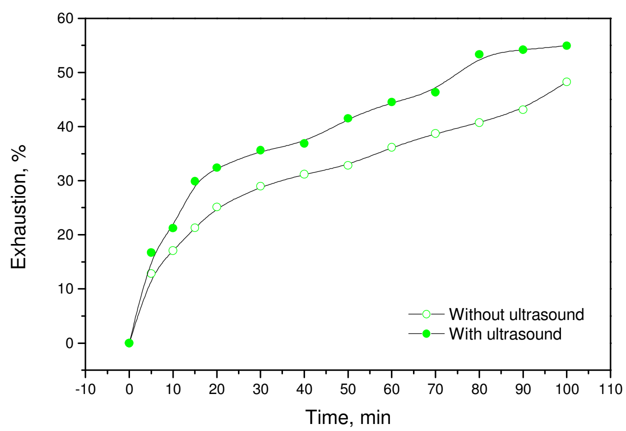

Fig. 2: *Dye exhaustion curve as isothermal dyeing at 50°C*

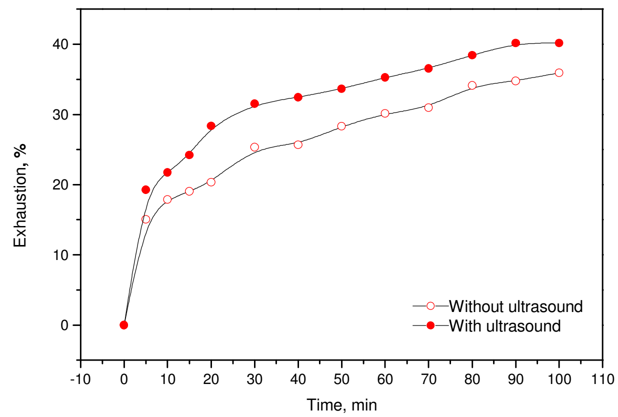

Fig. 3: *Dye exhaustion curve at isothermal dyeing at 40°C*

The registered differences in colour (Table 2) in the first case (60°C) are ΔE=4,4 (CIELab76) and ΔE=1,9 (CMC (2:1)), in the second case (50°C) are ΔE=4,7 (CIELab76) i ΔE=2,0 (CMC (2:1)), while in the third case, (40°C) are ΔE=5,1 (CIELab76) i ΔE=3,0 (CMC (2:1)), when observed at the light D65. The registered tolerance of 1.9 over 2.0 to 3.0 can be detected with the naked eye regarding the tolerance boundaries criteria CMC (2:1) which are less than 1.4. All test samples were darker than standard samples.

The results are similar at all temperatures. All the samples which have been dyed with the ultrasound energy at 40°C are significantly darker and have deeper colour in comparison with the referent sample.

Table 2: *Colour differences according to CIELab76 and CMC (2:1) criteria for standard sample dyed at a different temperatures*

Dye: c = 3,0 %, T = 60°C								
Standard:	**Without using ultrasound**							
***Test 1*:**	**Using ultrasound**							
Illuminant	Differences in color CELAB 76				CMC (2:1) good<1.4< blunder			
	DE*	DL*	Da*	Db*	DE*	DL*	DC*	DH*
D65-10	4.4	3.3 darker	1.9	2.1	1.9	1.4 darker	1.4 more turbid	0.3 redder
A -10	5.7	3.8 darker	3.3	2.8	2.4	1.6 darker	1.7 more turbid	0.3 redder
TL84-10	4.9	3.7 darker	1.7	2.7	2.1	1.6 darker	1.3 more turbid	0.6 redder
Dye: c = 3,0 %, T = 50°C								
Standard:	**Without using ultrasound**							
***Test 1*:**	**Using ultrasound**							
Illuminant	Differences in color CELAB 76				CMC (2:1) good<1.4< blunder			
	DE*	DL*	DE*	DL*	DE*	DL*	DE*	DL*
D65-10	4.7	3.3 darker	2.1	2.6	2.0	1.4 darker	1.4 more turbid	0.3 redder
A -10	6.3	3.7 darker	3.8	3.5	2.6	1.7 darker	1.7 more turbid	0.2 redder
TL84-10	5.2	3.7 darker	1.9	3.3	2.3	1.6 darker	1.5 more turbid	0.6 redder
Dye: c = 3,0 %, T = 40°C								
Standard:	**Without using ultrasound**							
***Test 1*:**	**Using ultrasound**							
Illuminant	Differences in color CELAB 76				CMC (2:1) good <1.4< blunder			
	DE*	DL*	DE*	DL*	DE*	DL*	DE*	DL*
D65-10	5.1	4.2 darker	2.7	-1.1	3.0	2.2 darker	0.5 stronger	1.8 redder
A -10	4.6	4.1 darker	2.1	-1.0	2.8	2.4 darker	0.2 stronger	1.4 redder
TL84-10	5.4	4.2 darker	2.7	-1.2	3.1	2.5 darker	0.5 stronger	1.6 redder

The temperature has a great influence on kinetic energy of the dye molecules, and therefore on the diffusion processes in the dyeing system. The exhaustion chart indicates that when the temperature is lower the exhaustion degree drops (Fig. 4). However, all the samples dyed with the ultrasound energy have bigger exhaustion. Besides that, ultrasound energy contributes to warming up the processing environment, so the additional warm up with the electricity is unnecessary, unlike the conventional way of dyeing.

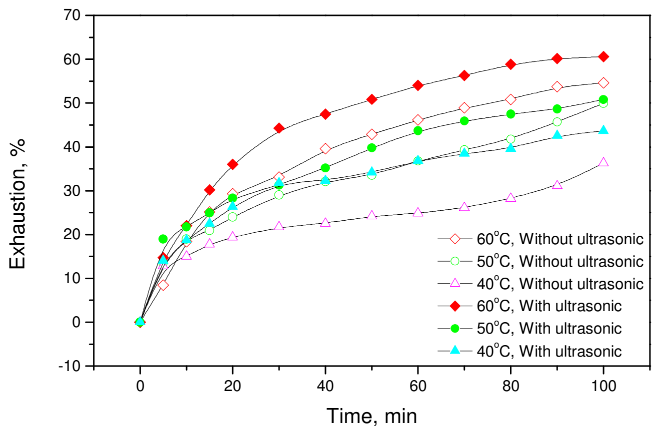

Fig. 4: *Dye exhaustion curve at different temperatures*

The consistency in washing of all dyed samples has been examined (under different temperatures). The overall evaluation of the washing consistency regarding the applied method is given in table 3.

Since the reactive dyes chemically connect themselves with the cellulose substrate and in that way form covalent connection, the dyed fabrics have good washing consistency. Analysis results showed in table 4, indicate that the consistencies are identical regardless the applied dyeing procedure. In other words, the dyeing method using the ultrasound energy produces the dyed fabric of the same quality.

Table 3: *Resistance to washing dyed of samples, depending on the dyeing methods*

Procedure	Number of measurements		
	1	2	3
Without using ultrasound	4	4-5	4
Using ultrasound	4	4-5	5

Mechanical features of the textile materials are very important and especially breaking force and elongation at break. They define the quality and applied value of the future textile product. It is usually required improved mechanical features, primarily more favourable breaking force and elongation at break. It is a fact that the wet chemical processing using the agents such as dyeing can have negative effect, especially on the sensitive fabrics surface layers, which finally reflects as smaller resistance to activity of external forces.

The results of breaking force and elongation at break of knitted fabrics are showed in table 4, according to different types of processing. After analyzing the data, it is noticeable that there is no degradation of previously mentioned knitted fabrics features (horizontally and vertically) during the ultrasound wave's activity.

Table 4: *The mechanical properties of knitted fabric according to the way of processing*

Investigated the properties	Non-coloured sample		Coloured samples 90 min, 60°C		Coloured samples 90 min, 60°C + ultrasound	
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
Breaking force (N)	138	115	140	113	135	117
Elongation at break (%)	95	101	90	102	97	99
SD (N)	0,9	1,5	1,6	2,6	2,6	2,1
CV (%)	1,4	4,8	4,2	8,5	5,1	6,2

4. CONCLUSION

This study focused on the colours of cellulose fabrics, dyed both conventionally and ultrasonically using a blue reactive dyes, in terms of exhaustion rate, some mechanical properties, stability and colour values differences in CIELab colour space.

Using the ultrasound waves in the dyeing process of the textile substrate – knitted fabrics made from cellulose, using vinyl sulfonic reactive dye has the following advantages:

- Energy saving when dyeing on low temperatures (cavitation effects contribute the reactive medium warming up) and shorter dyeing process time.
- Preserving the environment when decreasing the usage of chemicals and better usage of a dye.
- Consistency of dyed fabrics is equally good no matter which dyeing process is applied.
- Ultrasound waves do not influence on degradation of the fabrics breaking force and elongation at break.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

ROMANIAN FOLKLORE MOTIFS IN FASHION DESIGN

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Abstract: *The traditional Romanian costume such as the entire popular art (architecture, woodcarvins, pottery etc.) was born and lasted in our country since ancient times. Closely related to human existence, the traditional costume reflected over the years as reflected nowadays, the mentality and artistic conception of the people.*
Today the traditional Romanian costume became an inspiration source to the wholesale fashion production industry designers, both Romanian and international.
Although the contemporary designers are working in accordance with a vision, using a wide area of styles, methods and current technology, they usually return to traditional techniques and ethnic folklore motifs, which converts and resize them, integrating them in their contemporary space.
Adrian Oianu is a very appreciated Romanian designer who launched two collections inspired by his native's country traditional costumes: "Suflecata pan' la brau" ("Turned up 'til the belt") and "Bucurie" ("Joy"). Dorin Negrau had as inspiration for his "Lost" collection the traditional costume from the Bihor region.
Yves Saint Laurent had a collection inspired by the Romanian traditional flax blouses called "La blouse roumaine".
The paper presents the traditional Romanian values throw fashion collections. The research activity will create innovative concepts to support the garment industry in order to develop their own brand and to bring the design activities in Romania at an international level.
The research was conducted during the initial stage of a project, financed through national founds, consisting in a documentary study on ethnographic characteristics of the popular costume from different regions of the country.

Key words: *Fashion, Traditional Romanian costume, inspiration, designers*

1. INTRODUCTION

The traditional Romanian costume such as the entire popular art (architecture, woodcarvins, pottery etc.) was born and lasted in our country since ancient times. Closely related to human existence, the traditional costume reflected over the years as reflected nowadays, the mentality and artistic conception of the people. [1]

The various pieces of costume have gone out of use at different times during the 20th century. The first item to disappear in many areas was leather peasant sandals (*opinci*), although these could be seen in poorer villages again in the years just after the communist regime fell. In most rural areas men's traditional trousers were replaced by modern factory made trousers by mid century and in the post communism years jeans has become universally common. Traditional over garments became an expensive luxury, new garments only being purchased by people living in the very wealthy villages. More recently the traditional jacket makers in many areas have died with few new artisans being trainer to carry on their craft. [2]

Romanian folklore is the best preserved, most varied and traditional in Europe. The tasteful beauty of the regional costumes can be seen throughout Romania. The costumes reflect ethnic identity and document the historical and artistic values of the Romanian people. [3]

2. ROMANIAN FOLKLORE IN FASHION DESIGN

Nowday the traditional Romanian costume became an inspiration source to the wholesale fashion production industry designers, both Romanian and international. [4]

Although the contemporary designers are working in accordance with a vision, using a wide area of styles, methods and current technology, they usually return to traditional techniques and ethnic folklore motifs, which they convert and resize, integrating them in their contemporary space. The analysis of these forms of cultural expression supports the conclusion, according to which the reuse of these decorative motifs can create products with a great effect in contemporary fashion.[1]

2.1 Foreign designers

Philippe Guilet, a French fashion designer who has worked under the likes of Karl Lagerfeld and Jean-Paul Gaultier made headlines with his collection "Prejudice" which borrowed heavily from the traditional clothing and symbols associated with eastern-European peasants and also focused on the traditional uniforms of the "Callus" (Calusarii), folk dancers from the south western part of Romania. By titling his collection "Prejudice" (Figure 1), Guilet proclaims that it is possible to affect long-lasting social change through fashion. However, Guilet approached the collection and his investment in the Romanian culture quite seriously. [5]

Fig. 1: *Phiilipe Guillet- Collection Prejudices 100% ro*

Fig. 2: *Anthropologie*

Source: http://www.cotidianul.ro/o-colectie-de-moda-inspirata-de-artizanatul-romanesc-face-furori-in-presa-straina-164282/ and http://artboom.info/design/anthropologie-romanian-folk-inspired-collection.html

American brand Anthropologie (Figure 2) created an entire autumn-winter collection inspired from Maramures, selling in the US, Great Britain and Canada, but also online in over 30 different countries. The photo-shoot for the presentation catalogue was taken in scenery identical to the traditional villages in Maramures, and the clothes manage to transform the traditional pieces into super-fashionable ready-to-wear must-haves. [6]

Yves Saint Laurent had a collection inspired by the Romanian traditional flax blouses called "La blouse roumaine". Other international designers that included Romanian folk costume elements in their collections were: Tom Ford, Camelia Skikos (Figure 3) and Joseph Altuzzara. [7]

Fig. 3: *Camelia Skikos*
Source: http://cameliaskikos.com/blog-2/

2.2 Romanian designers

The variety of the traditional clothing pieces and the complexity of the decorative motifs became very fast inspirational sources for fashion designers. The interest for Romanian tradition and craftsmanship is found also in the Romanian designers collections. They created fashion collections having as an inspiration source the traditional Romanian costume.

Adrian Oianu is a very appreciated Romanian designer who launched two collections inspired by his native's country traditional costumes: "Suflecata pan' la brau" ("Turned up 'til the belt") and "Bucurie" ("Joy"). Both collection conquered fashion enthusiasts around the world. [4]

Dorin Negrau had as inspiration for his "Lost" collection the traditional costume from the Bihor region. He was the first Romanian designer who created an entire fashion collection based on Romanian folklore motifs. The main element of the collection was the Traditional Romanian costume that was made by his grandmother fifty years ago.

Andra Clitan believes that the national costumes are "a living document which lasted for centuries, sending to the new generation the message of authentic and artistic creations". She created a collection of 25 outfits which represents modern reinterpretations of the Traditional costumes from Trasylvania area, intitled "Mara Mi" (Figure 4).

Ingrid Vlaslov, the Romanian designer present repeatedly at Paris Fashion Week, wowed the audience with the spring-summer 2011 collection "I feel love.." (Figure 5). The collection represents a bridge between past and present, traditional and modern, a concept dedicated by the designer to the great master Constantin Brancusi. The main inspirational source was Romanian traditional art.

Other designers influenced by the Romanian folk costume were Valentina Vidrascu and Corina Vladescu. [1]

Fig. 4: *Andra Clitan – "Mara Mi"* ***Fig. 5:*** *Ingrid Vlaslov - "I feel love"*

Source: http://www.alo-moda.ro/pasarela-2009-mara-mi-by-andra-clitan.html and http://www.one.ro/fashion/designeri/colectia-i-feel-love-by-ingrid-vlasov-la-paris-fashion-week-7450571-foto?p=7

3. CURRENT RESEARCH IN FASHION RELATED TO NATIONAL FOLKLORE MOTIFS

Being recognized as an active and dynamic operator on the national and European research market, The National Research&Development Institute for Textiles and Leather promotes and develops multidisciplinary applied research in the field of textile & clothing and leather – footwear – rubber goods industry, targeting textile enterprises and other connected fields.

INCDTP defines its identity as a link between research and technology transfer by fostering partnerships with national and European enterprises in the field in order to help them increase their competitiveness and technological innovation capacity, through multifunctional products, advanced technologies and services.

Representing the research sector, the Institute is a part of all 4 textile clusters from Romania: *ASTRICO NE* (NE Region), *Romanian Textile Concept* (Bucharest-Ilfov Region), *Tradiții*

Manufactura Viitor (SE Region) and *Transilvania" Textile & Fashion* (Central Region). Through these clusters, the institute is a member of the Association of Romanian Clusters - CLUSTERO.

Representing the textile-clothing industry, an industry that promotes the cultural tradition and Romanian creativity, the Institute contributes with its activity to the promotion of Romanian spiritual and cultural values, by clothing design.

The current research in fashion related to national folklore motifs developed by INCDTP is to define the anthropometric characteristics of the population and the ethnographic features of the folk costumes from different regions of the country and use it as a source of inspiration for the fashion collections.

In the initial stage of one project, financed through national founds, a documentary study on ethnographic characteristics of the popular costume from different regions of the country was elaborated. The Traditional Romanian costume varies by region: Banat, Transylvania, Bucovina, Moldova, Crisana, Maramures, Dobrogea, Oltenia and Muntenia (Figure 6). The embroidery patterns have a certain meaning that differs from one region to another. In each of the country regions the combination of colors imposed by tradition are strictly respected.

The villages from Gorj are known for the most beautiful decorated popular costumes. The predominant colors of the traditional costumes from Arad are red and black. In Maramures the popular art is preserved in its original form and the predominant color of the folk costumes is green. The traditional costume from Moldavia is characterized by simplicity and sobriety, the color palette is often reduced to three colors: black, red and white, later associating other colors (blue and orange in Northen Moldavia), but in a limited extent. From the structural and ornamental point of view, the folk costume created in the mountain and plain areas of Oltenia (Figure 7) belongs to the category of Romanian folk costumes with two catrinte and finely pleated valnic having morphological similarities - of fabric, working techniques and cut – with the traditional garments of the inhabitants living in the Walachian Plain, Transylvania and the Banat. Specific for Oltenia are the bright cheerful colours of the embroideries and alesaturi, the splendour and sumptuosness of the decorative compositions made with precious materials- gold and silver metal threads, tinsels, silk, arnica, spangles, beads, twisted wool dyed in spinning mills – and an inexhaustible creativity, which allowed each woman an original suggestive interpretation of the traditional motifs repertoire. [1]

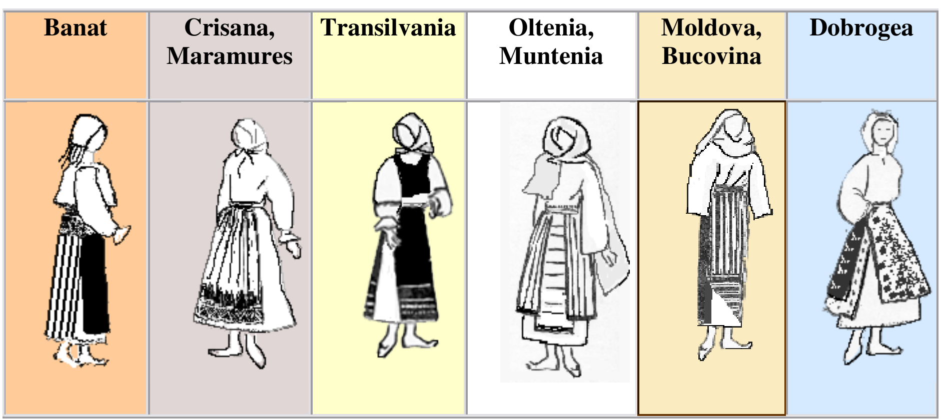

Fig. 6: *Romanian folk costumes from different regions of the country*
Source: http://www.romanianmuseum.com/Romania/aboutRomania.html#three

A clothing outfit of exquisite craftsmanship, the traditional costume from Muntenia (Figure 7), irrespective of ethnographic area, contributed significantly to the assertion of the folk costume as an important form of folk creation and to the development of the Romanian ethnographic heritage. The variety of the ornamental solutions, the refined colour harmonies and the original interpretation of various categories of motifs have led to an unmistakable aesthetic expression for each garment type.

The popular costume from Dobrudja (Figure 7) reflect the historical changes from this area, conferring them a unique artistic expression. The first form dates from the end of the last century and it's considered original due to the cutting and traditional decorations. It is the shirt (camasa dreapta) with two aprons with "peak" for women and a shirt with wide trousers, wrinkled (in dark colours) and red belt for men. This costume completed with a contemporary headband it's considered the prototype of the traditional Romanian costume from northen Dobrudja.

Fig. 7: *Folk costumes from Oltenia, Muscel (Muntenia) and Dobrudja*
Source: D. Isfanoni, P. Popoiu, Patrimony Romanian costume from the collections of„Dimitrie Gusti" National Village Museum, Ed. Alcor Edimpex, Bucureşti, 2007

The traditional costume from Moldavia (Figure 8) represents a certificate of high abilities and understanding, a standard of beauty that has a communication language of ancient traditions, a living testimony of a mass creation process. The traditional costume from Moldavia for women includes in its structure such components as: the covering of the head, shoes, jewelry and accessories. [8]

In Bucovina the folk costume reflects the skills and refinement of the women that manufacture the clothing pieces (Figure 8). A basic piece of the female costume is the flax blouse (iia) with hems ("sorocica"). The chromatic composition is dominated by red, yellow and orange, diferrent from the shirts from the other regions that are black and white. Unlike the most ornaments on the shirts that seem drawn or painted, the decorations from the flax blouses from Bucovina seem carved. [1]

The traditional costume from Maramures (Figure 8) has numerous notes of sobriety, beauty and kept well its undeniable ancient value in front of modernism. The folk costume of the old country of Maramures preserves the vigour of some ancient clothing pieces: women's zadii (rectangular woollen skirts) with broad stripes in red with black or yellow with blue and guba (a long white coat, woven with long wollen treads introduced into the filling to obtain afur effect) worn by both men and women.

Fig. 8: *Folk costume from Bucovina, Moldavia and Maramures*
Source: D. Isfanoni, P. Popoiu, Patrimony Romanian costume from the collections of„Dimitrie Gusti" National Village Museum, Ed. Alcor Edimpex, Bucureşti, 2007

The folk costume of Transylvania (Figure 9) is characterized by a unitary morphological structure of the basic clothing pieces. The geographical characteristics of the relief, the occupational profile and social status of the villagers as well as some influence due to the cohabitation with other ethnic groups (Saxons, Hungarians, Slovaks and Ucrainians) were the sources of a spectacular area diversity.

***Fig. 9:** Folk costumes from Transylvania and Banat*
Source: D. Isfanoni, P. Popoiu, Patrimony Romanian costume from the collections of„Dimitrie Gusti" National Village Museum, Ed. Alcor Edimpex, Bucuresti, 2007

The features characterizing the traditional costume of the Banat (Figure 9) as part of the Romanian folk wear, refer, on the one hand, to the existence of some unique pieces, to be found only in this historical province –opregul cu franjuri lungi (catrinta) and the conci (bonnet) worn by women-, and on the other hand, to the sumptuous embroideries and alesaturi made in gold and silver threads. [8]

This research leads to the revaluation of the Romanian cultural heritage and the promotion of traditional motifs specific to each region in the fashion collections both national and international. Also, it will create innovative concepts to support the garment industry in order to develop their own brand and to bring the design activities in Romania at an international level.

Estimated effects of this research leads to new information, specialized in fashion, available to SMEs in this field, increasing the availability of the Romanian clothing products on the external market and to maintain it on the internal market. At the same time it encourages the creation and development of Romanian fashion brands and the reduction of lohn production, supporting the SMEs from the clothing industry in Romania in order to achieve their specific ethnographic collections. [1]

4. CONCLUSIONS

The traditional Romanian costume has a great artistic value because of its spectacular cut and decorations In Romania there are 112 traditional costumes, from Banat are twelve costumes and in Caras five costumes. The folk costume is an emblem of recognition, a mark of ethnic identity, a document with certain historical and artistic value.

In conclusion, we can say that the sobriety of the cuts and the austere simplicity of the fabrics (wool, hemp) from the traditional Romanian costumes, is compensated by the refinement of the embroideries and its exuberance of color, which gives to every piece of clothing the precious value of a jewelry polished by the skilled hands of women.

The interest of the international designers for our traditional costume is a good way of promoting the traditional Romanian values.

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METHODS OF OBTAINING LONGITUDINAL STRIPES LAYOUTS

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Abstract*. From the technological point of view it is necessary that the phase of warping to be done two or three multiple warp, which results in two or three rolls of the warp final will meet only the warping. To achieve longitudinal striped fabric spinning machines is necessary to have all tensioning mechanism dispensing rolls which requires their special construction.*
The homogeneity of the fabric from the point of view of the warp yarns tension must be ensured by synchronizing operation of the tensioning two cutting mechanisms of the two reels on which the wires are wound with a degree of waving and thus the fuel consumption at the different weaving.
It is recommended that the design be adopted average float bonds, such that the wires can be wrapped around more than two final reels.
In terms of manufacturing technology with longitudinal stripes fabrics have a more complicated and expensive technology to cross-striped fabrics for the manufacture of which technology is simplified.
Cross-striped fabrics containing groups of warp threads those linked to floating average is materially different. Due to this degree of crimping of wires in the stripes with different bonds makes their contract to be different, having a direct influence on the wires consumption. The different contraction of wire weaving makes warp yarn length, contained in a linked reports are so different that it requires winding wires with different bonds also differing on the final rolls.
.

Key words: *floating, longitudinal stripes, plain weave, satin, floating, yarns, fabrics*

1. INTRODUCTION

Mapping method of thread groups with ties to obtain different average floating fabric with longitudinal stripes, was one of the most important issues for the designers and creators of fabrics. Although the concerns of project area, the result was the adoption of empirical solutions have not taken into account the real state of the internal structure of the fabric with such links. In their vast majority were limited to solving some particular cases structure without universal solutions [1].

The most obvious effect of stripes is obtained by associating connections with significantly different average flotation which alter the internal structure of the fabric itself. This aspect of the depth of the stripe is contained structure which makes it to be well defined and provide a high stability.

Average float bonds differ across striped fabric determines the inhomogeneous nature that can not be eliminated entirely, but it can be improved. One means by which to bring an improvement in the homogeneity of the fabric in terms of the degree of filling is apparently taking densities which increase average flotation.[2]

Fabrics obtained by combining floating links with different backgrounds, structure, consists of two parts: an area with yarn in which is used an average floating about as small, usually weave with floating average F = 1 and an area containing yarn bonds whose average flotation F > 1.

2.THE CONNECTION OF FABRIC DESIGN CONSTRUCTION WITH LONGITUDINAL STRIPES.

The appearance of longitudinal stripes contoured and highlighted the simple fabric consisting of a warp and a weft can be obtained only by means of combination of groups with links floating yarn mean differs significantly.

Striped effect achieved by this method produces change of the internal structure of the fabric, which makes the establishment striped to provide a permanent, that can not be diminished by humido-thermal processes finish or routine maintenance.

3.CRITERIA FOR ASSIGNING TIES TO EFFECT OF STRIPES

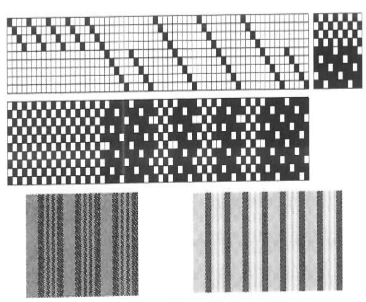
When setting drawings related to longitudinal stripes textile fabrics obtained by associating groups of threads with ties to pushups different environments must meet certain criteria which ensure positional stability of the wires and the appearance of longitudinal stripes [3]:

1. Ties that associates to provide a clear contrast characterized by the degree of occurrence of the woven yarn systems.
2. The number of yarn of a given connection must be at least equal to the number of warp yarns in a cell of the shoulder or the number of yarns in a ratio of about.
3. Yarns in a stripe with a certain connection will be woven into a whole number of shoulder cells.
4. Wires in stripes with different ties will be necessarily separated by tooth comb.

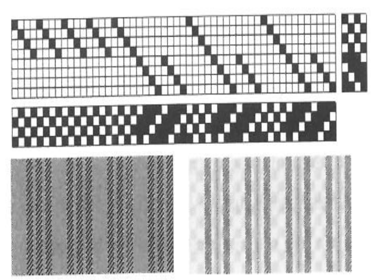
4. CONSTRUCTION OF THE RELATED DESIGNS

The combination of warp threads with different links and widths can result in a variety of fabrics with longitudinal stripes layout. [4]

Joining effect regarding the color effect is another meaning by which to obtain a better highlight of the longitudinal stripes appearance and an almost unlimited variety of aspect. In the fig. 1 are some examples of woven fabrics obtained by associating groups of wire ties, different thickness and width combined with color.



a)



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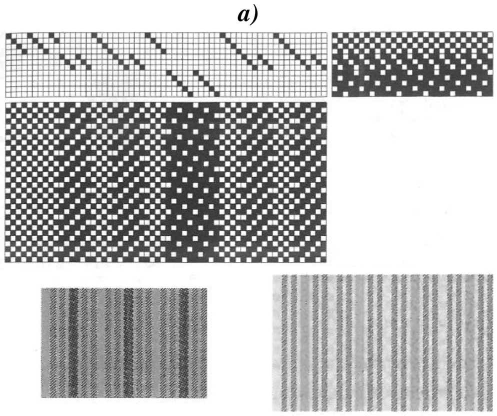

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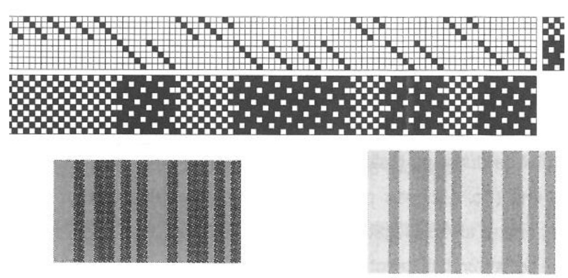

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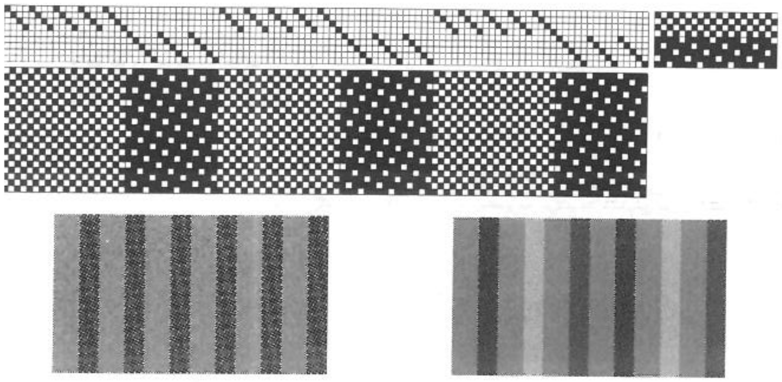

e)

Fig. 1: *Examples of woven fabrics obtained by associating groups of wire ties, different thickness and width combined with color*

To highlight the appearance of striped ties were associated with significantly different average flotation.

In all presented cases were adopted the background of woven fabrics which has the lowest average float F = 1. Striped configuration is evidenced by the adoption of the other groups of yarn, connections with higher average float and the warp. [3]

For the connection of Figure 1 was obtained by associating bond cloth of the ATLAS 5/2 Warp effect, the width of the stripes is different due to the number of threads adopted. It can combine stripes with widths equal to one for both links and unequal stripes on both ties that associate fig. 1 (b, c, d).

5. CALCULATE THE RATIO OF THE BOND

The report of bond fabrics with longitudinal stripes obtained by assigning different medium float ties is calculated as:

- in the woof

$$Ru_{dl} = \sum_{j=1}^{n}\left(\sum_{i=1}^{n} ni\right)Rui \qquad \textbf{(1)}$$

- in the warp:

$$Rb_{dl} = (c.m.m.m.c.)Rui \qquad \textbf{(2)}$$

To the connection with longitudinal stripes shown in figure 1 c) the ratio of the bond is calculated as:

- in the warp

$$Ru_{dl} = \sum_{j=1}^{n}\left(\sum_{i=1}^{n} ni\right)Rui = \sum_{1}^{2}(10+2+2+2)\cdot 2 + (2+1+1+2)\cdot 5 = 32+30=62$$

- in the warp:

$$Rb_{dl} = (c.m.m.m.c.)Rui = c.m.m.m.c(2,5) = 10\,fire$$

6. THE ASSESSMENT OF CONTRAST

The degree of systems development on the yarn fabric, is the contrast element that highlights streaking effect.

It is measured by the number of the systemic effects of the fabric per unit area is defined as the minimum number of warp yarns and weft in the report of bond strips. [4]

Figure 2. Has been associated with floating weave twill F = 1 D3 / 1 with average flotation F=2.

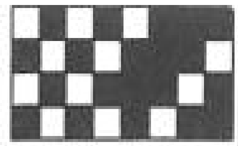

Fig. 2: The association cloth bond with the twill D3/1

In a report Ru = Rb = 4/4 from the 16 attachment points 8 are the with warp effect for weave and 12 for twill.

In the case of bond fabric association A5 / 2, Figure 7 in a report Ru = Rb = 10/10, 100 of the attachment points, the weave is 50 and the connection points 80 atlas the warp effect. If the first case the ratio between the points of bonding the warp effect is 1.5 second is 1.6. [5]

Given that the striped warp yarn density has different values depending on the flotation year average, it is necessary to calculate the degree of occurrence of points on the fabric binding the warp to take account of this. Therefore, the ratio of binding points of the warp effect is associated with the ties have to be related to the ratio of the maximum density of the yarns of the two ties.

7. WEAVING YARNS TO WOVEN FABRICS OBTAINED BY ASSOCIATION LINKS.

7.1 Weaving threads in shedding harnesses

Weaving threads into shedding harnesses shall conform to the following criteria.

a. criterion of the number of shedding harnesses
b. loading criterion of the shedding harnesses

Figure 3 is linked to a compound twill 4/2, 1/1, the average float F = 2 with a plain weave with a floating average F = 1. Charging the shedding harnesses in a report linking Ru = 8 +24 = 32 wire, 1 wire / SSA twill and 6 threads / wire to weave.

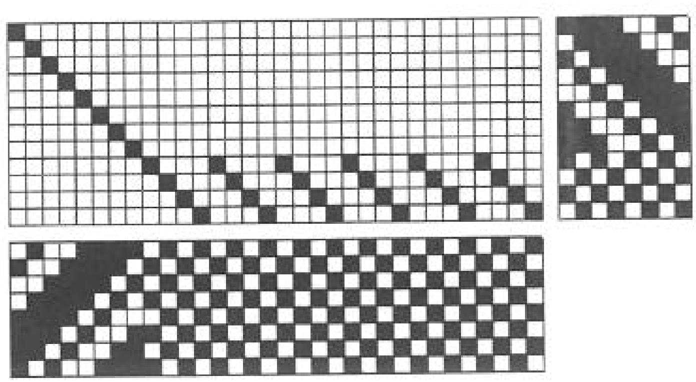

Fig. 3: Assigning a composed twill 4/2, 1/1 with a plain weave

c. the criterion of frequency bond to a report of the weft shedding harnesses

In Figure 4 the effect of longitudinal strips is obtained by the combination of a connection A5 / 2, with a plain weave. Degree of shedding harnesses loading in the report bond is equal to 1 wire / yarn.

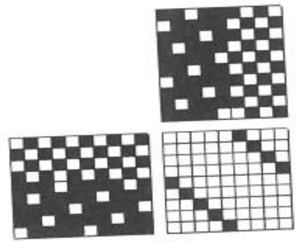

Fig. 4: Associating a link A5 / 2 with a plain weave

7.2.Weaving backward yarns

Weaving backward yarns for fabric links obtained by fundamental association or combination thereof shall conform to the following criteria. [1]

a. yarns from a stripe with a certain connection to be woven in a number of shoulder whole cell.
b. The number of wires from a stripe with a certain connection should be equal to the number of woven yarns in a cell or an integer from cells
c. Adjacent wires between two consecutive bonds will separate binding by tooth shoulder.

A warping wires backward incorrectly can lead to blurring effect stripes. An example of a link with the connection strips obtained from the longitudinal A5 / 2 by negativation, warping shown in Figure 5.

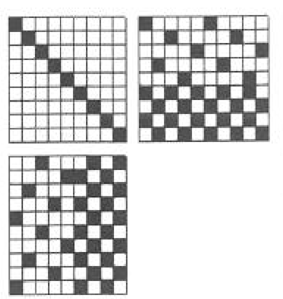

Fig 5: Connections with longitudinal stripes obtained in the connection A5 / 2 by negativation

Weaving the threads in the cell is the cell 2,4,7,9 stripes are woven yarn consecutive different links. Basically the striped fabric is completely blurred.

d. Number of wires woven into a cell of the shoulder must be strictly proportional to their density in stripes with different bonds.

In Figure 6 weaving yarn in the back was done with 4-wire the connection at the twill compound and 2-wire / connector to the canvas. In this case the ratio of yarn density is 4/2. Twill yarn density will be two times greater than that of the weave plain.

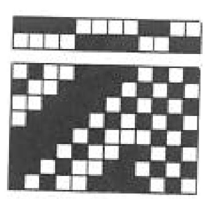

Fig. 6: Weaving backward yarn

In Figure 7 the connection associated A5 / 2 with cloth 3 shall be possible variants of the warping of backward yarns give different ratios between 3 to stripes and density of yarns, namely:

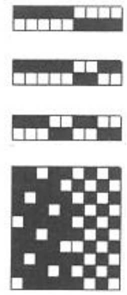

Fig. 7: *Assigning a bond A5 / 2 with a weave plain*

1. The density of stripped yarn with a density A5 / 2 is 1.25 times greater than the stripe weave of the yarns.
2. The report of backward warp threads is 5/2, and hence connecting yarns A5 / 2 have a density of 2.5 times higher than the weave
3. the ratio backward warp yarn is 5/4.

   e. It is recommended that the number of yarn from a stripe of a certain connection to an integer number of reports.

   f. If when for the diversification appearance of stripes can adopt on stripes a certain connection a number of threads which contains a whole number of reports in which stripe with connection A5 / 2 containing 12 wires

8. CONCLUSIONS.

In terms of manufacturing technology with longitudinal stripes fabrics have a more complicated and expensive technology to cross-striped fabrics for the manufacture of which technology is simplified.

Cross-striped fabrics containing groups of warp threads those linked to floating average is materially different. Due to this degree of crimping of wires in the stripes with different bonds makes their contract to be different, having a direct influence on the wires consumption. The different contraction of wire weaving makes warp yarn length, contained in a linked reports are so different that it requires winding wires with different bonds also differing on the final rolls.

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CHARACTERISTICS ANALYSIS OF THE STUDY MATERIALS REQUIRED FOR MEN COAT PRODUCT

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Abstract: *Garments is a means of artistic creation with not only the function of defense of the body and regulating physiological functions, but also by its beautifying. In order to achieve men coat product, we have the possibility to choose the material from a group of three materials that are completely different of yarn contents. After comparing measurements made for three types of materials were found in the composition of the material has a higher percentage of wool meets most conditions necessary for wearer comfort so is the material most commonly used to make the clothing for winter season.*
After comparing measurements made for three types of materials were found in the composition of the material has a higher percentage of wool meets most conditions necessary for wearer comfort so is the material most commonly used to make the clothing for winter season.
The difference between the material properties and material transformation phases in the product have been presented in order to emphasize the need for close co-working between professionals involved in making a fashion product from yarn, yarn, fabric and garment finishing product.
The types of materials used for making winter outerwear products greatly influences the design and technological design processesin their turn textiles are directly dependent on the characteristics by their structure. The difference between the material properties and material transformation phases in the product have been presented in order to emphasize the need for close co-working between professionals involved in making a fashion product from yarn, yarn, fabric and garment finishing product.
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Key words: *woven fabrics, structure, longitudinal stripes, features, density, fineness*

1. INTRODUCTION

In order to achieve men coat product, we have the possibility to choose the material from a group of three materials that are completely different of yarn contents.[1]

As hygienic requirements imposed on priority material are required laboratory experiments to reveal them. Table 1 presents the basic characteristics of the materials used for the product for coat garment for men.

Table 1: *The basic characteristics of the materials*

Crt. no.	Name	BUCEGI	VIANA	ELITA
0	**1**	**2**	**3**	**4**
1	Yarn content	90% wool, 10% celo	85% wool, 15% celo	70% wool, 30% sintetic yarns
2	Yarn fineness	14,5 Nm	35Nm	33Nm
3	Yarn density in U	161	220	228
4	Yarn density in B	142	215	275
5	Specific mass	180±15	140 ±10	87±10
6	Specific mass	162 ± 14	196 ± 14	79±9
7	Width	90 ± 2	140 ± 3	90±1
8	Breaking load in U	485	410	320
9	Specific mass in B	440	396	190

0	1	2	3	4
10	Bond of woven fabric	Pânză	-	-
11	Stretching resistance in U	18,1	18,5	15
12	Stretching resistance in B	24,2	19,2	17,3
13	Dimensional changes in U	2		1,5
14	Dimensional changes in B	1,5		1
15	Finishing treatments	Bleached, boiled, bleached, mercerized	Raveled, bleached, mercerized	Bleached, boiled, antistatic treatment

2. AIR PERMEABILITY

Air permeability was determined for each material from the set of three items of clothing for the completion of the coat men product.[2]

Following laboratory assessment determined that the best air permeability of BUCEGI material and has the lowest material is ELITA. Air permeability depends on the humidity of the sample and the thickness and porosity of its specific mass. First place occupied by BUCEGI fabric material is justified by a minimum thickness of 23 mm, through his structure was rare. BUCEGI material has a density in the warp de D_o = 228 yarn/10cm, and a weft density of D_o = 275 yarn/10cm, low values compared with the other materials. ELITE has the maximum material thickness compared to the other material due to a compact structure than the first fineness of yarns.

After determinations carried out, the obtained values are centralized in **Table 2** and in **Figure 1**.

Tabel 2: *Air permeability*

Crt. No.	Article	q(l/h)	Qmedium	Pa	l	Y	Rp	Dp	Q
1	BUCEGI	1800	1870	115,58	11137,58	0,42	$0{,}36X10^{-3}$	3	$10{,}15X10^{3}$
2		1900							
3		1900							
4		1850							
5		1900							
6	VIANA	3450	3400	28,33	2068,09	0,48	$0{,}23X10^{-3}$	3	$9{,}07X10^{3}$
7		3200							
8		3450							
9		3450							
10		3450							
11	ELITA	4175	4395	36,62	2673,62	0.23	$0{,}08X10^{-3}$	3	$4{,}38X10^{3}$
12		4300							
13		4400							
14		4700							
15		4400							

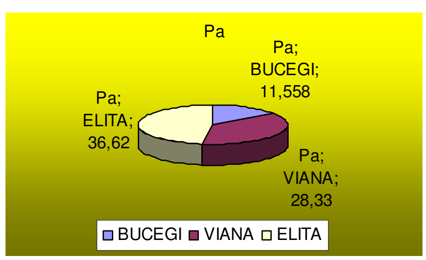

Fig.1: *Air permeability*

3. VAPOUR PERMEABILITY

The vapor permeability and resistance to vapor permeability of each material from the set of the three materials for the completion of the product coat men's clothing.[3]

After determinations carried out, the values obtained are centralized in **Table 3** and **Figure 2**

Tabel 3: *Vapour permeability*

Crt. No.	Article	Mi	Mf	Pv	μ	δ	Rv
1	BUCEGI	157,1	156,8	0,25	31,88	0,48	0,015
2	VIANA	177,1	177,05	0,14	18,21	0,23	0,012
3	ELITA	165,9	165,77	0,15	19,40	0,23	0,011

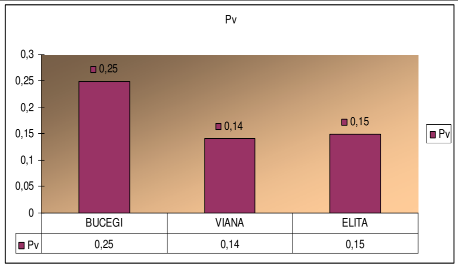

Fig. 2: *Vapour permeability of the three materials proposed for product realization garment - men coat.*

The first place is occupied by the material justified by high fineness of yarns, textured yarns of wool and anti - wrinkle treatment applied its finishing department treatment increases the rate of evaporation.[4] The texture has a favorable influence on the permeability of the vapor. Not only first justified by structural parameters and finishing treatments but the last. Viana material was subjected to antistatic treatment during the finishing process. This is due to retention of moisture vapor permeability decreases.

4. HYDROPHILICITY

Hydrophilicity analysis can be done by comparing its numerical values or how they evolve over time

Tabel 4 : *Hydrophilicity*

Crt. No.	**Article**	**VARIATION OF CAPILLARY ASCENSION**						**SPEED**	
		U			**B**			**U**	**B**
		2,0	5,0	8,0	2,0	5,0	8,0		
1	BUCEGI	33	50	58	15	40	53	1,725	1,662
2	VIANA	77	30	38	15	28	46	0,535	0,45
3	ELITA	10	22	22	10	10	10	0,381	0,25

It can be isolated the hydrophilicity of from their porosity of the material in that volume of liquid absorbed which is subject to the overall pore volume. Factors influencing the hydrophilicity are:

- The material structure
- Yarn composition.

After laboratory assessment may conclude that VIANA material is the most hydrophilic and ELITE material is least hydrophilic. In laboratory conditions, the method comprises exposing the sealed environment with a relative humidity of 100% of by the material specimens dried at 105+110^{0}C, or conditioned and determining the amount by vapor absorbed in 24 hours.

5. THE WETTABILITY

Graphs allow an overall assessment of the behavior in terms of wettability, pointing out that special treatment antistatic obvious influence this parameter.

For article VIANA, the application of anti-wrinckle treatments and simple dressing adversely affect wettability feature, the article BUCEGI lies on the first place and ELITA article that although treated with antistatic treatment, which accused that has a poor wettability ranging is the second lowest place.

Tabel 5: *The werrability*

Crt. No.	Article	Sl	t	Mo	Mu	H	hmed	ih
1	BUCEGI	10^{-2}	25	1,05 1,51	1,62 1,63	7,87 7,88	10,74	0,82
2	VIANA			0,89 0,89	0,96 0,97	8,32	7,88	0,49
3	ELITA			1,91	2,08 2,11	8,89 8,90	8,99	0,7

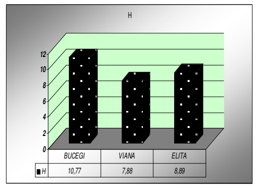

Fig. 3: *The wettabilitty*

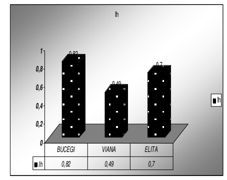

Fig. 4: *The wettabilitty*

Experiments have revealed that by wettability properties acquired through completion are of limited duration. Generally after ten washes a garment reduces its wettability at half the value obtained after treatment by wettability.The wettability is due to the nature of the starting material, it significantly increased if the mixture contains staple yarn.

In laboratory tests it was determined:

- Treatment of materials antipilling reduce the ability to absorb water vapor.
- Increased porosity material including a large air mass increases yarn wettability.

6. CONCLUSIONS

After comparing measurements made for three types of materials were found in the composition of the material has a higher percentage of wool meets most conditions necessary for wearer comfort so is the material most commonly used to make the clothing for winter season. For an overview of experimental results, we try a tabulation thereof, described in **Table 6**.

Table 6*: Centralization of obtained results*

Crt. No..	Article	Pa	Pv	Wettab.	H%	Total	Yarn composition
1	BUCEGI	1	3	4	1	9	90% wool, 10% celo
2	VIANA	2	1	3	2	8	85% wool, 15% celo
3	ELITA	3	1	1	2	7	70% wool, 30% sinthetic yarns

The types of materials used for making winter outerwear products greatly influences the design and technological design processesin their turn textiles are directly dependent on the characteristics by their structure. The difference between the material properties and material transformation phases in the product have been presented in order to emphasize the need for close co-working between professionals involved in making a fashion product from yarn, yarn, fabric and garment finishing product.

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PHYSICAL PROPERTIES OF ANTIBACTERIAL TREATED COTTON FABRICS AND EFFECT OF LAUNDRY CYCLE

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Abstract: *During daily usage of textiles, humidity and warmth conditions provide appropriate living conditions for bacteria and microorganisms in textile products. Bacteria growth, infection and cross infection by pathogens might develop due to usage of textile products. Especially since World War II, antibacterial textile products have developed as a result of the hygiene demand of the society.*
In this study, triclosan (sample A), quaternary ammonium plus triclosan (sample B), dichloro phenol (sample C), silver (sample D), quaternary ammonium (sample E) and chitosan (sample F) based six different antibacterial additives were applied on 100% cotton fabrics for antibacterial treatment. All six treated fabrics and the untreated fabric (control sample) were washed for 40 cycles; the antibacterial efficacies were tested; changes in tear strength and Berger whiteness values of the samples were recorded prior to washing and after 1st, 5th, 10th, 20th and 40th washing cycles.
Regarding all washing cycles, a decrease in tear strength results is observed between unwashed and 40 cycle washed samples. Textile materials such as bedlinen, pillow cases, surgeon gowns for which tear strength values are important and that have antibacterial treatments should be tested for tear strength values for different washing cycles to see if they meet minimum tear strength requirements. The change in tear strength and Berger whiteness of samples shows differences according to the antibacterial agent treated and washing cycle applied. Generally, slight decreases in tear strength values are observed. And slight decreases in whiteness, except for sample F which is treated with chitosan, are observed as well. Textile materials having antibacterial treatments should be tested for the special antibacterial agent they are treated and for the number of washing cycles that is required for their product life.

Keywords: *antibacterial treatment, tear strength, Berger whiteness, antibacterial efficacy, cotton fabric*

1. INTRODUCTION

Antibacterial textiles were developed in the World War II especially to overcome the problem of decomposing tents caused by microorganism reproduction due to moisture and heat conditions in tent fabrics [1]. Antibacterial textiles are used to prevent infections from microorganisms, to control infections, to prevent odor caused by microorganisms, to prevent staining, color change and quality loss in textiles caused by microorganisms [2].

In the literature there are numerous studies focusing on the antibacterial properties of textile materials having various antibacterial substances ranging from synthesized materials such as triclosan nanosilver to natural antibacterial substances such as chitin, chitosan and silver [3–9].

Zhang et al (2003) tested the antibacterial efficacy of chitosan treated cotton fabrics and obtained high values; they obtained efficacy for longer times when they added glutaric dialdehyde into the impregnation solution [3].

Aly et al (2004) evaluated the crease resistance and antimicrobial efficiency values of chitosan citrate treated cotton fabrics. Strength values, washing fastness values and Berger whiteness values of samples were measured as well. They observed that after heat treatment all values of the samples showed good results [4]. Balci and Babaarslan (2005) observed different strength results depending on the concentration of the antibacterial agent applied [5]. Mihaiilovic et al (2007) obtained higher tensile strength results when they treated the fabrics with antibacterial agent [6].

Orhan et al (2007) checked the antibacterial efficacy of triclosan treated cotton fabrics; they observed that washing cycle decreased the efficacy of the samples [7]. Jeong et al (2002) observed a decrease in the tensile strength values of chitosan treated wool fabrics [8].

Palamutcu et al (2007) concluded that the application of the antimicrobial treatments changes the tensile strength of the woven fabric. These treatments lead to a positive change in the tensile strength and crease recovery of angle of (weft direction) the treated fabrics. As result of the two antimicrobial test methods (AATCC100 and AATCC147), they observed that antimicrobial efficiency of each antimicrobial agent differ from each other and their efficiency is affected by the number of washing cycle [9].

2. EXPERIMENTAL APPROACH

In this study, triclosan (sample A), quaternary ammonium plus triclosan (sample B), dichloro phenol (sample C), silver (sample D), quaternary ammonium (sample E) and chitosan (sample F) based six different antibacterial additives were applied on 100% cotton fabrics for antibacterial treatment.

The antimicrobial bioactivity of samples against three microorganisms: Staphylococcus Aureus, Escherichia Coli and Candida Albicans, was evaluated in microbiology laboratory. All six treated fabrics and the untreated fabric (control sample) were washed for 40 cycles; the antibacterial efficacies were tested, the results of the antimicrobial tests were published elsewhere previously [20]. Changes in tear strength and Berger whiteness values of the samples were recorded prior to washing and after 1st, 5th, 10th, 20th and 40th washing cycles.

2.1 Materials and Method

In this work one natural (chitosan) and five different brands of synthetic antibacterial additives have been used for the treatment of 100% percent 153 g/m2 cotton woven fabric and evaluated at 0, 1, 5, 10, 20 and 40 washing cycles.

The tear strength of the samples were evaluated both in the warp and weft directions according to standard test method ISO 13937:2000. The mean value of at least ten samples is given as the tear strength value. The tear strength results in the warp and weft directions are given in Table 1 and Table 2, respectively. The Berger whiteness of the samples was measured with a spectrophotometer, Datacolor 600. The whiteness values of samples are given as the mean value of at least five samples in Table 3.

2.2 Results

The tear strength values in the warp direction, the tear strength values in the weft direction and the Berger whiteness values of the samples are given in Table 1, Table 2 and Table 3, respectively.

Table 1: *Tear strength values (Newton) in the warp direction*

Sample (warp direction)	unwashed	After 1st wash	After 5th wash	After 10th wash	After 20th wash	After 40th wash
control	4,76	4,48	4,00	3,75	3,51	3,71
A	4,47	4,65	3,94	3,83	3,75	4,00
B	4,33	4,52	3,65	3,73	3,43	3,48
C	4,55	4,02	3,73	3,88	3,68	3,39
D	4,44	4,15	3,60	3,66	3,65	3,71
E	4,34	4,24	3,72	3,71	2,50	3,00
F	4,15	4,08	3,00	3,66	3,98	4,00

Table 2: *Tear strength values (Newton) in the weft direction*

Sample (weft direction)	unwashed	After 1st wash	After 5th wash	After 10th wash	After 20th wash	After 40th wash
control	3,70	3,98	3,50	3,04	2,77	3,03
A	3,48	3,91	3,31	3,37	3,21	3,00
B	3,91	3,98	3,49	3,25	3,10	2,95
C	3,71	3,25	3,18	3,24	3,18	3,02
D	3,77	3,30	3,17	3,16	3,04	2,79

E	3,65	3,55	3,11	3,35	4,00	3,50
F	3,31	3,38	3,69	3,06	2,69	2,50

Table 3: *Berger whiteness values of samples*

Sample code	unwashed	After 1st wash	After 5th wash	After 10th wash	After 20th wash	After 40th wash
control	147,10	149,69	149,72	149,74	151,75	146,74
A	140,82	142,15	149,01	148,78	150,17	146,95
B	144,03	142,41	148,97	148,18	151,07	146,06
C	145,54	146,76	151,58	151,79	153,73	147,82
D	143,81	146,03	145,91	148,00	150,70	147,05
E	142,38	143,05	150,04	150,73	150,85	148,64
F	129,80	139,38	144,37	144,81	146,45	146,89

3. CONCLUSIONS

The tear strength values obtained in the warp direction are higher than the tear strength values obtained in the weft direction of the samples. This fact is a result of warp yarns being stronger than weft yarns in the fabric structure. After the first washing cycle all samples, either in the warp or weft direction, showed increases in tear strength values. This might be due to the shrinkage of the fabrics after the first washing cycle. Although small increases were observed between some washing cycles such as between the 20th and 40 th washing cycles, for both directions the samples showed slight decreases in tear strength test results. Regarding all washing cycles, a decrease in tear strength results is observed between unwashed and 40 cycle washed samples. Cotton fabrics are wear out as results of the mechanical enforcement during the repeated machine washing. Mechanical enforcement causes surfacial wear out effect on the yarns. Weakened yarns can be broke down with less mechanical enforcement, resulting lower tear strength value. The small increase observed between some washing cycles might be due to the accumulation of detergent on the textile material which causing a reinforcing effect against tearing motion on the warp or weft yarns of the fabric. Accumulated residual detergents or any other residuals may also effects the slippage movement of the warp or weft yarns over each other. When the warp or weft yarns slip easily over each other required fabric tearing force increases. And when the slippage of warp and weft yarns is not easily occurs yarns break down one by one and required tearing force of the fabric decreases. There are different behaviours reported about the tear strenght of the fabric in the literature where most of them are related to above explained residue accumulation [4-9].

Textile materials such as bedlinen, pillow cases, surgeon gowns for which tear strength values are important and that have antibacterial treatments should be tested for tear strength values for different washing cycles to see if they meet minimum tear strength requirements.

The Berger whiteness values of the samples did not show a siginificant decrease for none of the samples. The control sample showed an increase until the 20th washing cycle, and a slight decrease after the 20th washing cycle. This sligt decrease might be due to the accumulated detergent and debris in the fabric structure. Compared to the control sample, all samples showed lower Berger whiteness values, which proves that the antibacterial agents caused a change in the whiteness of the fabric. However, the overall change in whiteness after even the 40th washing cycle shows a slight decrease. For chitosan treated sample F, the whiteness indexes are showing a decrease as washind cycles are increased. Chitosan has a yellowish color, and as the number of washing is increased, the whiteness of the fabric increases. The increase of whiteness degree for chitosan treated sample F might be due to the removal of chitosan molecules as more washing cycles are applied. For all samples including the control sample, the overall change in whiteness is a slight change; and this slight change should be considered in textile materials where a certain whiteness is expected such as bedlinens especially for chitosan treatment.

The change in tear strength and Berger whiteness of samples shows differences according to the antibacterial agent treated and washing cycle applied. Generally, slight and tolerable decreases in tear strength values are observed. And slight decreases in whiteness, except for sample F which is treated with chitosan, are observed as well. Textile materials having antibacterial treatments should be tested for the special antibacterial agent they are treated and for the number of washing cycles that is required for their product life.

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INFLUENCE OF ENZYME PRE-TREATMENTS ON NATURAL DYEING OF PROTEINIC SUBSTRATES

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Abstract: *This study presents dyeing behavior aspects with Allium Cepa infusion of 100% wool yarns and 70% wool/30% Angora mohair blended yarns. Variants of yarns that were pre-treated according to the classical procedure of scouring were compared with variants of yarns that were subjected to proteolytic enzyme pre-treatment. The pre-mordanting technique with potassium alum was experimented. The influence of pre-treatments on natural dyeing was studied in terms of dyeing intensity, colour fastness to washing, artificial light, acid and alkaline perspiration, physical-mechanical and physical-chemical characteristics. Colour measurements have evidenced an increase of the tinctorial affinity to natural dye of wool fibre subjected to preliminary enzyme treatment followed by pre-mordanting. In the case of wool-Angora mohair blended yarns the tinctorial affinity to natural dye does not improve. Colour fastness to washing, acid and alkaline perspiration is good and very good for all the variants of treatment applied. Pre-mordanting has not positively influenced the colour fastness to light. Preliminary processes applied either in the classical or in the enzyme variant followed by pre-mordanting and dyeing induced a decrease of the breaking strength of 100% wool yarns by approx. 20% in the case of classical treatment and by 16% in the case of enzyme treatment while they do not negatively influence the breaking elongation values. For wool-Angora mohair blended yarns the enzyme treatment was much more aggressive compared to the classical one, leading to much lower values of the breaking strength, compared to the raw witness yarns, the decreases reaching up to 40%.*

Key words: *natural dyes, wool yarns, Angora mohair, Allium Cepa, mordanting*

1. INTRODUCTION

The current concerns for the environment as well as the norms and regulations in force have led to a growing demand for natural products in various industrial and industry-related branches. At present, natural dyes are reintroduced in the textile dyeing operations, because the synthetic dyes are associated with the emission in the environment of high amounts of chemical substances that are harmful for both the environment and human health. Numerous researches have evidenced the antifungal, antibacterial, antioxidative and UV protection properties of textile materials dyed with various natural dyes [1-3].

The development of efficient enzyme-assisted pre-treatments could improve the fibre sorption capacity for natural dyes and colour fastness. Enzymes were used for years in the textile industry because they activate under mild conditions and are biodegradable, being substrate-specific [4-5]. Both in natural dyeing and in textile chemical finishing, various methods to apply enzymes on different textile substrates such as cotton, wool, silk, synthetic fibres were approached [6-7]. Enzymes can facilitate diffusion and adsorption of natural dye at the surface and inside the fibre, acting especially at the surface level (cuticle layer) by modifying points of access to dyes. Another benefit of applying the enzyme treatments is the potential reduction of energy consumption of the dyeing process that could derive from the reduction of the bath temperature permitted by a higher enzyme induced affinity of the textile substrates. This study presents some aspects of the influence of enzyme pre-treatment, pre-mordanting and natural dyeing on the tinctorial capacity and on the characteristics of 100% wool yarns and 70% wool/30% Angora mohair blended yarns.

2. EXPERIMENTAL PART

2.1 Materials

100% wool yarns and 70% wool/30% Angora mohair blended yarns were developed in cooperation with SC STOFE Buhuşi SA, Romania. The natural dye was used as an extract in aqueous solution, obtained from dried scales on bulb of *Allium Cepa*. Potassium alum purchased from Sigma Aldrich was used for the mordanting process. Preliminary enzyme treatment was done with Perizym AFW proteolytic enzyme (Textilchemie & Dr. Perty), obtained from a combination of several types of proteases, with high specificity for proteinic fibers. Scouring were executed with a tensioactive product, a low foam non-ionic product based on polyethoxilated fatty alcohol Imerol JSF (Clariant) and Peristal WEB (Dr. Petry GmBH) was used as buffer solution.

2.2. Preliminary treatments

In order to determine the influence of the preliminary treatment and of the natural dyeing on the characteristics of 100% wool yarns and 70% wool/30% Angora mohair blended yarns, laboratory experiments were conducted using enzyme pre-treatment with proteolytic enzyme, in comparison with the classical scouring with non-ionic detergent. Treatments were conducted on Ugolini laboratory equipment (Hm 1:20), as follows:

***Classical preliminary treatment* (L$_1$)**

The yarns that are object of this study were scoured with a solution containing 2 g/L non-ionic scouring product (Imerol JSF), at a temperature of 40^{o}C, for 30 minutes. After this operation the yarns were subjected to repeated rinsing with warm water at 40^{o}C and with cold water and afterwards dried freely at room temperature.

***Enzyme preliminary treatment* (L$_2$)**

Prior to the natural dyeing, alternative treatment with Perizym AFW proteolytic enzyme product was carried on in order to improve wool tinctorial affinity and to reduce the felting capacity, effects that can be obtained by hydrolysis attack of protease on the scaled cuticle layer. 100% wool yarns and 70% wool/30% Angora mohair blended yarns were subjected to preliminary washing according to the classical scouring process, after having been immersed in a treatment bath at 30^{o}C, in which 3 g/L Peristal WEB (buffer solution) and 0.5 g/L Imerol JSF were added previously. After a checking of the bath pH (at a temperature of 70^{o}C) at 8.5 and its eventual correction with ammonia, Perizym AFW (2 g/L) enzyme was added. After the enzyme-catalysed reaction, with a duration of 30 minutes, the samples were squeezed, then in a first step rinsed at 40^{o}C in a bath acidulated with formic acid (pH=4) to deactivate the enzyme and subsequently rinsed with warm and cold water. The samples treated as such were freely dried at room temperature.

2.3. Preparation of the aqueous extract of *Allium Cepa*

To prepare the *Allium Cepa* extract, the mix resulted from adding 20 g of dried scales of the bulb to 1000 mL of purified water was boiled for 45 minutes. The resulted solution was left to cool for 24 h and afterwards filtered.

2.4. Mordanting

In this study the technique of pre-mordanting with metal salts was experimented. Mordanting was conducted on Ugolini laboratory equipment (Hm 1:30) at a temperature of 80°C for a duration of 45 minutes. Potassium alum - $AlK(SO_4)_2\bullet 12H_2O$ was used as mordant with a concentration of 2% (owf). The yarns thus treated were successively rinsed in hot water at 60°C, 40°C and respectively in cold water, then were squeezed and freely dried at room temperature.

2.5. Dyeing with plant infusion

Dyeing of pre-mordanted yarn variants was done with the obtained infusion, without additional dilution. Yarns that were not mordanted were also dyed for comparison purposes. The dyeing operation was conducted on Ugolini laboratory equipment (Hm 1:40), at a temperature of 90°C (the temperature gradient up to the dyeing temperature was 2°C/min) for 75 minutes. The pH of the dyeing bath was adjusted by adding 1 mL/L acetic acid, until its value reached 5. The samples were subsequently rinsed with hot water at 60°C, soaped with a solution of 2 g/L Kemapol SR 40 detergent and then successively rinsed with hot water at a temperature of 60°C, 40°C and respectively cold water, squeezed and dried.

2.6. Colorimetry measurements

In order to establish the efficiency of preliminary treatment on the natural dyeing, colour measurements were conducted using Microflash spectrophotometer from Datacolor, according to standard ISO 105 J03:2001.

2.7. Determination of dyeing fastness

The influence of preliminary treatments on the natural dyeing was determined by evaluating colour fastness to washing, light, acid and alkaline perspiration. Standard SR EN ISO 105-C 10: 2010 was used to determine fastness to washing, in respect of colour change in the washing solution and colour staining on the multifibre standard, the assessment was made on the grey scale basis. Dyeing fastness to acid (pH=5.5) and alkaline (pH=8) perspiration was evaluated on the basis of standard SR EN ISO 105-E 04: 2013. Dyed samples were tested in respect of their fastness to artificial light, using Xenotest Apolo-James Heal device, according to standard SR EN ISO 105-B02: 03, and the results were assessed based on the blue scale.

2.8. Determination of physical-mechanical and physical-chemical characteristics

In order to evidence the influence of preliminary enzyme treatment and of natural dyeing on the integrity of the analysed yarns, the main physical-mechanical characteristics were determined in comparison with raw yarns (untreated), as well as with the yarns preliminary treated according to the classical method. For these determinations SR EN ISO 2060/97 (RT, 65% humidity) and respectively SR EN ISO 2062:2010 standards were used. The alkali solubility index of keratin fibres was determined by the solubilisation of yarns for 1h in a NaOH 0.1N solution, at a temperature of 65^{o}C, after having first been scoured of fats by extraction in Soxhlet with oil ether and ethylic alchool, in accordance with STAS 8398-69 standard.

2.9. Electron microscopy

The influence of enzyme preliminary treatment and of natural dyeing on the scaled cuticle layer of keratin fibres that compose a yarn was evaluated with electron microscopy, a Quanta SEM 200-FEI being used for the determination

Table 1 presents the codification of the yarn variants considered in the study.

Table 1: *Codification of the yarn variants considered in the study*

Code	Fibre composition of yarns/Applied treatment
L-1	Raw 100% wool yarns
L-7	Raw 70% wool-30% Angora yarns
L_1-1	100% wool yarns pre-treated according to L_1 variant and dyed (without mordanting)
L_2-1	100% wool yarns pre-treated according to L_2 variant and dyed (without mordanting)
L_1-7	70% wool-30% Angora yarns pre-treated according to L_1 variant (without mordanting)
L_2-7	70% wool-30% Angora yarns pre-treated according to L_2 variant (without mordanting)
L_1-1Al	100% wool yarns pre-treated according to L_1 variant, mordanted and dyed
L_2-1Al	100% wool yarns pre-treated according to L_2 variant, mordanted and dyed
L_1-7Al	70% wool-30% Angora yarns pre-treated according to L_1 variant, mordanted and dyed
L_2-7Al	70% wool-30% Angora pre-treated according to L_2 variant, mordanted and dyed

3. RESULTS AND DISCUSSIONS

3.1. Colour measurements

Objective colour assessment conducted by a trained observer under standard conditions (D65 average daylight) have evidenced the evenness of natural dyeing for the 100% wool yarns and for the wool-mohair blended yarns. Trichromatic values and colour differences obtained for the yarn variants considered in the study are presented in Table 2.

Table 2: Colour measurements determined for 100% wool yarns and wool-Angora mohair blended yarns

Variant code	X	Y	Z	Colour difference					
				DL*	DC*	DH*	DE*	Rating	Observations
L_1-1	19.63	16.86	7.33				REFERENCE		
L_2-1	23.08	20.01	8.80	3.76	1.23	0.57	3.99	3	light, saturated, yellow
L_1-1Al	21.03	18.57	4.23				REFERENCE		
L_2-1Al	19.96	17.53	4.70	-1.25	-4.21	-1.91	4.79	3	dark, unsaturated, red
L_1-7Al	18.19	16.35	4.33				REFERENCE		
L_2-7Al	18.72	16.61	4.21	0.34	1.59	-0.82	1.82	4-5	light, saturated, red

***Obs:** Positive values of DL* indicate lighter samples compared to the reference; negative values of DL* indicate darker samples compared to the reference. Positive values of DC* indicate samples that are more saturated compared to the reference; negative values of DC* indicate samples that are more unsaturated compared to the reference. DE* represents the total colour difference between sample and reference.*

The data presented in Table 2 show a lightness difference between the witness sample scoured through the classical method followed by pre-mordanting (variant L_1-1Al) and the protease treated sample followed by pre-mordanting (variant L_2-1Al), with negative values for the latter. Negative values obtained for DL* reflect a darker colour for 100% wool yarns pre-treated with protease followed by pre-mordanting with potassium alum, thus evidencing an increase of wool fibre tinctorial affinity to *Allium Cepa* natural dye. In the case of wool yarns that were not pre-mordanted (variant L_1-1 compared to L_2-1), there was no evidence of an increase of tinctorial affinity in case of enzyme treatment applied prior to the natural dyeing with *Allium Cepa*. In the case of wool-Angora mohair blended yarns subjected to enzyme treatment and pre-mordanting (L_2-7Al variant) tinctorial affinity does not improve, the values obtained for DL* being sensitively equal with those obtained for the classical variant of pre-treatment (variant L_1-7Al), evidencing that Perizym AFW protease acts predominantly on the scaled cuticle layer of the wool fibre and does not show efficiency on the Angora mohair fibre.

3.2. Physical-mechanical and physical-chemical characteristics

The results for the physical-mechanical indices and the alkali solubility for 100% wool yarns that were subjected to classical or enzyme pre-treatment, pre-mordanted and dyed with *Allium Cepa* infusion, compared to those obtained for raw yarns are presented in Table 3.

***Table 3:** Physical-mechanical and physical-chemical characteristics determined for 100% wool yarns and 70% wool-30% Angora mohair blended yarns variants*

Variant code	Physical-mechanical characteristics				Physical-chemical characteristics
	Linear density (Nm)	**Breaking strength** (N)	**Breaking elongation** (%)	**Breaking length** (km)	**Alkali solubility (%)**
L-1 (raw)	24.2/1	1.61	5.51	3.90	6.1
L_1-1Al	22.8/1	1.28	7.44	2.92	9.37
L_2-1Al	24.9/1	1.35	6.93	3.37	9.43
L-7 (raw)	5.8/1	6.58	10.23	3.80	10.67
L_1-7Al	5.8/1	5.36	20.58	3.10	10.83
L_2-7Al	5.7/1	3.97	12.11	2.29	16.61

An analysis of the data reveals that the preliminary processes, followed by pre-mordanting and dyeing, induce a decrease of the breaking strength of 100% wool yarns by approx. 20% in the case of classical treatment and by 16% in the case of enzyme treatment. Breaking elongation is not negatively influenced, and it has values that are higher for both variants of treatment, compared to the value obtained for raw yarns. For wool-Angora mohair blended yarns it is a fact that enzyme treatment is much more aggressive compared to the classical one, leading to much lower values of the breaking strength, compared to the raw witness yarns, the decreases reaching up to 40%.

The analysis of alkali solubility values shown in Table 3, for variants of 100% wool yarns subjected to classical pre-treatment (variant L_1-1Al) or enzyme pre-treatment (variant L_2-1Al), pre-mordanted and naturally dyed, reveals a slight increase of the value of this parameter, compared to the one obtained for raw yarns. The values obtained indicate the formation of new bonds, respectively the modification of wool fibre configuration, without partial solubilisation of the molecular chains. It is known that an index of alkali solubility above 20 % indicates a break of disulphide bonds.

For wool-Angora mohair blended yarns subjected to enzyme pre-treatment, pre-mordanted and naturally dyed (variant L_2-7Al) the values obtained for alkali solubility are higher compared to classical treatment (variant L_1-7Al). This behavior can be explained by the labile character and high reactivity of Angora mohair fibre components of the yarn to the chemical agents, compared to the wool fibre. The Angora mohair fibre has a less ordered cortical structure, which is made of *ortho* and heterotype para (*ortho*$\rightarrow$*para* transition cells) randomly distributed, in contrast with wool, which has a highly orientated bilateral structure (*para* and *ortho*-cortical cells) [8-9]. This explains the higher values of alkali solubility and the lower values of breaking strength of wool-Angora mohair blended yarns, compared to the variants of 100% wool yarns similarly treated.

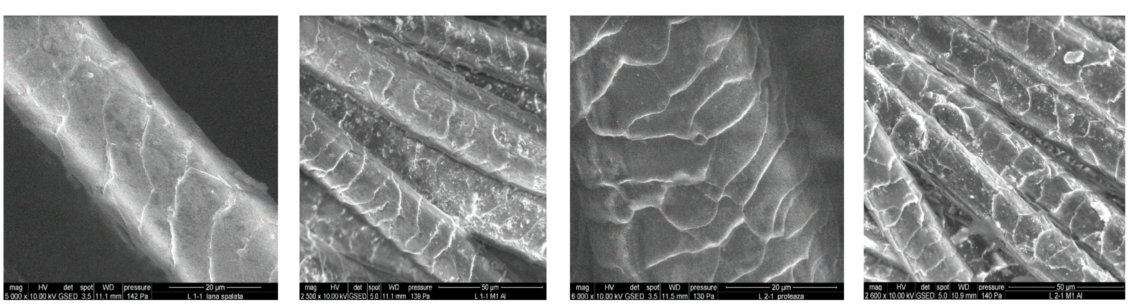
The values of colour fastness when 100% wool yarns and wool-Angora mohair blended yarns are dyed with *Allium Cepa* infusions, being pre-mordanted with potassium alum are shown in Table 4. From the point of view of colour change in the washing solution and colour staining on the multifibre standard, the colour fastness to washing is generally good, with 4/4-5 rating. A comparison of the dyed yarns from the standpoint of fibrous blend reveals a decrease of the fastness to washing of wool-Angora mohair blended yarns compared to the 100% wool yarns, irrespective of the preliminary treatment method applied, thus evidencing a lower fixation of the natural dye on the Angora mohair fibre. Dyeing fastness to acid or alkaline perspiration are good and very good for all the variants of treatment applied, the rating obtained for both colour change and colour staining on the multifibre standard are between 4-5/5. Colour fastness to light is poor, for all the variants experimented. The pre-mordanting treatment with potassium alum did not influence positively the colour fastness to light of *Allium Cepa* natural dye.

Table 4: *The colour fastness obtained for 100% wool yarns and for 70% wool-30% Angora mohair blended yarns dyed with Allium Cepa infusion*

Code	Colour fastness												
	Washing, 40ºC				Acid perspiration pH=5.5				Alkaline perspiration pH=8				Light 50ºC, RH 45% 50 h
	Change in colour	Staining			Change in colour	Staining			Change in colour	Staining			
		CO	PA	WO		CO	PA	WO		CO	PA	WO	
L_1-1	4-5	4-5	5	5	5	4-5	5	5	5	4-5	5	5	2-3
L_2-1	4-5	4-5	4-5	5	5	4-5	5	5	5	4-5	4-5	5	1-2
L_1-1Al	4-5	4	4	4-5	4	4-5	5	5	4-5	4-5	4-5	5	2-3
L_2-1Al	4-5	4	4-5	4-5	4	4-5	5	5	4-5	4-5	5	5	2-3
L_1-7Al	4	4	4	4	4-5	4-5	5	5	4-5	4-5	5	5	2
L_2-7Al	4-5	4	4	4	4-5	4-5	5	5	4-5	4-5	4-5	4-5	2

Observations: Evaluation on grey scale: *rating 5- very good fastness; rating 4/4-5-good fastness; rating 3/3-4-moderate fastness; rating 2/2-3-low fastness; rating 1/1-2-very low fastness;* ***Evaluation on a blue scale:*** *rating 8-exceptional fastness; rating 7-excellent fastness; rating 6-very good fastness; rating 5 good fastness; rating 4-acceptable fastness; rating 3- moderate fastness; rating 2- low fastness; rating 1-very low fastness*

The electron microscopy images obtained at various resolutions, for variants of 100 % wool yarns subjected to classical or enzyme preliminary treatment, followed by pre-mordanting with potassium alum and dyeing with *Allium Cepa* infusion are presented in Figure 1. The analysis of electronic images recorded on 100% wool yarns that were subjected to preliminary enzyme treatment reveals the presence of erosion area of wool fibre scales, differentiated from one part of the surface to the other, with rare spacings and detachments of the scales from the fibre body. Wool fibers that compose the yarn, having been pre-treated according to the classical variant have a smooth aspect, with intact scaled cuticle layer and do not present any degradation.



a. b. c. d.

Fig. 1: *Electronic images obtained for: a- L_1-1, b- L_1-1Al, c- L_2-1, d.- L_2-1Al*

4. CONCLUSIONS

This study presents some aspects of the influence of enzyme preliminary treatment with protease, pre-mordanting with potassium alum and natural dyeing with aqueous extract of *Allium Cepa* have on the tinctorial capacity and characteristics of 100% wool yarns and of 70% wool/30% Angora mohair blended yarns. Colour measurements have evidenced an increase of the tinctorial affinity to *Allium Cepa* natural dye of wool fibre subjected to preliminary enzyme treatment followed by pre-mordanting. In the case of wool-Angora mohair blended yarns that were subjected to enzyme treatment and pre-mordanting, the tinctorial affinity to natural dye does not improve, which is an evidence that protease acts predominantly on the scaled cuticle layer of the wool fibre and is not efficient on the Angora mohair component of the yarn. Preliminary processes applied either in the classical or in the enzyme variant and followed by pre-mordanting and dyeing induce a decrease by up to 20% of the breaking strength of 100% wool yarns, while they do not negatively influence the breaking elongation values. The values of alkali solubility indicate the formation of new bonds, respectively the modification of wool fibre configuration, without partial solubilisation of molecule chains. In the case of wool-Angora mohair blended yarns there is evidence that the enzyme treatment is much more aggressive in comparison with the classical one, leading to higher values of alkali solubility and to lower values of breaking strength (decrease by 40% compared to the raw witness yarns). This behaviour can be explained by the labile character and high reactivity specific to Angora mohair fibres that compose the yarn, due to a less ordered cortical structure, in contrast with the wool, which has a highly ordered bilateral structure. Colour fastnesses to washing, acid and alkaline perspiration are good and very good, for all the variants of treatment applied, the ratings obtained for both colour change and colour staining on the multifibre standard ranging between 4/4-5/5. Colour fastnesses to light are low for all the experimented variants. Pre-mordanting with potassium alum has not positively influenced the colour fastness to light in the case of *Allium Cepa* natural dye. Electron microscopy has allowed the evaluation of the effects of preliminary enzyme treatment and of natural dyeing on the state of the scaled cuticle layer of wool fibres, evidencing erosion areas of wool fibre scales, with rare spacings and detachments from the fibre body. Microscopic images have not evidenced areas of degradation of the cortical layer of wool fibres or of the fibrils exposure areas.

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SPIDER SILK

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Abstract: *The strengthness and toughness of spider fiber and its multifunctinal nature is only surpassed in some cases by synthetic high performance fibers. In the world of natural fibers, spider silk has been long time reconized as a wonder fiber for its unique combination of high strength and rupture elongation. Scientists in civil military engineering reveal that the power of biological material (spider silk) lies in the geometric configuration of strctural protein, and the small cluster of week hydrogen bonds that works toghethter to rezist force and dissipate energy. Each spider and each type of silk has a set of mechanical properties optimised for their biological function. Most silks, in particular deagline silk, have exceptional mechanical properties. They exhibit a unique combination of high tensile strength and extensibility (ductility). This enables a silk fiber to absorb a lot of energy before breaking (toughness, the area under a stress- strain curve). A frequent mistake made in the mainstream media is to confuse strength and toughness when comparing silk to other materials. As shown below in detail, weight for weight, silk is stronger than steel, but not as strong as Kevlar. Silk is,however, tougher than both.This paper inform about overwiew on the today trend in the world of spider silk.*

Key words: *Spider silk, combined strength and toughness, artificial muscle, metalized spider fiber*

1. INTRODUCTION

Spider silk is un natural material wich has been in the attention of the scientist for along time because its proprieties.Spider silk is a protein fiber spun by spiders. Spiders use their silk to make webs or other structures, wich function as nets to catch other animals, or as nests or cocoons for protection foe their offspring. All spiders produce silks, and a single spider can produce up to seven different types of silk for different uses. Spider silk may be used for a number of different ecological uses, each with properties to meci the function of the silk. [1]

2. GENERAL INFORMATION

Spider silk is five times as strong as steel. Scientists have discovered why spider webs are able to withstand huge forceswithout breaking. Ti fiind aut how much force spider webs can stand, scientists tested real spider webs and ran computer simulations. They found that some spider webs can withstand hurricane-force winds. Spider webs have are incredible. Spider web material is about onetenth the diameter of a human hair, but it has incredible strength. In fact, it is ten times stronger than a steel strand of the same weight.[1]

Spide webs have a very complex design. The way the web is built means that if a singlestrand of web breaks, the strength of the web actually increases.

Spider silk can react differently to different types of forces. If a light wind blow on the web, the silk softnes and become more flexible. The spider web can blow in the breeze without breaking. If a larger force is applied to one part of web, the silk in that part of the web becomes stiff and one or two threads break. The rest of the web stays intact.[1]

The spiders needs strong silk because it take a lot of energy to built a web. If only a couple ofthreads break, the spider dosen`t have to start building a whole web from scratch. Also, spiders need their webs to catch food. Instead, the web is flexible enough to stretch when an insect lands in it, strong enough not to break andstiky enough to trap the insect.[1]

In spite of the progress made in the last years by polimeric fibers and technologies, the seargh for a toughest and strongest fiber continues. The remarkable proprieties of spider fiber and the progress in biotechnology incresed the interest in using this as the future high quality fiber. However there are production problems. Spiders are difficult to be domesticated and forced to produce silk.

So all over world scientists are trying to make other creature to produce „spider silk". The stucture makes this lightweight natural material as strog as steel or even the Kevlar. Spider sik is a protein. Spiders make webs or other structures functining as catching nets or nest for protection for offsprings.[1, 2] A spider produced several types of fiber for different porposes but in a bigger colonies appears canibalic problems. There are studies about spider silk properties and production by Kaplan, Gosline, Viney, Volrath, Lazaris and Jin. This paper is a overwiew on the today trend in the world of spider silk.[3]

3. MECANICAL PROPERTIES

Some comparative properties (diameter off spider drag line silk in comrparing to other textile fibers) are shown in Table.1 [4]

Table 1: *Diameter of Spider Silk and Other Reference Fibers [4]*

	Liner Density(tex)	Diameter Mean value (micron)	Coeff.Variation %
Spider Silk	0.014	3.57	14.8
B.mori Silk	0.117	12.9	24.8
Merino Wool	0.674	25.5	25.6
Polyester	0.192	13.3	2.4
Nailon 6	0.235	16.2	3.1
Kevlar 29	0.215	13.8	6.1
Kevlar 49	0.315	13.4	6.2

For example drag line is betwee 3-4 micons in diameter and the cribellate silk was found as fine as 0.03 microns.

Spider silk is unusually strong, resilientand elastic fiber protein that is only surpassed by syntetic fibers. Table 2 [3] compares some selected properties of silk fibers. They have an unbeatible capacity for absorbing energy also known as resilience. This property makes silk fibers attractive for aplication with big energy absorbtion.

Table 2*: Average Values of Mechanical Properties* [3]

FIBER TYPE	DENSITY (g/cm^3)	MODULUS OF ELASTICITY (GPa)	TENSILE STRENGHT (GPa)	BREACKING STRAIN (%)	RESILIENCE ($M3/m^3$)
Spider Silk Argiope trifasciata	1,3	1-10	1,2	30	100
Spider Silk Nephila clavipes	1,3	1-10	1,8	30	130
Silkworm silk	1,3	5	0,6	12	50
Nylon 6,6	1,1	5	0,9	18	80
Kevlar 49	1,4	130	3,6	3	50
PBO	1,6	270	5,8	3	70
Steel	7,8	200	3,0	2	6

Mecanical properties of silk fibers are dependent not only on protein composition but also on spinning process, wich proceed in an aqueous environment. [5] The search for a biological role of supercontraction, possibly in combination with stretching le dto the consideration that the proccesing of the fiber is a situation in wich the fiber would be naturally subjected to both effects.

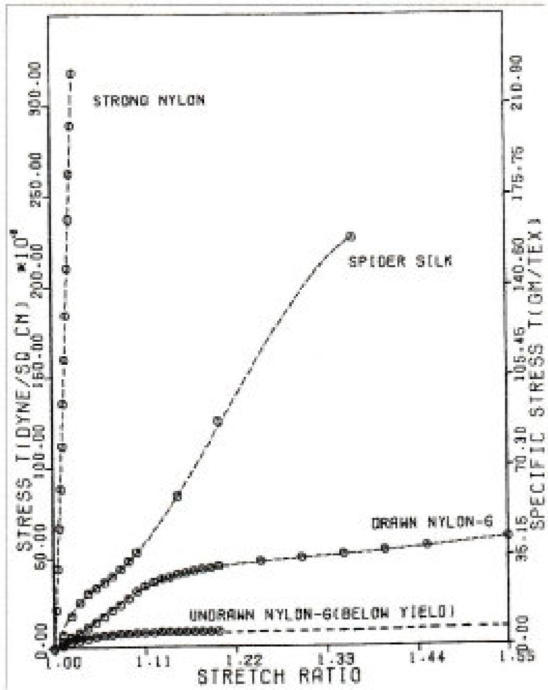

Fig. 1: *Tensile Stress-Strain Curve of Spider Silk and other Polyamide Fibers [4]*

The stress-strain curve of spider silk assumes a sigmoidal shape similar tot hat of an elastomer, demonstrating a well balance of strenght and elongation. [1], [6] The material properties of spider silk are different from specimen to specimen, according tothe ambient and wet conditions

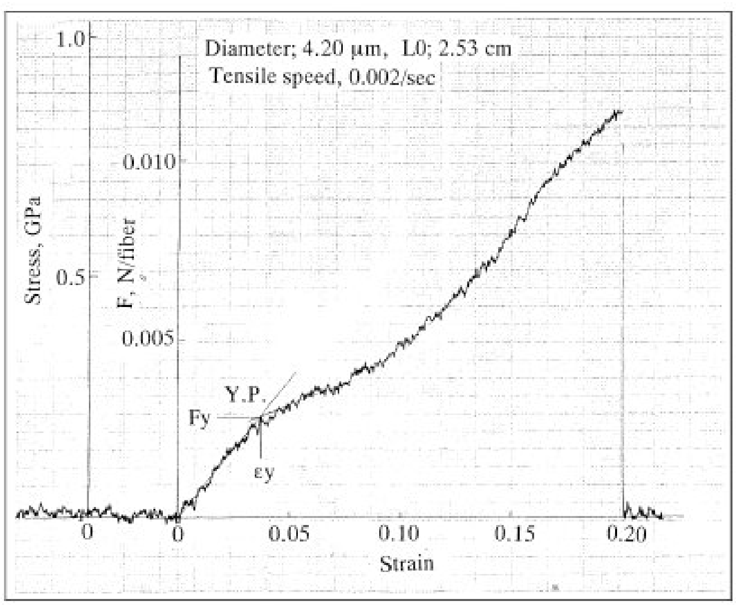

Fig. 2*: Tensile property of Single Fiber [1]*

The spinning process can be carried aut in air or under water producing silk having a wide range of properties and extreme fineness, from 0,01-4 μm. Spider silk is very durable and can resist degradation of environment. [1], [7]

4. CONCLUSIONS

The spider silk is used for a very longtime. It is very interesting that in the years 1920 there was a company in Timisoara that made women stocking of spider silk. Today the mass production is ready for a new begining. There are more possibilities: developing elemental technologies for making microorganisms produce fiber of spider silk, modifying silk worms for spider fiber or even genetically manipuleted goats for spider silk. Soon solving the problem of production costs spider silk will be used in large categories: military, clothes, Kevlar substitute or even artificial muscles. [1,2]

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STUDY REGARDING THE INFLUENCE OF THE BIOSCOURING TREATMENT IN ULTRASOUND ON 60 % COTTON + 40 % HEMP MATERIALS
PART I. STUDY REGARDING THE OPTIMIZATION OF THE BIOSCOURING TREATMENT

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Abstract: *The paper presents the optimization of the Bioscouring treatment in ultrasound on 60 % cotton + 40 % hemp materials, using the commercial product SERA ZYME C-PE (Roglyr Eco 183), based on 5-15 % Pectate Lyase (E.C.4.2.2.2). In order to assess more accurately the influence of some process parameters of the BIOSCORING treatment in ultrasound of 40 % hemp + 60 % cotton blended fabric - the concentration of enzyme (%) and treatment time (minutes) – on the weight loss, a mathematical modeling of the process was made, using a central compound rotatable program with two independent variables. The Bioscouring treatment was performed in ultrasound under the following conditions: (1-3 %) SERA ZYME C-PE (ROGLYR ECO 183) – Pectate Lyase; 2 mL/L HEPTOL NWS – sequestrant agent which have a binding role for the metal ions in water with high hardness, regardless of temperature; 2 mL/L SULFOLEN 148 - wetting and scouring agent; 10 % of the fleet of treatment was buffer (0.1 Molar sodium phosphate/disodium phosphate, pH = 7.5); liquid to fabric ratio - H 10:1, at temperature T = 55 ^{0}C and time - t = (20-60) minutes. Using the data obtained by measuring the weight loss, the optimum working parameters for the Bioscouring treatment in ultrasound with commercial enzyme SERA ZYME C-PE (ROGLYR ECO 183) were determined.*

Key words: *cotton, hemp, enzymes, bioscouring treatment with ultrasound, weight loss.*

1. INTRODUCTION

The Bioscouring treatment consists into eliminating natural attendants of the cotton and hemp fiber (non-cellulosic substances) using pectinases [1, 2]. For the enzymatic procedure the treatment with the commercial product SERA ZYME C-PE (Roglyr Eco 183), based on 5-15 % Pectate Lyase (E.C.4.2.2.2) in phosphate buffer solution of 0.1 Molar monosodium/disodium phosphate (pH = 7.5) was experimented. For all the experiments the ultrasound energy was used.

2. EXPERIMANTAL PART

For the research, 60 % cotton + 40 % hemp blended fabrics were used, with the following characteristics: width 120 ± 3 cm, weight 220 ± 10 g/m2, warp sett 200 ± 10 fibers/10cm, weft sett 170 ± 10 fibers/10 cm. The Bioscouring treatment was performed in ultrasound under the following conditions: (1-3 %) SERA ZYME C-PE (ROGLYR ECO 183) – Pectate Lyase; 2 mL/L HEPTOL NWS – sequestrant agent which have a binding role for the metal ions in water with high hardness, regardless of temperature; 2 mL/L SULFOLEN 148 - wetting and scouring agent; 10 % of the fleet of treatment was buffer (0.1 Molar sodium phosphate/disodium phosphate, pH = 7.5); liquid to fabric ratio - H 10:1, at temperature T = 55 ^{0}C and time - t = (20-60) minutes [1]. After a series of preliminary determinations, to achieve a minimum number of experiments, these were conducted using a central, rotatable second order compound program with two independent variables [3, 4]. The variation limits and experimental plan are presented in Tables 1 and 2.

Table 1: *The variation limits of independent variables*

Value. code / Real value	-1,414	-1	0	1	+1,414
x - enzyme concentration (% compared to fiber)	1	1,7	2	2,7	3
y - time (minutes)	20	34	40	54	60

Table 2: *The experimental plan with two independent variables*

Exp. No.	x	y
1.	-1	-1
2.	1	-1
3.	-1	1
4.	1	1
5.	-1.414	0
6.	1,414	0
7.	0	-1,414
8.	0	1,414
9.	0	0
10.	0	0
11.	0	0
12.	0	0
13.	0	0

3. RESULTS AND DISCUSSIONS

Experimental matrix and the measured values of the response function are shown in Table 3:

Table 3: *Experimental matrix and the measured values of the response function*

Exp. No.	Independent variables				Answers
	x		y		x
	x (cod.)	x (real) Enzyme concentration [%]	y (cod.)	y (real) Time [minutes]	(Y) Weight loss [%]
1.	-1	1.70	-1	34.00	3.09
2.	1	2.70	-1	34.00	2.98
3.	-1	1.70	1	54.00	3.40
4.	1	2.70	1	54.00	2.46
5.	-1.414	1.00	0	40.00	2.34
6.	1.414	3.00	0	40.00	3.39
7.	0	2.00	-1.414	20.00	2.74
8.	0	2.00	1.414	60.00	3.00
9.	0	2.00	0	40.00	3.11
10.	0	2.00	0	40.00	3.12
11.	0	2.00	0	40.00	2.90
12.	0	2.00	0	40.00	2.97
13.	0	2.00	0	40.00	3.10

3.1. Mathematical model interpretation obtained

In order to assess more accurately the influence of some process parameters of the BIOSCORING treatment in ultrasound of 40 % hemp + 60 % cotton blended fabric - the concentration of enzyme (%) and treatment time (minutes) – on the weight loss, a mathematical modeling of the process was made, using a central compound rotatable program with two independent variables**.**

The two chosen independent variables are:

x - the concentration of enzyme [%];

y - time (minutes).

As goal-function the weight loss (%) (denoted by Y) was chosen.

Enzyme concentration varies between 1-3 % and the treatment time between 20 - 60 minutes.

The second order central compound rotatable program has the following mathematical expression:

$$Y = b_0 + b_1x + b_2y + b_{12}xy + b_{11}x^2 + b_{22}y^2 \quad \textbf{(1)}$$

For the experimental data a program in Mathcad Professional and Excel was used, and a regression equation was obtained [3, 4, 5, 6]. The regression equation coefficients are presented in Table 4.

Table 4: *Regression equation coefficients, dispersion and the verification of the significance of the dispersion equation coefficients using the Student test*

Regression equation coefficients		Calculated dispersion "S"	Verification of the coefficients significance using Student test $t_T=t_{\alpha,\nu} = t_{0,05;6} = 2,132$ (If tc> t_T-term is significant)		
b0	3.040693	S=0.217896	tc0	1543.499	significant
b1	0.054338		tc1	44.13198	significant
b2	0.019705		tc2	16.00406	significant
b11	-0.05697		tc11	-40.2236	significant
b22	-0.05447		tc22	-38.4577	significant
b12	-0.2075		tc12	-84.264	significant

The regression equation obtained after eliminating insignificant coefficients is:

$$F(x.y) = 3.040 + (0.054)x + (0.019)y + (-0.056)x^2 + (-0.054)y^2 +(-0.207)xy \quad \textbf{(2)}$$

3.1.1. Verification of the coefficients significance

Verifying the significance of coefficients is important because it can confirm or invalidate the created model. The Student test compares the average of a random variable with mean standard deviation. For the central part of the program, in which all independent variables have zero code value the dispersion "S" is calculated. The dispersion value was shown in Table 4.

The significance of the regression equation coefficients was tested using Student test with critical table value for the test $t_{\alpha,\nu} = t_{0,05;6} = 2,132$. The test values and the significance of the coefficients were presented in Table 4.

3.1.2Verification of the model adequacy

The appropriate model was verified using Fisher test and percentage deviation.The deviations values are shown in Table 5.

To verify the model adequacy and its ability to express the studied phenomenon mathematical, the Y_{calc} values were calculated and the deviation "A" between the measured and calculated values was established according to Table 5. It can be observed that some of the individual deviations do not fit within the limits imposed by ± 10 %, which indicates a poor adequacy of the model.

Table 5: *Adequacy calculation model*

No.	Y meas	Ycalc.	(Ymas. – Ycalc.)^2	Deviation "A"	Average square of residuals "PMrez"	Dispersion of reproducibility "S_0^2"	Ratio Fc = PMrez / S_0^2	Statistics Fc<F'c $F'_c = F_{\nu1, \nu2, \alpha} = F_{5;5;0,01}$= 6,59	Fisher test Fc>Ft $Ft=F_{\nu1, \nu2, \alpha} = F_{12;12;0,05}$ = 2,69
1.	3.09	2.647	0.19562	14.313				Fc=22.121	Fc= 1.262914
2.	2.98	3.171	0.03662	-6.422					
3.	3.4	3.102	0.08873	8.761					
4.	2.46	2.795	0.11275	-13.649					

5.	2.34	2.849	0.26004	-21.792	0.9109	0.00985	22.121	22.121 >6,59 In-appropriate model	1.262914 <2,69 In-appropriate model
6.	3.39	3.003	0.14929	11.397					
7.	2.74	2.903	0.02686	-5.982					
8.	3	2.959	0.00162	1.345					
9.	3.11	3.040	0.00480	2.228					
10.	3.12	3.040	0.00628	2.541					
11.	2.9	3.040	0.01979	-4.851					
12.	2.97	3.040	0.00499	-2.380					
13.	3.1	3.040	0.00351	1.913					

The degree of concordance of the mathematical model was verified using F'_c statistics. Initially the average square of residuals PM_{rez} and the reproducibility of dispersion S_0^2 were calculated, obtaining the values shown in Table 5. The ratio $Fc = PMrez/S_0^2$ was compared with the critical value $F'_c = F_{\nu 1,\, \nu 2,\, \alpha} = F_{5;5;0,01} = 6{,}59$.

To verify deviation of the survey data from the mean value the Fisher-Snedecor test was used. F_c = 29.20031 calculated value is greater than the critical value $F_c = F_{\alpha\,,\, \nu 1,\, \nu 2} = F_{0,05\,;\,12,\,4} = 5{,}91$ which indicates that the deviations appear due to experimental errors.

The approximation quality of the mathematical model expressed by the standard error shows the scattering of the experimental values around the regression equation: 36.07 %.

The correlation coefficient has the value: r_{x1x2}= -0.11241, r_{x1y} = 0.1552379 and r_{x2z} = -0.0562956. The significance of the simple correlation coefficients is checked using the Student test. The calculated values are: tc $_{x1y}$= 0.521184, tc $_{x2y}$= 0.187008, tc $_{x1x2}$ = -0.3752093.

The calculated values are lower than the critical table value $t_{\alpha,\, \nu}=t_{0,05;\, 11} = 2{,}201$ for t_{x1y} and t_{x2y} which indicates that there is a relationship between variables, t_{x1x2} = -0.3752093 so there is some correlation between independent variables.

The square of the correlation coefficient $R^2 = R_{xY}$ is called coefficient of determination and expresses that part of the variation of variable Y which can be attributed to variable x.

The multiple determination coefficient 0.20818 shows that the influence of the two independent variables on the outcome is 20.81 %, the rest being caused by other factors.

The obtained models scans are viewed geometric as hyper-surfaces in three-dimensional space of independent variables. The hyper-surface represents the response of the model; because the extreme points (maximum, minimum) of the hyper-surfaces present technological interest their exact location is searched or at least knowledge about the shape of the surface in the extreme field neighboring. The surface can be cut by planes of type *y=ct,* resulting response contours. The response interpretation and search of extremes are more difficult and it preferred to bring the surface into a form more accessible for the analysis using canonical transformation. Allowing a much easier localization of the extreme, the canonical transformation can be seen as an optimization method.

The canonical analysis transforms the regression equation in a more simple form and interprets the resulting expression using geometric concepts:

$$F(x.y) = 3.040 + (0.054)x + (0.019)y + (-0.056)x^2 + (-0.054)y^2 +(-0.207)xy \qquad \textbf{(3)}$$

The canonical form of regression equation and the new center has the coordinate's axes: $x = -0.062$, $y = -0.294$. Value of the dependent variable in the center of the response surface is: $yc = 3.041$.

The coefficients of the canonical form were calculated and the equation which resulted is:

$$y = 3.041 -0.158\, z_1^2 + 0.048\, z_2^2 \qquad \textbf{(4)}$$

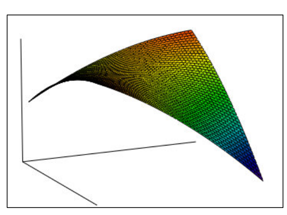

Fig. 1: *The dependence of the goal-function on the independent variables:*
(x – enzyme concentration and y – treatment time)

Figure 1 presents the plot which shows the dependence of the goal-function on the two independent variables. The response surface of the regression equation is a hyperbolic paraboloid, the canonical equation coefficients having different signs. The metric invariant of changing coordinates is different from 0, so there is a single center, of type "saddle".

The constant level curves obtained by cutting the response surface with constant level plans presented in Figure 2 allows the evaluation of the dependent variable *Y*, according to the conditions imposed by the independent variables *x* and *y*.

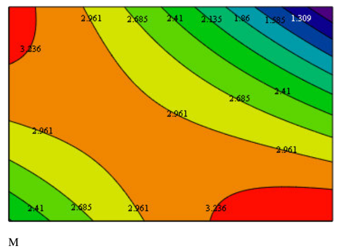

Fig. 2: *Contour curves for various values of Y (weight loss)*

Figure 2 presents contour curves for various values of weight loss, 2.34 to 3.40 between. On the response surface from figure 2 which is type "saddle" form, a stationary point of coordinates $x = -0{,}062$ and $y = 0{,}294$ can be observed. These encoded coordinates are associated with an enzyme concentration of 1.9 % (o.w.f) and a treatment time of 44 minutes. The value of the goal-function at this point is $Y = 3.041$.

3.2 Interpretation of the obtained mathematical model technology

By analyzing the expression of the obtained goal function:

$$F(x.y) = 3.040 + (0.054)x + (0.019)y + (-0.056)x^2 + (-0.054)y^2 +(-0.207)xy \qquad \mathbf{(5)}$$

these can be seen:

- the influence of the two independent parameters, *x* (enzyme concentration) and *y* (treatment time) on the dependent variable *Y* (weight loss) manifests in the same way. Both variables *x* (enzyme concentration) and *y* (treatment time) directly influence the outcome *Y* (weight loss);
- the influence of variable *x* (enzyme concentration), on *Y* (weight loss) is 1.44 %;
- the influence of variable y (treatment time), on *Y* (weight loss) is 0.62 %;
- the existence of quadratic form for both parameters indicates that the response surface defined by the obtained mathematical model, is well formed, reinforcing the hypothesis regarding the influence of both parameters on the outcome;
- the ratio between the coefficients of the quadratic and free term quantifies the speed of *Y* (weight loss) outcome change variation to the variation of the two parameters; variables *x* (enzyme concentration) influences with 1.51 % the outcome function and *y* variable (time of treatment) influences with 1.44 % respectively;
- the influence of the interaction of the two parameters on the dependent variable is 6.80 %.

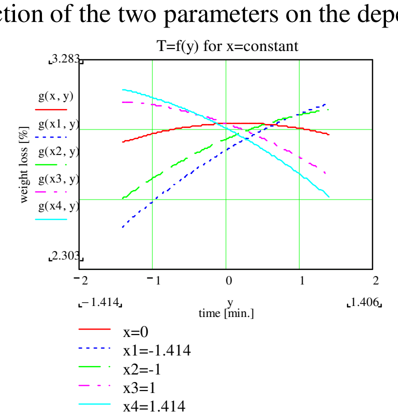

Fig. 3: *The dependence of the goal-function on all significant values of y parameters for x = constant*

Figure 3 shows the dependence of the goal-function on one of the two independent variables for all significant values of the parameters, given that the second independent variable is constant. It can be observed how, for a constant value of enzyme concentration, the graph representing the variation of weight loss versus time, indicates for the interval [–1414, 0], (between 20–40 minutes) an increasing in weight loss and the existence of a maxim point around 44 minutes, which indicates a big influence of this parameter on the weight loss, and for the interval [1, 1414] (between 54–60 minutes) it can be seen that with time increasing, the weight loss decrease.

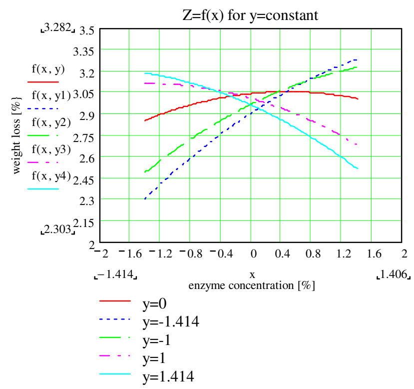

Fig. 4: *The dependence of the goal-function on all significant values of x parameters for y = constant*

Figure 4 shows the dependence of the goal-function of one of the two variables for all significant values of the parameters, given that the second one is constant. From the graph it can be seen how the enzyme concentration is influencing the weight loss, as the curves have not similar forms. For the interval [–1414, 0] the weight loss increases with the increasing of enzyme concentration, and for the interval [1, 1414] weight loss decreases with the increase of the enzymes concentration. By analyzing the graph it can be observed that conducting the experiment with small values for variable y (for 20–34 minutes) there is an increase in weight loss with the increasing of enzyme concentration. Conducting the experiment with high values for the variable y (for 54–60 minutes) it can be observed a decreasing of the weight loss with the increasing of enzyme concentration.

4. CONCLUSIONS

The optimum parameters established by this optimisation are:
- Enzyme concentration – 1.9 %;
- Treatment time – 44 minutes.

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STUDY REGARDING THE INFLUENCE OF THE BIOSCOURING TREATMENT IN ULTRASOUND ON 60 % COTTON + 40 % HEMP MATERIALS PART II. STUDY REGARDING THE INFLUENCE OF BIOSCOURING TREATMENT FOLLOWED BY A WHITENING TREATMENT USING VARIOUS METHODS

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Abstract: *This study shows a comparative characterization of whitening treatment using various processes for 60 % cotton +40 % hemp materials scoured by Bioscouring treatment in ultrasound described in our previous work. The results of the extraction of noncellulosic impurities using the Bioscouring treatment was expressed as weight loss, hydrophilicity. Some of these bio-scoured samples were whitened using various procedures: Classical procedure with hydrogen peroxide (30%), with catalyst and with laccase enzyme. By whitening procedure, the double bonds from chromophore groups of natural pigments from cotton and hemp are destroyed by oxidation reactions, the Π electrons being those responsible for the yellow color of the fabrics.*
In order to characterize the quality of the enzymatic pretreatment compared to the classical one, the values of the degree of white were studied after different type of bleaching (hydrogen peroxide, catalyst and laccase) for the samples treated with the same concentration of enzyme SERA ZYME C-PE (ROGLYR ECO 183) - Pectate Lyase.
For comparing the degradation occurred during the enzymatic preatreatment of cellulosic fabrics, before and after bleaching with enzymes, catalyst and classical method, measurements of the tensile strength and elongation at break for the treated 60 % cotton +40 % hemp material, were performed.

Key words: *cotton, hemp, bioscouring treatment with ultrasound, weight loss, whitening, whiteness degree.*

1. INTRODUCTION

After the Bioscouring treatment the material becomes much cleaner with higher absorbent properties (hydrophilic). By whitening procedure, the double bonds from chromophore groups of natural pigments from cotton and hemp are destroyed by oxidation reactions, the Π electrons being those responsible for the yellow color of the fabrics. Whitening can be done using several methods, such as classical method with peroxide or enzymatic method with different type of enzymes.

2. EXPERIMENTAL PART

Researches were carried out using fabrics treated using the method Bioscouring presented in the first part. The Bioscouring treatment was performed in the presence of ultrasounds, under following conditions: (1-3%) SERA ZYME C-PE (ROGLYR ECO 183) - Pectate Lyase, 2 mL/L HEPTOL NWS - sequestering agent with the role to bind the metal ions in water with high hardness regardless of temperature; 2 mL/L SULFOLEN 148 - wetting and scouring agent; 10 % of the fleet treatment was buffer (0.1 molar sodium dihydrogen phosphate/disodium hydrogen phosphate, pH 7.5); fabric to liquid ratio – H- 1:10, at temperature T = 55 ^{0}C and time "t" between 20-60 minutes [1].

The bleaching treatments applied to the scoured samples were carried out under the following conditions: [2, 3]

- *Classical procedure*: 3 mL/L hydrogen peroxide (30%) + 1 g/L NaOH + 4.5 mL/L sodium silicate; fabric to liquid ratio – H - 1:20; Temperature = 90-95 ^{0}C (in ultrasounds only 80 ^{0}C); time = 40 min.

- *Procedure with catalyst*: 3 mL/L of catalyst solution prepared from 1 g of catalyst + 1.5 mL 30 % hydrogen peroxide); fabric to liquid ratio – H - 1:20; Temperature = 60 ^{0}C; time = 40 min.

- *Procedure with laccase enzyme*: 3% o.w.f. (over fiber) commercial Laccase - Lava Zyme LAC, wich is a suitable enzyme for bleaching of cellulosic materials + buffer 0,1 molar acetic acid/sodium acetate (pH = 5); fabric to liquid ratio – H - 1:20; Temperature = 60 ^{0}C; time = 40 min.

The properties of 60 % cotton + 40 % hemp materials bioscoured according to the experimental program [4] presented in the first part are presented in Table 1.

Table 1: *The properties of cotton 60 % + hemp 40 % materials after the Bioscouring treatment*

Samples	Enzyme concentration (%)	Weight loss (%)	Hydrophilicity (s)	Degree of white R (%)
1	1.70	3.09	6	46.20
2	2.70	2.98	3	45.33
3	1.70	3.40	8	46.23
4	2.70	2.46	7	46.05
5	1.00	2.34	5	44.55
6	3.00	3.39	3	46.48
7	2.00	2.74	3	45.90
8	2.00	3.00	9	47.53
9	2.00	3.11	5	45.43
10	2.00	3.12	8	45.45
11	2.00	2.90	7	44.75
12	2.00	2.97	8	44.80
13	2.00	3.10	6	46.48
Blank				43.63

In order to characterize the quality of the enzymatic pretreatment compared to the classical one, the values of the degree of white were studied after different type of bleaching (hydrogen peroxide, catalyst and laccase) for the samples treated with the same concentration of enzyme SERA ZYME C-PE (ROGLYR ECO 183) - Pectate Lyase.

The results of the extraction of noncellulosic impurities using the Bioscouring treatment expressed as weight loss, hydrophilicity and degree of white, obtained by different bleaching treatments are shown in Table 2.

Table 2: *Comparative characterization of bleaching treatments on the scoured samples using the Bioscouring treatment with Pectate Lyase*

No.	Samples	Type of bleaching	Weight loss (%)	Hydrophilicity (seconds)	Degree of white R (%)	Observations
1.	Blank	-	-	-	43.63	Extraction with Pectat Lyase shows a lower weight loss compared with the samples treated with catalyst or laccase. The degree of white obtained after the classical treatment is higher than that obtained after the other
2.	10	Classical: Fabric to liquid ratio H = 1:20 Temperature = 90-95^{0}C (in ultrasounds only 80 ^{0}C) time = 40 min 3 mL/L H_2O (30 %) 1 g/L NaOH 4.5 mL/L Na_2SiO_3	0.99	2	64.73	
3.	11	With Catalyst:	1,91	2	46.45	

		Fabric to liquid ratio H = 1:20 Temperature = 60 ^{0}C time = 40 min 3 mL/L of the catalyst (solution prepared from 1 g catalyst + 1.5 mL 30% hydrogen peroxide)				treatments
4.	12	With laccase Fabric to liquid ratio H = 1:20 Temperature = 60 ^{0}C pH = 5 - 0.1 molar buffer solution of acetic acid / sodium acetate time = 40 min 3% o.w.f. Laccase (Lava Zyme LAC) soluble enzyme for bleaching cellulosic materials	2,72	2	46.75	Extraction with Pectat Lyase shows a lower weight loss compared with the samples treated with catalyst or laccase. The degree of white obtained after the classical treatment is higher than that obtained after the other treatments
5.	13	Control Fabric to liquid ratio H = 1:20 Temperature = 60 ^{0}C time = 40 min	0.40	2	47.48	

In order to compare the degradation occurred during the enzymatic preatreatment of cellulosic fabrics, before and after bleaching with enzymes, catalyst and classical method, measurements of the tensile strength and elongation at break for the treated 60 % cotton +40 % hemp material, were performed [5]

Table 3 summarizes the results of these measurements.

Table 3: *Determination of material degradation after enzymatic pretreatment*

No.	Pretreatment type	Tensile strength [N]	Elongation at break [%]	Observations
1.	Classical	364.1	15.2	The degradation evidenced by measurements of the tensile strength and elongation at break is 16.9 % after the treatment with catalysts, 15.2 % after the treatment using the classical method and 14.5 % after the treatment with laccase
2.	Catalyst	344	16.9	
3.	Laccase	373.3	14.5	
4.	Control	360.8	15	
5.	Blank	302.9	8.9	

3. CONCLUSIONS

During the researches carried out in this study it was found out that:

- The sample treated with enzyme Pectate Lyase shows a lower weight loss than the sample treated with catalyst or laccase enzyme.
- The degree of white obtained after the classical treatment is higher than the degree of white obtained after the other treatments.
- The degradation evidenced by measurements of the tensile strength and elongation at break is higher after the treatment with catalysts, followed by the classical treatment then the treatment with laccase.

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COLOR STABILITY OF NATURALLY DYED DENIM FABRICS

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Abstract: *The desire to colour textiles is as old as spinning and weaving. Natural dyes have been used since thousands of years for their long endurance, soft and elegant colours. But the invention of synthetic dyes has limited the application of natural dyes. The health hazards associated with the use of synthetic dyes and also the increased environmental awareness have revived the use of natural dyes during the recent years. The major performance characteristic of a dye is its ability to maintain the colour in normal use and is known as colorfastness. The study provides information regarding colourfastness properties of naturally dyed denim fabrics. Three vegetable materials were used for dyeing denim fabrics: Punica granatum (bark powder), Indigofera tinctoria (leave powder) and Juglans regia (walnut dried shells). The results of the study indicated that using Walnut shells and Punica granatum deeper and more stable shades of colors are obtained in comparison with Indigofera Tinctoria dyed denim samples. All samples highlight a change in color in the sense of fading which has occurred to the highest extent when exposed to artificial light and washing. When tested against water, alkaline and acid perspiration, it is noticed that better results are obtained, and color change appear in a smaller extent.*

Key words: *vegetable dyes, denim, color fastness, efficiency, fading*

1. INTRODUCTION

People never stopped adding colour to their life, starting from the clothes they wear, the cosmetics they apply on their face and the way they dye their hair. Colour is a reflection of our mood, feelings and personality. Today, dyeing is a complex, specialized science. Nearly all dyestuffs are now produced from synthetic compounds. This means that costs have been greatly reduced and certain application and wear characteristics have been greatly enhanced. Synthetic dyes are being used in all commercial applications. Large amounts of water are used to flush conventional synthetic dyes from garments and then this waste water must be treated to remove the heavy metals and other toxic chemicals before they can be returned to water systems. [1]

European regulations are more stringent in terms of dye environmental impacts. Many countries are rich in natural and renewable resources and they often have expertise on how to produce and process these resources in a sustainable way. The economy should have only to realize that abundant dye sources are just around us and finding another valuable use for these plants coupled with appropriate technology can encourage more people to conserve these resources. Although the Earth possesses large plant resources, only little has been exploited so far. More detailed studies and scientific investigations are needed to assess the real potential and availability of natural dye-yielding resources. Almost all parts of the plants produce dyes. It is interesting to note that over 2000 pigments are synthesized by various parts of plants, of which only about 150 have been commercially exploited [2].

In developing countries with a textile tradition, natural dyeing is still practised, but only as a handcraft. Recently, a number of commercial dyers have started looking at the possibilities to overcome environmental pollution caused by the synthetic dyes, by replacing them with natural dyes. Natural dyes produce soft shades as compared to synthetic dyes. In spite of the better performance at multiple washing, recently the potential use of natural dyes on textile materials has been attracting more and more scientist to study the natural alternative for dyeing due to the following reasons:

- wide spread of natural dyes sources and huge potential
- available experimental evidence for allergic and toxic effects of synthetic dyes
- available information on different natural colorants, including methods for their extraction and purification.

Technology for production of natural dyes could vary from simple aqueous extraction to complicated solvent systems or to sophisticated supercritical fluid extraction techniques, depending on the product and purity required. Purification may consist in filtration or reverse osmosis or preparatory HPLC, and drying of the product may be obtained by spray or under vacuum or using a freeze-drying technique.

For successful commercial use of natural dyes, appropriate scientific techniques need to be established by scientific studies on dyeing methods, dyeing kinetics and compatibility of selective natural dyes, in order to obtain shades with acceptable colour fastness behavior and reproducible colour yield [3].

In the last few decades, denim garments has gained popularity unimaginable for those who initially wore it for protection, rather than for fashion. Denim has become a wardrobe staple. Fit, comfort and price are the most important factors affecting the purchase of denim jeans. Due to longer life span of jeans, the denim industry continues to hold an advantageous position over other types of apparel [4]. In 2010, Greenpeace published a report denouncing the pollution caused by the denim industry [5]. Apart from conventional cotton production, which can be one of the most water-consuming industries, the report was also critical of jeans laundry, printing and dyeing processes, which involve high water usage and heavy toxic metals such as cadmium, lead, copper and mercury. A renewed international interest has arisen in natural dyes due to increased awareness of the environmental and health hazards associated with the synthesis, processing and use of synthetic dyes [6]. Most of the natural dyes have no substantivity for the fiber and are required to be used in conjunction with mordants. A mordant, usually a metallic salt, is regarded as a chemical, which will be fixed on the fiber and which will attach the dyestuff. A link is formed in this way between the fiber and the dye [7]. In general, textile fibres can allow the adherence of the dyes in their structures as a result of van der Waals forces, hydrogen bonds and hydrophobic interactions (physical adsorption). The uptake of the dye into the fibres depends on the nature of the dye and its chemical constituents. The strongest dye-fibre attachment is a result of a covalent bond with an additional electrostatic interaction where the dye ion and fibre have opposite charges [8].

2. EXPERIMENTAL PART

The textile production companies consider two options to overcome the ecological impact of finishing procesess: the high-tech wastewater treatment solution, which involves high implementation costs and the alternative of making the dyeing process more eco-friendly by using dyes obtained from renewable resources. Considering the latest option, MODAZEN Company started to gain interest on using natural dyes within the industrial denim garment production. For this reason MODAZEN INC initiated VEGDENIM project, financed through ERANET CROSSTEXNET Programme.

In the last ten years, the demand for natural dyes and the interests generated by them has been going hand in hand with fashion trends. Colours obtained with vegetable dyes are warm and have particular nuances. Nevertheless they have two problems that are the same of the industry: color fastness and reproducibility.

Colour fastness means the resistance of the colour when exposed to different procedures textiles may suffer during manufacture and use. Denim garments are dyed in aqueous solutions of dyestuffs, together with dyebath additives such as salt, alkali, acids and other auxiliary chemicals. The dyestuff must first be absorbed onto the fibre surface and then diffuse into its interior.

In the present work, vegetable materials of *Indigofera tinctoria* (leaves powder), *Punica granatum* (pomegranate bark powder) and *Juglans* (walnut shells) were used to dye denim fabrics at optimized dyeing conditions and the resulted colour fastness of the dyed samples was evaluated (colour fastness to washing, acid & alkaline perspiration and light).

Known natural destructive agents for vegetable dyes are light, moisture, oxygen and other atmospheric gases which can lead to fading. Most dyes are organic compounds, therefore are sensitive to the action of destructive agents.

For evaluation of naturally dyed denim fabrics, the following tests were performed:

- color fastness to washing, according to SR EN ISO 105 C06: 2010

- color fastness to acid perspiration, according to SR EN ISO 105 E04: 2013
- color fastness to alkaline perspiration, according to SR EN ISO 105 E04: 2013
- color fastness to water, according to SR EN ISO 105 E01: 2013
- color fastness to artificial light, according to SR EN ISO 105 B02: 2003

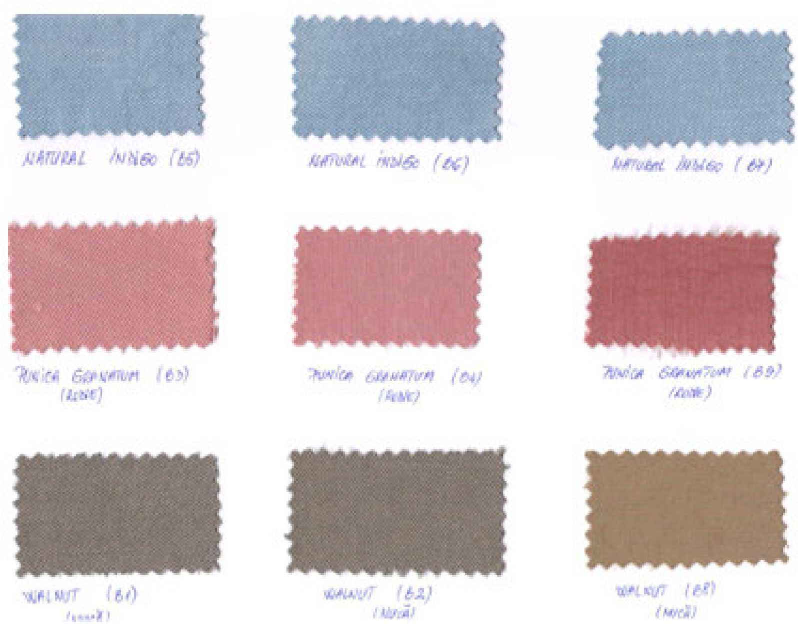
Materials used:

- Denim naturally dyed samples, dyed with extracts of pomegranate, walnut and indigo – supplied by MODAZEN INC (dyeing process is protected by a pattent owned by the project coordinator)
- Adjacent multi-fiber, purchased from James Heal, England
- ECE Detergent with phosphate, without optical brighteners, purchased from James Heal, England

Testing equipments used during evaluation:

- Scourotester – for washing fastness
- Memmert oven – for water and perspiration fastness
- Xenotest Appolo – for light fastness
- Hunterlab – used for measuring color change

A number of 9 denim samples dyed with vegetable natural dyes prepared by MODAZEN INC. were tested by INCDTP in order to evaluate their colour fastness properties. Preliminary chemical and physical–mechanical tests were performed in order to characterize the denim garments.



Picture 1: *Naturally dyed denim samples*

3. RESULTS AND DISCUSSIONS

The results of physical-mechanical tests suggested that different base materials were used during preliminary dyeing procedures:

Table 1: *Physical-mechanical test results*

Test / Applicable standard		Sample code								
		B1	B2	B3	B4	B5	B6	B7	B8	B9
1.	Weight per unit area (g/m^2)	400	395	397	341	381	386	384	349	343

2.	Thickness (mm)	0.84	0.84	0.84	0.75	0.84	0.84	0.85	0.73	0.85
3.	Density – warp (no. yarns/10 cm)	368	363	366	552	363	364	361	502	447
	Density – weft (no. yarns/10 cm)	224	221	219	273	219	218	220	276	283
4.	Breaking force (N) warp	1647	1554	1607	1678	1685	1756	1792	1433	1184
	Breaking force (N) weft	1146	1133	1018	626	1200	1333	1240	765	778
5.	Alongation at breaking (%) warp	32.7	31.8	38.5	27.9	29.1	29.0	28.8	26.2	31.3
	Alongation at breaking (%) weft	18.58	17.7	20.1	12.2	17.73	18.56	18.22	13.25	12.2
6.	Tear resistance (N) warp	60.4	58.3	56.3	30.3	40.1	40.5	39.7	28.9	55.8
	Tear resistance (N) weft	57.8	55.5	44.5	18.49	29.5	32.1	28.5	20.9	31.7
7.	Air permeability (mm/sec)	24.84	25.76	29.32	19.52	30.54	30.26	29.10	17.56	17.06

The change in color has been made by visual assessment, using the grey scale from James Heal, and confirmed by instrumental analysis. Grades according to ISO 105 A02 have been atributed to each tested sample. An interpretation of the attributed grades:
1 = Poor durability of the colour
2 = Moderate durability of the colour
3 = Good durability of the colour
4 = Very good durability of the colour
5 = Excellent durability of the colour

Table 2: *Colour fastness test results*

No. crt.	Color fastness test	**Walnut shells**			**Natural Indigo**			**Punica granatum**		
		B1	B2	B8	B5	B6	B7	B3	B4	B9
1.	Washing	1-2	1-2	1-2	2	3-4	3	1-2	1	1
2.	Acid perspiration	4-5	4	4-5	3	4-5	4-5	3	2-3	3
3.	Alkaline perspiration	4-5	4	4-5	2-3	4-5	4-5	4	4	4
4.	Water	4-5	4	5	2-3	4-5	4-5	3-4	4-5	4-5
5.	Light	1	1	1	1	1	1	1	1	1

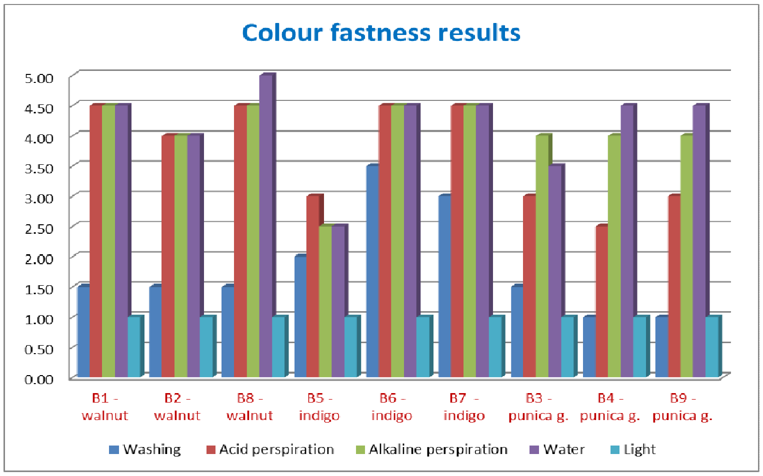


Fig. 1: *Graphic representation of colour fastness results*

As it can be seen, the greatest modification of the colour has occured in the case of the following tests: colour fastness to light and colour fastness to washing. Acceptable results have been obtained for color fastness to water and perspiration in the case of using walnut shells and indigo dye.

Table 3: *L*a*b* values obtained for naturally dyed denim samples*

Sample:	**B1 - Walnut shells**			**B5 - Natural Indigo**			**B3 - Punica granatum**		
Parameter:	L*	a*	b*	L*	a*	b*	L*	a*	b*
Reference value:	55.07	1.11	7.34	69.99	-2.96	-11.16	65.34	17.98	4.35
Washing	62.90	-0.77	3.31	76.94	-2.46	-7.02	74.55	13.15	2.62
Acid perspiration	56.38	0.80	7.55	74.25	-2.84	-8.44	68.30	16.72	7.70
Alkaline perspiration	56.27	0.90	7.04	74.62	-2.60	-8.12	66.64	17.37	5.07
Water	55.52	0.94	6.58	75.02	-2.85	-7.12	67.18	17.10	4.25
Light	78.34	-0.43	4.57	88.71	-2.11	7.19	85.05	5.77	5.96
Sample:	**B2 - Walnut shells**			**B6 - Natural Indigo**			**B4 - Punica granatum**		
Parameter:	L*	a*	b*	L*	a*	b*	L*	a*	b*
Reference value:	54.84	0.87	6.89	70.00	-3.02	-11.38	64.19	18.48	4.96
Washing	63.63	-0.61	3.66	72.67	-2.56	-11.39	75.25	10.64	7.22
Acid perspiration	56.83	1.19	8.07	70.88	-2.70	-11.64	68.88	16.74	8.22
Alkaline perspiration	56.14	0.99	7.11	71.14	-2.72	-11.51	65.81	17.75	5.85
Water	55.98	1.00	6.68	69.56	-2.82	-11.95	64.24	18.03	5.32
Light	78.55	-0.32	4.54	88.12	-2.21	6.07	82.14	6.12	6.43
Sample:	**B8 - Walnut shells**			**B7 - Natural Indigo**			**B9 - Punica granatum**		
Reference value:	L*	a*	b*	L*	a*	b*	L*	a*	b*
Initial value:	58.52	3.22	17.29	71.38	-3.13	-11.04	55.09	21.84	8.89
Washing	65.18	2.22	16.74	73.59	-2.33	-11.03	66.10	19.37	8.59
Acid perspiration	59.15	3.66	17.88	71.03	-2.58	-11.44	58.55	19.37	8.59
Alkaline perspiration	58.08	3.87	18.58	71.01	-2.68	-11.67	57.80	20.14	6.98
Water	58.70	3.49	17.16	71.47	-2.56	-11.10	56.24	20.36	6.77
Light	70.52	1.03	13.64	88.22	-2.09	6.55	80.45	7.79	8.33

Analyzing the data obtained it can be seen that all the saples have been losing saturation, samples luminosity has increased and the shade was altered. The data obtained through visual assessment was confirmed: the most significant fading was observed in the case of samples submitted to washing and to artificial light for denim garments dyed with natural indigo, followed by Punica Granatum. The best results obtained were noticed in the case of using walnut shells.

4. CONCLUSIONS

Many producers are also realising that low consumption and more careful and efficient use of water, energy and raw materials bring benefits to their performance. There is clear evidence that opportunities exist for optimizing the use of natural resources, while simultaneously creating opportunities for cost savings and increased competitiveness. Textile industry is continuously searching for new technologies in order to accomplish the consumer's demands. In recent years, there has been a revival of the use of dyes and colors of natural origin for coloring textile products. This increasing demand for the material with natural origin is because of the health hazards attributed to some of the synthetic dyes.

Natural dyes are subjected to more destructive agents who can fade significantly the color of a naturally dyed product. Considering the low affinity for natural dyes specific for cotton fibers used within traditional denim garments, the purpose of this study was to assess the fastness properties of the preliminary samples obtained by MODAZEN INC within Crosstexnet EraNet Project - VEGDENIM.

Laboratory tests were performed, according to specific standardized methods. The visual assessment of the samples subjected to different treatments was confirmed instrumental results. All samples highlight a change in colour in the sense of fading, which has occurred to the highest extent at exposure to artificial light and washing. Slightly fading has been observed also for the other performed tests, but to a much smaller extent. As a conclusion generated from the information gathered so far: colour fastnesses of denim naturally dyed samples are generally poor. Optimization of the dyeing procedure is necessary.

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SYMMETRY CLASSIFICATION OF THE DECORATING PATTERNS OF FABRICS IN GREECE

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Abstract: *The systematic science is based on the categorization of determined repeated units. These units give us the possibility of systematic observation of phenomena and description of their regularity. Many tried they interpret the particularities of these units, as code information or indicators of national identity. The categorization of symmetry, regarding to the placement of patterns more generally, leads in repeated description. It is realized that the patterns, are placed in not accidental forms, from the artists of concrete cultural unit. It is an important tool, with regard to in the organization and in the objective presentation of these cultural particularities. In the present statement become study and classification of textile patterns of various geographic regions of Greece, via their symmetric provisions. The comparison of results provides precious material that concerns the cultural influences that accept the various patterns per region. As well as from the historical and geographic data that practice influence in each region. The contact of the local population with populations outside the borders of Greece, resulted in the increase of the imagination and this is reflected directly in the symmetries used, as the decorative elements are met represent a considerable complication. The colors, the designs, the motifs are used at Epirus could be characterized as Doric, contrary to the stitches of the islands that someone would think that they were reflect their daily life, as they are simpler and more playful.*

Key words: *categorization of symmetry, placement of patterns, design, fundamental unit, arrangement*

1. INTRODUCTION

"Pattern is born when one reproduces the intuitively perceived essence" (Soetsu Yanaki). Human psychology leads us to create repeating patterns of geometrical shapes. Through history there have been numerous applications of patterns to woven fabrics, furniture and buildings as well as many other items of everyday use. Subdivision of two-dimensioned space has generally one major purpose: to be pleasing to the eye.

2. SYMMETRY

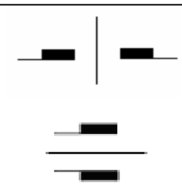
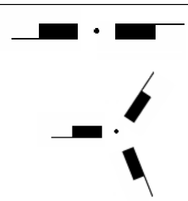
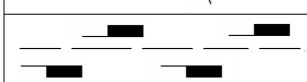
Symmetry is everywhere in our lives and demands our attention. It overwhelms human activity, from decorative design and textiles, to architecture and advertising logos. Field and Golubitsky considered symmetry to be "the accurate correspondence of the form and the element arrangement on the opposite sides of a dividing line or plane or around a centre or an axis." [1] Symmetry can be thought as one of the most basic geometrical concepts. [2] Mathematicians may consider it simply as a motion in the two-dimensional plane. A symmetric figure is any figure which is comprised of more than one identical part. Symmetry may provide a connecting link among the different scientific fields. Hence, harmony and proportion may help in the connection of seemingly different scientific fields. Symmetry provides a different perspective from which the whole world can be unified.[3]

3. THE BASIC SYMMETRY OPERATIONS

Regular repeating patterns are characterized by the repetition of a motif (fundamental unit) at regular intervals. The process of symmetry analysis begins by identifying the fundamental part of the design, which is the part from which the whole pattern is generated. In other words, the smallest element required to explain the repetition forming the pattern. The area enclosing this smaller element is known as the “fundamental region”.

In symmetry analysis the first requirement is to identify the fundamental unit, while the next step includes the determination of the motion by which, when that part is repeated in one or two directions, it forms the whole design. If a design is composed of only one non repeated fundamental part, it is called “**asymmetrical”.** Put simply, asymmetry may be either the absence of symmetry in a design or is the characteristic of a fundamental unit. [4] A motif or a design may be asymmetrical or symmetrical. A symmetrical motif is a figure which includes two or more parts of identical size, shape and content. A simple design commonly consists of arrangements of one or more elements. In more complex designs the conspicuous or seemingly significant parts are groups of elements. Usually there is expected symmetry, but sometimes that expectation is not met. This is called symmetry breaking. In nature and art, symmetry is imperfect. However we treat it as ideal. It seems that this approximation deceives the mind while it pleases the eye. [5] However, it is a common fact that symmetry in a design gives a pleasing effect of balance and order, with an aspect of intrigue and enchantment. Through these, their geometric characteristics and properties may be examined. [6]

Table 1: *Symmetry classes and kinds of motion involved in producing different design patterns from the fundamental part illustrated [3]*

	**Fundamental part**	
Pattern	Motion	
	Translation	Rigid motion with repetition along a line
	Bilateral symmetry (or mirror reflection) -vertical -horizontal	Rigid motion with repetition across a line
	Rotation (point) -b-fold -multiple (3-fold)	Rigid motion with repetition around a point
	Glide reflection (translation & mirror reflection)	Rigid motion with reflected repetition along a line

Classification and design analysis according to symmetry group entails a thorough examination of underlying structure. The repetition of the motif of a design has limitless possibilities, and can be either asymmetrical or symmetrical. In point of fact, symmetry describes how the fundamental units of a design are combined and placed in the plane in order to form a pattern. This affects only one basic parameter of the design and that is its structure. Basically there are four kinds of movement, and consequently four classes of symmetry may be defined:

- translation
- bilateral or reflection
- rotation
- and glide reflection [7]

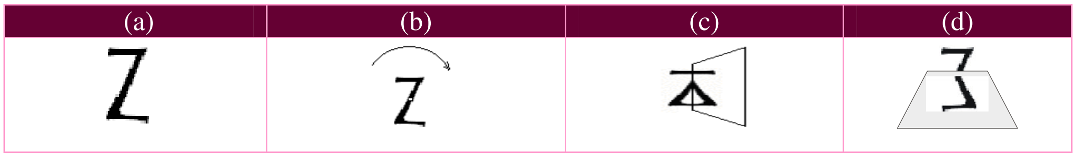


Fig. 1. *The letter z is a typical example of 2-fold rotational symmetry in letters. It can be rotated around its roto-cetre at an angle of 180^0. However, it doesn't present any reflectional symmetry, either vertical or horizontal ((c), (d)).[8]*

3.1. Symmetry Classification of Motifs in Greek Region

The motif arrangements which are found in Greek traditional art can be in woodcarvings, mosaics, ceramics, woven fabrics, stamped fabrics and embroideries. The design forms of each locality are based entirely on tradition. They are formed during eras or at places influenced by certain human or geographic particularities. Thus, the arrangements can be classified as: lowland, mountainous and insular.

The decoration of the embroideries, relatively to the arrangement, is controlled by human intelligence. It can be circular, dimensional, vertical or to both directions. As for the color and theme, in combination with the stitch type, the variety is so great that the researcher can determine at a glance the place of origin. It is expectable that at each region are select symmetrical arrangements which express the certain place of origin. In the present research, the symmetrical arrangements of certain geographical areas of Greece - the Ionian Islands, the Dodecanese, the Cyclades, and Mainland of Greece and Epirus – are analyzed and compared. The results are listed below.

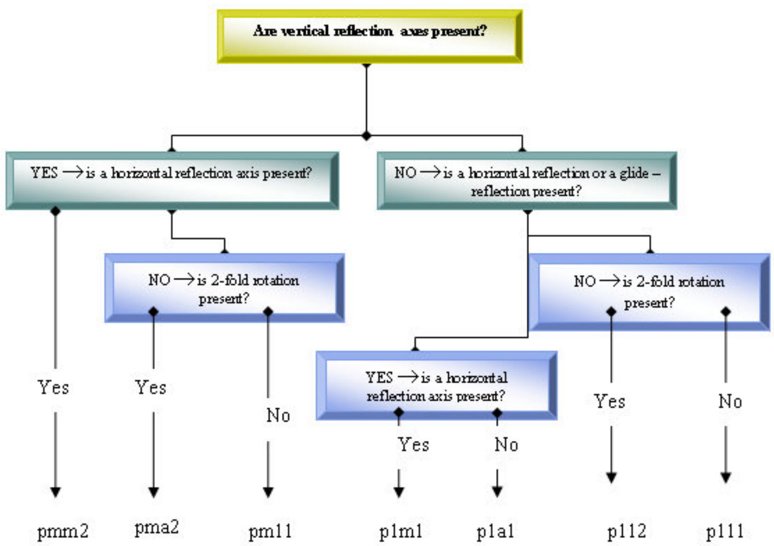


Diagram 1- *Classification methodology*

The method used for the classification of the decorative motif, is applied according to the universal bibliographic sources, using the above mentioned questionnaire. [4] The logic is based on the detection of the axes of symmetry that may exist in the arrangement of motifs and the potential centers of rotation. [3]

Regarding the area of the Ionian Islands, a total of 74 designs from the local weaving and embroidery art were analyzed. The results are presented in the table and the histogram that follows:

Table 2. *Area of the Ionian Islands- design arrangements*

Symmetry classification	**Number of patterns**	**Percentage %**
pmm2	20	27.03
p1a1	3	4.05
p111	12	16.22
pm11	29	39.19
pma1	7	9.46
p112	1	1.35
p1m1	2	2.7

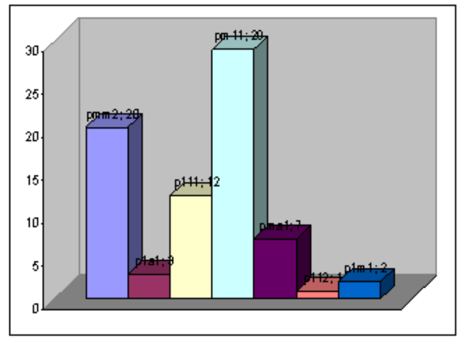


Fig. 2. *Area of the Ionian Islands- design arrangements*

Due to the number of islands and their specificities, there is a great variety and many variations of designs. A feature of the Dodecanese islands is the Byzantium residents, which continued to be used in daily life for several years, until today. A typical example is the costume of Simi, which resembles fairly to the Byzantine one. The lifestyle of the inhabitants of these islands is reflected in the folk art objects. A part of folk art is embroideries and costumes. Imports from other areas due to trade, affect a variety of designs. From the area of the Dodecanese 158 projects were analyzed, which can be categorized as follows:

Table 3. *Area of the Dodecanese- design arrangements*

Symmetry classification	**Number of patterns**	**Percentage %**
pmm2	30	18.99
p1a1	5	3.16
p111	28	17.72
pm11	80	50.63
pma1	13	8.23
p112	1	0.63
p1m1	1	0.63

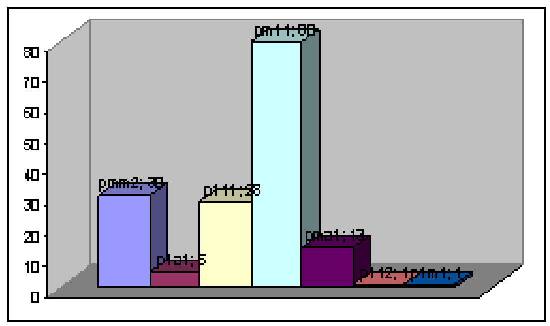


Fig. 3. *Area of the Dodecanese-design arrangements*

It is observed that the arrangements of the designs do not follow a wide variety of movements. The basic movements are the vertical shifting and reflection and double reflection.

The West side of the Mainland of Greece, as a folklore section, is not limited to the conventional administrative boundaries of Aitoloakarnania and Evrytania, but it is spread over a wider area to the northwest and east. The northern and eastern part is par excellence, highland and inaccessible areas with mountains, full of firs, and in any case cold climate. Hills and high peaks in dense order, create deep canyons that leave very little space for small valleys. Because, of the above mentioned geographic particularity, the everyday life is very difficult.

The remaining space presents a completely opposite scene, as it has the great privilege of being by the sea. The economy of this place has always been sustained by the two primitive professions, namely agriculture and animal stockbreeding, as they were the determinants of advancement. The slow pace at which evolution took place had as counterbalance, the spread of immutable traditional elements of folklore.

Regarding the region of Epirus, and the Western mainland, a total of 122 projects from local weaving art were analyzed. From the results given in the table and the histogram below, the following conclusions may be extracted:

Table 4. *Area of west side of the Mainland-design arrangements*

Symmetry classification	**Number of patterns**	**Percentage %**
pmm2	9	5,69
p1a1	17	10,76
p111	35	22,15
pm11	1	0,63
pma1	0	0
p112	2	1,26
p1m1	58	36,71

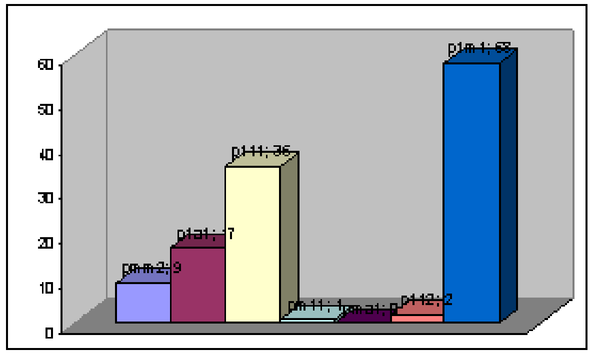


Fig. 4. *Area of west side of the Mainland-design arrangements*

In these locations there is no rotation of the basic pattern. The simple horizontal reflection or shifting and the shifting reflection, are the main categories which most of the pattern arrangements of the samples taken off this geographical region were classified. The designs follow in such a way the psychism and the robustness, which characterize the identity of their creators.

Observing the table and the histogram, there is a great variety of ways the motifs "move" in the arrangement. The main bulk lies in arrangements by shifting, reflection, reflection and double reflection combined with rotation. The rotational motion and the great variety are due to Western influences and the geographical and cultural characteristics of the region.

Comparing the representations of the embroideries, with those of Central Greece and Epirus it is noticed that they use different colors. It could be said, accurately, that they are more light, more positive, while the subjects used outside the plant and animal kingdom are directly related to the sea.

Regarding Epirus, 124 design arrangements were examined. The results are given in the following table:

Table 5. *Area of the Epirus- design arrangements*

Symmetry classification	**Number of patterns**	**Percentage %**
pmm2	26	16,45
p1a1	11	6,96
p111	35	22,15
pm11	1	0,63
pma1	5	3,16
p112	11	6,96
p1m1	34	21,52

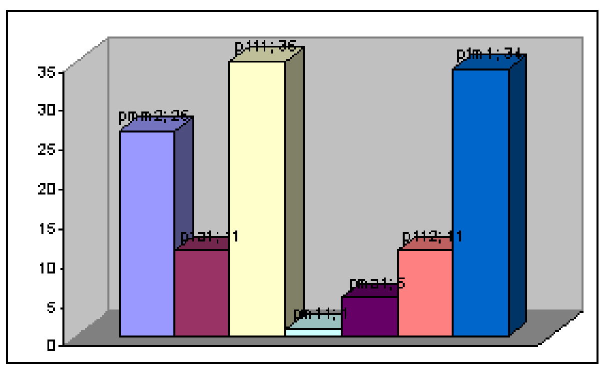


Fig. 5. *Area of the Epirus-design arrangements*

Observing the above mentioned data, it is obvious that the classification of patterns which come from Cyclades, exhibit the greatest dispersion. Shifting, horizontal and double reflection and rotation is of the most widespread movements. Typical examples of this style are given below, together with the codes.

4. CONCLUSIONS

The geographical and geological characteristics affect the psychism of the habitants and thus the tradition and costume style. It wouldn't be unreasonable to say that all these differences are influenced by the local environment, both geographically and culturally. The final form of every pattern layout consist the reflection of the conditions governing the historical memories of each place.

Socio-economic, geographic, climatic, etc. conditions, interactions, and positive production, the purchase of materials for construction, modulates the so called form.

Therefore, the following conclusions can be extracted: The decorative patterns used in the regions of Western Mainland and Central Epirus, show little variety of symmetries. About 50% of the patterns are classified to the pmm2 category, while the distribution of decorative motifs in the other categories, is quite limited. Essentially, the symmetries used are quite strict. The arrangement of the patterns is done under specific rules and repetitions. This coincides with what is known about the region of Central Mainland and Epirus. The decorative motifs originating from these areas are stricter both in their themes and colors, as well as the symmetry that is followed.

Observing the corresponding diagrams that are reflecting the symmetries of motifs used in the Cyclades and Dodecanese islands, a broad distribution of symmetries of the used decorative motifs is noticed. The rotation of the basic structural unit of the pattern is used to a large extent, giving a lighthearted style to the final design. The reflection symmetries pmm2, although occupying a wide range of preference at the insular part of Greece, they do not have the almost exclusive use, observed at the regions of Mainland and Epirus. This fact supports that the sea life and the geographical distribution of ground, contributed to the creation of more lighthearted decorative structures and favored the existence of a big variety of designs. The contact of the local population with populations outside the borders of Greece, resulted in the increase of the imagination and this is reflected directly in the symmetries used, as the decorative elements that are met represent a considerable elaboration.

The colors, the designs and the motifs that are used at Epirus could be characterized as Doric, contrary to the stitches of the islands that someone would think that they reflect daily life, as they are simpler and more playful.

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STRESS - STRAIN CURVE ANALYSIS OF WOVEN FABRICS MADE FROM COMBED YARNS TYPE WOOL

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Abstract: *The paper analyses the tensile behaviour of woven fabrics made from 45%Wool + 55%PES used for garments. Analysis of fabric behaviour during wearing has shown that these are submitted to simple and repeated uniaxial or biaxial tensile strains. The level of these strains is often within the elastic limit, rarely going over yielding. Therefore the designer must be able to evaluate the mechanical behaviour of such fabrics in order to control the fabric behaviour in the garment.*
This evaluation is carried out based on the tensile testing, using certain indexes specific to the stress-strain curve. The paper considers an experimental matrix based on woven fabrics of different yarn counts, different or equal yarn count for warp and weft systems and different structures. The fabrics were tested using a testing machine and the results were then compared in order to determine the fabrics' tensile behaviour and the factors of influence that affect it.From the point of view of tensile testing, the woven materials having twill weave are preferable because this type of structure is characterised by higher durability and better yarn stability in the fabric. In practice, the woven material must exhibit an optimum behaviour to repeated strains, flexions and abrasions during wearing process.
The analysis of fabrics tensile properties studied by investigation of stress-strain diagrams reveals that the main factors influencing the tensile strength are: yarns fineness, technological density of those two systems of yarns and the weaving type.

Key words: *fabrics, elasticity modulus, stress-strain diagrams.*

1. INTRODUCTION

The fabric tensile properties depend on the tensile properties of the two yarn systems and the fabric structural parameters (yarn fineness, technological density of the two yarn systems and weaving type). One of the main objectives in designing a fabric is the tensile behaviour. By means of the tensile behaviour one can analyze the fabric behaviour during wearing process, as it shows that these are subjected to simple or repeated uniaxial or biaxial tensile strains. The level of these strains can be close to the ultimate tensile strength or they can have small, insignificant values; that is why the designer must anticipate the behaviour to such strains.

The complexity of reality requires, in statistical surveys, the follow-up of two directions:
- description of a population by a feature or multiple features highlighting;
- comparison between populations [1].

This can be appreciated by determining the indices inferred from the stress-strain diagram, relevant for the peculiarities of the strain process as follows [2], [3]:

– Proportionality, elasticity, yielding and breaking limits;
– Elasticity modulus for warp and weft yarns, calculated with:

$$E_{twarp} = \frac{200 \cdot F_p}{\varepsilon_p \cdot P_{weft} \cdot T_{tex}}, \text{ [N/tex]} \quad \textbf{(1)}$$

$$E_{tweft} = \frac{200 \cdot F_p}{\varepsilon_p \cdot P_{weft} \cdot T_{tex}}, \text{ [N/tex]} \quad \textbf{(2)}$$

where: F_p and ε_p – the force and elongation corresponding to the proportionality limit;

P_{warp} and P_{weft} – the fabric warp and weft density;

T_{tex} – yarn's linear density.

– Work of rupture

$$W_{warp} = f_{warp} \cdot F_{rwarp} \cdot a_{rwarp}\text{, [daN.m]} \quad \textbf{(3)}$$

$$W_{warp} = f_{warp} \cdot F_{rwarp} \cdot a_{rwarp}\text{, [daN.m]} \quad \textbf{(4)}$$

where: f_{warp} and f_{weft} – the work factor for warp and weft direction, determined on the stress strain curves;

F_{rwarp} and F_{rweft} – breaking force for warp and weft testing direction;

a_{rwarp} and a_{rweft} – fabric breaking elongation [mm] for warp and weft testing direction

– Specific work of rupture, expressed through the following relations:

$$W_{mwarp} = \frac{W_{warp}}{M \cdot b \cdot l_0}\text{, [N.m/g]} \quad \textbf{(5)}$$

$$W_{mweft} = \frac{W_{weft}}{M \cdot b \cdot l_0}\text{, [N.m/g]} \quad \textbf{(6)}$$

$$W_{swarp} = \frac{W_{warp}}{M \cdot b \cdot l_0}\text{, [N.m/m}^2\text{]} \quad \textbf{(7)}$$

$$W_{sweft} = \frac{W_{weft}}{M \cdot b \cdot l_0}\text{, [N.m/m}^2\text{]} \quad \textbf{(8)}$$

where: W_{warp} and W_{weft} – work of rupture for warp and weft direction, [N.m]; M – sample mass, [g/m2]; b – sample width, [mm]; l_0 – sample initial length, [mm], [4].

Indicators values for appreciation tensile properties of woven materials can be influenced by the creasing behavior.The creasing of woven materials made from combed yarns type wool used for ready-clothes is an undesired deformation effect with temporary or permanent character, which is caused by a composed strain of bending and compression during utilization, processing or maintenance. It is manifested by the appearance of wrinkles, folds or stripes on the surface of wovens materials, thus diminishing their qualitative appearance and also their practical value.

The quality and durability of textile/fabrics are appreciated by determining the tension properties expressed by indicators, whose variation limits differentiate themselves and depend on:

- basic structural characteristics: geometrical structure and fibrous composition of the component yarns, tie, yarn systems numbers
- structural features derived from basic structures: the degree of waving of the yarns, fabric thickness/per unit of length, area, volume;
- surface features: fabric luster appreciated through the pilling resistance or the number of bundle fibers which are analyzed quantitatively and qualitatively [5];
- processing parameters;
- finishing process parameters.

2. EXPERIMENTAL PART

2.1. MATERIALS AND METHODS

The fabric variants used for tensile testing were determined based on an experimental matrix (see Table 1) that included 3 input variables: yarn count for weft and warp system, yarn count balance between weft and warp system and fabric structure.

Table 1: *Experimental Matrix*

Variant Code	X1	X2		X3
	Yarn count balance	**Nm_{warp}**	**Nm_{weft}**	**Fabric structure**
A1		60/2	60/2	P6/66/6
A2		60/2	60/2	D2/1
A3		60/2	60/2	D2/2
A4		60/2	60/2	plain
A5		52/2	52/2	D2/2

A6	$Nm_{warp}=Nm_{weft}$	52/2	52/2	crepe
A8		52/2	52/2	D2/2
A9		52/2	52/2	D2/12/5
A10		52/2	52/2	D2/1
A12		52/2	52/2	plain
A13		52/2	52/2	P2/22/2
A14		48/2	48/2	D2/2
A16		60/2	60/2	D2/1
A7	$Nm_{warp} \neq Nm_{weft}$	52/2	52/1	D2/1
A11		52/2	30/1	D2/1
A15		64/2	37/1	plain
A17		56/2	37/1	D2/1

The basic parameters (fibre composition, linear density, technological density of the two yarn systems and weave type) have been determined for the finished fabric through classical means and standardized methods.

Processing of yarns from blended fibres is technically and economically justified by their superior workability, usability and durability obtained at convenient costs. The physical- mechanical characteristics are pre-established by choosing the components, and quantitatively by components dosing, such that the yarn corresponds to its destination.

The fibre composition of the warp and weft yarns extracted from the fabric sample has been determined through standardized methods on representative specimens, through microscopic analysis and burning test.

Structural parameters of analysed articles, determined through standardized methods are indicated in Table 2.

Table 2: *Structural parameters of analysed articles*

Variant Code	Fibrous composition	$P_{warp/weft}$ (fire/10cm)		Flotation		Fabric structure
		Warp	Weft	Warp	Weft	
A1	45%Wool70s+55%PES (1645)	330	310	6	6	P 6/6 6/6
A2		310	210	1.5	1.5	D2/1
A3		280	240	2	2	D2/2
A4		235	220	1	1	plain
A5		280	240	2	2	D2/2/
A6		260	250	1.5	1.5	crepe
A8		260	270	1.5	1.5	D2/1
A9		260	235	2	2	D2/2
A10		295	280	2.5	2.5	D 2/1 2/5
A12		265	245	1.5	1.5	D2/1
A13		280	300	1.5	1.5	D2/1
A14		210	180	1	1	plain
A16		265	250	2	2	P 2/2 2/2
A7		280	245	2	2	D2/2
A11		240	270	1	1	plain
A15		320	230	1.5	1.5	D2/1
A17		290	300	1.5	1.5	D2/1

The fabrics were made from 45%wool +55%PES yarns of different counts, as mentioned above. The fabrics were finished with specific technologies. The tensile testing was performed using an H 1K-S UTM Tinius Olsen (Hounsfield) testing machine, having 1 kN load cell. The tests were done accordingly to standard (SR EN ISO 2062, 2002), on both directions – weft and warp [6].

2.2. RESULTS AND DISCUSSIONS

The raw data for each stress-strain curve was saved for further processing. The proportionality field and breaking point was recorded for each curve. Fig. 1, Fig. 2, presents the stress-strain curve of two variants, as examples, one example for a fabric with $Nm_{warp} = Nm_{weft}$ and the other with $Nm_{warp} \neq Nm_{weft}$

The qualitative and quantitative analysis of the stress-strain curves (see Table 3) allows emphasising the following aspects: the variation intervals for tensile limits; the factors that differentiate the stress-strain curves for the studied variants - testing direction; fibrous composition; weaving draw through mean flotation of yarns; technological density of warp respective weft yarns.

The stress-strain curves were used to calculate the indicators for tensile behaviour mentioned above.

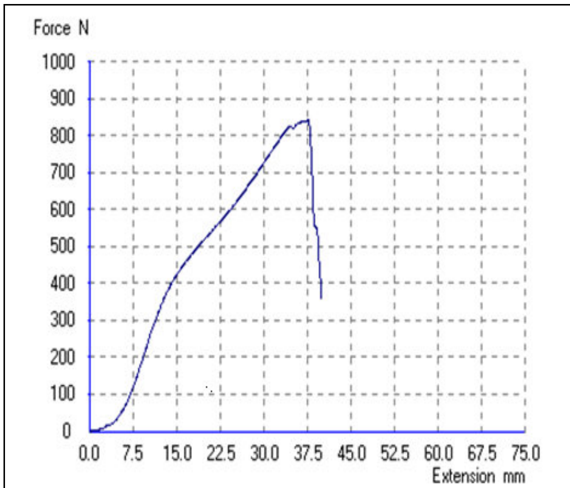

Fig. 1: *Stress-strain curves for woven fabric tested varianta A3 45%wool +55%PES (Nm_{warp} 60/2; Nm_{weft} 60/2) requested the warp direction*

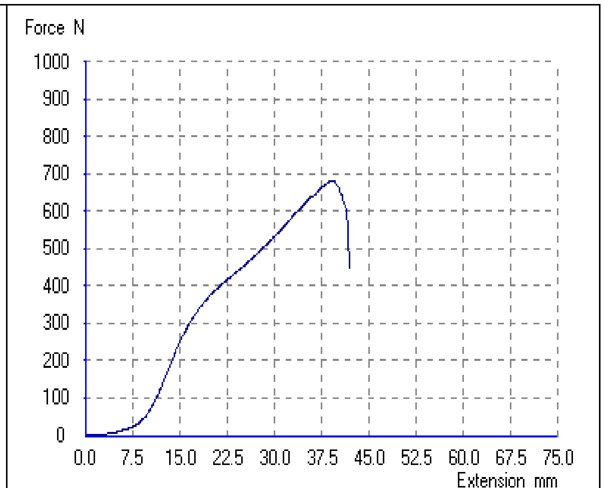

Fig.2: *Stress-strain curves for woven fabric tested varianta A3 45%wool +55%PES (Nm_{warp} 60/2; Nm_{weft} 60/2) requested the weft direction*

Table 3: *The tensile indicators for woven materials made 45%Wool + 55%PES*

Variant Code	F (daN)		ε (%)		E (cN/tex)		f_W	
	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft
A1	79.70	90.80	35.35	34.11	182.30	272.29	0.51	0.49
A2	91.20	60.40	46.42	41.39	153.35	187.41	0.50	0.48
A3	84.10	68.20	32.87	29.3	242.77	344.97	0.56	0.48
A4	64.70	62.80	31.31	27.71	222.79	270.15	0.54	0.53
A5	77.40	63.20	34.19	30.34	177.00	223.91	0.51	0.53
A6	66.60	62.90	35.28	32.25	209.22	239.84	0.53	0.52
A8	81.30	67.50	32.79	38.75	214.21	171.96	0.55	0.50
A9	75.90	65.70	36.24	30.9	231.39	253.39	0.54	0.52
A10	92.30	80.40	36.73	31.45	181.32	218.06	0.56	0.52
A12	86.00	76.40	37.44	36.49	202.98	201.33	0.51	0.51
A13	81.10	54.60	47.7	55.8	130.05	161.08	0.54	0.52
A14	77.40	60.10	41.7	39.25	210.86	190.73	0.50	0.48
A16	71.70	66.20	33.15	32.72	284.55	239.36	0.55	0.49
A7	90.00	72.50	36.77	32.11	214.45	215.18	0.54	0.48
A11	61.10	58.50	35.85	36.2	193.67	255.78	0.54	0.51
A15	80.70	53.90	40	32.04	154.32	230.39	0.56	0.54
A17	76.20	62.30	38.1	35.65	196.41	193.58	0.54	0.53

(***Table 3*** *continued*)

Variant Code	W (daN.m)		Wm (daN.m/g)		Ws (daN.m/m^2)	
	Warp	Weft	Warp	Weft	Warp	Weft
A1	1.42	1.53	1.26	1.35	284.80	306.56
A2	2.12	1.20	2.16	1.22	424.96	240.69
A3	1.55	0.95	1.35	0.83	309.86	189.88
A4	1.10	0.92	1.36	1.13	219.98	183.15
A5	1.34	1.02	1.27	0.97	268.55	204.19
A6	1.25	1.05	1.30	1.10	249.06	210.97
A8	1.46	1.30	1.45	1.29	292.61	260.91

A9	1.49	1.06	1.39	0.99	297.37	212.86
A10	1.90	1.31	1.56	1.08	379.70	262.97
A12	1.65	1.43	1.62	1.40	330.95	285.27
A13	2.09	1.58	1.80	1.37	417.79	316.85
A14	1.61	1.13	1.92	1.35	321.53	225.30
A16	1.30	1.05	1.25	1.01	261.00	210.75
A7	1.78	1.12	1.52	0.95	356.11	223.24
A11	1.18	1.08	1.54	1.41	236.57	216.01
A15	1.81	0.93	1.80	0.93	361.54	186.51
A17	1.57	1.17	1.63	1.22	313.37	234.62

The following useful observations can be drawn based on the analysis of the values from Table 2 and on their graphical representation:

- for woven fabrics with **Nm_{warp} = Nm_{weft}**

– the maximum breaking strength for warp direction has been recorded for variant **A9**, characteristics: F_{warp} = 92,30 daN, Nm_{warp} 52/2; Nm_{weft} 52/2, P_{warp} = 295 yarns/10cm; P_{weft} = 280 yarns/10cm; warp yarns twist T = 648 twists/m respective twist of weft yarns T = 637 twists/m and compound diagonal bonding $D\frac{2\ \ 2}{1\ \ 5}$. Variant **A1** has the maximum breaking strength for weft direction, F_{weft} = 90,80 daN, Nm_{warp} 60/2; Nm_{weft} 60/2, P_{warp} = 330 yarns/10cm; P_{weft} = 310 yarns/10cm; warp yarns twist T = 747 twists/m respective twist of weft yarns T = 735 twists/m and panama weave $P\frac{6\ \ 6}{6\ \ 6}$.

– the minimum breaking strength for warp direction has been recorded for variant **A4**, F_{warp} = 64,70 daN, Nm_{warp} 60/2; Nm_{weft} 60/2, P_{warp} = 235 yarns/10cm; P_{weft} = 220 yarns/10cm; warp yarns twist T = 712 twists/m; weft yarns twist T = 701 twists/m, plain weave. Variant **A16** has the minimum breaking strength for weft direction, F_{weft} = 53,90 daN, Nm_{wrap} 60/2; Nm_{weft} 60/2, P_{warp} = 320 yarns/10cm; P_{weft} = 230 yarns/10cm; warp yarns twist T = 723 twist/m; weft yarns twist T = 712 twists/m; diagonal bonding $D\frac{2}{1}/$.

- for fabric variants with **$Nm_{warp} \neq Nm_{weft}$**

– the maximum breaking strength for both testing directions has been recorded for variant **A7**, F_{warp} = 81,30 daN, F_{weft} = 67,50 daN Nm_{warp} 52/2; Nm_{weft} 52/1, P_{warp} = 260 yarns/10cm; P_{weft} = 270 yarns/10cm; warp yarns twist T = 648 twists/m and weft yarns twist T=520 twists/m; having diagonal bonding $D\frac{2}{1}/$.

– the minimum breaking strength for warp direction has been recorded for variant **A15,** F_{warp} = 61,10 daN, Nm_{warp} 64/2; Nm_{weft} 37/1, P_{warp} = 240 yarns/10cm; P_{weft} = 270 yarns/10cm; warp yarns twist T = 764 twists/m; weft yarns twist T = 596 twists/m; plain bonding. The minimum breaking strength value for weft direction has been determined for variant **A11**, F_{weft} = 54,60 daN, Nm_{warp} 52/2; Nm_{weft} 30/1, P_{warp} =280 yarns/10cm; P_{weft} = 300 yarns/10cm; warp yarns twist T = 648 twists/m; weft yarns twist T = 637 twists/m; twill weave $D\frac{2}{1}/$.

The plain weave is characterized by the smallest values of the ultimate strength, in the direction of both the warp and the weft yarns, which is justified by the fact that the evolution of the two yarn systems provides a good positional stability of yarns, these having a bigger crimp frequency. In order to point out the influence of the fabric on the tensile properties the studied variants, the bonding was expressed through mean flotation F_{warp} for warp yarns respective mean flotation F_{weft} for weft yarns.

The intersection between a warp yarn and weft yarn is called a bonding point, thus the bonding contains all bonding points having a warp or weft effect along longitudinal or transversal direction. One or more bonding points with the same effect and forming one bonding segment can exist in longitudinal or transversal direction.

3. CONCLUSIONS

Based on the analysis of the tensile behaviour determined for the fabric variants, the following general conclusions can be drawn:

1. The influence factors on tensile strength of woven materials are: yarns fineness, technological density of warp respective weft yarn systems and bonding type. The maximum values have been recorded for fabric variants having compound diagonal bonding, fundamental diagonal bonding and panama bonding due to their bigger yarn flotation (a value of 1.5; 2 or 6). Meanwhile, the minimum values have been observed for variants having plain bonding for which the flotation value is 1.

2. Elasticity modulus is bigger on warp direction owing to the smaller influence of the twist degree. The increasing of the twist degree lead to the increasing of the twist angle and decreasing of the yarn elasticity.

3. Depending on shape of the stress-strain curve, the mechanical work factor can have one from the following values: fw = 0.5 – ideal case; fw < 0.5 case in which both yarn systems manifest a reduced deformation strength; fw > 0.5 case in which both yarn systems manifest an increased deformation strength. From the experimental data results that the mechanical work factor has values over 0.5 for almost all fabric variants.

4. From the point of view of tensile testing, the woven materials having diagonal bonding are preferable because this type of structure is characterised by higher durability and better yarn stability in the fabric. In practice, the woven material must exhibit an optimum behaviour to repeated strains, flexions and abrasions during wearing process.

5. It can establish a fabric hierarchy in term of their behaviour to tensile strength based on the evaluation of the specific mechanical energy consumed to break the specimen. The value of the quality index is influenced by: the nature of the utilized raw material; adopted technological process and parameters of processing; the parameters of geometrical structure at which the product is accomplished; technology and technological finishing parameters applied to the product.

6. The woven fabrics accomplished from yarns type combed wool (blend of 45% Wool+ 55%PES) are characterized by specific structural parameters and specific aspect, as well as by their physical-mechanical properties which satisfy the requirements of a certain area of utilization (external clothing products).

The percentage of chemical fibres blended with wool fibres influences both the development of the technological process and the physical-mechanical characteristics of the fabrics. A factor that must be especially taken into account is the shrinkage, which diminishes as the polyester fibres are introduces.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

THE OPTIMIZATION OF PLUSH YARNS BULKING PROCESS

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Abstract: *This paper presents the experiments that were conducted on the installation of continuous bulking and thermofixing "SUPERBA" type TVP-2S for optimization of the plush yarns bulking process. There were considered plush yarns Nm 6.5/2, made of the fibrous blend of 50% indigenous wool sort 41 and 50% PES. In the first stage, it performs a thermal treatment with a turboprevaporizer at a temperature lower than thermofixing temperature, at atmospheric pressure, such that the plush yarns - deposed in a freely state on a belt conveyor - are uniformly bulking and contracting.*
It was followed the mathematical modeling procedure, working with a factorial program, rotatable central composite type, and two independent variables. After analyzing the parameters that have a direct influence on the bulking degree, there were selected the pre-vaporization temperature (coded x_1,^oC) and the velocity of belt inside pre-vaporizer (coded x_2, m/min). As for the dependent variable, it was chosen the plush yarn diameter (coded y, mm). There were found the coordinates of the optimal point, and then this pair of values was verified in practice. These coordinates are: x_{1optim} = 90^{o}C and x_{2optim} = 6.5 m/min. The conclusion is that the goal was accomplished: it was obtained a good cover degree for double-plush carpets by reducing the number of tufts per unit surface.

Key words: *woollen carpet, double plush technology, mathematical model, yarn diameter.*

1. INTRODUCTION

Using modern technologies and performing equipment to obtain qualitatively plush carpets *with reduced manufacturing costs* represents a priority for any trading company that has as object of activity to produce and trade carpets.

The real value of a carpet is determined by its physical and mechanical properties: carpet mass and thickness; behaviour in static and dynamic regime; resistance to friction wear; resistance to tufts pulling; charging with static electricity; soiling sensitivity; capacity of thermal and phonic insulation [1]

By analyzing the advantages and disadvantages of manufacturing technologies for mechanically woven carpets, one can conclude that double-plush weaving technology is recommended when wishing to satisfy higher and higher customers' demands from the standpoint of comfort and other utilization characteristics offered by carpet.

The tendency is to accomplish an optimal fabric cover coefficient with a reduced number of tufts per unit surface. It is therefore necessary *to increase the plush yarn volume* by various methods. The present work synthesize the experiments carried out on plush yarns Nm 6.5/2, made of the fibrous blend of 50% indigenous wool sort 41 and 50% PES. The research is unique in Romania and was done between 2009-2010 at S.C. INCOV S.A. Alba Iulia – the biggest carpet manufacturer in our country till 2014.

Bulking and thermofixing the plush yarns determine the increase of dimensional stability, an improvement of tinctorial affinity, an increased regularity of carpet surface aspect, a better resistance to friction wear and an increased comfort at carpet exploitation [2, 3].

2. MATERIALS AND METHOD

The installation of continuous bulking and thermofixing "SUPERBA" performs, in the first stage, a thermal treatment by means of a thermo-vaporizer at a temperature lower than the thermofixing temperature and at atmospheric pressure, such that the yarns freely deposed on a belt conveyor are uniformly bulking and contracting.

The main parameters that can be adjusted at this installation and have a direct influence upon the bulking degree are:

- moving velocity of woollen yarns layer (v_1= 0- 750 m/min);
- belt conveyor velocity inside pre-vaporizer (v_2= 5.5-8.6 m/min);
- pre-vaporization temperature (t_1 = 90-99^{0}C);
- vapor temperature in the thermofixing tunnel (99.1- 150.24^{0}C).

There were chosen as independent variables: x_1- pre-vaporization temperature (^{0}C) and x_2 – velocity of belt conveyor in pre-vaporizer (m/min) because previous researches showed that they have the greatest influence on bulking process of plush yarns. The dependent variable y (mm) is the diameter of the plush yarn Nm 6.5/2, obtained from the fibrous blend 50% indigenous wool sort 41and 50% PES.

We have used the factorial program, *rotatable central composite type*, with two variables at five variation levels (-1.414, -1, 0, 1, +1.414). It was used the central composite design because it is very efficient and provides much information in a minimum number of required runs. The existence of five central points (x_1=0, x_2=0) helps the researcher to improve the precision of the experiments. A design is called "rotatable" if the variance of the estimated response depends on the distance from the centre of the design.

The experiments were carried out according to an experiment matrix (Table 1) for two independent variables. Mathematical modeling was used to optimize the plush yarn bulking process [4,5,6]. The general form of the 2-variables second order regression equation is:

$$y = b_0 + b_1 x_1 + b_2 x_2 + b_{11} x_1^2 + b_{22} x_2^2 + b_{12} x_1 x_2 + \varepsilon \qquad \textbf{(1)}$$

It was determined the second order regression equation based on the matrix of experiments:

$$y = 0.726975 + 0.002091 x_1 - 0.00096 x_2 - 0.0014 x_1^2 + 0.00015 x_2^2 - 0.0005 x_1 x_2 \qquad \textbf{(2)}$$

Table 1. *Matrix of experiments*

No.	Independent variables				Dependent variable		
	x_1 (^{0}C)		x_2 (m/min)		y_{mas} (mm)	y_{calc} (mm)	Δy (%)
	code	real	code	real			
1	-1	92	-1	6	0.725	0.72379094	0.17
2	1	94	-1	6	0.728	0.72897244	-0.13
3	-1	92	1	6.5	0.725	0.72287694	0.29
4	1	94	1	6.5	0.726	0.72605844	-0.08
5	-1.414	90	0	7	0.717	0.72121859	-0.59
6	1.414	96	0	7	0.726	0.72713123	-0.16
7	0	95	-1.414	5.5	0.726	0.7280286	-0.28
8	0	95	1.414	8	0.722	0.7253222	-0.46
9	0	95	0	7	0.726	0.72697462	-0.13
10	0	95	0	7	0.728	0.72697462	0.14
11	0	95	0	7	0.726	0.72697462	-0.13
12	0	95	0	7	0.726	0.72697462	-0.13
13	0	95	0	7	0.728	0.72697462	0.14

In the last column of Table 1 there are written the values of Δy , computed with the following formula:

$$\Delta y = \frac{y_{mas} - y_{calc}}{y_{mas}} \cdot 100 \ (\%) \qquad \textbf{(3)}$$

The value Δy shows the difference between the measured value of yarn diameter (coded y_{mas}) and the computer value of diameter (coded y_{calc}). It is noticed that Δy can be positive or negative.

The significance of the coefficients for the regression equation (2) was tested by the Student test, accordingly to the Table 2.

Table 2. *Significance test for the coefficients of the regression equation*

	t_i	Coefficients of regression equation
t_{c0}	3029061	b_0 significant
t_{c1}	13938.33	b_1 significant
t_{c2}	-6380	b_2 significant
t_{c11}	-8114.71	b_{11} significant
t_{c22}	-8672.46	b_{22} significant
t_{c12}	-1666.67	b_{12} significant

The critical value for Student test was taken from a table: $t_{\alpha;v} = t_{0.05;\,6} = 1.94$.

The model adequacy was verified by means of the Fisher-Snedecor test and with percentage deviations. The computed value $F_c = 3.27$ is higher than the critical value taken from the table $F_{v1,v2,\alpha} = F_{12;12;0.05} = 2.69$.

The mathematical model conformity degree was verified by the same test. The computed value F_c is 11.47, which means that it is smaller than the critical table value $F_{tab} = F_{v1,v2,\alpha} = 15.98$.

Also the Fisher-Snedecor test was used to verify the deviation of the sampling data from the mean (average) value. The computed value $F_c = 21.82$ is higher than the critical value from the table, $F_{tab} = F_{0.05;12.4} = 5.91$ which indicates that the deviations are due to the independent variables and not to some experimental errors [5].

In the end, it was computed the correlation coefficient $r_{ymas;ycalc} = 0.79123$ by *Microsoft Excel* application. This value shows a pretty good agreement between the experimental and predicted values from the model.

From the analysis of the equation coefficients, there can be formulated the following conclusions:

- The sign (+) for the coefficient b_1 and the sign (–) for the coefficient b_2 show that the two independent parameters have a different influence on the resultative variable y, i.e. the increase of yarn diameter is more significant when the temperature increases and the yarn velocity through the vaporizer decreases.
- The ratio between the coefficients of the quadratic terms and the free term indicates a variation rate of the yarn diameter of 0.19% due to temperature modification, and of 0.02% due to the modification of the standing time in the pre-vaporization zone.

The response surface of the regression equation has a parabolic shape like a bowl that opens downward (shown in Figure 1). Its maximum has the coordinates: $x_1 = -1.41$ and $x_2 = 1$, corresponding to the pair of natural values:

- $x_{1optim} = 90^0C$
- $x_{2optim} = 6.5$ m/min.

Figure 2 puts in evidence the influence exerted by x_1 and x_2 that act simultaneously upon y.

Figures 3 and 4 show the influences of these two working parameters that act independently on the plush yarn diameter.

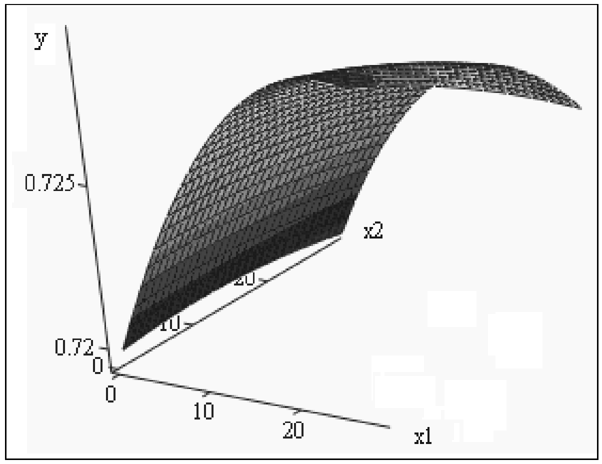

Fig. 1: *Response surface of the second order regression equation*

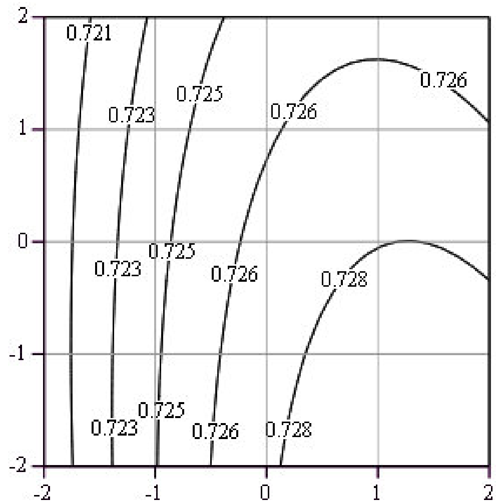

Fig. 2: *Influence of temperature (x_1) and belt velocity through the pre- vaporizer (x_2) on the plush yarn diameter*

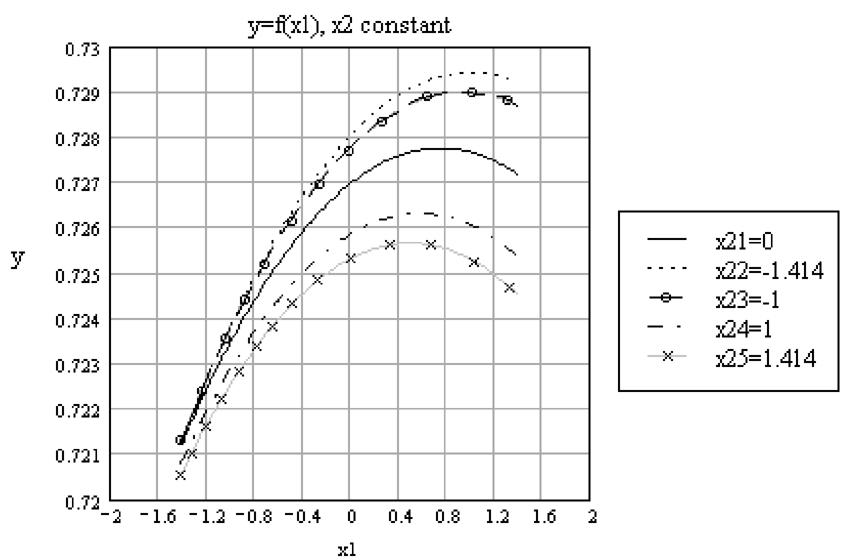

Fig: 3. *Influence of pre-vaporization temperature on the plush yarn diameter*

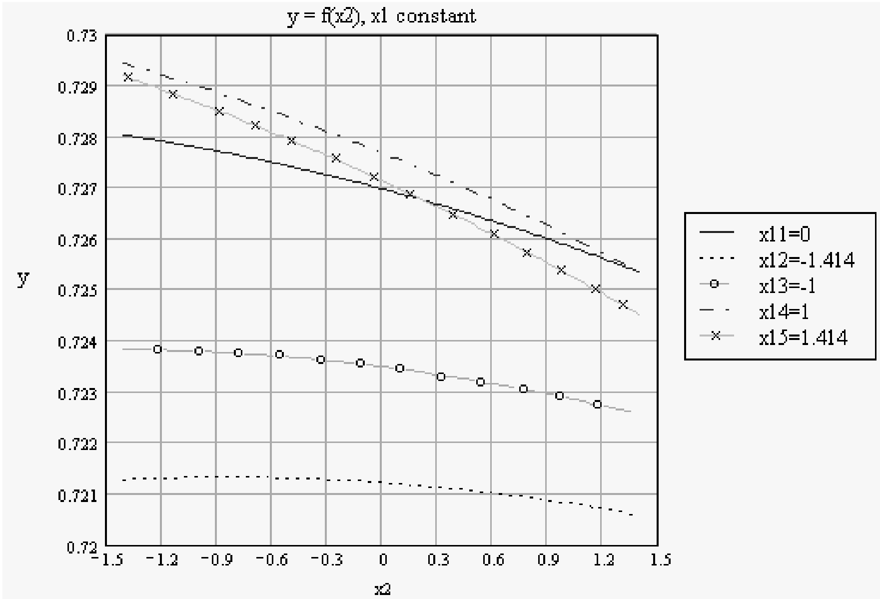

Fig: 4. *Influence of belt velocity through the pre-vaporizer (x_2) on the plush yarn diameter*

From the previous graphics, one can notice that the optimum values of the yarn diameter increase through the pre-vaporizer are obtained for the pair of coded values: x_1 = -1.414 and x_2= 1, and x_1 = 0, x_2= 1.414 respectively, corresponding to the pair of natural values:

- $x_1 = 90^0$C and x_2 = 6.5 m/min;
- $x_2 = 95^0$C and x_2 = 8 m/min.

Since the value of the parameter x_2 = 8m/min is close to the maximum admissible working speed of pre-vaporizing and thermofixing installation, we recommend the utilization of the pairs of values: x_1= 90^0C and x_2= 6.5 m/min, which provides the optimum value for the resultative, as well as a reduced power intake.

Then we proceeded to the verification of optimal values. With this aim in view, we made temperature and velocity adjustments resulted from optimization, and the measured value of the yarn diameter was of 0.749. The computed value of 0.726 represents an increase by 3.2%, which leads to the conclusion that the process optimization according to the mathematical model was accomplished.

3. CONCLUSIONS

The goal of this research was to accomplish an optimal cover degree for double-plush carpets by reducing the number of tufts per unit surface.

This paper presents a bulking method for the plush yarns Nm 6.5/2, obtained from the fibrous blend 50% indigenous wool sort 41 and 50% PES.

Experiment planning carried out on the installation of continuous bulking and thermofixing “SUPERBA” was based on the matrix specific to the factorial program, rotatable central composite type, with two variables at five levels of variation. After mathematical modeling procedure, it was found the optimum point with the coordinates (in natural values): pre-vaporizing temperature of 90^0C (coded x_1) and belt velocity in pre-vaporizer of 6.5 m/min (coded x_2).

Checking up in practice the optimal values for working parameters x_1 and x_2 has shown that in reality there is an increase of plush yarn diameter with 3.2% higher than the value estimated based on the second order regression equation.

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STUDY ON ULTRASONIC DEGREASING OF SHEEPSKIN WASTE

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Abstract: *Leather industry is a relatively large source of waste from raw material, so skin waste recovery is a goal of clean technologies. Capitalisation of skin waste aims to obtain: chemical auxiliaries, technical articles, hydrolyzed protein, artificial leather, composite building materials, heat sources and collagen biomaterials with applications in medicine, cosmetics, etc. A first step in the recovery of skin waste is the degreasing operation. Ultrasound is an effective tool to improve the efficiency of the conventional degreasing affecting the chemical substances as well as the treated skin. In addition, the processing time is reduced. Ultrasound is known to enhance the emulsification and dispersion of oils/fat. The usual degreasing methods requires more emulsifier/solvent ratio and process time for emulsification and additional solvent for washing out the emulsified fat. This paper investigates the possibility of recovery through ecological processes of leather waste from finishing operations for further capitalisation. The present study aims emulsification and subsequent removal of the fat present in the chamois powder waste from polishing operation with the aid of ultrasound by an aqueous ecofriendly method. The study also took into account the ultrasonic treatment of the leather waste using trichlorethylene as a medium of propagation-degreasing, and realized a comparative analysis of efficiency of fat extraction by Soxhlet method and via ultrasonication. IR-ATR and optical microscopy highlight both morphological and chemical-structural changes of treated materials by different degreasing methods.*

Key words: *ultrasonication, cavitation effect, resonator tube, spectral analysis, morphological structure.*

1. INTRODUCTION

Green chemistry is an upcoming and emerging field of interest for today's researcher, representing an environmental friendly procedure applicable in leather manufacturing in order to reduce hazardous chemical material output. Innovative methods promote green chemistry of leather making process.

Leather industry is a relatively large source of waste from raw material, so skin waste recovery is a goal of clean technologies, given that only 25% of the raw skin is found in finished products. Worldwide, about 70% of protein waste is recovered, and for the rest is undertaken research in order to find solutions for more efficient use [1]. Capitalisation of skin waste aims to obtain: chemical auxiliaries, technical articles, hydrolyzed protein, artificial leather, composite building materials, heat sources and collagen biomaterials with applications in medicine, cosmetics, etc.

A first step in the recovery of skin waste is the degreasing operation. Organic solvents are currently employed as degreasing agents and grease from sheepskin dry degreasing can be recovered from the organic solvents and sold on the commodity market [2, 3].

The five different methods commonly used for degreasing are [4, 5]:

- degreasing in an aqueous medium with an organic solvent and a non-ionic surfactant;
- degreasing in an aqueous medium with a non-ionic surfactant;
- degreasing in a solvent medium;
- degreasing by pressurized extraction with a fluid;
- degreasing by supercritical extraction with a fluid.

Degreasing process also involves diffusion problem in skin/hide matrix structure having three-dimensional weave of collagen fiber bundles. The diffusion problem includes: (a) transport of degreasing chemicals into the fat site at the interior of skin/hide; (b) emulsification of fat at the interior of the skin/hide and (c) removal of the emulsified fat from the matrix. Thus, uniform and near complete removal of natural fat present in the skin/hide is not an easy task to perform [5, 6]. Hence, large amounts of environmentally sensitive organic solvents (such as white spirit, perchloroethylene or trichloroethylene) surfactants and emulsifiers are used in degreasing process. There is a need to overcome these challenges in the degreasing process through process innovations such as the use of ultrasound, to develop more efficient and cleaner technique.

Ultrasound is an effective tool to improve the efficiency of the degreasing process using a frequency higher than 20 kHz which affect the chemical substances as well as the treated skin. In addition, the processing time is reduced. It has been reported that the ultrasonic field affects the particle size and particle distribution of the used chemicals. Enhanced penetration through the pores of the leather matrix is achieved by a decrease in particle size and a uniform distribution of the particles. Ultrasound is known to enhance the emulsification and dispersion of oils/fat [3].

The usual degreasing methods requires more emulsifier/solvent ratio and process time for emulsification and additional solvent for washing out the emulsified fat. It takes about 2–3 h with 1–6 h washing time with brine to remove the emulsified fat. Some physico-chemical principles of water-based degreasing process have also been described recently [6]. Surfactants such as nonylphenol ethoxylates, conventionally used in degreasing process have been banned by European Union from the year 2005. Therefore, it is very essential to develop a degreasing methodology without involving such toxic substances. Dry cleaning of finished leather with solvent was studied earlier with 22 and 44 kHz ultrasonic waves for 8 min to remove the oily dirt adhered with the leather [7]. Dry cleaning was good and there was no change in the property of leather. Ultrasound has been employed successfully for emulsification of oils/fat and in the preparation of fatliquor emulsion with reduction in emulsion particle-size [8, 9]. The application of ultrasound in leather processing has been studied elsewhere [10, 11]. The uses of ultrasound in soaking [12], liming [13], dyeing [14], tanning [15] and fatliquoring [16] have been reported.

This paper investigates the possibility of recovery through ecological processes of chamois leather waste from finishing operations for further capitalisation. In the present work, the influence of ultrasound in fat removal has been studied. The research objective is to develop eco-friendly effective degreasing system for chamois powder waste from polishing operation using ultrasound at low intensity at specified frequency range without necessitating temperature control. The study also took into account the ultrasonic treatment of the chamois powder waste using trichlorethylene as a medium of propagation-degreasing, and realized a comparative analysis of efficiency of fat extraction by Soxhlet method and via ultrasonication.

2. APPARATUS AND MATERIALS

For the comparative degreasing experiments were used: specific reagents such as: trichloroethylene (TCE), distilled water, and hydroalcoholic solution; chamois powder waste resulting from polishing operation, provided from sheep skin finishing company.

The analysis techniques were: IR-ATR spectroscopy using a DIGILAB – SCIMITAR Series FTS 2000 spectrometer with ZnSe crystal, 750 - 4000 cm^{-1} range, 4 cm^{-1} resolution, and optical microscopy using an Optical Microscope EUROMEX ME 2665(Holland) with video digital camera.

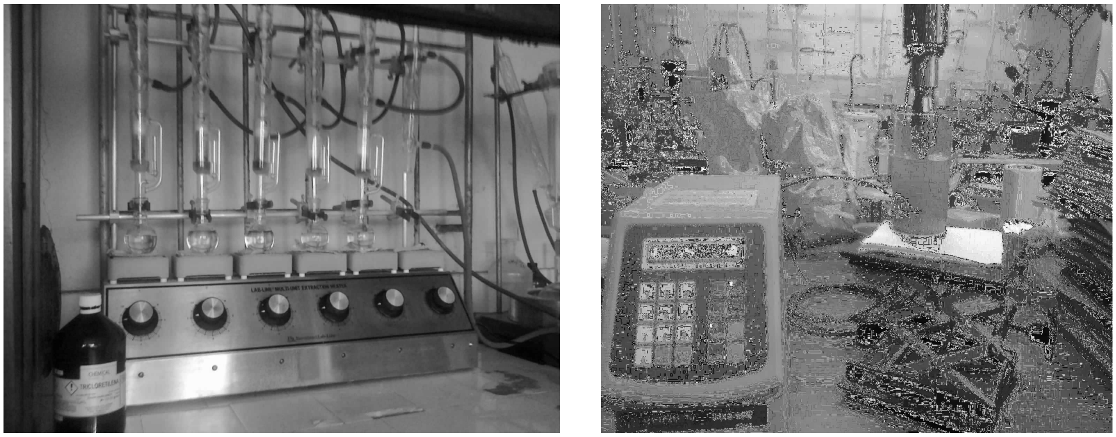
For degreasing a classic Soxhlet installation and an ultrasonic device Sonic Vibrocell type with resonator tube were used (figure 1).

3. WORKING METHOD

Effectiveness of degreasing by ultrasonic method was compared with the classical Soxhlet method of degreasing.

Soxhlet extraction [17-19]

Six parallel sheepskin powder samples with a weight of 5 g each were extracted individually with 300ml of trichloroethylene solvent. Each Soxhlet apparatus worked continuously for 3h with approximately three extractions performed per hour. After fat extraction sample cartridges were subjected to washing with 50% alcohol solution, and then dried at 50°C for 24 hours and conditioned at 20 °C and 65% humidity for 24 hours.



a. *b.*

Fig. 1: *a) Soxhlet installation; b) Ultrasonic device with resonator tube*

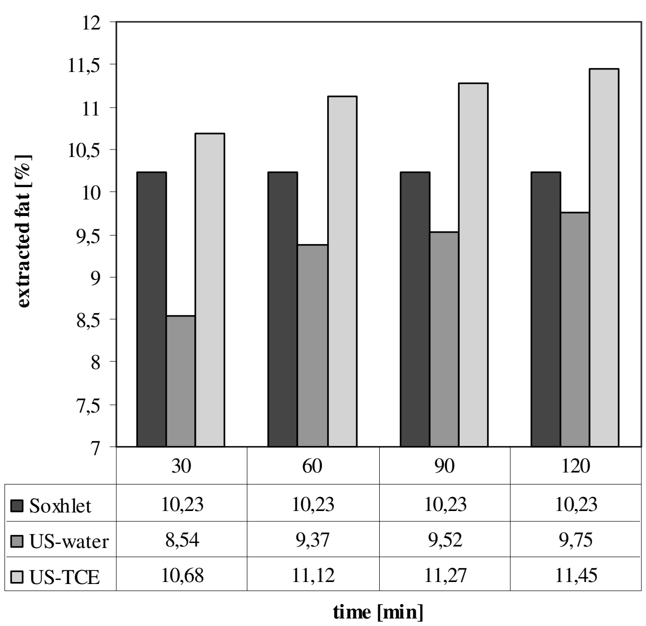
Ultrasonic extraction

Six parallel samples with a weight of 5g each were ultrasonicated in 150 ml of distilled water, and other six samples of the same weight in 150 ml of trichloroethylene.

The ultrasonic device worked at the following parameters: power actually dissipated to the system: 70 W; frequency: 25 kHz; duty cycle: 2 s; time: 30 min ÷ 2h. In order to find out the influence of ultrasound effects, ultrasonic experiments were carried out without external cooling or heating of ultrasonic bath; in these conditions the ultrasonic bath temperature temperature does not exceed 50 ^{o}C in 2h process time. The extracted samples were then washed with 50% hydroalcoholic solution to recover any remaining organic residue and then dried in the same conditions as above.

4. RESULTS AND DISSCUTION

The results for fat extraction with Soxhlet apparatus in comparison with ultrasonic degreasing in water and TEC are shown in figure 2.



	30	60	90	120
Soxhlet	10,23	10,23	10,23	10,23
US-water	8,54	9,37	9,52	9,75
US-TCE	10,68	11,12	11,27	11,45

Fig.2. *Extracted fat percentages depending on the duration and method of degreasing*

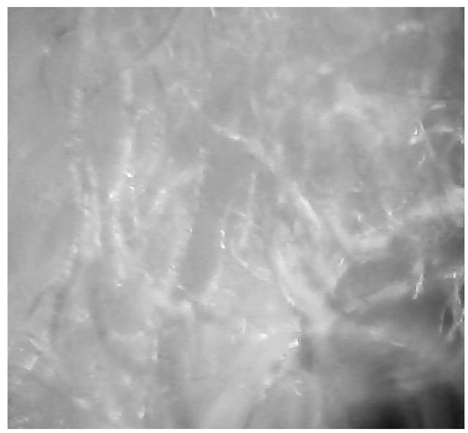
As can be seen in figure 2 the use of the ultrasonic tube enhances the fat removal processes from samples. Thus, the highest yields are observed at the combined use of sonication with degreasing agent (TCE) for a period of 120 min; the percentage of fat removed is superior to the Soxhlet method. The highest percentage of fat is removed for 2h process time regardless whether the sample is degreased by ultrasonication in distilled water or in solvent bath. Concomitant use of sonication and degreasing solvent enhances the cavitation effect, enabling a more rapid removal of fat. Ultrasound also helps to perform an aqueous degreasing and to obtain a good removal of fat from the skin.

The enhancement in degreasing with ultrasound is due to possible mechanisms as follows:

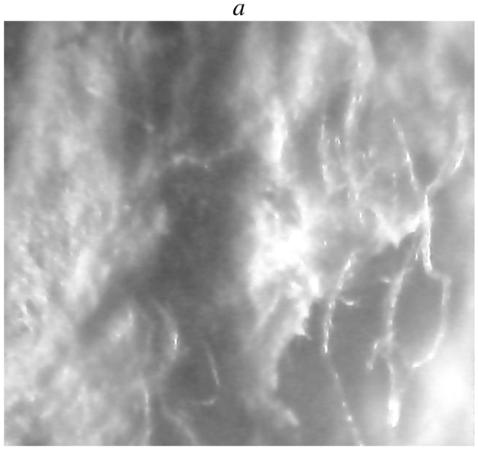
- fat cells undergo breaking processes due cavitation which facilitates the release of fat and its subsequent removal;
- the action of ultrasound helps the solvent/emulsifier to penetrate the fat site from the interior of the skin;
- the dispersing effect of ultrasound facilitates better emulsification of the fat from the skin;
- the removal of the emulsified fat from the skin matrix is improved.

Microscopic images of an initial sample (greasy skin powder) and of the skin after fat extraction by the methods described above are shown in Figure 3. Thus, we can observe the surface changes of the samples subjected to degreasing by various methods; the sample sonicated in a solvent shows a more pronounced loosening of the constituent fibers as compared with the samples degreased by Soxhlet method, and by sonication in distilled water, respectively. The initial sample of greasy skin shows a pronounced agglomeration of fibrous component due to the presence of fatty substances on the surface and within the material.

a



b



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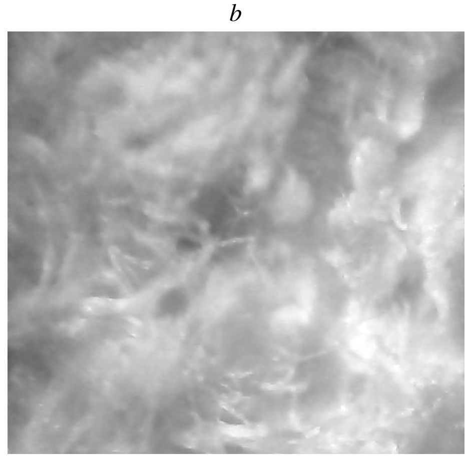

d

Fig. 3. *Aspects of skin powder treated in different conditions obtained by optical microscopy: a) initial sample; b) extracted in Soxhlet; c) ultrasonicated in water for 2h; d) ultrasonicated in TCE for 2h.*

IR-ATR spectra of the initial sample and of the samples degreased via sonication in water and TCE for 2 h are presented in figure 4.

The spectra in the figure 4 show a shift of the characteristic peaks in the range 3450-3300 cm^{-1} (of NH + OH groups) and of 3200 cm^{-1} spectral band (of free OH groups) of the initial sample to 3100 cm^{-1}, and 3000 cm^{-1} bands respectively, which could indicate possible new intermolecular interactions through Hydrogen bonds.

It can be also seen a decrease in signal intensity of spectral bands characteristic of CO groups from amide I located between 1650-1650 cm^{-1}, of NH groups from amide II located between 1555 - 1545 cm^{-1}, and of NH +CH groups from amide III located between 1240-1230 cm^{-1}, for the sonicated samples (b) and (c) compared to the control sample (a). Decreasing of signal strength and response surface of spectral bands might be due to the cavitation effect which causes possible breaks of physical bonds and new intermolecular bonds formation.

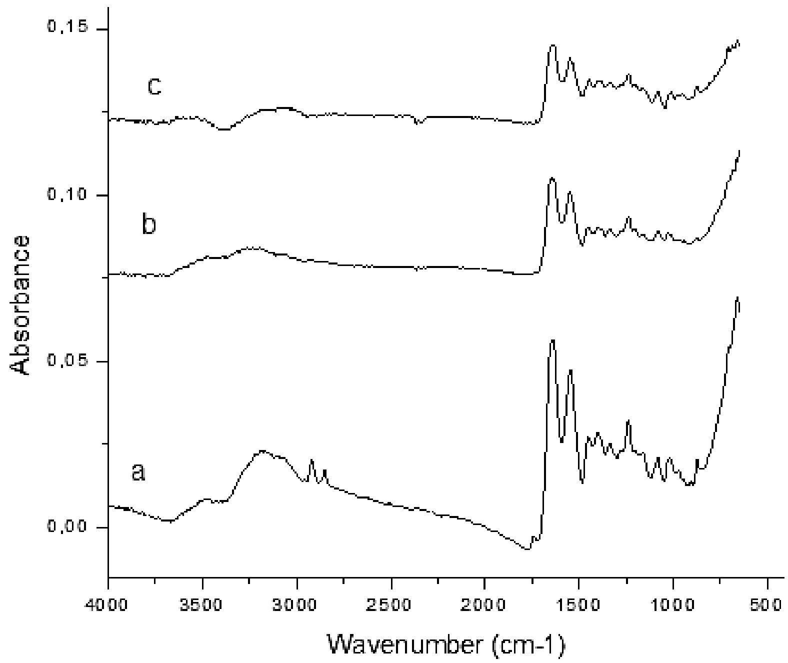

Fig. 4. *IR spectra of sheepskin waste powder: a) initial sample; b) ultrasonicated in water for 2h; c) ultrasonicated in TCE for 2h.*

5. CONCLUSIONS

1. The use of ultrasound in degreasing improves significantly the removal of fat from the skin powder waste.
2. Concomitant use of sonication and degreasing solvent (TCE) enhances the cavitation effect, enabling a more rapid fat removal; the highest yields are observed for a sonication period of 120 min.
3. The percentage of fat removed by sonication with solvent is superior to the Soxhlet method, at the same time decreasing the amount of solvent used for degreasing and reducing the working time.
4. Ultrasound also helps to perform an aqueous degreasing and to obtain a good removal of fat from the skin powder waste helping to minimize or eliminate the use of detergents and solvents.
5. IR-ATR and optical microscopy highlight both morphological and chemical-structural changes of treated materials by different degreasing methods.
6. The results can be a starting point in finding new ways of extracting components of interest from these sources of waste such as chemical auxiliaries, hydrolyzed protein, artificial leather, composite building materials, and collagen biomaterials, etc.

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DETERMINANTS TO THE CONSUMPTION OF LEATHER PRODUCTS

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Abstract: *The current paper looks at some of the determinants in the consumption of leather fashion products by the 16-34 year old population of Québec. Although the Québec population presents some idiosyncrasies, we surmise that our results could probably be generalized to similarly aged population groups in the western world. Leather goods are now often considered as luxury items, a sub-sector of the fashion industry which has been outgrowing all others in the last few years. Yet leather is often seen as non-ethical, requiring the killing of animals, and non-ecological, since the production process is polluting. Those two opposing forces make the future of leather very uncertain. Surprisingly, very little literature has been written on the subject.*
This paper presents a survey in which the authors tried to identify the determinants to the consumption of leather in the 16-34 age groups, often referred to as Generation Y. Our findings reflect this dichotomy between the consumer's interest for apparel and his or her negative reaction to some characteristics of leather. Although not as influenced as fur by ethical and ecological concerns, leather products the object of similar reactions.
This paper concludes on some recommendations to participants in the leather industry who should note this trend and try to position their products in such a way as to minimize the negative elements and bank on the more positive aspects.

Key words: *Leather, Apparel, Consumer behaviour, Luxury*

1. INTRODUCTION

The present paper has roots in two different literature streams.

The first deals with the production of leather goods. The treatment of an animal's hide to turn it into leather is a relatively dirty and polluting process. Today's consumer being more and more concerned with ethical behaviour and protection of the environment, this situation may impact negatively on the sale of leather products. Moreover, the fact that natural leather requires the killing of an animal, also has, though at a lower level than in the case of fur, an impact on the consumer's perception.

The second focuses on attitudes and consumption of luxury goods. The arrival of LVMH in the leather trade has clearly stated that leather goods often are luxury items. Knowing that the commerce of luxury goods has fast outgrown the consumption of other apparel, the leather trade is therefore in a position to rapidly become more and more important in the coming years.

Since there have been very few articles trying to evaluate the impact that the above two factors may have on the commerce of leather, we looked at the consumer's perception of leather when shopping for apparel and accessories, and more specifically at how some of the determinants to the purchase of leather may behave in a manner closer to the consumption of fur than to the consumption of general apparel and accessories.

2. LITERATURE REVIEW

The emphasis that the LVMH group has placed on leather goods and its acquisition of companies in this area in the last decade and a half has clearly marked the arrival of leather in the luxury sub-sector [1]. Knowing that luxury goods and brands represent an important part of today's global economic activity [2] and that they have fast outgrown other areas in the last decade, one can only forecast a fairly positive outlook for the commerce of leather apparel and accessories. At the same time, young consumers are now more and more attracted to this segment of the market; hence, in a market characterised by increased competitiveness and the saturation of certain sub-segments, they present a potentially profitable target market [3]. The young consumer often is at the forefront of cultural and consumption changes; Widdicombe and Woffitt even us the term “barometers” of cultural change and evolution [4]. Younger consumers are also perceived as being more susceptible to marketing campaigns: in this light they constitute an ideal target market for fashion communications [5].

Another factor favouring the expansion of the leather trade in apparel and accessories is the emphasis now put on the sustainability of the industry [6]. As mentioned by McDonough and Braungart [7] this sustainability should not be understood as a simple return 100% natural fibers and raw materials, as the resale of garments or the reuse of materials also offers an interesting avenue (Fletcher and Grose [8] talk about a process starting with the fibers’ selection, ending with the possibility to give the product a the second life) yet some sustainable materials, like leather, may have a particular appeal.

There also is a negative side to the consumption of leather. One will argue that leather production is a highly polluting process. To counter this reality, most important leather production countries have passed laws to ensure that the process is conducted in as sustainable a manner as possible [9]. Yet some pressure groups such as PETA [10] still point to the weaknesses of the production process. A number of consumers are influenced by such organisations and consider that the fact that leather production requires the killing of animals makes it, almost by definition, anon-ethical process [11]. Yet not all of them are; some consumers react to this trend toward political correctness [12] and adopt a more positive attitude to the consumption of leather goods. In some of the relatively small literature looking at the consumer’s perception of leather, Belton and Clinton have found that one’s overall perception of leather consumption, one’s environment, and one’s education level all impact on the consumers’ propensity to buy exotic leather goods [13]. Belleau *et al.* have also found that fashion oriented people will also see the consumption of leather in a more positive light [12].

In spite of the growing emphasis on the consumption of ecological goods, and the abundance of articles on the consumption of fur, one must note that very little has been said or written on the consumption of leather goods, and more specifically of fashionable leather goods.

3. METHODOLOGY

We developed two questionnaires comprised of 15 questions of which 5 pertained to socio-demographic information whereas the remaining 10 looked at the determinants in the consumption of, in the first case, leather fashion goods and, in the second case, the consumption of fur products. The questions also compared the respondents’ perceptions of fake leather goods to real leather and similarly of fake fur to real fur. Since “younger” consumers account for an important part of apparel purchases and represent the future market, we chose to focus on the 16-34 age groups.

The hearth of our questionnaires was built on three questions asking respondents to evaluate the importance of 11 determinants in their consumption of apparel in general, leather goods and fur goods along with their synthetic counterparts. The determinants chosen were those generally mentioned in the literature on apparel/fashion consumption: style, durability, material, and ecological impact, ethical considerations, country of manufacture, brand name, environment (parents, friends), price, vendor location, ease of care. Respondents were asked to rate these 11 on a scale of 1 to 10 (1 being not important at all and 10 being very important).

The leather questionnaire led to 1145 valid responses whereas the fur questionnaire gave us 1016. The survey was limited to the province of Québec for convenience purposes. Our samples were non-probabilistic using a snowball, or chain sampling, approach. It was passed on the internet during the month of October 2013 using Survey Monkey, with the help of two of ours students’ groups who were asked to transfer the surveys to as many people as possible in these age groups with the only caveat that they must not be related to the Fashion School. The data were analyzed with SPSS.

4. RESULTS

We first compared our two groups on the general apparel determinants to ensure that they were indeed comparable. As expected, since the respondents knew from the start the questionnaires focused on either fur or leather, no significant differences appeared between the groups answering the leather questionnaire and the one filling the fur one except on those items which may be more “material” specific: ecological impact (t = -4,173; sig. = 0,000), ethics (t = -2,732; sig. = 0,006), and country of origin (t = -3, 713; sig. = 0,000). In all three cases, as the negative value of the t-test shows, respondents gave more importance to these determinants when answering a fur questionnaire.

Our leather sample was comprised of 821 females and 315 males. Although we had a definite over representation of females which should sound an alarm bell when trying to generalize our findings, we had a sufficient number of male respondents to do so. The same imbalance was found in our age groups (with 807 respondents in the 16-24 group and 338 in the 25-34 group) yet even our smaller group was sufficiently important to enable us to feel confident about our findings. Our sample was fairly representative of the Québec population, in these age groups, in terms of education with a slight over representation of respondents with a college or university degree.

We first looked for confirmation of Belleau *et al'*s findings to somewhat validate that our results were in line with previous research. We tested our question on the respondents' self-appraisal of their interest for fashion, in comparison with their peers (on a scale of 1 to 6 with 1 being much less and 6 much more) with their answers on the probability that they purchase a leather garment or accessory in the coming two years. We found a very strong correlation (r = 0,311; sig. = 0,000) thereby confirming Belleau *et al's* findings. We also tested Belton and Clinton's finding of a positive relationship between people's intention to purchase a leather item and education level. In this case, like these authors, we found a strong positive relationship (F = 8,170; sig. = 0,000) between education and the intention to purchase a leather item.

ANOVAs were performed on the relationship between the determinants to leather goods consumption and the level of education. Our results show a positive relationship between the importance of the ecological impact (F = 5,851; sig. = 0,001) and of the country of origin (F = 4,632; sig. = 0,000); the importance of ethical concerns is fairly equal among all educational levels. One possible explanation is that the concern for ethics is more generalized throughout the population. Correlation analyses between one's perceived interest for fashion and ethics, ecological impact, and country of origin (as determinants to the consumption of leather) lead to no highly significant results (sig. < 0,001).

For ease of further analysis and discussions of our findings on the overall importance of consumption determinants, we reclassified all answers on our core questions (impact of determinants on purchase of apparel, leather goods, and synthetic leather goods) into three broad categories: little or no importance (scores of 1 to 3), some importance (scores of 4 to 7), very important (scores of 8 to 10). It is interesting to note (see table 1) that the importance of the selected determinants are fairly similar between general apparel items and fake leather goods with the exception of durability which appears much less important in the case of fake leather (a difference of more than 10 percentage points). This may in part be explained by the fact that a fake leather item may be bought with very current, faddish, fashion considerations in mind.

On the other hand, one also notes that determinants of leather items purchases differ importantly from those identified for regular apparel. In fact: style, durability, material, and country of origin score more than 10 % higher in terms of the importance that these determinants have on the purchase of leather goods as compared to regular apparel. Elements of style and durability may be explained by the cost of the items, in comparison to regular apparel, while the material and country of origins may be linked to the consumer's need for reassurance that he or she is purchasing an item made of genuine leather.

Insofar as the leather consumer is concerned, a factor analysis (Varimax rotation) shows that we can find three sub-groups of determinants. The first is comprised of style, durability, material, and price and explains 48 % of the variance in the purchasing decision. The second, made up of ecological impact, ethics, and country of origin explains 13,3% of the variance.

Table 1 also shows that, in most cases, where a difference exists between the sexes, women, in general, attach more importance to most determinants. On the other hand very little difference shows up between the two age groups studied.

Table 1: *Leather survey results*

Leather	Apparel					Leather					Fake leather				
	% Very important	Diff. M/W		Diff. Age (Y/O)		% Very important	Diff. M/W		Diff. Age (Y/O)		% Very important	Diff. M/W		Diff. Age (Y/O)	
		t-test	Sig.	t-test	Sig.		t-test	Sig.	t-test	Sig.		t-test	Sig.	t-test	Sig.
Style	78,6	-4,628	0,000			69,9	-3,147	0,002			64,2	-5,660	0,000		
Durability	52,5			-3,231	0,000	73,3	-4,416	0,000			41,1				
Material	43,3	-2,837	0,005			66,6	-3,893	0,000			36,8				
Ecological impact	18,0	-3,673	0,000			22,8	-4,640	0,000			15,5				
Ethics	17,6	-2,310	0,021			24,8	-3,089	0,002			15,7			-2,196	0,030
Country of origin	10,8	-3,733	0,000			22,7	-2,357	0,019			10,9				
Brand	24,4	4,102	0,000			32,3					21,8	2,662	0,008		
Environment	13,3	-3,061	0,002	3,044	0,002	14,2	-2,314	0,021			14,1				
Price	65,1	-4,347	0,000			60,6	-2,782	0,005			62,0	-4,135	0,000		
Vendor location	22,1					26,5	-2,849	0,004	2,335	0,020	18,9				
Ease of care	35,5	-2,381	0,017	-3,671	0,000	43,0	-3,917	0,000			34,4			-2,599	0,009

Our fur sample was comprised of 685 females and 331 males. We find here the same imbalance as with the leather sample yet can here again state that our male sample was large enough to be of use. The same may be said of our age distribution with 716 respondents in the 16-24 age group and 305 in the 25 to 34.

The same observation can be made in this case as with leather in that there is limited variation in the importance of determinants between apparel and fake fur. The only determinants with a variation of more than 10 % are style, durability, and price. These may be explained in part by the fact that fake fur items, although not as expensive as real fur, are still, in general, at the expensive end of fashion items.

Here again, one finds major differences between real fur and general apparel. Whereas style is much less important, ecological impact, ethics, and country of origin are much more important. This is in line with the literature which shows that the commerce of fur still has this negative aura and the observation that consumers, in the western hemisphere, are shying away from fur.

Out of curiosity, as we did in the case of leather, Belleau *et al's* hypothesis (although they never looked at this possibility), we looked at the possible correlation between their perceived interest for fashion in comparison to their peers and the intention to purchase fur. Here again we found a positive correlation (r = 0,238; sig. = 0,000). As was the case with leather, and here again in spite of the fact that Belton and Clinton have not looked into the relation between education and the intention to purchase a fur item, we conducted an ANOVA and found a significant positive result (F = 20,48; sig. = 0,000). These two results, although weaker than in the case of leather, certainly open a further research avenue as to this positive relationship between education and one's interest for fashion, on one side, and one's "more positive" outlook on leather and fur.

Table 2: *Fur survey results*

Fur	Apparel					Fur					Fake fur				
	% Very important	Diff. M/W		Diff. Age (Y/O)		% Very important	Diff. M/W		Diff. Age (Y/O)		% Very important	Diff. M/W		Diff. Age (Y/O)	
		t-test	Sig.	t-test	Sig.		t-test	Sig.	t-test	Sig.		t-test	Sig.	t-test	Sig.
Style	78,6	-7,581	0,000	2,293	0,022	54,6	-5,123	0,000			61,6	-6,880	0,000		
Durability	52,9			-2,104	0,036	55,0	-3,761	0,000			40,6				
Material	44,8	-4,965	0,000	-2,164	0,009	53,1	-4,661	0,000			37,9	-2,9555	0,003		
Ecological impact	17,9			-3,596	0,000	36,3	-3,174	0,002			24,5			-2,194	0,028
Ethics	20,7	-2,396	0,017	-3,552	0,000	37,7	-4,133	0,000			23,6				
Country of origin	15,6	-2,045	0,041	-3,206	0,001	27,7					14,4				
Brand	26,2	2,301	0,022			25,2					20,0				
Environment	16,2			1,963	0,050	13,7					12,2				
Price	65,9	-2,966	0,003			48,2	-3,606	0,000			52,1	-3,890	0,000		
Vendor location	22,6	-2,479	0,013			24,3	-2,241	0,025			17,3				
Ease of care	31,4	-3,751	0,000	-3,288	0,001	32,8	-2,007	,0045			34,6	-2,586	0,010		

We also performed ANOVAs on the relationship between the determinants to fur goods consumption and the level of education, and one's perceived interest for fashion. Here again our results show a positive relationship between the importance of the ecological impact (F = 3,439; sig. = 0,004) and the level of education of the respondents. As was the case with leather, no highly significant results (sig. < 0,001) could be found when correlating one's perceived interest for fashion and ethics, ecological impact, and country of origin (as determinants to the consumption of fur).

5. CONCLUSIONS AND RECOMMENDATIONS

The results presented above show that, in the 16-34 age group, ecological impact, ethics, and the country of origin of goods are important determinants in the consumer's decision process when he or she buys apparel. Although not as important as in the case of fur, these determinants are rated between 4 and 12 percentage points more important for leather goods than for regular apparel. Sellers of leather goods must therefore take good care not to forget these considerations when communicating with the young consumer. The country particularly stands out in the case of leather for which its importance is rated 11,9% higher than for regular apparel. Leather products often being at the higher price end of the apparel/accessories segment, consumers are all the more concerned with ensuring that they have the quality of product that they pay for.

Another observation is that women constantly assign all determinants, and more specifically the three we just discussed (ecological impact, ethics, and country of origin), a higher importance factor than males. Special attention must therefore be placed in the communications to women who not only buy for themselves but, as other studies have shown, often buy for other members of the family or are strongly influential in the decision process.

The above conclusions are all the more important when one notices that the determinants to the purchase of fake leather goods are in line with those of regular apparel and that the findings for real leather behave somewhat similarly to the determinants to the purchase of fur goods (although not in as important a way). One possible explanation of this state of affairs is that some of the discourse on the non-ethical aspects in the commerce of fur is transferred to the commerce of leather.

An important weakness of our research is that it was conducted only in the province of Québec. Yet other research has shown that the results found in Québec are partially generalizable to the rest of the country and from there to the rest of North America. Actors in the leather industry should therefore investigate the importance of ethics, ecological impact, and country of origin on the purchase of leather goods in order to position themselves appropriately in the market.

As mentioned in the above text an interesting research avenue arises from our findings. Whereas one can intuitively accept the positive link between one's interest for fashion and one's intentions to purchase a leather (or fur) item, this positive relationship between education and the intention to purchase leather or fur items is much less intuitive. Is this linked to better (or lesser) understanding of the ethical concerns and ecological impacts, to a better financial situation thereby enabling the more educated people to afford these items, to a lesser influence of pressure groups, etc. ?

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

THE TOTAL SOLUTION FOR DEVELOPING NEW PRODUCTS OF FOOTWEAR INDUSTRY

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Abstract: *This paper presents new solutions for shoemakers, for developing new products and new markets of footwear industry using the basic function of the* ***system CRISPIN Dynamics CAD SUITE****. These are the key issues - this is why* ***CRISPIN Dynamics CAD SUITE*** *has developed a range of quality software products to give the shoemaker a major advantage in shoemaking. This application offer functions for creating realistic looking designs of footwear products and for flattening the styles for development in 2D. There are also facilities to re-centre front and back guide lines, change foot (no need to re-digitize) and set the correct heel height and roll. It is also possible to create guidelines to match with the last and extend the last for a boot design. The last type can also be changed to a type that allows the entire last surface to be used for a design. The system brings cutting-edge CAD/CAM technology to footwear designers providing benefits through all stages of their product development process. Major benefits include the ability to visualise a design for appraisal and the transfer of the design into* ***CRISPIN 2D*** *pattern development products. This allows increased productivity, shorter lead times, accurate interpretation of 3D designs in 2D and a reduction in the number of samples needed before approval of the design.*

Key words: *design, footwear, last, solid body, style, line, pattern, grading*

1. INTRODUCTION

By classic methodology, footwear designing is a very complex and laborious activity. That is because classic methodology requires many graphic executions using manual means, which consume a lot of the producer's time. The decisive step in this way has been made some time ago, when, as a result of powerful technical development and massive implementation of electronical calculus systems and informatics, CAD (Computer Assisted Design) systems were used in footwear industry. One of the most important uses of calculus systems in footwear design is interactive design by using the CAD system.These are the key issues - this is why **CRISPIN *Dynamics*** have developed a range of quality software products to give the shoemaker a major advantage in shoemaking. This paper presents the basic function for footwear design using the system **CRISPIN *Dynamics* CAD SUITE**, a CAD/CAM system for footwear.

2. CRISPIN DYNAMICS CAD SUITE

This application offers functions for creating realistic looking designs of footwear products and for flattening the styles for development in 2D. There are also facilities to re-centre front and back guide lines, change foot (no need to re-digitize) and set the correct heel height and roll. It is possible to create guidelines to match with the last and extend the last for a boot design. The last type can also be changed to a type that allows the entire last surface to be used for a design. The applications in the suite are:

- **LastMaker** - a program providing the means to design and modify lasts with outputs to various 3D file formats.
- **ShoeDesign** - a program for designing uppers on 3D lasts provided by **ModelTracer** or **LastMaker**. Create realistic looking designs and flatten the styles for development in **Engineer**.
- **ShoeCost** - a program to estimate the cost of producing a particular design. Takes input from various sources including **Engineer**.
- **2D Engineering –** a program for designing on 2D lasts provided by Shoe Design, and Digitizing.

This product has been developed for shoemakers who wish to ensure that their business remains competitive by increasing the efficiency, speed and accuracy of pattern development and grading.

This paper presents the main functions for footwear designing in 3D and 2D space using the applications **Last Maker, Shoe Design and Engineer** [1], [2].

3. FUNCTIONS FOR CREATING AND ADJUSTING THE SHOE LAST

Computer-aided manufacturing (CAM) system is widely used in shoe last manufacturing, which has achieved the digitalization of the machine program from the free-form surface detection method to produce numerical control (NC) required by the shoe last CAM software system automatically. In this type of free-form surface NC, it is common to digitalize the shape of the entity through the three dimensional (3D) measuring system after obtaining the scanned data and processing the natural pattern; the next step is rebuilding the surface model. There are two steps involved in remodelling the discrete data, which has become an entity shape in recent years: the first is ordering the measurement data, the second is the generating for creating the design. In this section will be discussed the method for measurement data technique and creating the format of the solid part of the shoe last technique using the application **Last Maker** [1], [3]. The main function for creating and modifying the format of the shoe last are following:

3.1 Recording the shape of the last

The shape of the last is recorded in 'point cloud data' format performed with the application ModelTacer. The digitizing process is realized with MicroShibeG2X.

For digitizing the shape of the shoe last we perform the steps:

- steps for recording the base point,
- steps for recording the limit of the shoe last and the points for creating "cloud data" format of the last (see fig.1).

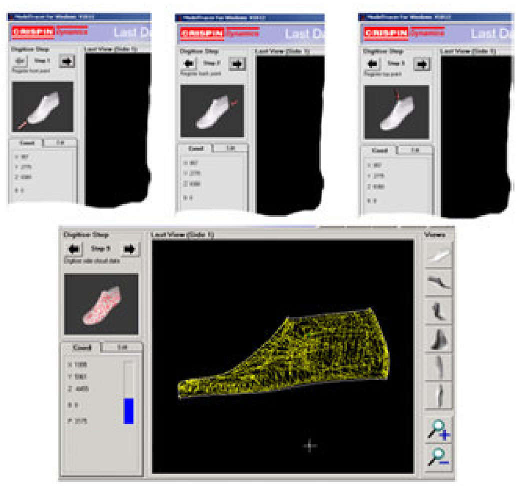

Fig.1: *The steps for creating a shoe last "point cloud data" format*

3.2 Import the shoe last in other application and adjusting the last parameter, comparing and analyzing the new Shoe Lasts

Shoe last is imported in **Last Maker** application**.** The application offers information about the last: Gender, Size, Index, Width index, Toe Spring, Heel Height. This information displayed in the Last Info option is automatically changed accordingly (see fig. 2).

Using the function of the Last Maker application we can visualize and modify the parameters of the shoe last. This function for comparison brings possibility to compare two different lasts; the result can be measured or displayed as a solid last (fig. 2).

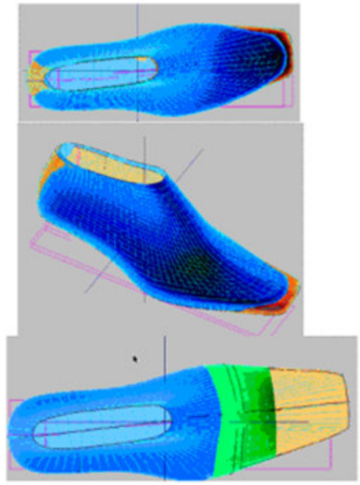

Fig. 2: Importing the shoe last in Last Maker and modification of the initial format

3. 3 Proportional Grading

In the dialog Gender Table select Gender you want use for grading, size and width parameters of the current last. In figure 3 are: Window of Gender Table and the results of function grading.

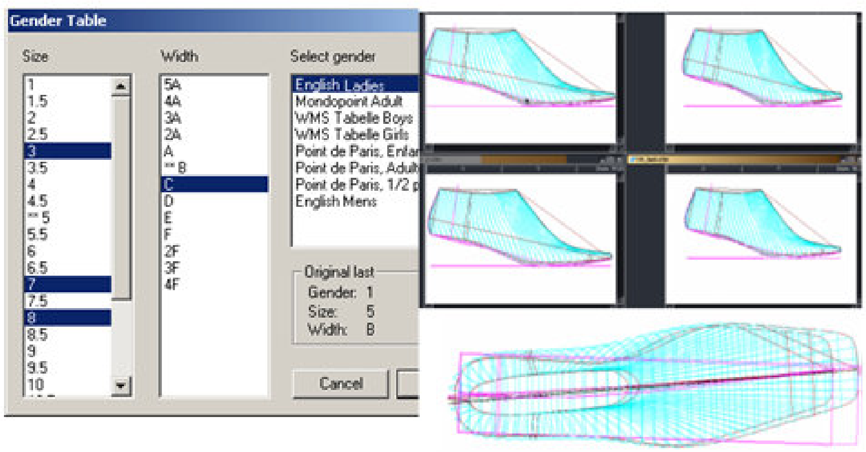

Fig. 3: Creating the shoes last for other numbers using Last Maker application

4. FUNCTIONS FOR CREATING AND ADJUSTING THE 3D DESIGN OF THE FOOTWEAR

The module **Shoe Design** brings cutting-edge CAD/CAM technology to footwear designers providing benefits through all stages of their product development process. Major benefits include the ability to visualize a design for appraisal and the transfer of the design into **CRISPIN 2D** pattern development products, see table no. 2. This allows increased productivity, shorter lead times, accurate interpretation of 3D designs in 2D and a reduction in the number of samples needed before approval of the design.

4.1 Input of last data can be taken from **CRISPIN Model Tracer** from our **CRISPIN Last Maker** product.

The last can be extended for designing industrial, leisure or fashion boots (see fig. 4). Guidelines and reference points can be embedded in the last surface to help maintain design standards etc.

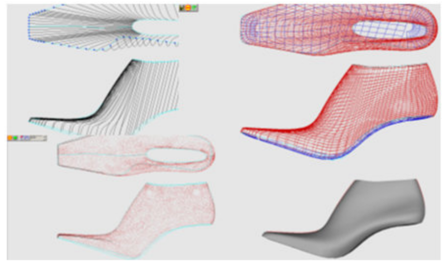

Fig. 4: *Creating the shoes last format 'solid corp.' using Last Maker session of Shoe Design application*

4.2 Creating Style-lines

Style-lines are generated on the last surface with this 'user friendly' software product allowing new designs to be achieved in minimum time whilst achieving an accurate representation of the shoe (see fig. 5).

Fig. 5: *Creating style-line on the last surface with this 'user friendly' using the session of Shoe Design application*

4.3 Flatting

The last form, last bottom and style lines can be accurately flattened at any time during this process (see fig 6) and transferred to a **CRISPIN 2D** pattern development product.

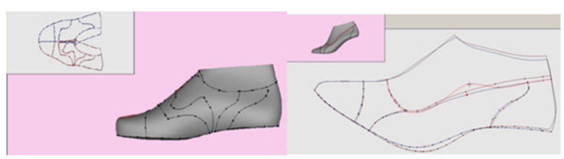

Fig. 6: *Using Shoe Design perming the flattening of the shoe last for creating 2D part*

4.4 Analyzing format of the shoe last and creating design and panel

The shoe can be rotated for visualization or to assist in generating the style lines enabling the designer to view the design from any angle to achieve the desired result (see fig. 7). Enhanced visualization is achieved by applying features such as stitching, eyelets and laces together with colors and textures. An interactive sole design facility is provided.

Fig. 7: *Creating and analyzing realistic looking designs of the footwear products*

5. FUNCTIONS FOR DEVELOPING INTO A FULL SHELL, MAKING THE PARTS AND GRADING

For creating 2D designing of the footwear we use **CRISPIN Dynamics Engineer** to perform the following processes: digitize the flattened or standard half shell, develop into a full shell using various dependant line types, create the individual parts and grading.

5.1 Input

Input is from a 2D digitizer or CRISPIN ShoeDesign. You can use any 2D digitiser supported by the 'Wintab' standard. Digitising is easy to learn, fast and accurate (fig. 8).

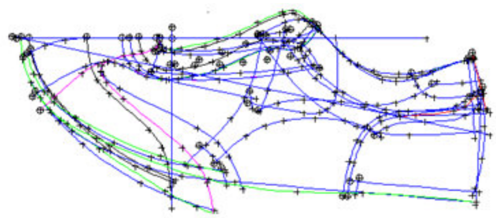

Fig. 8: *The session Engineer for digitizing the base model*

5.2. Creating 2D design

Using the CRISPIN function we develop into a full shell and create sundries effect for the footwear patterns (fig. 9).

Fig 9: *Full shell and sundries effect for footwear patterns*

5.3 Pattern development and execution of the assessment of part pattern

Using the function 'Parts Manager' allows the operator to quickly view the part names developed in the pattern with the ability to view the parts as required (see fig. 10).

Engineer features ready-to-use database connectivity through our 'Data Store' product. This will allow the transmission of patterns around the world for evaluation or interactive on-line 'redlining'. Using the task Assess we can perform the assessment of part pattern for determinining the economic efficiency. (fig. 10)

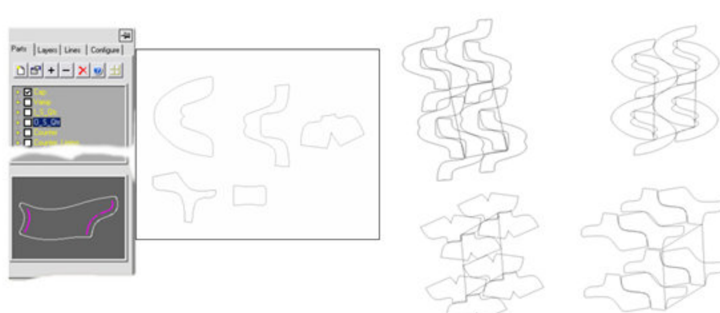

Fig. 10: *Pattern development, creating and visualization of data base of the component parts the base model's and part pattern assessment*

5.4 Grading

The grading a pattern and/or parts can to make by using the **Grade Task Tool Tray**. This task has many functions which launches the dialogs providing all the facilities to set up a size range and grading parameters. The major functions for the grade are: Choice of **Arithmetic** or **Geometric grade** and whether or not width fittings apply.

Using arithmetic grading basically means that you simply add the size increment value to the previous graded size. If you were to plot the size change on a graph you would find that the resulting line is straight. Geometric grade, where the increment values are applied as a percentage, will produce a curved line.

Using geometric grading basically means that you apply the size increment value as a percentage of the previous graded size. If you were to plot the size change on a graph you would find that the resulting line is curved.

– The definition of the model size, its length and width measurements. The button at the left will start a special measure function. (see figure 11) The values measured are actually stored within the pattern documentation.

– Create and place **Grade Centres** to control the grading process

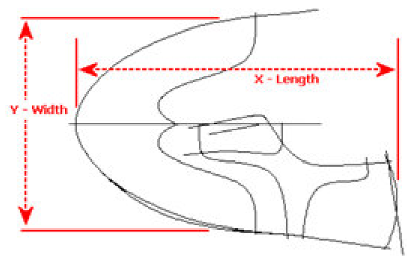

Fig. 11: *Full shell and sundries effect for footwear patterns*

Notes:

1. A 'free space' grade centre actually 'sits' on a single point base line.
2. Any subsequent grade centres can be placed on any standard line type or the intersection of any two lines.
3. When a single line is picked you will be able to put the grade centre at either end of the line.
4. A grade centre can be placed on another grade centre's base line point, thus 'stacking' them at a single location.

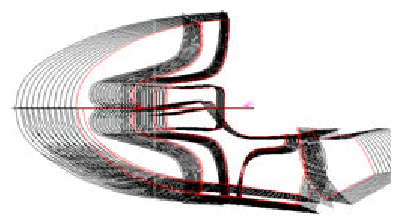

Fig. 12: *Results of the grading*

6. CONCLUSION

With **CRISPIN Dynamics** we can visualise a range of designs on-screen, work out the costs of a new style and even cut out sample shoe components. Reliance on manual skills is largely eliminated, so the staff can work creatively, but with increased accuracy and productivity. Also, it is possible to send designs to a distant office or manufacturing centre in a matter of minutes.

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[6] *** DELCAM Crispin CAD

CONTRIBUTIONS TO DESIGN CHANNELS INJECTION INTO MOULDES FOR FOOTWEAR

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Abstract: *Semi products used in the shoe manufacturing are mostly made through polymer blend injecting in moulds. The injection moulds are designed with one or more cavities. When the mould has only one cavity the injection is made straight in cavity through one canal or through one main canal and more auxiliary canals. In multiple cavity injection always uses the primary canal and more auxiliary canals. The cavities of the mould may be posted symmetrically or asymmetrically referring to the main canal. The correct dimensioning of the injection system determines the quality of the injected pieces and the productivity of the manufacturing process. In the same time, the injection parameters have a lot of values depending of the injected plastic mass. The aspects of the designing of the moulds for shoe manufacturing are complex. The paper presents some contributions in the designing of the injection systems of the mould cavities in shoe industry. It develops some aspects about the optimization of the principal and secondary injection canals placing confronted by the mould cavities, some aspects about the injection canals placing straight contactly with the mould cavities depending on the shape and the dimension of the cavities and some aspects about the dimensioning of the injection canals.*

Key words: *footwear, moulds, injection systems*

1. INTRODUCTION

The semiproducts used in the shoe manufacturing are mostly made through polymer blend injecting in moulds. The injection moulds are designed with one or more cavities.
The moulds with one cavity are used in shoe making straight on the vamp and in polymer blend shoe making.

The moulds with two cavities are used for making of the soles which were assembled on the vamps and for making of the inner soles with plastic mass injected joint.

The moulds with more then two cavities (always in an even number) are used in heels and heel covers making and, sometimes, in simultaneous making of two pairs of soles [1].
When the mould has only one cavity the injection is made straight in cavity through one canal or through one main canal and more auxiliary canals.

The cavities of the mould may be posted symmetrically or asymmetrically referring to the main canal.

The penetration of the polymer blend from the distribution canals to every cavity of the mould is made through one barrier which realizes a flow rate and a temperature increasing compensating the heat losses along the canals [2].

The unit between the injection nozzle, the canals and the barriers passed by polymer blend to the mould cavity make up the injection system of the mould.

The designing of this unit means to post the cavities and the injection canals in the mould, to dimension the canals and to post the contact points between the injection canals and the mould cavities.

The correct dimensioning of the injection system determines the quality of the injected pieces and the productivity of the manufacturing process.

The injected pieces of the shoe manufacturing use the systems with direct injection through only one unheated canal or through one unheated main canal and more auxiliary distribution canals, or through one heated canal and more auxiliary distribution canals [1,2].

The shoes, the shoe soles, the heels etc. have a large variety of shapes, dimensions and sizes. In the same time, the injection parameters have a lot of values depending of the injected plastic mass.

The aspects of the designing of the moulds for shoe manufacturing are complex and represent a problem for the specialists.

The paper presents some contributions in the designing of the injection systems of the mould cavities in shoes industry, about the placing of the main and auxiliary injection canals referring to the mould cavities, about the dimensioning of the canals and the barriers, about the placing of the injection canals straight contacting the mould cavities.

2. THEORETICAL AND EXPERIMENTAL CONTRIBUTIONS

2.1. The placing of the injection canals referring to the cavities of the mould

When the polymer melting is injected in many cavities of the same mould, it is used one main canal and more auxiliary canals.

The mould cavities may be placed symmetrically to the main canal (in this case, the auxiliary canals have equal diameters and lengths) or asymmetrically In the unsymmetrical placing case there are used auxiliary canals with different diameters and different lengths.

The grouping possibilities of the cavities around the main canal [2] are figured in Fig. 1.

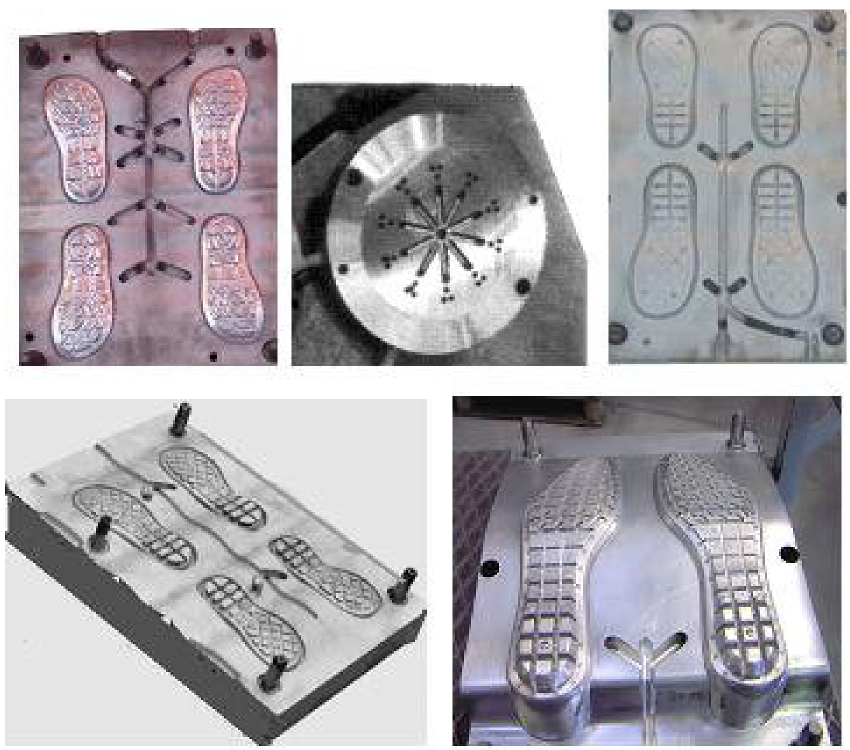

Fig.1: *The placing possibilities of the mould cavities referring to the main injection canal*

2.2. The dimensioning of the injection canals

When the distribution canals of the polymer melting is dimensioned in the mould cavities there are restricted: the filling of all mould cavities must take place in the same time; the friction head in the canals must be minimal and the filling volumetric speed of the cavities must be constant whatever of their placing referring to the main canal. The theoretical conclusions [2] show that the circular section of the distribution canals is better for polymer blend flowing. In this case, the flow speed has a second degree curve distribution along the section Fig. 2.

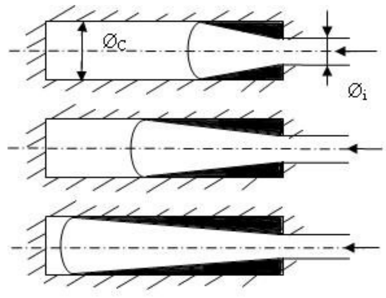

Fig. 2: The polymer blend flowing through a circular section injected

When the thermoplastic plastic masses flow (liquefied in injection equipment), the Reynolds coefficient has the following values: Re=0,5-0,05; so, the flowing is a parallel one. In this case, the friction and the friction head have big values.

The friction relation (1) is:

$$\lambda = \frac{64}{\mathrm{Re}} \cong 1280 \div 12800 \qquad \textbf{(1)}$$

This friction goes to the friction head, relation (2):

$$\Delta p = \lambda \frac{l}{D} \frac{v^2}{2} \rho = \frac{64}{\mathrm{Re}} \frac{l}{D} \frac{v^2}{2} \rho \qquad \textbf{(2)}$$

l - canal length, [m]; D- canal diameter, [m]; v- speed, [m/s]; ρ-density, [Kg/m^3].

Replacing the Reynolds definitely parameters, it results relation (3):

$$\Delta p = 32 \frac{\eta l v}{D^2} \qquad \textbf{(3)}$$

H- dynamic viscosity.

Replacing the speed with the flow rate Q, in relation (3)

$(v = \frac{4Q}{\pi D^2})$, it results: $$\Delta p = 40{,}77 \eta \frac{1}{D^4} Q \qquad \textbf{(4)}$$

Relation (4) shows that a small diameter variation for the same flow rate Q goes to the variation of the friction head with a four exponent.

In working condition, the smallest diameter will be choose; so, the technological loses through the solidification of the plastic mass in the feeding canal will be reduced.

The dimensioning of the feeding canals must provide zero value for the speed loose. In general case, when the mould has “n” cavities, when the feeding of the cavities is simultaneously (having a uniform flow rate in each auxiliary canal) the diameter of the canals is in relations (5), (6) and (7).

$$nq = Q \qquad \textbf{(5)}$$

where:
n-number of the auxiliary canals;
q-flow rate through the auxiliary canal;
Q-flow rate through the main canal.

$$\frac{n \pi d^2}{4} v = \frac{\pi D^2}{4} v \qquad \textbf{(6)}$$

where:
D-diameter of the main canal [m];
d-diameter of the auxiliary canal [m].

$$nd^2 = D^2 \tag{7}$$

where:
d-diameter of the auxiliary canals, [m];
D-diameter of the main canal, [m];

Considering the friction head through the auxiliary feeding canals for a symmetrical placing, their diameter must be modified, so the flowing speed of the polymer blend will be constant. So, relation (7) becomes:

$$nd^2 \triangleright D^2 \tag{8}$$

The unsymmetrical placing of the cavities (referring to the main canal) imposes feeding canals with different diameters. The placing of the cavities in symmetrical positions (referring to the main canal) is the most important condition for a constant flow speed through the feeding canals, in the feeding of different cavities of the same mould.

3. RESULTS AND DISCUSSION

After years researches, the authors observed that the nozzles and the feeding canals of the moulds used in shoe manufacturing have small diameters, between 3 and 7 mm. Using bigger diameters (an advantage in the injection process) goes to the decreasing of the injection net efficiency because of the plastic mass solidificated into the feeding canal losses.

Table 1 shows some dimensions of the feeding canals of the moulds used in shoe manufacturing [3]. The dimensioning of the canals depends on the mass of the injected pieces and on the type of the polymer blend.

Table 1: *The diameter of the injection canals depending on the polymer and the mass of the injected piece*

Polymer	Mass of the piece , g				
	20-50	50-100	100-150	150-200	200-300
	Canal diameter, mm				
Polymerized vinyl chloride	4	4,5	5	5,5	6
Polystyrene	4	4,5	5	5,5	6
Polypropylene	5	5,5	6	6,5	7
Polyethylene	4,5	5	5,5	6	6,5
Polyamide	4	4,5	5	5,5	6

The values in Table 1 were calculated for a minimum level, for the moulds designing. If it will be necessary, when the moulds will be experimentally verified, the diameters of the nozzle and of the injection canals will be increased.

The length of the injection main canal depends on the size of the mould plates, on the number of the auxiliary canals and on the cavities volume. The recommendation is a ratio l/d between 5 and 9 (l-canal length; d-canal diameter).The penetration of the plastic material from the distribution canal to each cavity of the mould is through a barrier, Fig. 3.

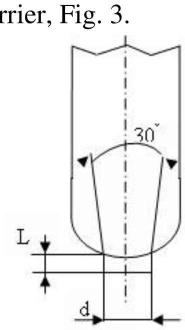

Fig. 3: *The representation of the injection canal barrier: d-barrier diameter ; l-barrier length*

The presence of the barrier determines a flow speed and a melting temperature increase compensating the heating losses along the canals. Generally, the designing of the barriers is for minimum dimensions; so, after the mould testing, the dimensions may be increased, in case. The dimensions of the barriers depending on the injected pieces mass are presented in Table 2.

Table 2: *Dimensions of the injection canal barrier*

No.	Piece mass ,g	Barrier diameter, mm	Barrier length, mm
1.	20-50	0,8-1,2	2
2.	50-100	1,2-1,8	2,5
3.	100-150	1,5-2,5	2,5
4.	150-200	1,5-2,5	3
5.	200-300	1,5-2,5	3

When the injection is made in cavities having large variations for the cross and longitudinal dimensions, the polymer melting moves forward in a jet, along a filling direction which is in an opposite direction in comparison with the injection nozzle; so, the mould cavity fills up through pressing while the injected polymer cools, Fig. 4. The cooling takes place layer by layer as long as the polymer blend contacts the walls of the mould cavity [1],[4]. When the whole cavity fills up, the pressure in the mould cavity has a maximum value; in time, increasing the feeding speed goes to the cooling of the polymeric material into the canal and to the sealing of the cavity.

An important aspect in the injection of the polymer melting is the placing of the contact points of the injection canals referring to the mould cavities.

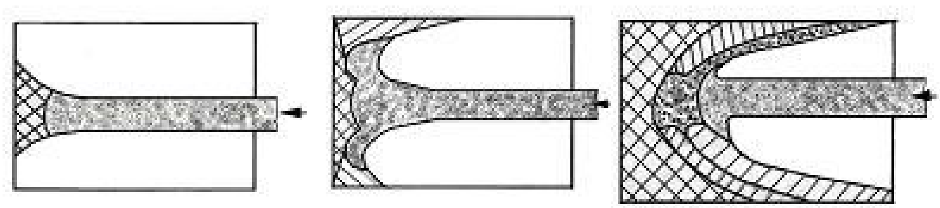

Fig. 4: *The filling up of the mould cavity through pressing*

When the injection of the shoe soles takes place, the phenomenon is more complex (due to the variation of the dimension along the two axes); so it has some solutions, [5] showed in Fig. 5.

When the injection point is chosen it must consider the polymer blend flowing but the soles aspects after the plastic mass solidification, too.

It is known that, after the breaking of the connection between the plastic mass from the feeding canal and the injected object, on that contact area appears a visible sign. The feeding along the length of the cavity goes to the most uniform filling up. But this solution is a rare one in the injection of the shoe soles, because of the contact area between the sole and the feeding canal, the sign being an aesthetic one. The solution will be adopt only if this inconvenient may be invisible. Often, the feeding of the soles cavities will be made along a normal line of those length.

When the soles injection is straight on the vamps (when the injection is made from the exterior of the cavity, respectively the sole area with non-slip relief) the placement of the injection point will be invisible due to the design of the relief.

In the case of soles injection obtained as semi-products which will be assembled with sewing or gluing on the vamps, the injection will be made from the exterior of the cavity. In this case, the choosing of the injection point will not be restricted by the esthetics conditions anymore.

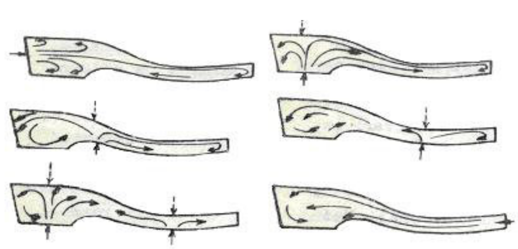

Fig. 5: *Some variants of the placing of the contact point between the injection canal and the cavity, in the soles injection*

When the main canals of the moulds are heated and the polymer blend is in a fluid state, it will make 2-3 auxiliary distribution canals. So, the injection efficiency will be increased without the increasing of the lost plastic mass which solidified into the canals.

4. CONCLUSIONS

The designing of the injection systems of the moulds used in the shoe manufacturing must respect the following conditions:

- When the feeding is simultaneous in more cavities, the cavities designing will be in symmetrical position relating to the feeding main canal. So, the flowing speed of the polymer melting through the canals is constant.
- When the distribution canal of the polymer melting in the mould cavity will be dimensioned, the filling up of all mould cavities must be in the same time; the flowing way of the polymer melting must be as short as possible; the passing from the main canal to the auxiliary ones must have big curvature radius; the pressure losses into the canals must be minimum; the volumetric filling up speed into the cavity must be constant even the position of the cavity is relative to the main canal.
- The nozzles and the feeding canals of the mould cavities used in shoe manufacturing have diameters between 3 and 7 mm. The using bigger diameters (which is a favorable situation for the injection process) goes to the decreasing of the injection net efficiency, because of the looses caused by the solidification of the plastic mass into the feeding canals.
- When the injection of the shoe soles is made, the placing of the injection canals in straight contact with the cavity will be adopt as the connection band on the sole surface to be invisible.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

STORAGE OPTIMIZATION IN AN EXISTING BUSINESS LEATHER GOODS

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Abstract: *The deposit is the sector in a business where profit can be calculated exactly and improved logistics cost reduction, increased efficiency, optimization of distribution, surveillance elements of the supply chain, traceability - continuous monitoring, improved quality of supplies / services to customers. The study presented in this paper was conducted in the company of handbags S.A. Artima, in Chisinau. The organization has analyzed a large number of storage areas, all meeting the confort function, but that is not used within the storage area. As a storage facility used deposit old buildings that are located within the enterprise and deposits from building company. Analyzing the current situation we can conclude only negative: large number of deposits, leading to loss of control and stored products; storage located at a distance from each other, which leads to the increase of the supply materials for the production sectors. To establish and analyze the negative points above, the paper calculated the actual extent of area use and storage facilities. According to figures obtained, we see that the surfaces of all deposits not used to the fullest. The best result is recording finished goods warehouse, where the coefficient of area use record figure of 0,86, which means that 14% are used for the space between the goods stored, the space motion. A result very little is recording central warehouse supplies, use the volume coefficient is 0,20. In this paper, several recommendations that will make enterprise the following benefits: improved productivity; increase in the accuracy of data; increase customer loyalty and increase their expectations.*

Key words: *deposits, functions, objectives, enterprise, classification*

1. INTRODUCTION

According concept between production and transport logistics, transport and consumer must necessarily be deposits. The existence of deposits is related to the need to maintain stocks. Storage is considered an activity of the product according to the quantity and quality required, in the right place at the right time. Role deposit consists of [1]: coordinating supply and demand; achieve cost savings; continuation or postponement of production / processing; achievement of marketing objectives.

The diversity of work being performed in different repositories, it is basically the same, or very similar. This is due to the fact that different types of storage to meet specific functions. For each warehouse, range of functions and their importance depends on many factors, including the owner and user storage space, their political peculiarities suppliers and customer base, scale user activity and products covered storage. In logistic systems, deposits can perform the following main functions [1, 2]: keeping the goods, raw materials, semi-finished; strengthening supply; dividing the batch creating a structure type; providing value-added services; preparing batches of raw material through manufacturing; forming a logical chain service system. Performance of the functions presented in operations requires handling the products. These operations fall into the following categories: loading and unloading; movements to and from the storage area; the execution orders.

Storage includes the following elements: the placement of material during their stay in stocks; facilities to ensure the safety of material (buildings, tanks, etc.); ancillary facilities (input to ground, driveways, etc.); a set of special devices and equipment for storage, handling, stacking and packaging materials, semi-finished or finished products (shelving, forklifts, etc.); weighing and measuring; information and control necessary for the subsystem of accounting, control, coordination and implementation, and to check the availability of resources (products) and their conservation.

The main objectives of warehouse logistics are [2, 4, 5]: organizing a rational system of warehouse operations with minimal cost to perform data operations; efficient use of all components, making full use of the storage areas (storage, handling and processing equipment, driveways, etc.); identifying and removing unused properties; providing timely and complete information on the dynamics of stocks; keeping the optimum materials and finished products; reduced costs for storage, handling, transport.

2. CALCULATION OF SURFACE DEPOSITS

The deposits are characterized by area, volume, number of days of storage, respectively optimum height. The storage area can be structured as [6]:

- Area: reception area (unloading training load units, reception quantitative and qualitative); storage (storage, storage, conditioning, packaging purposes of loading and unloading of raw materials and finished products from storage); surface delivery (order for delivery, preparation for sale, making consignments for dispatch to customers).
- Auxiliary area: offices; spaces organizational processes related to inventory management; laboratories for quality control of raw materials and finished products; social spaces, sanitary transport; movement corridors.

For smooth running of the production activity following deposits are required main storage materials; warehouse of finished products; deposit recoverable materials.

a) The surface deposit materials

Total storage of raw materials (leather, artificial leather auxiliaries) is determined by the relationship:

$$S_T = S_u + S_a \quad [m^2] \tag{1}$$

where: Su - area occupied actually stored materials; Sa - auxiliary surface including: reception area, reception of goods; handling and movement; collection surface-shipment; area occupied by furniture technology for recording.

Auxiliary surface is determined by the relationship:

$$S_a = S_u \cdot K \quad [m^2] \tag{2}$$

where: K = 0,4 to 0,5 is ratio of the area of use.

The storage capacity is calculated for regulatory storage for 20 days. Storage of raw material by material can be made by stacking or palletizing.

When stored by stacking area capacity is calculated by the following equation:

$$S_u = S_s = \frac{V}{h} = \frac{Q_f \cdot N_c \cdot l \cdot g \cdot z}{h} \tag{3}$$

where: S_s is the area occupied by the stack; N_c - consumption norm or requirement material [m / day]; l - width is in m; g - the thickness of a layer of material, in m; z - equal to the number of days of storage 20 days; h - the height of the stacks: 1,5 - 2 m.

When storing several types of material:

$$S_u = S_{u1} + S_{u2} + S_{u3} + \ldots + S_{un} \quad [m^2] \tag{4}$$

Stacks can be performed on the floor or shelf deposit.

When storing the relationship palletizing calculation is:

$$S_u = \frac{N_{cel}}{4 \cdot S_{cel}} \quad [m^2] \tag{5}$$

where: N_{cel} is the number of cells in which the shelf blades are inserted; S_{cel} - the surface of a cell rack.

$$N_{cel} = \frac{S_c}{q_c} \tag{6}$$

$$S_c = n_f \cdot Q_f \cdot z \cdot n_{sc} \cdot N_c \quad \textbf{(7)}$$

where: N_c - material requirements or consumption norm; S_c - current stock; Q_f - production task in pairs / minutes • man; nsc - number of exchanges; z - number of days of storage is 20 days; qc - the ability of a cell [m^2] or [kg].

b) Area warehouse for finished products

The capacity of the warehouse is designed for a period of 10 days. Storage of finished products is done in cartons sits on the shelf or directly on the floor.

Surface deposit:

$$S_T = S_u+S_a = S_u + (0,4\div0,5)\ S_u = S_u \cdot (1+(0,4\div0,5)) \quad \textbf{(8)}$$

The usable area is the relationship:

$$S_u = \frac{N_{cel}}{4 \cdot S_{cel}} \quad [m^2] \quad \textbf{(9)}$$

$$N_{cel} = \frac{Q_f \cdot 10}{n_{pcel}} \quad \textbf{(10)}$$

where: Q_f is the task of production; 10 - the number of days stored; n_{pcel} - the number of products in a compartment set according to the number of a box and the number of boxes that can be placed in a palette.

Assessment of actual utilization of storage areas and is achieved through the following coefficients [7] surface utilization coefficient; coefficient of utilization position; coefficient of utilization of the volume; coefficient using landfill capacity over time; total cost per unit stored.

• Use of the surface coefficient (Kus), which represents the degree of utilization of the total area of the actual storage (Sd) and the total area of the deposit (Sdt):

$$Kus = \frac{Sd}{Sdt} \quad \textbf{(11)}$$

• Height warehouse utilization coefficient (Kuî), by which it determines the use of warehouse height is calculated as the ratio between the average height of the deposit (Îm) and the maximum useful height (Îmu):

$$Ku\hat{i} = \frac{\hat{I}m}{\hat{I}mu} \quad \textbf{(12)}$$

• The coefficient of utilization of the volume (Kuî), which is the percentage use of the volume of the deposit being calculated as the product of the coefficient of use of the surface (Kus) and the pumping rate of the user (Kuî):

$$Ku\hat{i} = Kus \cdot Ku\hat{i} \quad \textbf{(13)}$$

• Coefficient while using landfill capacity, calculated as the ratio of the product of the amount deposited (Qd) and days of operation of the landfill (Zf) and the product from the warehouse capacity (Cd) by calendar days of the year (365):

$$Kfcd = \frac{Qd \cdot Zf}{Cd \cdot 365} \quad \textbf{(14)}$$

• The total cost per unit stored (CTud), with which one can know the expenses necessary for the storage unit volume during a calendar year, calculated using the following formula:

$$CTud = \frac{Vi \cdot A + Che}{Qd} \quad \textbf{(15)}$$

where: Vi is the value of all fixed assets inventory in the warehouse; A - the depreciation of fixed assets; Che - operating expenses; Qd-quantity stored.

3. DEPOSITS CHARACTERISTIC OF THE LEATHER GOODS ENTERPRISE

The deposit is the sector in a business where profit can be calculated exactly and improved logistics cost reduction, increased efficiency, optimization of distribution, surveillance elements of the supply chain, traceability - continuous monitoring, improved quality of supplies/services customer [8].

The study presented in this paper was conducted in the company of handbags S.A. Artima, in Chisinau. The enterprise has analyzed a large number of storage areas, all meeting the confort function, but that is not used within the storage area. As a storage facility used deposit old buildings that are located within the enterprise and deposits from building company. The number, type, size and location of the place deposits in the company specified in table 1.

Table 1: *Number and types of deposits in the company*

Nr. deposits	Name of the facility	The location	Nr. de space	Area, m^2	Height, m
1.	Finished goods warehouse	Building company, 2nd floor	1	128	5,5
2.	Central Storage of materials	Building company, 1st floor	1	131,5	5,5
2.a.	Deposit materials	Across enterprise	1	170	5,5
2.b.	Raw materials warehouse	Across enterprise	1	170	5,5
3.	Central warehouse supplies	Building company, 1st floor	1	90	5,5
3.a.	Warehouse supplies 1	Across enterprise	2	124	5,5
3.b.	Warehouse supplies 2	Across enterprise	1	72	5,5
4.	Repository for technical means	Building company, 2nd floor	1	96	5,5
5.	Warehouse workshop	Building company, floor 3 and 4	5	18	5,5

Finished goods warehouse (figure 1) is a space where products are packaged and stored. Because the final product is packed in boxes 1-3 products each space is equipped with equipment. Here is the output stored until delivery, which usually occur every week. In terms of location, is favorably located as it is close to the elevator.

Fig. 1: *Finished products warehouse*

Fig. 2: *Central Storage of materials*

In the central warehouse of materials (figure 2) are kept baled material, rolls of paper, cardboard, polypropylene rolls, thread, elastic tape, velcro, Astrakhan, as well as adhesives, ie all basic and auxiliary materials which products are made.

In stores across the company are kept the same types of materials as in the office. Here, however, there is downloading, receiving and keeping bales and all kinds of materials. And when they are needed in production are transferred to the central warehouse of materials and raw materials, and will be launched in production.

Warehouse supplies (figure 3) consists of a central space in the building enterprise located on the 1st floor, just two storage for supplies and accessories located in the building across company. Warehouse supplies office is located in building enterprise space on the 1st floor, where it is stored and kept supplies. The store located on the 1st floor, central warehouse supplies are stored and maintained so as accessories, zipper, eyelets, rivets, tags, and other accessories and supplies small size and is launched directly in production.

For keeping of delivery and accessories are in stock, and the remaining models no longer produced is used warehouse building across company. Also, store supplies 2 (figure 4) are stored as products such as wheels, handles mechanical, carcasses, etc. In these spaces not used any type of machine, since this type of accessories is kept in large size boxes on the floor.


Fig. 3: *Central warehouse supplies*


Fig. 4: *Warehouse supplies two*

Repository for technical means of production is the space of sections which currently operates. Here are stored the old machinery or inoperative. Within each section are producing technological flows, each flow sheet has each workshop deposit. The deposit is located in the workshop production floor sections 3 and 4, there are kept supplies needed for a week to plan production. Each workshop warehouse has fixed storage shelves of delivery and accessories.

From the above we can conclude only negative: number of deposits, leading to loss of control and stored products; outdated equipment that occupies a lot of space; lack of specialized equipment needed for the activity in the deposits; storage located at a distance from each other, which leads to the increase of the supply materials for the production sectors.

To establish and analyze the negative points above, below calculated actual level of use of the areas and storage spaces. The data obtained are shown in table 2.

Table 2: *Coefficients determining the actual level of use of storage and areas*

Name of the facility	Use of the surface coefficient	The coefficient of use of height	The coefficient of utilization of the volume
Finished goods warehouse	0,86	0,45	0,39
Central Storage of materials	0,79	0,27	0,21
Deposit materials	0,70	0,27	0,19
Raw materials warehouse	0,70	0,27	0,19
Central warehouse supplies	0,55	0,36	0,20
Warehouse supplies 1	0,48	0,45	0,22
Warehouse supplies 2	0,67	0,36	0,24
Repository for technical means	0,93	0,27	0,25
Warehouse workshop	0,67	0,36	0,24

The coeficineții give as close to 1, so the storage area is used as efficiently as possible. Minimum allowable occupancy areas, height and volume is 0,66. According to figures obtained, we see that the surfaces of all deposits not used to the fullest. The best result is recording finished goods warehouse, where the coefficient of area use record figure of 0,86, which means that 14% are used for the space between the goods stored, the space motion. But all that storage does not use his height to the maximum, which is observed by the coefficient of utilization that reaches heights of 0,45, which leads to the use ineficentă room volume, only 39%. All other results it is observed that the surface height is used very little, all deposits recorded in the 0,66 index, reaching even to 0,27, this is due to lack of special equipment. Similarly, if the height is not used within premises or their volume is not used in full capacity. Deposits due to lack of material fixed pallet racking, Bale, as the volume used is only 22% and even reach 19%. All this is because the bales of materials are stored directly on the floor. A result very little is recording central warehouse supplies, use the volume coefficient is 0,20. Similarly, the coefficient of utilization of the storage volume supplies 1 and 2 recorded 0,22 to 0,24. Although these deposits are kept out of production or the products in stock, room volume is used inefficiently. Products stored in these rooms could be transferred to the central warehouse supplies, if it has the right machine. Other storage also does not record high coefficient.

The calculations can be noted that the concentration of all products stored can be done in several central areas where they would dispose of specialized equipment such as racks of different types and electric height for seating products.

4. CONCLUSIONS

Analysis of the deposits in the leather goods enterprise allowed the following conclusions:

- In the enterprise used a large number of storage spaces. This highlights the many negative aspects, such as: distance in e storage areas; records stored on raw ineffective.
- Old equipment, and even absence. Because of the lack of storage equipment, bales of material are deposited directly on the floor, which takes up only the surface of the deposit, while its height is used. Old equipment, such as racks, used for storing accessories.
- Renting storage space across the enterprise and use of income given to purchase equipment and warehouse management system.

These proposals will bring enterprise the following benefits: improved productivity; increase in the accuracy of data; increase customer loyalty and increase their expectations; reduce and streamline routes and movement of raw materials and finished products; reducing storage space by more efficient use of height; reduce cases of missing stock; organization and efficient use of storage space; increase product quality.

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MAPPING THE VARIATIONS OF TENSILE STRENGTH OVER THE AREA OF SHEEPSKIN LEATHER

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Abstract: *Leather is not a uniform material from a structural perspective. The physical properties of leather change depending on the animal type and the animal individually. Furthermore these properties vary depending on the position and direction of sampling over its area. The aim of this study was to measure some physical properties of garment sheepskin leathers over the whole areas and then draw strength maps to provide information for cutting of leathers for garment production. For this aim, surface area of 10 chromium tanned nappa sheep leathers have been sampled with standard press knife of tensile strength into 2147 samples. 5 leathers were sampled perpendicular and the other 5 leathers were sampled parallel to the line of backbone of sheep skins. Thickness, tensile strength, elongation at break values for each sample has been measured and recorded. Then strength maps were drawn by using MATLAB (Matrix LABoratory) software that allows matrix manipulations, plotting of functions and data. The findings showed that the strength and stretch properties change directionally and locational over the area of the leather, the strength decreased gradually while moving away from the line of backbone to the edges and the areas around kidneys were weaker than the areas around neck.*

Key words: *Leather, Sheepskin, Garment, Tensile Strength*

1. INTRODUCTION

To begin with, leather is a sheet material with the area of each piece ranging from tens of square centimetres to six, seven or more square meters depending on the animal from which it was obtained. Until the development of woven textiles it was the only material available in sheets of this size [1].

However leather is not a uniform material from a structural perspective. The physical properties of leather change depending on the animal type and the animal individually. Furthermore these properties exhibit variations in different parts over the leather area.

Leather is anisotropic material, its fibre bundles reportedly being oriented in different directions depending on the location on the skin and the animal from which it originated [2,3]. This difference in direction of fibre bundles reportedly affects some physical properties such as ultimate tensile strength, and accounts for some of the variability observed in properties of finished leather [2].

The strength of leather varies so widely in different parts of the skin as to make recorded values meaningless if the location of the test piece is not indicated [4].

The scientific and commercial significance of variations in strength and stretch in leather has been discussed by Daniels considering the works of Wilson and Swaysland [5, 4, 6]. The studies were based on calf skins and hides. However there is not any information available on sheepskins, which are an important material for garment leathers.

Producing garments from leathers have significant differences than textiles. Leather is a specific material showing different touch, elasticity, drape, strength, etc. properties of its own. The garments are made up of many patterns, because area and physical properties of leather are not uniform. Placing patterns on leathers and cutting are also more difficult than textile. A certain number of leather batch is sorted for a garment, the patterns are placed considering physical properties of leathers, where the pattern will be used and the form of the garment [7].

The aim of this study is to measure some physical properties of garment sheepskin leathers over the whole areas and then draw strength maps to give information to for cutting of leathers for garment production.

2. MATERIAL AND METHOD

2.1 Material

- 10 chromium tanned sheepskin leathers obtained from a company producing leathers for garment manufacture
- Hydraulic press and press knives for cutting leather specimen
- Satra-Thickness gauge for thickness measurement of leathers,
- Shimadzu AG-IS Tensile Tester and Trapezium-2 software for testing physical properties,
- MATLAB R2011a software for drawing maps of strength

2.2 Method

Physical properties of leathers represent some variations related to humidity and temperature [8]. Leather samples have been conditioned at 23±2°C and 50±5% relative humidity for 48 hours and the tests were carried out at the same conditions according to TS EN ISO 2419 standard [9].

The thicknesses of leather samples have been measured with SATRA Thickness Gauge according to TS 4117 EN ISO 2589 standard [10].

The tensile strength and percentage of elongation of leather samples have been measured by using Shimadzu AG-IS Tensile Tester and Trapezium-2 software according to TS EN ISO 3376 standard [11].

The samples were cut by using a standard press knife with the dimensions shown in Fig. 1.

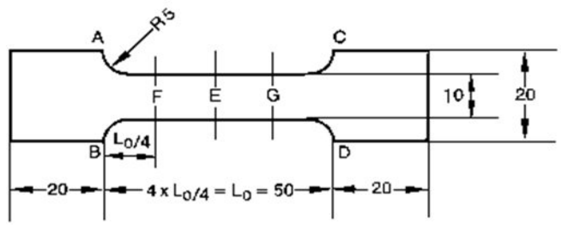

Fig.1: *Dimensions of press knife used for tensile strength*

The samples were taken perpendicular to the line of backbone from 5 leathers and parallel to the line of backbone from the other 5 leathers as shown in Fig. 2 and Fig.3. [Wilson].

Fig.2: *Perpendicular sampling*

Fig.3: *Parallel sampling*

Table 1: *Leather codes and their sampling direction, areas and number of samples*

LEATHER CODE	SAMPLING DIRECTION TO BACKBONE	LEATHER AREA (dm^2)	NUMBER OF SAMPLES
A	Perpendicular	70	228
B	Perpendicular	70	216
C	Perpendicular	71	195
D	Perpendicular	62	193
E	Perpendicular	80	243
F	Parallel	71	209
G	Parallel	83	257
H	Parallel	80	225
I	Parallel	72	205
K	Parallel	63	176

The tensile strength was calculated with the formula (1):

$$Tensile\ Strenght = \frac{Breaking\ load\ (N)}{Area\ of\ cross\ section\ (mm^2)} \quad \textbf{(1)}$$

Each sample was coded regarding to its position over the leather area and the tensile strength data was entered into MATLAB spreadsheet cell according to its original position. Then the maps of strength were plotted by using the "Plot Catalog" function in MATLAB.

3. RESULTS AND DISSCUSSIONS

The minimum, maximum and mean values of thickness, tensile strength, elongation% and maximum force during break measurements for the samples taken perpendicular and parallel to the line of backbone are given in Table 2 and Table 3 respectively.

Table 2: *Thickness, Tensile Strength, Elongation % and Max. Force of perpendicular samples*

LEATHER		Thickness (mm)	Tensile Strength (N/mm^2)	Elongation %	Max. Force (N)
A	Min	0,37	2,53	22,66	10,36
	Max	0,53	21,68	82,99	97,56
	Mean	0,45	9,09	50,53	40,46
B	Min	0,35	2,38	33,39	12,36
	Max	0,58	22,69	90,55	95,30
	Mean	0,47	7,66	62,20	36,20
C	Min	0,38	3,41	30,22	15,36
	Max	0,58	20,26	93,96	106,20
	Mean	0,45	9,76	57,83	44,46
D	Min	0,35	4,17	28,57	15,84
	Max	0,52	18,46	95,89	77,75
	Mean	0,43	10,47	57,94	44,81

E	Min	0,38	2,43	36,79	10,47
	Max	0,59	25,48	91,62	122,32
	Mean	0,46	9,66	57,26	44,56
Mean of Perpendicular Samples	Min	0,37	2,98	30,33	12,88
	Max	0,56	21,71	91,00	99,82
	Mean	0,45	9,33	57,15	42,10

Table 3: *Thickness, Tensile Strength, Elongation % and Max. Force of parallel samples*

LEATHER		**Thickness (mm)**	**Tensile Strength (N/mm^2)**	**Elongation %**	**Max. Force (N)**
F	Min	0,34	3,44	31,29	14,10
	Max	0,57	11,82	155,99	57,91
	Mean	0,45	6,69	85,06	30,68
G	Min	0,35	5,52	40,12	20,57
	Max	0,57	19,06	150,46	91,65
	Mean	0,48	11,69	74,15	56,58
H	Min	0,32	5,34	32,24	22,41
	Max	0,62	20,37	134,32	106,67
	Mean	0,44	11,15	65,65	49,49
I	Min	0,33	3,42	28,96	12,66
	Max	0,50	21,39	159,79	85,56
	Mean	0,41	10,66	78,02	43,35
K	Min	0,27	4,87	30,57	14,42
	Max	0,50	18,47	142,99	77,62
	Mean	0,42	8,61	71,62	36,62
Mean of Parallel Samples	Min	0,32	4,52	32,64	16,83
	Max	0,55	18,22	148,71	83,88
	Mean	0,44	9,76	74,90	43,34

When the data of Table 2 and 3 is compared, it is seen that the mean thickness of leather samples are almost the same being 0.44-0.45mm. That has to be expected because the leathers have been supplied from a garment leather producing company from the same batch.

There is a significant difference in elongation %. The mean elongation percent of parallel samples are % 74.9 and bigger than the mean elongation percent of perpendicular samples, which is % 57.15.

The directions of maximum and minimum stretch in the area now recognised as the "Official Sampling Position" (OSP) run respectively parallel and perpendicular to the backbone. However across the rest of the hide the direction of minimum and maximum values varies. The maximum values run more or less in the direction of the hair follicle, as this roughly follows the direction of the underlying fibre structures. This is indicated in Fig.4. [5]

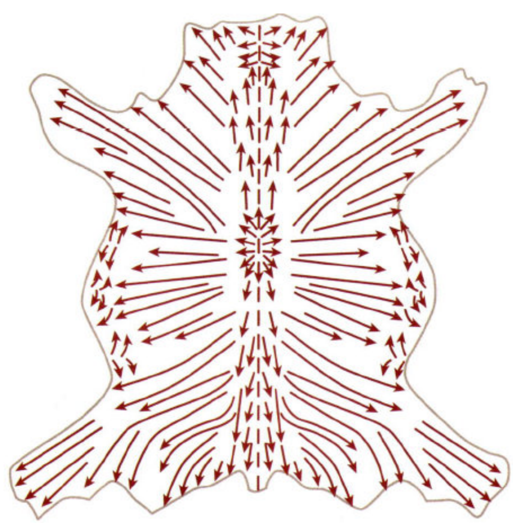

Fig.4: *The direction of the hair follicle approximately follows the underlying fibre direction*

The findings for the elongation % can be used in pattern cutting of garment leathers. The patterns which will be used in moving parts of the body such as arms, elbows, etc. and will be subject to elongation during usage can be placed parallel to the backbone line of sheepskins and the patterns which needs less elongation can be placed perpendicular to the backbone.

The mean tensile strength values of perpendicular and parallel samples show only a little difference, being the perpendicular samples' values slightly lower. However the variations in tensile strength values are remarkable. The mean tensile strength values varies in the range of 2.98-21.71 N/mm^2 and 4.52-18.22 N/mm^2 for perpendicular and parallel samples respectively. This means 4 to 7 multiple times strength variations over the area for the same leather. Acceptable quality standards recommended by United Nations Industrial Development Organization (UNIDO) for chromium tanned garment leathers are 10 N/mm^2 for tensile strength [12]. So, the same leather can meet or fail the quality standards depending the region of sampling. The standard for sampling location (TS EN ISO 2418) determines the standard sampling region for leathers [13]. But, even for a leather which can pass the tests, its week areas can fail the quality. Fig.5 and Fig.6 shows the maps of tensile strength values over the area of whole sheep skin leathers.

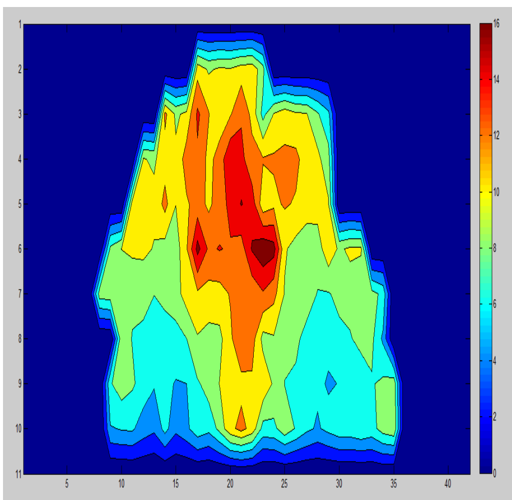

Fig.5: *Map of strength of perpendicular samples*

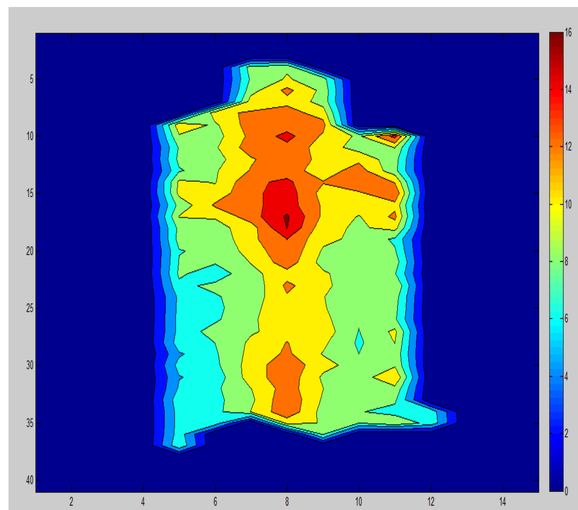

Fig.6: *Map of strength of parallel samples*

4. CONCLUSIONS

- The leather is an anisotropic material, the strength and stretch properties change directionally and locational over the area of the leather
- The strength is not even over any very large area
- The strength is highest close to the backbone line of leathers
- The strength decreases gradually while moving away from the line of backbone to the edges
- The areas around kidneys are weaker than the areas around neck
- These maps can give an aspect for the leather cutters and leather garment producers

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FAST FASHON AND SECOND HAND CLOTHES BETWEEN ECOLOGICAL CONCERNS AND GLOBAL BUSINESS

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Abstract: *The paper presents the concept of the fast fasion and how these lead to an excessive consumption of clothes and as result a growth of the worn products market. The paper also aims to establish how fast fashion is influenting not only the economy also the environment. The fast fashion model can also damage developing economies with a low household income, which are not the necessary most important markets of these companies. Our study has identified the influences in increased purchase behavior and focused esspecialy of the positive relationship between income and clothing expenses. We found out that it is a large gap between the European countries regarding clothing expenses in year and Romania is for far the lowest consumer. It is presented the second hand clothes import-export trade during 2007-2012 and we found out that there is an inverse relation between the balances sheet of import-export of textile products between the developed and developing countries. The authors conclude that the Romania is the largest European importer of second hand clothes but has no large scale recycling. Since collection is done on a voluntary basis it can be confusing for population to know how and where to discard used clothing therefore it is recommended a focus on collection systems of second hand clothes. The methodology used for this paper has mainly been a literature study where both scientific literature, such as scientific articles and reports, and popular science articles have been studied. We also use official information provided from National and International statistical Offices. Academic research on the effects of redirecting used clothing from the waste stream is still in its infancy; however this paper provides some insights into the phenomenon which may add to the emerging literature.*

Key words: *fashion, environment, consumption expenditure, worn clothing trade, textile recycling, Romania.*

1. FAST FASHION AND CONSUMER EXPENDITURE ON CLOTHES

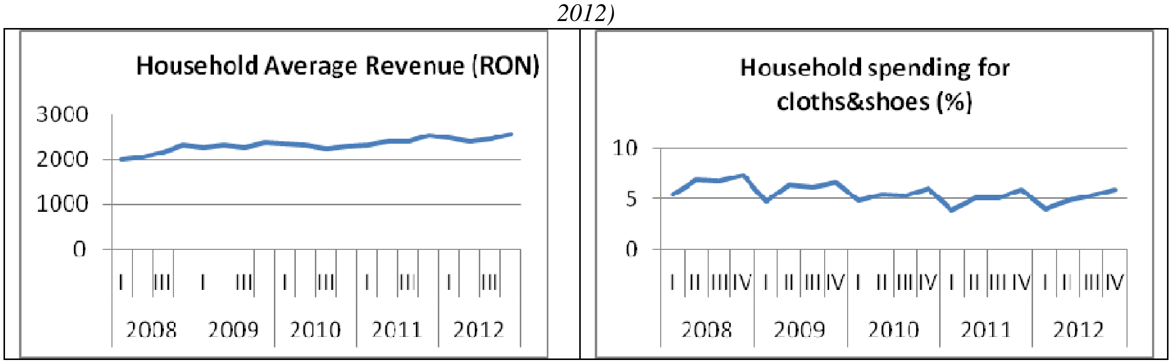
Fashion is defined as an expression that is generally accepted by a group of people over time and has been characterized by several marketing factors such as low predictability, high impulse purchase, shorter life cycle, and high volatility of market demand [1]. More than ever, fashion means fast and becomes unfashionable in a relative short period of time and make consumers to buy new clothes to feel fashionable. That leads to a new industrial trend, the fast fashon concept, which refers to the concept of shortening lead time and offering new products to the market as fast as possible. The increase of fast fashion is causing an important increase in the volume of clothing consumed especially in the developed countries of the world. According a FAO and ICAC [2] survey while the consumption increase in recent years is greater in developing countries 20% between 2004 and 2007, the consumption is also increasing in developed countries with only 8% during the same period. Fast fashion characterizes the speed of today's clothing production and consumption: clothing is designed to be cheap, easy, and rapid to produce, and is created to be distributed, sold, and consumed in ever-increasing quantities [3].

Today's fashion system, on its entire value chain, is complicit in the current ecological crisis, compromising both environmental and human well-being. The conversion of raw textile fiber to finished fabric and final products draws on cheap labor, air pollution, depleting water resources and the use of harmful chemicals [4] . Since these resources take the same amount of time to grow and regenerate, regardless of the product speed to market and waste disposal, the increased rate of production and consumption of fast fashion is agraveting the garments industry's negative impacts. Therefore the consumption growth has implications both in terms of increased textile waste flows and in terms of the environmental impacts related with production, use and end-of-life management of textiles. Most of the studies about environmental burden of clothing focus on the energy consumption, chemicals or toxicity aspects, pay little attention to the effects of redirecting used clothing from the waste stream. In this paper we refer only to the implications of increased textile waste flows on the environment, in terms of the use and end-of-life management of clothes.

The main stream of fast fashion literature indicated folowing key variables that are related with the consumer behavior: renewal cycle, price, quality and supply [5],[6],[7] to wich we add sustainability concerns. The big fast fashion stores like H&M, Gap, Zara, C&A, and United Colours of Benetton etc. have made clothing so affordable that it has lead to an overconsumption of unsustainable clothing. In the case of fast fashion, clothes are often discarded due to not being fashionable anymore. The fast fashion model can also damage developing economies with a low household income, which are not the necessary most important markets of these companies. The weight of household income as a determinant of household expenses has been proven many times in consumer expenses research [8],[9].

There is a positive relation between income and clothing expenditure according to investigations of total disposable income, specific sources of income, and total consumption spending.[10] Clothing and footwear expenditure fluctuated around 370 billion Euros, which means 5.3% of total household consumption. Italy, Germany and the UK are Europe's largest fashion markets in terms of consumption. Average spending on Fashion in the EU-27 is about 700 Euro[11] per year per capita with national averages ranging from under 50 Euro per person in Romania to 1200 Euro per person in Italy. In 2013, the average monthly consumption of a family was 38,51RON (8,5Euro), considering that in urban areas, the members of the households spent a month on clothing, 45,69RON (10 Euro), and in the countryside, 29,15 RON (6,5 Euro)[12]. Chart no.1.shows the household average revenue in Romania and the household spending for clothes in the period 2008-2012.

Chart 1. *The Household Average Revenue and Household spending for cloths and schoes in Romania (2008-2012)*



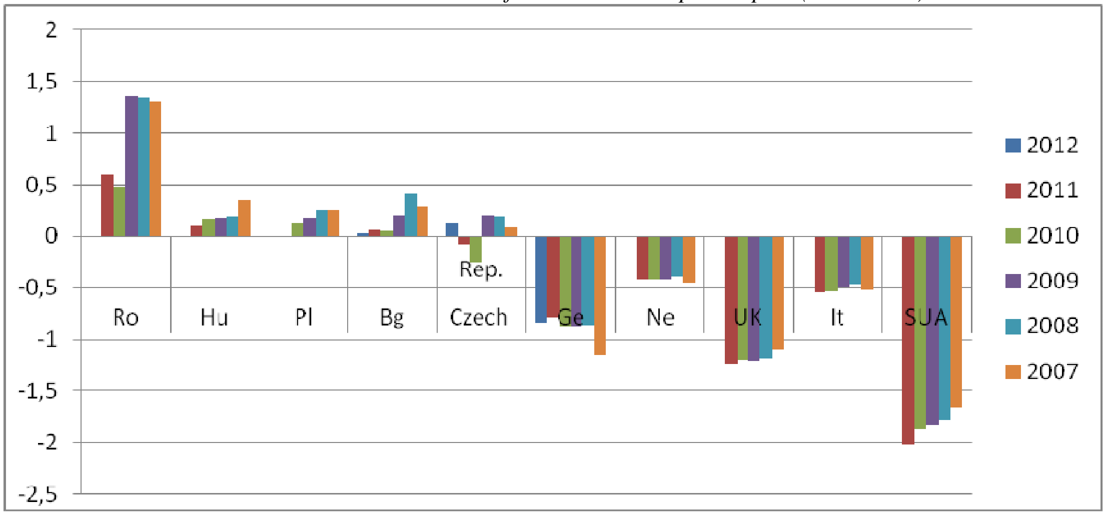
Source: INNS(2008-2012)

2. WORN CLOTHING TRADE IN THE USA AND EU COUNTRIES (2007-2012)

This cheap, second hand clothing is often bundled and sold in developing nations with poor structured distribution channels for transnational clothing corporations and is instead peddled in markets for a small amount. Exporting used clothing products to developing economies for further consumption, a concept usual called "global reuse", provides utility to peoples in developing countries but it can have negative also economical and eclogical consequences.

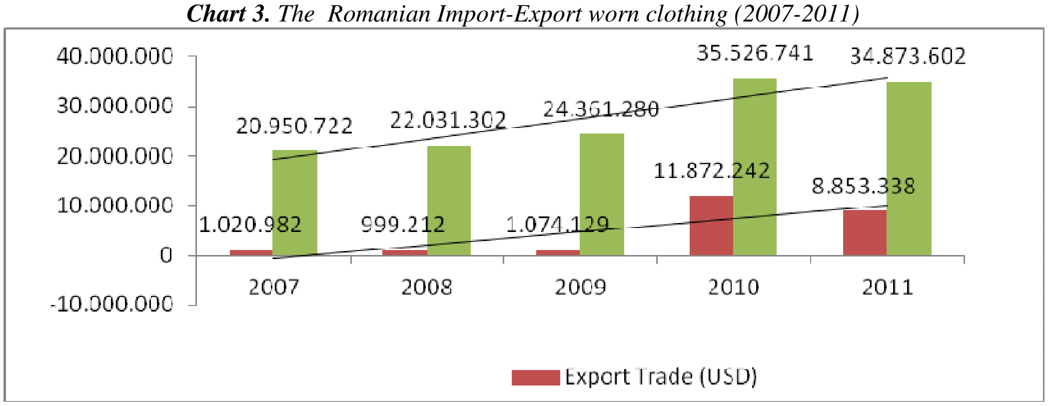
The chart no.2 shows the comparative situation of imports and exports of worn clothing from countries with high consumption of fashion compared to countries with low-level buying, ie countries where household consumption items of clothing is low. Presentations of data are in the logarithmic scale to reduce the wide range of value to a more manageable size. It was also introduce t he USA, although it is not an EU member, because it is the world leader in the worn clothes trade. There is an inverse relation between the balances of import-export of textile products between the developed and developing countries. A special case appears to represent Romania, where the import of second hand clothes had a dramatic increase compared to countries of the former communist bloc. Chart 3 present the positive trend of imports and exports of second hand products in Romania.

Chart 2. *The balance sheet of worn clothes import-export (2007-2012)*



Source: own calculation based on OTEXA, COMTRADE database

Chart 3. *The Romanian Import-Export worn clothing (2007-2011)*



Source: own calculation based on COMTRADE database

3. ECONOMIC AND ECOLOGICAL IMPLICATIONS OF WORN CLOTHING TRADE

From an economic perspective, a significant import of second hand textile products may decrease production for its own market, the decline in sales of new products with cheap, widely available clothes, and last but not least may increase tax evasion. While the supply of fashion (design, manufacture, production and marketing) is well documented, about how the second hand clothing is distributed once it arrives in the destination market it is less known. In Romania there is no nationally organized textile waste collection, nor systematic statistics about it.

From the ecological point of view, worn products also generate waste which, due to lack of proper disposal technologies in developing countries get to pollute more the environment. Although second hand clothing has become a fashion in itself, there is still a widespread opinion that second hand clothing are „dirty" and for those who cannot afford new clothing. That also leads to landfill.

Even as it is estimated that the textile recycling industry recycles approximately 1,9 billion tons of post-consumer textile waste each year, this only accounts for approximately 15% of all textile waste, leaving 85% in the landfills so that textile waste occupies nearly 5% of all landfill space**.** Only within UK the annual textile waste is 2.3 million tonnes, of which only 24% is recovered for reuse and around one million tone of textile waste ends up in landfill every year [13]. In the USA an estimated 14.3 million tons of textiles were generated in 2012, or 5, 7% of total municipal solid waste generation. [14]

According to the European Environment Agency (EEA) [15] recycling level in 2011 in Romania was only 1% of municipal waste, lawest among the EU-27 states. Recycling was most common in Germany (45% of waste treated), Ireland (37%), Belgium (36%), Slovenia (34%), Sweden (33%), the Netherlands (32%) and Denmark (31%). Although „*municipal waste consists to a large extent of waste generated by households, but may also include similar wastes generated by small businesses and public institutions and collected by the municipality; this part of municipal waste may vary from municipality to municipality and from country to country, depending on the local waste management system.”* we consider this report suggestive, because textile waste resulting from household consumption are included here.

4. CONCLUSIONS

Fast fashion is a concept that will continue to influence the apparel industry over the next years and will have a direct effect on the way consumers purchase and also discards their used or useless clothes. Romania is one of the biggest beneficiaries of secondary trading of worn clothing with both positive and negative conseqences. As results from our studies, Romania is by far the largest European importer of second hand clothes. Because such large volumes of second hand clothing are constantly being imported and consumed, large volumes re- worn clothing held by the consumer are discarded. It creates a large waste stream at the end of the functional life of clothes, which are finaly disposed of in landfills but Romania has no large scale recycling. Since collection is done on a voluntary basis and not necessarily in cooperation with municipal waste management it can be confusing for population to know how and where to discard used clothing therefore it is recommended a focus on collection systems of second hand clothes. The recycling of textile waste brings benefits to all three aspects that define sustainability: economical, social and environmental, especially in solving the numerous ecological problems and boosting new economy sectors [16]**.** Research on recycling techniques are also needed, both in the area of separation and production based on recycled fibres.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

ECO DESIGN IN DESIGN PROCESS

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Abstract: *Eco-design is a new domain, required by the new trends and existing concerns worldwide, generated by the necessity of adopting new design principles. New design principles require the designer to provide a friendly relationship between concept created, environment and consume. This "friendly" relationship should be valid both at present and in the future, generating new opportunities for product, product components or materials from which it was made. Awareness, by the designer, the importance of this new trend, permits the establishment of concepts that have as their objective the protection of present values and ensuring the legacy of future generations. Ecodesig, by its principles, is involved in the design process, from early stage, the stage of product design. Priority objective of the designers will consist in reducing the negative effects on the environment through the entire life cycle and after it is taken out of use. The main aspects of the eco-design will consider extending product exploitation, make better use of materials, reduction of emission of waste. The design process in the "eco"domein must be started by selecting the function of the concept, materials and technological processes, causing the shape of macro and microgeometrics of the product through an analysis that involves optimizing and streamlining the product. This paper presents the design process of a cross-sports footwear concept, built on the basis of the principles of ecodesignului.*

Key words: *Biomimesis, design, ecodesign, eco-product, footwear.*

1. INTRODUCTION

How an eco-concept answers to the ecological requirements cand make the difference between a winning or a loosing product on the consumers market. Based on a set of technical capabilities, the eco-concept is focused on solving the problems that cand make the design proccess a succesful one. [1].

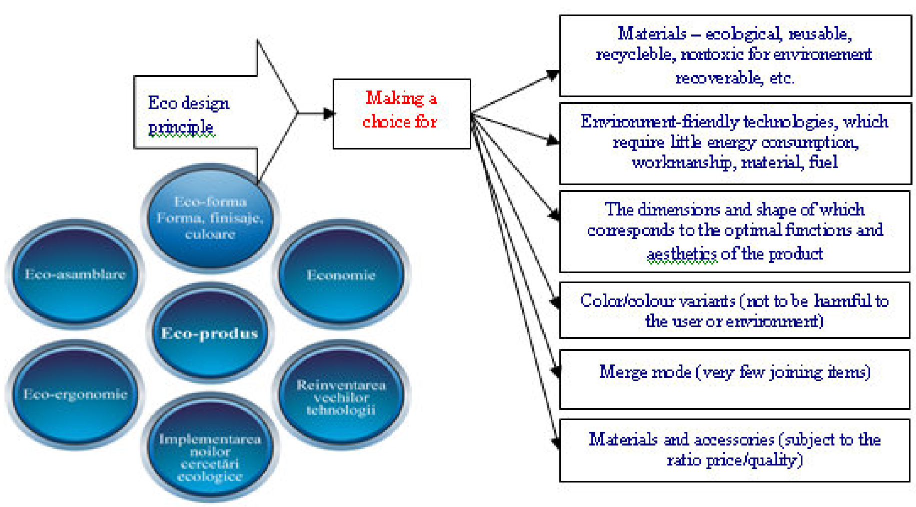

Fig.1 *Eco design principle [3]*

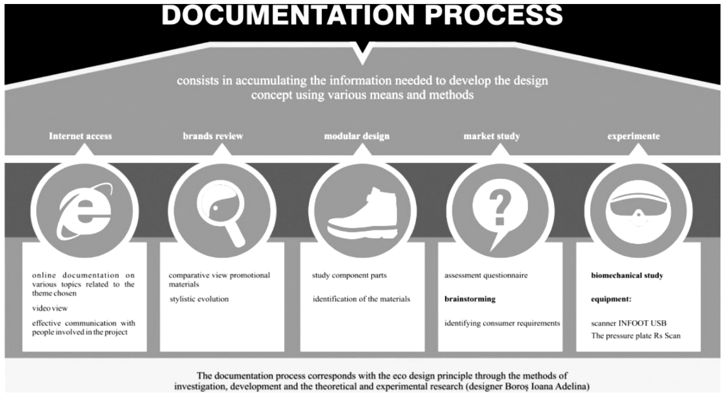

Fig.2*: The documentation process applys the principle of eco-design through research methods, both theoretical and experimental*

Eco-design involves designing and/or rethinking products in order to make them profitable and environmentally friendly. In accordance with the principles of eco-design is to consider including reviewing the functionality of products in relation to the analysis of the value. This factor allows the removeal of those attibutes of a product that are usless, or thate can harms the environment, replacing them with useful functions.

2. GENERAL INFORMATION

The designer, having as main working principles the ecodesign tools, the value analysis and study on the evaluation of user needs, will make decisions that will lead to improvements in the product lifecycle, generating a concept of sustainable development. The designer must assume his the importance of his role in the conception and argummentation of eco-products. Starting from phase zero of the concept, which involves: documentation, competitive market analysis, and users needs, the conclusions that determines the new concept, sketches of ideas, experimental studies and tests instruments optimal solution choice, the designer will use IT assets (computers, software design, 3D printers, scanners) that meet the principles of eco-design (Fig.1) and that presents minimal risk to the environment. [2]

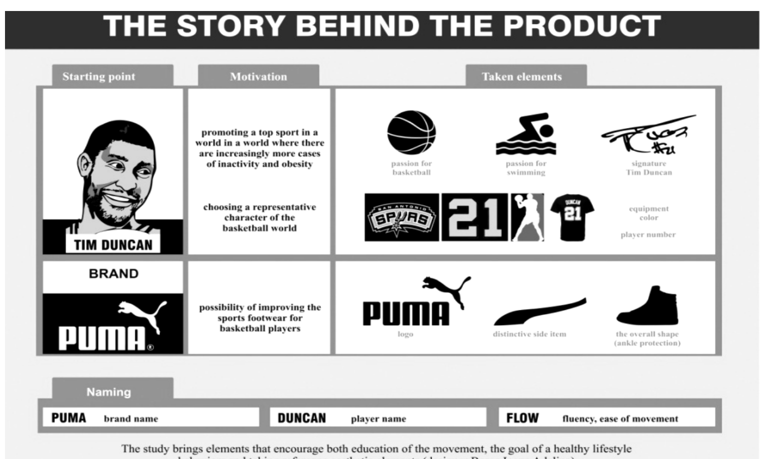

Fig.3: *Documenting aesthetic elements of established benchmarks of the brand analyzed*

Environmental parameter represents the main element of reference throughout the life cycle of the product. The objective of applying eco deisgn methods and principles in design, initiates analysis regarding the optimization of the number of components, materials, items and time required for assembling or fixing the product; measurements or analysis of energy consumption (in use), the weight of the product, the calculation of human resource needed, the cost and benefits of organic improvements. The aesthetic value of the product which is the necessary requirement for success on the market will be based on the choice of the materials with low impact (nontoxic, natural, recyclable, or who have been totally or partially recycled, which implies a minimum energy consumption in their process of extraction, processing, use, recovery and recycling). Adoption the new requirements in the "ECO" domain causes the widening of the designers area of qualification. The designer must know the whole life cycle of the concept (manufacturing, mining, removing it from use) to give a creative solution for the moment the product is being taken out of use. (fig. 1).[4] Optimizing the life cycle concept aims: sustainability and product reliability, easy solutions for maintenance and repair, the concept of a modular product structures, sustainable design, increasing the quality of the product through new technologies, user satisfaction. Optimizing the end of producs life relies on decisions concerning the possibility of re-using of the whole product or of certain parts of it, the possibility of remanufacturing, recovery or reuse, recyclability of materials, incineration. Ecodesig involves the designer in analysis regarding: dematerialization, shared use of the product and integrate additional functions, functional optimization of the product.

The designer is a member of a multidisciplinary project team. Studies on the factors of success of the eco-design process highlights the need for motivation and awarness of the work team and the management of the undertaking and the support of an expert in eco-design for advice, know-how and knowledge of the environment. Ecodesignul appeals and biomimesis, "Innovation Inspired by Nature", which represents a "new science that studies nature's models and then imitates or inspires from these models and processes to solve human problems". Benyus suggests looking in the nature of a "model", putting the emphasis on the sustainability as an objective of biomimesis.[5, 6, 7]

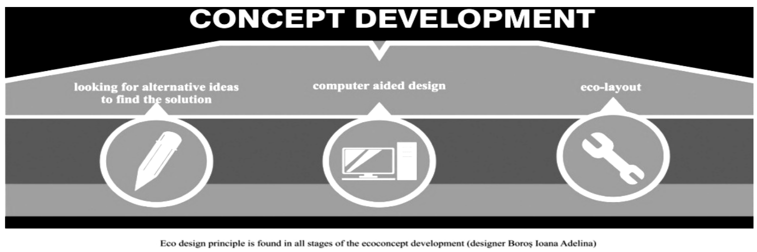

Fig.4: *Eco-development concept based on the principle of eco-design*

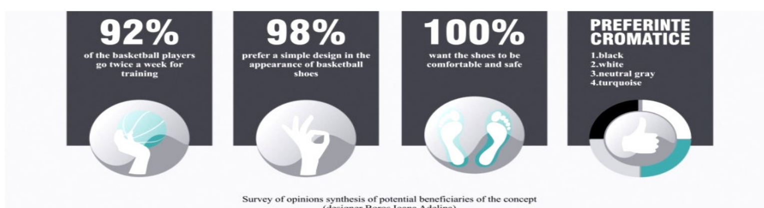

Fig.5 *Summary of the survey of views enable allows the development of new features (including aesthetic)*

3. THE APPLICATION OF ECO-DESIGN IN DESIGN PROCESS

The design process defined by the following stages: documentation, sketches of ideas, the best solution, the 2D and/or 3D design (layout) is shown in Fig.2-Fig.8 (boards made by designer Boroş Ioana Adelina). Each stage contains elements of ecological design, demonstrating the designers concern for environment.

The elements of inspiration in the field of biomimesis can be found argumented by shape, texture and finishes proposed by designer. The choice of modern materials (Bio Skin, SBS rubber, CFRP, knitwear, Vectran 3D threads, Carbon fiber, Natural rubber) correspond to the functions of the new product. The proposed materials ensure: increase the life time of the product, the novelty of form, the new function attributed to the product properties through innovative sneaker with airbags.

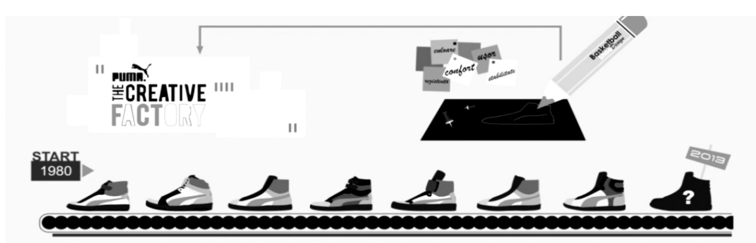

Fig.6: *Analysis of stylistic evolution is based on specific eco-design means*

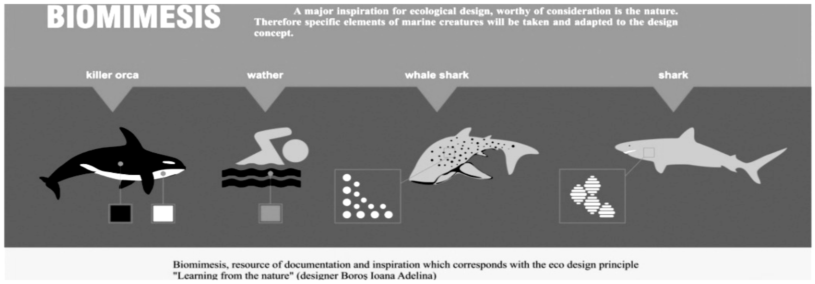

Fig.7: *Biomimesis, source of inspiration for: form, texture of surfaces, finishes (were influenced by orca, shark, swimming style)*

4. CONCLUSIONS

Design concept stages, supported by the principles of eco-design, demonstrates the importance of the designer's role: in the creation of eco-products; of biomimesisis as a source of inspiration (items relating to the shape, structure, texture, finish are take over as inspiration); virtual design instruments, layout and prospecting, communication used in order to achieve the economy of conventional supplies, labor, time, energy (specific activity of design and marketing). The choice of materials and modern technologies supports new functions of product (shoe with an air bag), which extends the life of product form a moral and physicall point of view. Eco-concept stages (from the documentation until the issue of removal from use) apply the principles of eco-design (methods, techniques, technologies, ways to streamline the entire process from the ecological point of view).

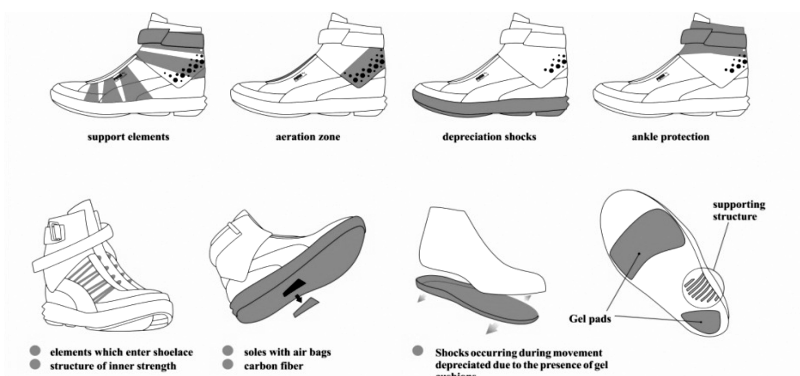

Fig.8: *The final concept, the result of eco-design principles*

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

BRANDING PROCESS - FUNDAMENTAL PROCESS IN THE TEXTILE INDUSTRY ORGANIZATIONS

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Abstract: *More companies in textile industry organizations understand that in making a decision a key factor is the performance of organizational processes. Products are becoming more numerous and increasingly resemble each other.In this conditions the brand can make the difference in a highly competitive market. Both academic specialists and professionals believes that the brand has become an intangible capital of a company which ensures its long-term profitability. In a globalized economy brand break the barriers of space enabling the company to have a great vision, far beyond its reach.*
Methodology was based on a bibliographical research. The research has indentified the najor role that brands can play both for customers and manufacturers in the textile Industry organizations.
In conclusion literature ande experience has shown that large companies both brands operating in B2B markets and the B2C markets, have an increasingly higher for long-term competitive advantage.

Key words: *Branding process, business process, customer, manufacturer, organizational process.*

1. INTRODUCTION

Increasingly more companies in textile industry organizations understand that in making a decision, whatever level is adopted, a key factor is the performance of processes. Therefore, studying them and finding the most appropriate ways to improve processes state in management attention because it offer an "extra" organization in providing competitive advantage.

As a result of business process, products are becoming more numerous and increasingly resemble each other, the innovation being imitated shortly after onset. Also, it is difficult for consumers to distinguish one provider from another, to make a better distinction between products. When products are almost identical, certain elements make one choice over another. Therefore, managers have placed the problem of finding those elements to promote their products to competitors. It was the brand.

The brand can offer customers additional value through the information they receive, by minimizing risk buying decision due to extra recognition. [1] states that if a product can be copied relatively easily, the same can be done with a brand.

The brand can make the difference in a highly competitive market. [2], citing a research conducted by SMDavis shows that:

• 72% of buyers will pay 20% more for their favorite brands
• 50% would pay 30% more
• 40% will pay 25% more
• 25% say price does not matter
• 50% are "driven" brands

Both academic specialists and professionals [3], [4], [5], [1] believes that the brand has become an intangible capital of a company, a strategic asset , which ensures its long-term profitability.

2. THE IMPORTANCE OF THE BRAND PROCESS IN TEXTILE INDUSTRY ORGANIZATIONS

In a globalized economy brand break the barriers of space enabling the company to have a great vision, far beyond its reach. Therefore, more and more managers have turned their attention to the branding process, giving it a strategic importance because it creates long-term assets that allow growth and maintain competitive advantage. A strong brand provides protection company in direct competition fighting, but with new entrants, is a key element in the customer's purchase decision process (Figure 1).

Buying center may consist of one or more persons with the intention of buying the same size and structure as in the complexity of the purchase decision. In the literature, many scholars [1];

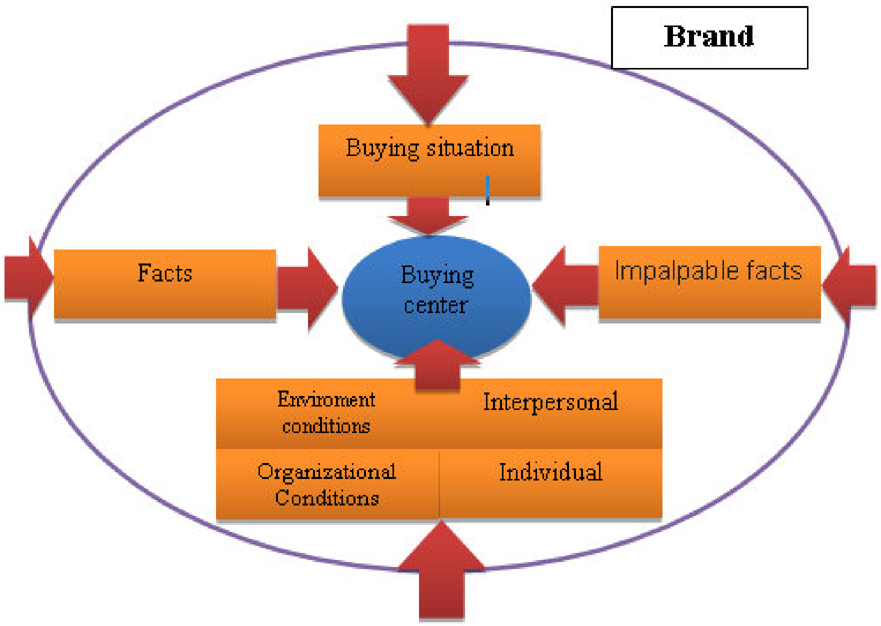

Fig. 1: *Brand influence in the purchasing decision (source Kotler, 2011)*

[6], [7] showed that one of the directions in which the management organization must act to ensure the best possible position in the market is the process of building a brand -branding process.

We believe that the branding has direct implications in all business processes, influencing them and being influenced by them, contributing together to create value (Figure 2).

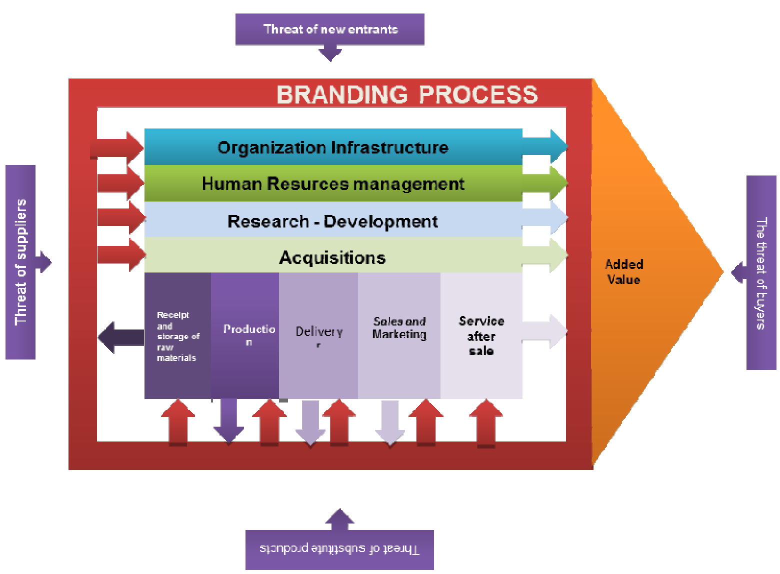

Fig. 2: *Branding process relationship with other organisational processes*
(Adapted from Baltzan şi Phillips, 2009)

The above are some arguments constitute the major role played by the branding success of an organization, which led to the decision to be studied further.

The brand, in the sense of another famous scientist, specializing in branding, [3] is defined as "based on a product, but one that brings another dimension that distinguishes it from other products that meet the same needs."

This differentiation can be sensible, tangible product that comes from performance, or symbolic, emotional, intangible that is related to what the brand represents. [3] emphasize that what distinguishes a brand and differentiates from product is the sum of consumer perception and feelings that he has towards product attributes and how it performs. Another aspect that distinguishes it is the perception of the brand name and what it represents and the perception of the company associated with the brand.

Quoting [1] we can say that:

- A brand is a promise.
- A brand is the totality of perceptions about a product, service or company.
- A brand holds a distinctive position in the minds of customers, based on previous experience and expectations of future ventures.
- A brand is a summary of attributes, benefits, beliefs and values that differentiate, reduce complexity and simplify the decision making process.

Construction, management, support, protect, analyze, improve brand of an organization are activities that involve not only the work of a brand manager or a team brand. All these activities are elements of a transverse process in the organization that contribute to all departments: management, marketing, financial, operational. This involvement in the processes of building, developing and sustaining a brand, which together represent generic branding process make it a holistic process. The brand becomes a strategic asset of the organization [1] which, through careful management, may lead to competitive advantage and long term profitability of the organization.

The importance of business-to-business brands in a survey made by German Institute of trial Marketing Centrum Muenster, shows, after an analysis of the German markets, that the most important functions of branding in this sector are:

- Increasing the efficiency of information
- Harm reduction
- Added-value / benefit level image

Therefore, we can say that the brand is all tangible and intangible attributes of a product, plus associations that the company's marketing activities bring to the process of communication, consumer information on their consumer perception derived from all the previous ones and does not Finally, the company's image and value of the all.

3. THE BRAND'S ROLE - FOR CONSUMERS IN TEXTILE INDUSTRY ORGANIZATIONS

For consumers, the brand is providing some important information shown in Figure 3. The brand is showing the manufacturer, allowing consumers to make choices according to their desires and knowledge.

In the current economic and information environment, consumers are informed and have knowledge that allow them not only to know the characteristics of a brand but their marketing programs - campaigns, promotions, benefits./All this is brought support for consumer decision making regarding the choice of product he needs. The information about a brand are more satisfying to the consumer, the decision-making product selection is one faster.

From an economic perspective, the brand allows the consumer to reduce the costs of search for the desired product, both in terms of risk choice and in terms of time for product search.

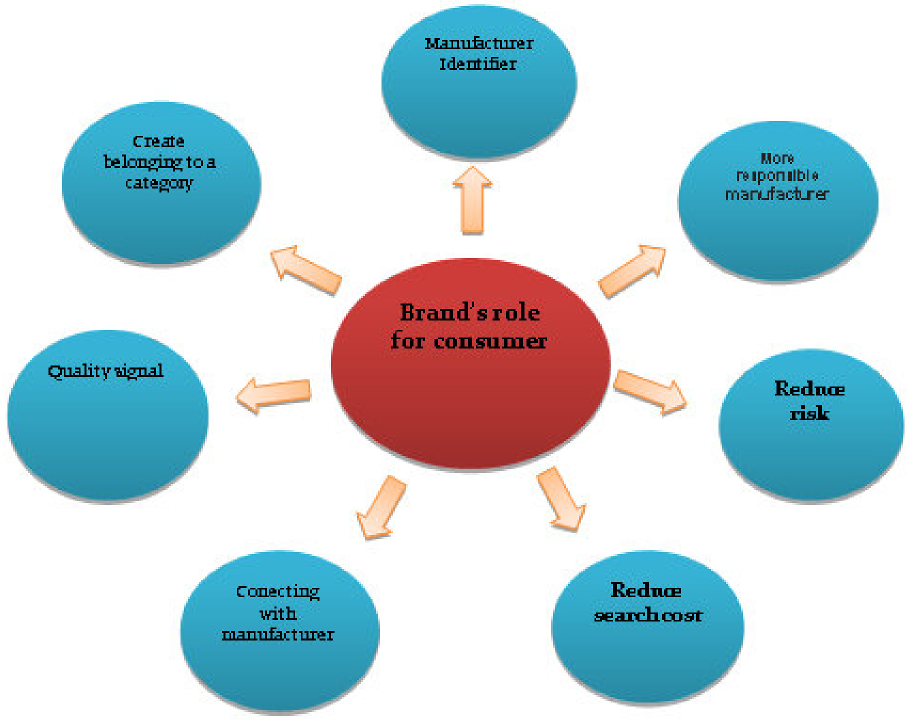

Fig. 3: *Brand's role for consumer in textile industry organizations*

The relationship established between brand and consumer is a type of commitment. The consumer is the one that gives confidence and brand loyalty, waiting in return the brand to meet its expectations in terms of product quality, while its strength, performance, distribution, price, etc. Thus, the consumer aware of the advantages and benefits that the brand offers, since his needs are met.

4. THE BRAND'S ROLE - FOR MANUFACTURER IN TEXTILE INDUSTRY ORGANIZATIONS

If consumers, the brand is an important factor for the manufacturer provides a number of important advantages [3] (Figure 4.).

Serves primarily as a means of identifying products thus simplifying procedures for distribution, storage, organization, product inventory, facilitates the company's accounting records.

From another point of view, the brand is one that can provide legal protection for the unique qualities of a product. The brand is benefiting from the protection of intellectual property can be protected in a special program. The packaging and presentation can be protected by copyright and design. In this way the company can invest more in brand development and benefit from the value of the asset of the company.

Over time, this investment in brand emphasizes its distinct elements, highlighting the unique qualities that meet consumer demands. These elements are what ultimately determines the impulse consumer choice again the same product. Brand loyalty thus created predictability and security of demand determines the market, which gives the company stability. The brand becomes, thus, a safe, extremely strong insurance company's competitive advantage in a market [3].

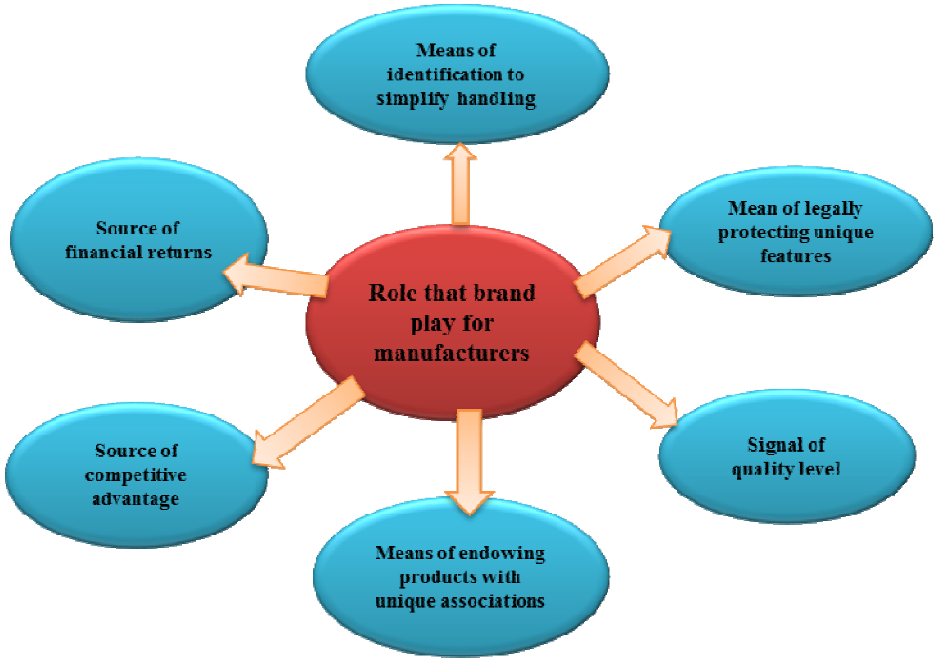

Fig. 4: *Brand's role for manufacturers in textile industry organizations*

[3] pointed out that, in essence, the brand becomes a legal property with intrinsic value that is able to influence consumer behavior can be marketed and ensure the company's future earnings stability. This is why in times of economic growth, the value of these brands are sold, bought, in some cases far exceeds the value of movable and immovable assets of the company. Enormous price paid for the acquisition of companies, was justified by long-term returns that brands these companies make in time. This price is still lower than what would be meant as investment material for the creation of new brands.

5. CONCLUSIONS

The proposed conceptual model, identifying the interaction between the main processes of the company and branding process, considered as the engine of continuous improvement of the process of branding, integrate metrics the three coordinates: marketing, financial and consumer.

The implementation of this model in SC POLICOLOR SA for SPOR, in the time interval 2010-2011, the results showed that although the action plan was not fully implemented as economic and financial conditions have been unfavorable, the company has managed to make efforts and keep one of its intangible capitals at a more than respectable.

Brand positioning indicator, for studied brand SPOR shows that, overall, the measures taken have resulted in finding uptrend despite the lack of sizeable budgets. The increase brand positioning, which won first place in 2011 among the brands chosen, show that the proposed model branding process improvement through the implementation of the scheme is properly validated and functional in all industries.

Branding has become, in organizations that use process approach, a process integrator whose influence on other processes and depending on other processes may be an important determinant of success or failure of an organization.

Increasing economic development, globalization, have increased the value that brands bring companies. The brand has become an intangible asset of the company that far exceeds the value of tangible assets. Brands are traded, brands are those that require most times the price of a company.

A long period of time, brands from industrial organizations operating in the B2B sector has been regarded as insignificant judging from their target group. Experience has shown that large companies both brands operating in B2B markets and the B2C markets, have an increasingly higher for long-term competitive advantage.

In the literature, few researchers have approached branding as a process. The conclusion reached in this paper is that branding is a process and not just any, but a process of organization related to activities in all sectors of the organization, touches all the important processes of the organization and it is an essential element of progress.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

ECOLABEL – TOOL FOR PROMOTING SUSTAINABLE CONSUMPTION AND PRODUCTION

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Abstract: *The ecolabel is one of the indicators that quantify sustainable consumption and production, and ultimately, sustainable development. Ecolabelling is only one type of environmental labelling, and refers specifically to the provision of information to consumers about the relative environmental quality of a product. Ecolabels are granted on request of various organizations, both public and private, and are recognized only locally or nationally, regionally or internationally. Often coexist at the same time and same place, several types of environmental labels. The acceptance of a particular ecolabel is optional, and is made usually based on reputation, trust and awareness about the label and the level to promote certain brands for better lifestyle and for use the eco, organic or green products. There are currently tracking worldwide by Ecolabel Index, which is the largest global directory of ecolabels, 449 ecolabels in 197 countries, and 25 industry sectors, from which 109 are for textile products. The number of EU Ecolabel greatly increased, so that in the period 2000 - 2010, the increase was more than 20 times. At the end of 2012, 17176 products or services was awarded EU Ecolabel. Curently, certainly, the number is much higher. Today, in the Ecolabel Index appear registered in Romania 23 types of ecolabels. Also, Romania currently has awarded 586 licenses for Eu Ecolabel, from which two for textile products and two for footwear.*

Key words: *ecolabel, sustainable development, consumption, production, textiles, footwear*

1. INTRODUCTION

The world leaders, at the Rio+20 Conference in June 2012 identified the green economy as an important tool for achieving sustainable development.

The EU Sustainable Development Strategy sets out the objective of promoting sustainable consumption and production patterns. Addressing social and economic development within the carrying capacity of ecosystems and decoupling economic growth from environmental degration is an essential requirement for sustainable development.

According to Eurostat, the ecolabel is one of the indicators that quantify sustainable consumption and production, and ultimately, sustainable development.

Overall, changes in sustainable consumption and production since 2000 show a rather mixed picture:

- almost 20% increase in resource productivity, mainly driven by a fall in consumption of non-metallic materials by the construction sector
- crisis stopped the growth in material consumption, but economic recovery indicates another turnaround
- waste management improved due to EU and national efficient waste management strategies
- significant fall of four air pollutants SOx, NOx, NMVOC and NH3 emissions
- increase in the number of smaller households contributed to a one-third increase in households' electricity consumption
- 1.6% drop in final energy consumption
- EMAS registrations doubled in the EU between 2004 and 2012
- more than 50% increase in organic farming between 2005 and 2011. [1]

These days all of us are trying to be more environmentally friendly and conscious. But how does a consumer judge a product's environmental impact? How does one know what to buy and what to avoid?

In response to these questions, the ecolabel helps consumers. It is a voluntary tool that provides consumers with guidance on environmental issues that include the product offered for sale. Ecological criteria considered in the eco-label are numerous and are based on life cycle assessment of products (raw materials - process - distribution - use - disposal) is reviewed periodically; in addition to environmental criteria, are included criteria of performance and durability.

An ***ecolabel*** is a label which identifies overall environmental preference of a product (i.e. good or service) within a product category based on life cycle considerations. In contrast to a selfstyled environmental symbol or claim statement developed by a manufacturer or service provider, an ecolabel is awarded by an impartial third party to products that meet established environmental leadership criteria.

Ecolabelling is only one type of environmental [performance] labelling, and refers specifically to the provision of information to consumers about the relative environmental quality of a product. There are many different environmental performance labels and declarations being used or contemplated around the world. [2]

2. TYPES OF ECOLABELS

In the context of a wide variety of ecolabels, such standardization is necessary. This standardization process brings a number of benefits, particularly for consumers, and being able to ensure the accuracy of the information included on certified organic labels, so as not to be deceived in their choice. In this sense, the ISO working committee ISO/TC 207 - Environmental management, subcommittee SC 3 - Environmental labelling, an international forum of technical experts who, in their discussions and decisions, they take account of new trends and effects marketing of a product or service ecolabel.

As part of its ISO 14000 series of environmental standards, the International Standards Organisation has drawn up a group of standards specifically governing environmental labeling.

The ISO 14020 series of standards provides businesses with a globally recognized and credible set of international benchmarks against which they can prepare their environmental labelling, which is increasingly used on products and in advertising, in response to consumer demand.

The ISO 14020 family covers three types of labeling schemes:

- type I - is a multi-attribute label developed by a third party
- type II - is a single-attribute label developed by the producer
- type III - is an eco-label whose awarding is based on a full life-cycle assessment [3]

3. APPEARANCE AND EVOLUTION OF THE ECOLABELS

The first ecolabel, Blue Angel, appeared in 1977 in Germany, many more being created in the 90s, such as Green Seal, U.S., in 1989; Nordic Swan, Northern European countries (Finland, Iceland, Norway, Sweden and Denmark) in 1989; Umweltzeichen (Austrian Ecolabel) in Austria in 1991; NF in France, in 1991; Milieukeur in the Netherlands in 1992; Good Environmental Choice in Sweden in 1992; ***EU Ecolabel*** in 1992; Hungarian eco-label in Hungary in 1993; AENOR in Spain in 1993; Environmental Choice Program in Canada in 1995; Environmentally friendly products in the Czech Republic in 1998 and more.

There are currently tracking worldwide by Ecolabel Index, which is the largest global directory of ecolabels, **449 ecolabels** in **197 countries**, and **25 industry sectors**.

Their distribution by sector is as follows:

- appliances: 59
- building products: 115
- cleaning products: 70
- electronics: 75
- forest products / paper: 88
- ***textiles: 109***
- tourism: 51
- other (campsite services, bed mattresse, ***footwear***): 100

Their distribution by country is as follows:

- EU countries: Germany – 96, United Kingdom – 86, France – 69, Italy – 59, Netherlands – 57, Belgium – 55, Spain – 53, Austria – 52, Sweden – 50, Denmark – 46, Poland – 38, Finland – 35, Portugal – 35, Ireland – 31, Czech republic – 27, ***Romania – 23***, Greece – 22, Luxembourg – 22, Bulgaria – 19, Slovenia – 18, Estonia – 17,Hungary – 16, Slovakia – 15, Lithuania – 14, Latvia – 13, Cyprus – 12, Malta - 10
- other relevant european countries: Switzerland – 74, Norway - 38
- other relevant countries: USA – 195, Canada – 107, China – 56, Japan – 48, India – 30, Turkey - 27

In May 2013 were monitored 435 ecolabels, which means that there were still 14 types of new labels in less than one year. [4]

4. EVOLUTION OF THE EU ECOLABELS

Ecolabel license is an indicator defined as the number of Ecolabel or "EU Flower" licences in European countries. The Community Ecolabel is awarded to products and services with reduced environmental impacts. It is administered by the European Commission and receives the support of all EU Member States and the European Free Trade Association (EFTA). Ecolabel criteria are discussed in the European Union Ecolabelling Board (EUEB) whose membership includes representatives from industry, environmental protection groups, consumer organisations and representatives for SMEs.

Criteria of the European Ecolabel product groups, directly applicable in all Member States, including Romania, are found today in subsequent decision of the European Parliament and Council Regulation no. 66/2010/CE on the EU Ecolabel. For each group of products / services are such decisions. [5]

Currently, European Ecolabel is an integral and effective part of the Sustainable Consumption and Production Action Plan, being found in other tools of this type, such as Green Public Procurement, the Eco-Management and Audit Scheme (EMAS), the Ecodesign Directive, the Environmental Technologies Action Plan (ETAP) etc.

From the appearance, in 1992, until now the number of authorizations for EU Ecolabel had an increasing trend. Thus, after the first four years, 1992-1995, in which no authorization was granted, in 1996 were issued the first six licenses for the use of European Ecolabel. Then their number greatly increased, so that in the period 2000 - 2010, the increase was more than 20 times.

Today, the EU Ecolabel (EU Flower) can be found not only in the European Union, but also in other countries such as Switzerland, Norway, New Zealand, Turkey, USA, Japan, China etc.

Table 1: *Number of licenses for EU Ecolabel in Europe in period 2000 - 2010 [6]*

	Number of licenses										
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EU (27 countries)	49	88	127	149	223	276	338	508	705	939	1067
EU (25 countries)	-	-	127	149	223	276	338	508	702	935	1063
EU (15 countries)	49	88	127	149	223	272	326	485	666	890	1024
Austria	-	-	2	2	7	11	12	29	24	37	48
Belgium	-	1	2	2	2	4	4	6	10	12	16
Bulgaria	-	-	-	-	-	-	-	-	-	-	-
Czech Republic	-	-	-	-	-	1	2	8	13	14	11
Cyprus	-	-	-	-	-	-	1	1	1	2	3
Denmark	-	18	27	28	45	53	55	61	52	52	56
Estonia	-	-	-	-	-	-	-	-	2	2	2
Finland	-	2	1	1	2	3	3	5	6	8	9
France	-	17	27	32	43	45	50	89	137	187	245
Germany	-	1	2	3	7	13	21	29	51	59	67
Greece	-	9	9	11	14	6	16	19	21	28	28
Ireland	-	1	1	-	-	-	9	11	20	24	24
Italy	-	13	28	34	54	82	95	160	237	336	331
Latvia	-	-	-	-	-	-	-	3	3	3	-
Lithuania	-	-	-	-	-	-	-	-	1	1	1
Luxembourg	-	-	-	-	-	-	-	-	-	-	-
Malta	-	-	-	-	-	-	1	1	1	1	1

United Kingdom	-	1	2	2	4	5	7	12	17	24	33
Netherlands	-	2	3	5	11	11	11	9	17	24	43
Poland	-	-	-	-	-	2	3	6	8	11	12
Portugal	-	2	3	4	5	5	6	7	12	14	17
România	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**4**	**4**
Slovenia	-	-	-	-	-	-	4	2	3	3	3
Slovakia	-	-	-	-	-	-	-	-	1	2	-
Spain	-	12	12	14	16	19	21	28	41	59	80
Sweden	-	9	8	11	13	15	16	20	21	26	27
Hungary	-	-	-	-	-	1	1	2	3	6	6
Switzerland	-	-	-	-	-	-	-	-	22	31	45
Norway	-	-	-	1	3	3	3	6	6	6	6

At the end of 2012, 17176 products or services was awarded EU Ecolabel. [7]. Today, certainly, the number is much higher. Here is, for example, the number of licenses for EU Ecolabel for textile products and footwear in EU, today.

Table 2: *Number of licenses for EU Ecolabel for textile products and footwear in EU in April 2014 [8]*

Country	Textile products EU Ecolabel	Footwear EU Ecolabel
Austria	592	2
Belgium	586	2
Bulgaria	1	2
Croatia	1	2
Cyprus	0	2
Czech Republic	6	2
Denmark	652	3
Estonia	2	2
Finland	581	6
France	588	2
Germany	591	3
Greece	2	2
Hungary	1	2
Ireland	570	2
Italy	1132	46
Latvia	2	2
Lithuania	6	2
Luxembourg	574	2
Malta	0	2
Netherlands	570	2
Poland	2	2
Portugal	8	2
România	***2***	***2***
Slovakia	2	2
Slovenia	1	2
Spain	584	8
Sweden	589	3
United Kingdom	781	2

In the European Union in October 2011, was elaborated third EU Ecolabel Work Plan for 2011-2015 (after the 2002 and 2006 versions). The purpose of this plan is to set a number of realistic and achievable objectives for these five years:

a) expand the range of Ecolabel product groups, focusing on products having both important potential marker uptake and environmental improvement potentials

b) increase the number of articles of Ecolabel products on the market

c) continually reinforce the overall environmental benefits of the scheme and its contribution to sustainable consumption and production.

5. ECOLABEL IN ROMANIA

Romania does not have a national ecolabel.

In the Ecolabel Index appear registered in Romania ***23 types of ecolabels***, namely: AISE Charter for Sustainable Cleaning, BIO Hellas, C.A.F.E. Practices, Dolphin Safe / Dolphin Friendly, EarthCheck, Ecocert, Eco-Schools, EPEAT, ***EU Ecolabel,*** Fairtrade, Forest Stewardship Council (FSC) Chain of Custody Certification, Forest Stewardship Council® (FSC) Forest Management Certification, Green Globe Certification, HAND IN HAND, Hungarian Ecolabel / Környezetbarát Termék Védjegy, Marine Stewardship Council, National Programme of Environmental Assessment and Ecolabelling in the Slovak Republik (NPEHOV), Natrue-Label, Naturally Sephora, Passivhaus, Programme for the Endorsement of Forest Certification (PEFC) schemes, Sustainable Agricultural Network, TCO Certified.

Romania currently has awarded ***586 licenses for Eu Ecolabel***, categorized thereby:

- all purpose cleaner – 45
- bed mattresses – 0
- camp site services – 0
- copying and graphic paper – 185
- dishwashing detergents – 5
- flushing toilets andurinals – 0
- ***footwear – 2*** (DIVISION ANATOMICOS S.L. (DIAN): EVA color Blanco and 02/S color Blanco, Azul, Negro, Verde, Rojo, Amarillo, Naranja, Violeta i Fucsia)
- growing media – 0
- hand dishwashing detergents – 3
- hard coverings – 5
- heat pumps – 0
- imaging equipment – 0
- indoor paints and varnishes – 32
- industrial and institutional automatic dishwashing detergents – 4
- industrial and institutional laundry detergents – 0
- laundry detergents – 3
- light bulbs – 0
- lubricants – 41
- newsprint paper – 10
- outdoor paints and varnishes – 10
- personal computers – 0
- portable computers – 0
- printed paper – 10
- sanitary tapware – 0
- soaps and shampoos – 8
- soft (textile) coverings – 0
- soil improvers – 0
- TVs – 57
- ***textile products – 2*** (TOP SPUN YARN PTY LTD UK: Raw White Yarn 100% wool and Raw White Yarn Wool/Nylon Blend)
- tissue paper – 163
- tourist accommodation services – 3
- wooden floor coverings – 0
- wooden furniture – 0 [8]

Table 3: *Number of licenses for EU Ecolabel in Romania in period 2012-2014 [8]*

	Time		
	10.06.2012	15.05.2013	15.04.2014
No of license	136	280	586

As can be seen, we can say that in Romania, in recent years, the number of products / services that obtained the European Ecolabel has increased a lot. However, the number of EU Ecolabels in Romania remains at a very low level compared with many other countries, especially European.

According to the information available on the website of the Ministry of Environment of Romania, the number of Romanian companies who obtained the European Ecolabel in Romania in the period 2008-2013 increased from year to year, but the number is still very small. [9]

Table 4: *Number of licenses for EU Ecolabel of Romanian companies in Romania in period 2008-2013 [9]*

	Year					
	2008	2009	2010	2011	2012	2013
No of license	1	2	3	10	22	24

6. CONCLUSIONS

The purpose of introducing ecolabel is to promote products with a reduced environmental impact during their entire lifecycle in comparison to other products of the same product group. Promoting these products contribute to the efficient use of resources and a high level of environmental protection by providing consumers with accurate, exact and scientifically based information about products.

Ecolabels are granted on request of various organizations, both public and private, are recognized only locally or nationally, regionally or internationally. Often coexist at the same time and same place, several types of environmental labels. The acceptance of a particular ecolabel is optional, and is made usually based on reputation, trust and awareness about the label and the level to promote certain brands for better lifestyle and for use the eco, organic or green products.

Ecolabelling has a number of major benefits:

- informing consumer choice
- promoting economic efficiency
- stimulating market development
- encouraging continuous improvement
- promoting certification
- assisting in monitoring [10]

Taking into account the interest shown by various institutions, companies or consumers, and the upward trend in the number and types of ecolabels, we can say that truly ecolabel is an instrument of sustainable production and consumption, an instrument of sustainable development.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

STAGE OF TEXTILE RECYCLE WASTE IN ROMANIA

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Abstract: *Aim of this article is to examine the stage of textile recycle waste in Romania. For this purpose were analyzed the main sources of textile waste from Romania (industry of manufacture of textiles, wearing apparel, leather and related products, imports of textiles, clothing and footwear and imports of second hand clothings) and also evolution of the quantity of textile waste in Romania. The benefits (economic and environmental) of the collection and recycling of waste and the legislation on the waste management, have determined the diversification and increasing the number and the capacity of recovery and disposal of waste in Romania. We found the most textile waste in Romania was deposited in deposits onto or into land, in the proportion of 18.51%. This proportion is under the EU average of 34.03%, but is much higher than in other European country. Also, has been an increase in the number of incinerators, in the last years. With all of this, the interest in textile waste management in Romania is far from being to the level of European, where are associations who dealing with the collection and recycling of textiles and is achieved a selective collection of textile waste in the points especially designed for this thing.*
The information for this paper was gathered from literature, from the EUROSTAT database and INSSE database analysis and by Internet.

Key words: *reused, recycled, textile, waste, disposal*

1. INTRODUCTION

Textile waste called in time as MTS (Secondary Textiles), MR (recyclable materials) and MTR (Reusable Textiles) come primarily from textile manufacturing processes (spinning, yarn preparatory, weaving, knitting, chemical finishing), manufacturing, processing in other industries (chemical fiber plants or units processing the textiles) or as a result of physical and moral wear after some time of using textiles. [1]

According to the Council for Textile Recycling, textile waste can be classified as either pre-consumer or post-consumer waste. Pre-consumer textile waste consists of "*by-product materials from the textile, fibber and cotton industries*" and post-consumer waste is "*any type of garment or household article made from manufactured textiles that the owner no longer needs and decides to discard*".

The waste resulting in the manufacturing processes for textile subsectors, (resulting from spinning phases, yarn waste from spinning mills, mills, knitting, weaving heads and strips from cutting mills, patches from cutting phases, etc.) can be reintroduced into the manufacturing process and can be used to obtain vicuna yarn, unwoven textiles, cotton upholstery for furniture and cars, insulating materials, geotextiles, etc. Recoverable waste may be subject to cutting operations, unweaving and defiberizing in order to salvage fibers from them. Further, by working with appropriate classic/unconventional traditional technologies, these fibers can be used to make protective clothing, technical textiles and thermal and phonetic insulating materials, building materials, textile composites (automotive, naval, construction industry), geotextiles, agro textiles, products for environmental protection. It is estimated that in each year 750,000 tons of this waste is recycled into new raw materials for the automotive, furniture, mattress, coarse yarn, home furnishings, paper and other industries. Through the efforts of this industry approximately 75 percent of the pre-consumer textile waste that is generated is diverted from our landfills and recycled. [2]

Because today, clothing not only responds to practical needs; fashion has become a form of self-expression and the sheer volume and variety of textile products available on the market have reached unprecedented levels. The textile industry is a $1 trillion worldwide business. [3] But textiles are not used just for clothes - they are use also in households, hospitals, workplaces, shops, constructions, vehicles etc., in the form of cleaning materials, interior textiles, packings, leisure equipment, protective equipment and so on. All this type of article, made of some manufactured textile that the owner no longer needs and decides to discard can given to charities but more typically are disposed of into the trash and end up in municipal landfills. The main reasons for what the garments are discarded are: lower quality, new fashion trend or clothes were bought for one specific occasion. [4]

If these products are collected then they can be reused and recycled. According to the Council for Textile Recycling once sorted, the used clothing and textiles are reused and recycled in one of the following manners [5]:

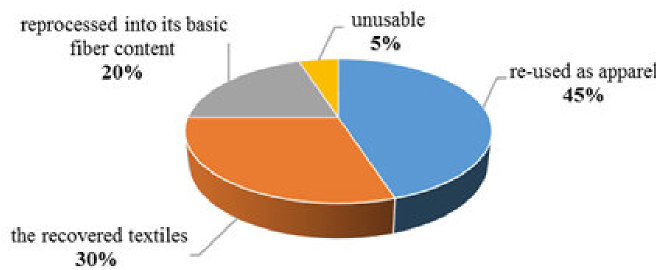

Fig. 1*: The life cycle of secondhand clothing*

As it can be seen, 45% is re-used as apparel. These items are generally processed into large bales that are then sold in the U.S. to the secondhand clothing industry or are exported to emerging market nations where demand for top quality secondhand clothing is particularly high. 30% of the recovered textiles are cut into wiping rags or polishing cloths that are then used in commercial and industrial settings and 20% is reprocessed into its basic fiber content - the fibers are then remanufactured to create furniture stuffing, upholstery, home insulation, automobile sound-proofing, carpet padding, building materials and various other products. The remainder of the 5% is unusable. This category includes wet textiles, moldy textiles or contaminated with solvents, who are not fit for recycling, and are discarded.

The economists and environmentalists studies on technical and economic requirement for sustainability revealed the need for increasing waste prevention and recycling. A few reasons why recycling is important are: recycling programs cost fewer than waste disposal programs; the high water, energy, manufacture consume makes it much cheaper to recycle than to produce some new textile products; recycling can be financially rewarding, people can receive money for turning in certain recyclable products; recycling creates jobs; recycling conserves natural resources such as water oil and natural gas; recycling prevents the destruction of natural habitats etc. [6]

2. COLLECTION, RECYCLING AND TREATMENT OF TEXTILE WASTE IN ROMANIA

Collection, recycling and waste management is a priority for Romania and is found in Romania's commitments towards EU.

The waste regime in Romania is regulated by the Emergency Ordinance no. 78/2000, subsequently amended and supplemented. Law 27 of 2007 is the legislative act which obliges Romanians to sort waste. The problem is that so far has not been set up the selective collection system in the entire country. Resolution no. 870/2013 regarding the approval of National Waste Management Strategy 2014-2020, provides that the waste which do not comply recycling standards, but they have the corresponding calorific value, one of them being the textiles, can be and should be subject to recovery or thermal treatment with energy recovery installations appropriately equipped.

Latest official statistics show that in Romania were generated around 363,315 million tonnes of waste, of which 99.4% are non-hazardous and 0.6% hazardous waste. From these, 18,774 tonnes are textile waste. Much of these, 76.43% are generated by industry of manufacture of textiles, wearing apparel, leather and related products. [7] At these wastes is added the textile waste generated by other industries and households.

The evolution at the last years, of the quantity of textile waste generated by the Romanian industry of manufacture of textiles, wearing apparel, leather and related products is shown in figure 2.

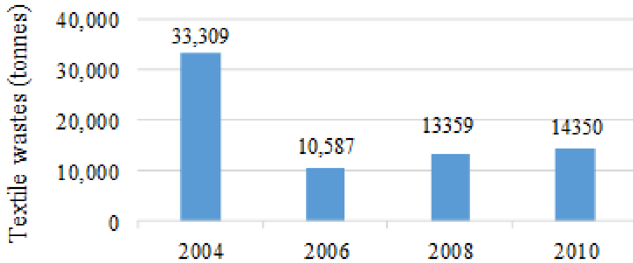

***Fig. 2**: The evolution of the quantity of textile waste generated by the Romanian industry of manufacture of textiles, wearing apparel, leather and related products*

Decreasing evolution of waste generated by industry of manufacturing textiles, wearing apparel, leather and related products, was determined mostly by the decreasing of the number of companies from this Romanian industry, as can be seen in Table 1. [7]

***Table 1**: Evolution of the number of enterprises from Romanian industry of manufacture of textiles, wearing apparel, leather and related products*

	2008	**2009**	**2010**	**2011**
Manufacture of textiles	1,770	1,631	1,499	1,317
Manufacture of leather and related products	1,938	1,759	1,572	1,483
Manufacture of wearing apparel	5,867	5,313	4,480	4,111

In the same time, on the Romanian market is an increase in imports of textiles, clothing and footwear which will increase, sooner or later, quantity of products which will be recycled. The evolution of imports of textile, show that the value of them increased 1.7 times compared to 2000, reaching at about 4 billion euros in 2013. [8]

***Table 2**: Romanian textiles, clothing and footwear import (millions EURO)*

Import (millions EURO)	**2000**	**2004**	**2008**	**2013**	**Evolution 2013/2000**
Textiles, clothing and footwear	2,369	3,361	3,717	4,086	1,7

Talking about the textile products in Romania have to we mention and imports of second hand clothes, whose evolution in recent years is one ascending both the quantity and the value level. The evolution of imports of second hand clothes show the growth of these imports with more than 20 million kilograms in 2011 compared to 2008.

***Table 3**: Romanian second hand clothes import (2008-2011)*

	Trade Value (USD)	**Trade Quantity (kg)**
2008	22 031 302	29 319 631
2009	24 361 280	34 095 462
2010	35 526 741	40 337 255
2011	34 873 602	49 777 741

The benefits (economic and environmental) of the collection and waste recycling and the legislation on the waste management, who was adopted in the EU, have determined the diversification and increasing the number and capacity of recovery and disposal facilities.

From this point of view, in 2010, between the EU member countries stands out United Kingdom with 20,388 and Germany with 11,370 recovery units other than energy recovery, Netherlands with most units of incineration / energy recovery – 2,329. Regarding the hazardous waste storage at the first place in EU is Bulgaria who has 189 landfill for hazardous waste. [7]

In Romania, the number and the types of recovery and disposal of waste are presented in

Table 4. [7]

Table 4: *The number and the types of recovery and disposal of waste, in Romania*

Incineration / energy recovery (R1)	72
Recovery other than energy recovery	112
Incineration / disposal (D10)	15
Deposit onto or into land	145
Landfill for hazardous waste	8
Landfill for non-hazardous waste	137

The textile waste in Romania (in 2010), are deposited in the proportion of 18.51% in deposits onto or into land. This proportion is under the EU average of 34.03%, but is much higher than in France 0.708%, in Italy 1.156%, in Netherlands 1.964 %, in United Kingdom 3.351% or 0.061% in Germany. It can mentioned that there is an increase in the number of incinerators, compared to 2011, when there were only seven centers incineration (Alesd, Campulung, Bicaz, Deva, Fieni, Hoghiz and Medgidia). [9]

Alongside the firms whose the main object of activity is the recovery and disposal of waste in the campaign of textile waste collection came the sellers textile companies. For example the Swedish retailer H & M has started a campaign to recycle old clothes in all its stores in the 48 countries where it is present. Customers can bring used clothing in the stores H & M and they will receive a voucher in order to buy new clothes. Second hand clothes will be used later to produce other clothes, rags or cleaning materials or insulation materials in the automotive industry.

3. CONCLUSION

The increase the consumption of textile products and clothing, reflected of the import growth of the textile, clothing and footwear and the import growth of second hand clothes, and knowing the economic benefits that can be obtained by collecting and recycling have determined the growth the number of firms involved in the recovery and recycling textile, in Romania.

Joining the Romanian at the EU and adopting EU legislation on waste management and recycling have contributed to the growth efforts and interest in the issues raised by the waste in general and the textile waste in particular.

The interest in textile waste management in Romania is far from being to the level of European countries in which besides the fact that there are associations that deal particular for collection and recycling of textile and garment , this are involved in various awareness campaigns and educate students on the importance of population and collecting useless clothes (SMART-Secondary Materials and Recycled Textiles, Council for Textile Recycling, Textiles Recycling Association in UK, American Reusable Textile Association (ARTA), European Textile Recycling Alliance, abbreviated as ETRA, De Vereniging Herwinning TEXTIEL (VHT) etc.) is performed and selective collection of textile waste in specially designated points for this.

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ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

SUPPLY –CHAIN AND LOGIC MODELS FOR THE TEXTILE AND CLOTHING COMPANIES

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Abstract: *The textile and clothing industry is characterized by specific supply-chain models with companies situated in a complex cluster type structure. Depending on the size, the volume and the variety of production, companies can be classified as follows: large companies, griffes, medium size companies and subcontracting companies. The logic of companies is defined by the main feature of the textile and clothing field, namely the logic of collections, determined by the seasonality and classified into several types: planning, fast -fashion, fast fashion/ planning. The market share defined by stylistic content, product quality and price determine their typology: mass-market, bridge, difusión, prêt-a-porter/haute-couture. The study conducted on a number of companies in the textile-clothing industry revealed the following: high share of SMEs (75%), dominant role of garments in the production (74.5%), fast-fashion logic of imitating companies is predominant (94%) and mass-market type products have the highest market share (71%).*
Success in national and international challenges that must be faced by the textile - clothing sector: complete liberalization of world trade, the implementation of quality standards, the adoption of the EU Customs Code and relocation can be provided only by changing the supply -chain models and business strategies with a focus on short series products with high customization and functionalization, new models of e-commerce services, e - business, etc.

Key words: *griffes, fast-fashion,seasonality, mass-market, customization .*

1. INTRODUCTION

The fundamentals that make up the strategy, management and organization of a company are determined by key strategic factors: business model, supply- chain characteristics and competitive positioning in the market.

Business models currently adopted by companies in the textile and clothing field are characterized by specific features and distinct evolution trends, which determine the short and medium term competitiveness of companies. The main production and organizational dynamics that occur during the *supply chain* [1] require increasing need for coordination of the supply chain, which is the basis of competitive advantage in the field.

Business models are chosen based on current and future market opportunities, the capital needs to start a business, the possibility of developing strategic partnerships, and especially the distinctive competencies of the entrepreneur and human resources available [2].

It should be stressed that today the term "industry" is increasingly replaced by the "system", understood as a vertically-integrated sector, with reference to the entire supply chain [3].

In most cases, enterprises are located within a large network consisting of supply relationships, depending on a variety of products, technologies and specific materials and the need to manage relationships in a coherent manner.

Overall, this system can be seen as an aggregate of enterprises, like a sector cluster, that is a group of business operators and organizations whose competitive advantage is enhanced by the mutual relations and connections established and strengthened. Cluster sectors have variable importance and share, but are closely interconnected.

2. EXPERIMENTAL STUDY

In this context the textile and clothing industry in Romania is a dynamic sector in the national economy with a high level of performance and it employs major workforce, mainly women; contributes to the social stability, being represented in all the country's counties; has a significant share in the national economy's exportation; contributes with positive balance to the country's external trade balance.In 2012 the textile and clothing industry has achieved the following shares in Romania's macroeconomic indicators: 2.74% of GDP; 4.4% of industrial production; 10.89% of exports, 7.98% of imports; 17.2% of the total number of employees in the industry.

Textile industry faces a number of challenges at national and international level which determined changes in the structure and organization of the production.

The study performed at national level during 2010 - 2013 shows that the structure of the *supply chain* in the textile and clothing industry is grouped into four main segments [4], which develop vertically and in other two other segments which can be considered connected and serve to support the entire supply chain, i.e. the mechanical-textile sector and advanced tertiary sector (trade fairs, technical and *design* schools, promotional and communication services, etc.) - (Fig. 1).

Fig.1: *Supply –chain*

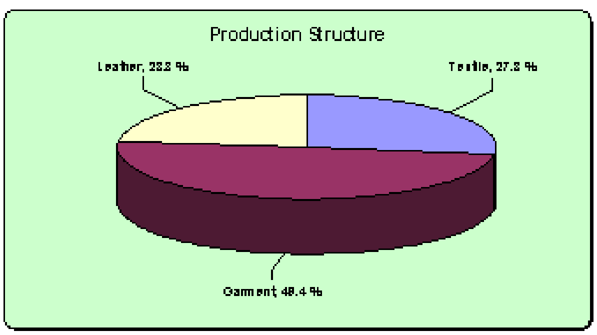

Chart no.1: *Production structure*

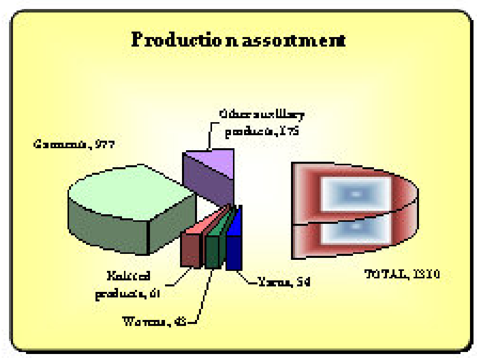

Chart no.2: *Production assortiment*

In 2012 the national production structure included: 27.3% textiles, 49.4% garments and 23.3% other articles- Chart no.1. In the study performed on a number of 1310 companies located throughout the country, the results shown in Chart no. 2 were obtained, which show a radical change in the structure, namely: yarns: 4%, fabrics: 3.5%, knitwear: 4.7%, garments: 74.5% and others: 9.5%.

A significant increase can be seen in the share of clothing sector which represents in the industrial process the link of the chain with the lowest added value and with low competitive advantages in time (as a result of the weak specialization and *labor-intensive* connotation*)* but it represents the fundamental link in the sector's dynamics, as it has the role of the manufacturer of the good for the end consumer, who perceives it as a main actor of such process. The competitive advantage of the enterprise in this sector is not conferred by the industrial process, but by factors such as image, brand, distribution.

Depending on their size and position on the market, the companies in this field may be [5]:**large industrial companies**, often integrated in textile holdings, which provide a complete range of products from different sectors and companies of large sizes, with a very strong trademark image, competitive on the international markets ;***griffes***, with a range of products presenting an increased degree of diversification, exceeding the field of clothing products and including accessories, perfumes or home items***;*****medium** offering a more reduced range of products, manufacturing their own trademarks or under license and which are oriented over specific sectors, such as, for example, men or women clothes, *casual sport-wear, active wear*, underclothes or stockings;**big international companies**, which are characterized by the control of design and logistic activities and by a global procurement activity.The size of the Romanian companies in 2012 is presented in Chart no.3.

The results of the study prepared and presented in Chart no. 4 show a significant share of SMEs, of about 75% but also a significant difference as compared to the large companies (18.8% as compared to 2.0% nationally)

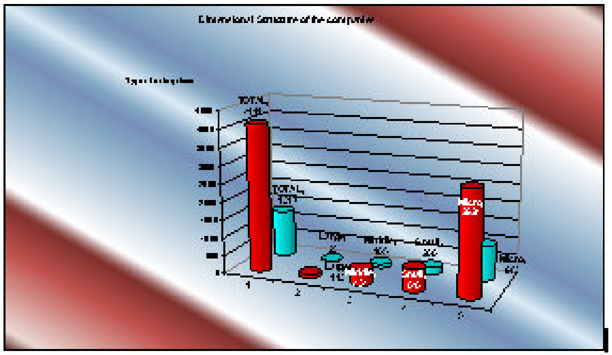

Chart no. 3: *Dimensional structure of the companies*

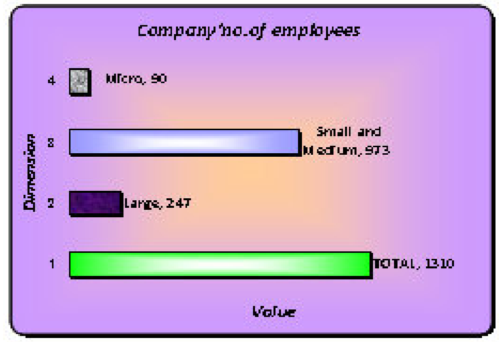

Chart no.4: *Company`no.of emploees*

Depending on the market share addressed, the following types of textile products made by the companies have been identified (Fig.no.2):***mass market***, characterized by low price and simple stylistic content: they are basic products, weakly differentiated; ***bridge*** products are those for the intermediate market share, therefore products with a certain stylistic content, but with affordable prices for the majority of persons;***diffusion*** products address to the intermediate-superior market share, made of a narrow circle of wealthy persons, with financial resources; ***prêt-à-porter*** products, representing the synthesis between the programmed clothing industry and the *haute couture*;***haute couture*** products: characterized by their fame and by the high fashion content of items made straight to the shape, the symbol of an exclusive market share.

For a total of 1310 campaigns (Chart no. 5) the results showed that the products with the highest share are: ***mass-market*** products (71.0%) and ***prêt-à-porter sau haute couture*** products are not so common in the national production.

The company's business model is strongly influenced by one of the characteristics of the textile-clothing sector: the logic of collections is determined by the seasonality. This deeply influences the operational activities of the companies in this sector. The seasonality character acquires various meanings, depending on the adopted operative logic. Depending on the production calendar and the frequency with which the collections are made, there are three types of companies:

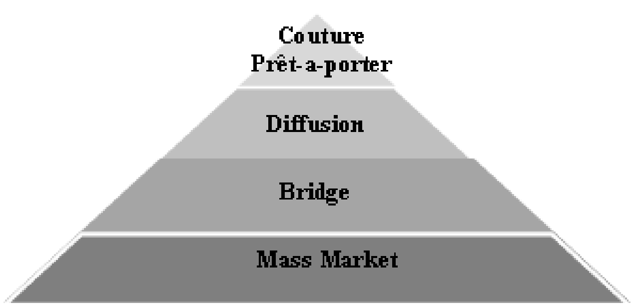

Fig.2: *Types of textiles*

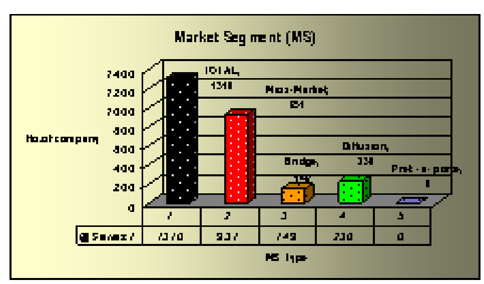

Chart no 5:

- **<u>planning company</u>,** which consists in manufacturing products which anticipate the market's trends and represent mainly by the enterprises situated on the superior market share, those creating fashion trends, known as *market makers.*

Logic of planning company

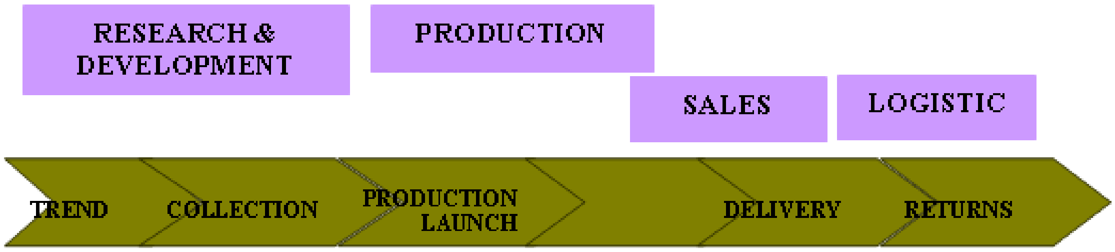

Fig. 3: *Logic of fast-fashion company*

<u>- fast-fashion: (fig.3)</u> adopts the opposite logic, following a "*pull*" type strategic orientation and producing for stock: due to their proximity to the market and the rapidity of responses, these companies launch high fashion textile products in accordance with the customers' requirements. They are, thus, "imitating companies", which manufacture small series models, following the signals issued by the fashion market (magazines, fairs etc.).

<u>- *fast-fashion/* planned:</u> was conceived to combine the advantages of the planning companies (stylistic originality and, consequently, strong brand identity) with those of the *fast-fashion* companies (quick reaction to the market signs, re-procurement speed). This solution involves the manufacture of season collections, which are completed with other models or mini-collections, manufactured based on the evaluation of the recorded trends and the sales feedback.

The results obtained in the study show (Chart no.6) that the share of companies in Romania is mainly based on fast –fashion logic (94.0 %) with „imitating" companies.

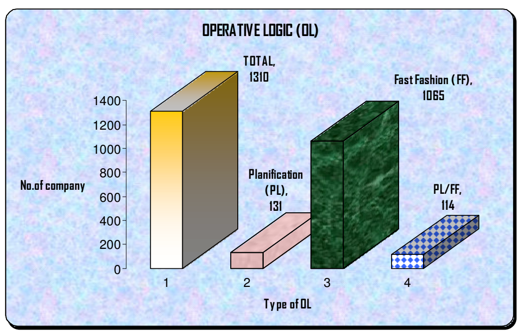

Chart no.6: *Types of the companies*

3. CONCLUSIONS

The success to the national and international challenges that must be faced by the textile-clothing sector, represented by the complete liberalization of the world trade, the implementation of quality standards, the adoption of the EU Customs Code, relocation, can be provided only by changing the supply-chain models and business strategies with a focus on short series products with high customization and functionalization, new models of e-commerce services, e-business, etc.

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