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A study on material selection of reusable surgical garments

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REZUMAT – ABSTRACT

Studiu privind selecția materialelor textile destinate echipamentelor chirurgicale reutilizabile

În prezent, sunt folosite două categorii de echipamentele medicale: de unică folosință și reutilizabile. Aceste echipamente oferă protecție împotriva virusurilor și, de asemenea, protejează personalul medical împotriva expunerii la agenții patogeni cu transmitere sanguină. Folosind tehnologii de înaltă performanță, pot fi realizate halate chirurgicale și huse din diverse materiale. În selecția acestor materiale, trebuie luată în considerare destinația îmbrăcămintei și condițiile de desfășurare a intervenţiior chirurgicale. În acest studiu, sunt investigate structurile materialelor din care sunt confecționate costumele infirmierelor și halatele chirurgicale reutilizabile, folosite în intervenții chirurgicale. Relația dintre destinația halatelor chirurgicale și a costumelor pentru infirmiere și valorile permeabilității la aer și la apă a fost studiată comparativ. Caracteristicile echipamentelor utilizate au fost comparate cu caracteristicile specifice ale echipamentelor chirurgicale, în conformitate cu standardul pr EN 13795. În urma acestui studiu, au fost selectate diferite tipuri de materiale pentru halate chirurgicale, în funcție de tipul intervenției chirurgicale.

Cuvinte-cheie: halat chirurgical, intervenție chirurgicală, material textil reutilizabil, analiză, material, standard pr EN 13795

A study on material selection of reusable surgical garments

Today, surgical garments are manufactured in two groups as disposable and reusable in the medical market. These garments prevent viruses from passing on to the patient and also keep medical staff from blood pathogens exposures. With modern technology it is possible to obtain surgical gowns and drapes by using many different materials. Therefore, in the selection of materials used in surgical gowns, purpose of clothing and surgical conditions must be considered. In this research, material structures of reusable scrub sets and reusable surgical gowns used in surgical operations are investigated and the relationships between specifications of surgical gowns and surgical scrub sets and air and water permeability values was evaluated by correlation analysis. Existing features of garments are compared with the specified properties of surgical garments according to the pr EN 13795 standard. As a result of the study, different types of material for surgical gown are proposed according to the types of surgery.

Key-words: surgical gown, surgery, reusable material, analysis of the material, pr EN 13795 standard

Surgical gowns are designed for acting as physical barriers between sterile and non-sterile zones especially for being able to keep the viral agents away from the patients and also keep the blood related pathogens away from the health personnel in order to create a safe operation environment and to minimize the risks for both parties [1].

The major uses of gowns are twofold. First, gowns are used in surgery and while performing invasive procedures, both to decrease the transmission of skin flora from the healthcare staff and to protect the staff against contact with potentially infective material, such as blood. Second, gowns are used when caring for patients with certain infectious disease to aid in preventing cross-transmission [2].

Surgical garments used to protect the patient and the surgical team during surgery must have a number of features. Pore size in the surgical garment, liquid repellency – liquid-tightness, air permeability and other properties need to be analyzed [3].

Liquid repellent feature of surgical clothes is very important to prevent the growth of bacteria in moist environments. Fluid repellent surgical clothes are sufficient only in the absence of moisture and fluid such as eye surgery and micro-surgery. If surgery is necessary in patients with problems such as Hepatitis B, Hepatitis C or HIV must be used liquid repellent fabric for surgical gown, during the course of an operation, to prevent contamination of the patient [4].

Air permeability of surgical clothes varies according to its raw material. Surgical gowns that allow moisture to evaporate are more suitable to provide the heat balance of the body easily. Surgical gowns that are made from fabric with better air permeability and water vapor transfer rate, have the ability to provide a wider comfort. If surgical gown does not allow enough evaporation and transfer, can cause discomfort and disrupt the balance of the body [5].

Materials used in surgical gowns must prevent the penetration of bacteria and viruses by linking liquids. But the same material must allow water vapor to escape for ensuring protection of body's heat balance [6].

Nowadays two categories of materials are used to manufacture surgical gowns: reusable and single-use material. Reusable surgical gowns are manufactured

Fig. 1. Scrub sets used in surgical operations

Fig. 2. Surgical gown used in surgical operations

from woven fabrics and are subjected to washing and sterilization process before each use. But disposable surgical gowns are manufactured from nonwoven fabrics and are designed for a single use [7].

With modern technology, it is possible to obtain surgical gowns and drapes using many different materials. The choice of using single-use or reusable gowns must take into consideration rules relating to the barrier and comfort properties of gowns, safety of patient and staff and the risk of bacterial contamination [6].

METHODOLOGY

In this research, reusable surgical gown used in surgical operations in different hospitals located in and around Izmir have been tested, in order to evaluate their relevance for pr EN 13795 [8].

These surgical clothes are scrub sets (fig. 1) and surgical gowns (fig. 2) to be worn on top of scrub sets, primarily from twelve hospitals in different qualification found in and around Izmir. These hospitals purchased surgical clothes from five separate companies (table 1). The names of these companies are not revealed in this study and these firms are represented by *A, B, C, D* and *E* letters. Later, materials of reusable scrub suits and reusable surgical gowns coming from these companies were analyzed.

Material content of supplied scrub sets are shown in table 2 and material content of surgical gowns are shown in table 3.

Firstly, samples of the aboveare conditioned for standard atmospheric conditions (20ºC ± 2 and 65 ± 2% relative humidity). Then the weights of these samples was determined according to TS 251, warp and weft densities were determined according to TS 250 EN 1049-2 and warp and weft yarn counts were determined according to TS 255. In addition, to decide on the barrier effectiveness of the materialswater resistance and air permeability tests were performed.

The following devices were used performing these tests:

– Water permeability tester – for water permeability, according to TS 257 EN 20811 (Shirley Hydrostatic Head Tester);
– Air permeability tester – for air permeability, according to TS 391 EN ISO 9237 (Karl Schöreder KG).

In the research, the relationships between specifications of surgical gowns and surgical scrub sets and air and water permeability values was evaluated by correlation analysis.

In this research, also surgical garments are classified in two groups taking into account of the amount of

Table 1

SURGİCAL GOWN SUPPLIERS OF THE HOSPITALS

Number of hospitals	Suppliers
7	*A*
2	*B*
1	*A, B, C, D*
1	*A, D*
1	*E*

Table 2

MATERİAL TYPES OF SCRUB SUİTS

Company code	Type of the material
A	100% cotton
A	65% PES + 35% cotton
C	65% PES + 35% cotton
D	65% PES + 35% cotton

Table 3

MATERİAL TYPES OF SURGİCAL GOWNS

Company code	Type of the material
A	100% cotton
A	100% cotton + Impertex
A	65% PES + 35% cotton + Impertex
B	100% cotton
C	100% Cotton + Impertex
D	100% cotton
D	65% PES + 35% cotton + Impertex
D	100% cotton + Impertex
E	100% PES

Table 4

SPECİFİCATİONS OF SURGİCAL SCRUB SETS										
Company code	**Weight**, g/m²		**Yarn count**, Ne				**Fabric density**, pcs/cm			
	Cotton	***Cotton/PES***	***Cotton***		***Cotton/PES***		***Cotton***		***Cotton/PES***	
			A	*Ç*	*A*	*Ç*	*A*	*Ç*	*A*	*Ç*
A	142	114	30/1	30/1	46/1	40/1	29	36	32	48
B	-	-	-	-	-	-	-	-	-	-
C	-	105	-	-	48/1	46/1	-	-	32	46
D	-	113	-	-	44/1	42/1	-	-	32	46

fluid exposure and operation time. Garments worn in surgeries with less bleeding like microsurgery, rewiew operating and eye surgery or in short – term operation was evaluated as standard performance clothing. Garments worn in surgeries with much bleeding and long-term operation like cardio-vascular surgery, neurology, gynecology, orthopedic operations and etc. were evaluated as high performance clothing.

FINDINGS

The specifications of the materials of the surgical scrub sets used in this study are shown in table 4. Water and air permeability values of the materials of these scrub sets are listed in table 5.

Material specifications of surgical gowns are shown in table 6. Also water and air permeability values of these surgical gowns are shown in table 7.

In order to demonstrate the relationships among technical specifications of the materials of surgical scrub sets and air permeability and water permeability values of these materials correlation analysis were performed. The results of correlation analysis are as follows:

- between the warp yarn count and the fabric weight (g/m^2) of the materials was found a negative correlation ($r = -1$, $p < 0.01$). Accordingly, the warp yarn count decreases with increasing fabric weight (g/m^2);
- positive correlation was found between warp yarn count and air permeability of the materials ($r = 1$,

Table 5

THE AİR AND WATER PERMEABİLİTY RESULTS OF SURGİCAL SCRUB SETS				
Company code	**Air permeability**, $lt/dm^2/min.$		**Water permeability**, cm H_2O	
	Cotton	***Cotton/PES***	***Cotton***	***Cotton/PES***
A	258	268	42	42
C	-	322	-	42
D	-	313	-	39

Table 6

SPECIFICATIONS OF SURGICAL GOWNS																
Material type		**Yarn count**, Ne					**Fabric density**, pcs/cm					**Weight**, g/m²				
		A	*B*	*C*	*D*	*E*	*A*	*B*	*C*	*D*	*E*	*A*	*B*	*C*	*D*	*E*
Cotton	*A*	20	22	-	20	-	20	20	-	19	-	149	195	-	178	-
	Ç	18	20	-	20	-	27	43	-	40	-					
Cotton/PES	*A*	44	-	-	-	-	32	-	-	-	-	113	-	-	-	-
	Ç	42	-	-	-	-	46	-	-	-	-					
PES	*A*	-	-	-	-	62	-	-	-	-	35	-	-	-	-	74
	Ç	-	-	-	-	64	-	-	-	-	42					
PES reinf.	*A*	-	-	-	-	68	-	-	-	-	36	-	-	-	-	91
	Ç	-	-	-	-	64	-	-	-	-	61					
Cotton/PES (R)	*A*	-	-	-	42	-	-	-	-	31	-	-	-	-	115	-
	Ç	-	-	-	44	-	-	-	-	48	-					
Cotton (R)	*A*	20	-	20	20	-	20	-	22	17	-	151	-	155	187	-
	Ç	20	-	20	22	-	27	-	27	44	-					
Co reinf.	*A*	76	-	60	*	-	36	-	29	*	-	65	-	65	82	-
	Ç	72	-	64	*	-	45	-	41	*	-					

Table 7

THE AİR AND WATER PERMEABİLİTY RESULTS OF SURGİCAL GOWNS										
Material type	**Water permeability**, cm H_2O					**Air permeability**, lt/dm^2/min.				
	A	*B*	*C*	*D*	*E*	*A*	*B*	*C*	*D*	*E*
Cotton	41	48	-	45	-	525	48	-	168	-
Cotton/PES	36	-	-	-	-	263	-	-	-	-
PES	-	-	-	-	44	-	-	-	-	278
PES reinf.	-	-	-	-	86	-	-	-	-	*
Cotton/ PES (R)	-	-	-	41	-	-	-	-	285	-
Co (R)	44	-	46	46	-	490	-	567	90	-
Co reinf.	69	-	42	>1 000	-	*	-	*	*	-

Note:
Cotton/PES: Cotton – polyester reinforced portion of polyester gown;
Cotton/PES/(R): Cotton – polyester reinforced portion of cotton – PES blend gown;
Cotton (R): Cotton portion of cotton reinforced gown;
Cotton reinf.: Reinforced portion of cotton reinforced gown;
*Values could not be measured due to the structure of the fabric

$p < 0.01$). According to this, it can be said that air permeability value increased with increasing warp yarn count;

- between the air permeability and the fabric weight (g/m^2) of the materials was found a negative correlation ($r = –1$, $p < 0.01$). Accordingly, the air permeability decreases with the increase in fabric weight and material less permeable to air molecules.

In order to demonstrate the relationships among technical specifications of the materials of surgical gowns and air permeability and water permeability values of these materials are performed correlation analysis. The results of correlation analysis are as follows:

– between the weft yarn count and the fabric weight (g/m^2) of the materials was found a negative correlation ($r = –0.928$, $p < 0.01$). Accordingly, the weft yarn count decreases with increasing fabric weight (g/m^2);
– between the warp yarn count and the fabric weight (g/m^2) of the materials was found a negative correlation ($r = –0.941$, $p < 0.01$). Accordingly, the warp yarn count decreases with increasing fabric weight (g/m^2);
– between the warp yarn count and the weft yarn count was found a positive correlation ($r = –0.993$, $p < 0.01$). Accordingly, the weft yarn count increases with the increase in the warp yarn count;
– between the weft yarn count and weft density of the materials was found a positive correlation ($r = –0.941$, $p < 0.01$). Accordingly, the weft yarn count increases with the increase in weft density;
– between the weft density and the fabric weight (g/m^2) of the materials of the materials was found a negative correlation ($r = –0.902$, $p < 0.01$). Consequently, the weft density increases with the increase in yarn count and grams per square meter (g/m^2) naturally decreases;
– between the weft density and warp density of the materials was found a positive correlation ($r = –0.624$, $p < 0.05$). Accordingly, the weft density increases with the increase in warp density;
– between the warp yarn count and warp density of the materials ($r = –0.615$, $p < 0.05$) was found a positive correlation. Accordingly, the warp yarn count increases with the increase in warp density;
– between the air permeability and warp density of the materials ($r = –0.784$, $p < 0.01$) was found a negative correlation. As a result, warp density decreases with increasing air permeability;
– between the water permeability and warp density of the materials was found a positive correlation ($r = –0.588$, $p < 0.05$). As a result, warp density increases with the increase in water permeability value. As a result, material passes less liquid.

CONCLUSIONS AND RECOMMENDATIONS

Clothing used in surgical environment are surgical scrub sets and surgical gowns.Surgical gowns are the most important protective environment. So they should be designed to divide into two groups according to the type and duration of the surgical operation. Surgical scrub sets are worn into the surgical gown, so these sets are planned to produce single type.

In the study, in determining the type of material for surgical scrub sets, pr EN 13795 for surgical garments was used. According to this standard, areas of surgical garments that are close to the surgical wound and front part and sleeves of surgical garments are defined as “critical zones” and regions that are away from the surgical wound are defined as “less critical zones”. Accordingly, surgical scrub sets are taken part in surgical gowns, so they are defined as less critical region.

The selection of material type of surgical scrub sets are based on water permeability properties according to the pr EN 13795 standard. According to this standard, for less critical zones of surgical garments, with standard performance and high performance surgical garments, the value of water permeability defining to

TS 257 EN 20811 must be at least 10 cm H_2O. In the study, analyzing the water permeability results of the materials used, has been determined that the value of each type of material was more than 10 cm H_2O. Therefore, results of air permeability have been taken into account for the selection of fabrics. According to the air permeability results, value of the air permeability of surgical scrub sets that are made of 65% PES + 35% cotton are determined significantly higher. Weight is very important for the person wearing the garment. Weight of PES/cotton fabric is lower than weight of 100% cotton fabric. Therefor this fabric is recommended.

In the selection of the material of surgical gown with standard performance requirements used in operations with short-term or with less bleeding operations like micro-surgery, review operations and eye operations, EN 13795 standard is used. For the critical zones of surgical gown, the value of water permeability should be observed for at least 20 cm H_2O according to TS 257 EN 20811. For the production of surgical garments requiring standard performance, microfilament material should be used, because water resistance value of this material is 86 cm H_2O, according to TS 257 EN 20811. Also the weight of this material is very low (91 g/m^2), therefor is considered to be more comfortable for the user. Also addition of carbon fibers to the polyester yarns using in the front and in the arms of these garments are recommended. Fabrics that include these yarns in the weaving process may obtain permanent antistatic property. Thus, these fabric structures will be resistant to shrinking and won't spread particles during their usage.

Another recommended issue is providing liquid repellency with fluorocarbon finishing process of these fabrics [7].

In the fabric selection of high-performance garments used in surgeries with long-term and much bleeding surgeries such as cardio-vascular, neurologic, gynecologic, orthopedics surgeries and the surgeries of patients with HIV, Hepatitis B, Hepatitis C virus, EN 13795 standard is used. According to this standard, water permeability values for critical areas of surgical garments that requires high performance must be at least 100 cm H_2O and for less critical regions, this value must be at least 10 cm H_2O according to the TS 257 EN. For this reason, for the fronts and sleeves which are critical areas of high-performance reusable surgical garments, are recommended to be textile laminates. Also, adapting the terms of clothing comfort, sewing, washing and terms of use, back portion of surgical gowns are recommended to be made from 100% PES microfilament fabric.

The results of this study include technical specifications of surgical gowns and the evaluation of these properties. Investigation of the properties of existing garments is thought to give some information to the surgical team and clothing manufacturers for the correct use of these garments in hospitals.

However, specifications of current clothing materials cannot provide full compliance with the standards of surgical gown. Therefore, for the safety of the patient and the surgical team, is suggested to investigate the air and water permeability values of clothing materials for different fiber types and mixtures of them and their relationship with the fabric finishing in further studies.

BIBLIOGRAPHY

[1] Pamuk, O. *Cerrahi Personel ve Hastanın Kullanımına Yönelik İşlevsel Medikal Ürünlerin Geliştirilmesi.* Unpublished doctoral theses, Ege University, 2006

[2] Rutala, W. A., Weber, D. J. *A review of single-use and reusable gowns and drapes in health care*. Infection Control and Hospital Epidemiology, 2001

[3] Pamuk, O., Ondoğan, Z. *Tek Kullanımlık Cerrahi Giysiler İçin Test Yöntemleri*. In: Medikal Teknik, August 2003, pp. 44-45

[4] Ondoğan, Z. *Cerrahi Giysilerde Özellikler*. In: Tekstil & Teknik Dergisi, 1999, issue 175, pp. 76-79

[5] Ondoğan, Z., Pamuk, O. *Cerrahi Ortamda Kullanılan Giysilerin Genel Özellikleri*. In: Tekstil ve Konfeksiyon, 2002, vol. 12, issue 3, pp. 153-155

[6] Sen, A. *Cerrahi Ortamda Cerrahi Personelin Giyebileceği Özel Giysi Geliştirilmesi*. Unpublished Phd Theses, Ege University, 2005, pp. 110

[7] Pamuk, O., Ondoğan, Z. *Cerrahi Personelin Ameliyat Önlükleri İle İlgili Görüşlerinin Belirlenmesi Üzerine Bir Araştırma*. In: Tekstil ve Konfeksiyon, 2008, vol. 18, issue 2, pp.142-148

[8] European Standard EN 13795, *EU Standard for surgical drapes, gowns and clean air suits, used as medical device*

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Study regarding the optimization of the bioscouring treatment with ultrasound on 100% cotton materials

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REZUMAT – ABSTRACT

Studiu privind optimizarea tratamentului de biocurățare enzimatică cu ultrasunete, aplicat pe materiale textile din 100% bumbac

Lucrarea prezintă optimizarea tratamentului de biocurățare enzimatică cu ultrasunete aplicat pe materialele textile din 100% bumbac, folosind preparatul enzimatic Sera Zyme C-PE (Roglyr Eco 183). Pentru acest tratament s-a folosit un program central compus rotabil de ordinul 2, având ca variabile independente concentraţia de preparat enzimatic și timpul de tratare. Pe baza datelor obținute prin determinarea pierderilor de masă, s-au stabilit parametrii optimi de lucru pentru tratamentul de biocurățare cu preparatul enzimatic Sera Zyme C-PE (Roglyr Eco 183), în câmp ultrasonor.

Cuvinte-cheie: bumbac, enzime, biocurățare cu ultrasunete, pierderi de masă, regresii multiple

Study regarding the optimization of the bioscouring treatment with ultrasound on 100% cotton materials

The paper presents the optimization of the bioscouring treatment with ultrasound on 100% cotton materials, using Sera Zyme C-PE (Roglyr Eco 183) commercial enzyme. For the bioscouring treatment a central, rotatable second order compound program was used, with the following independent variables: enzyme concentration and treatment time. Using the data obtained by measuring the mass loss, the optimum working parameters for the bioscouring treatment in the presence of ultrasound with Sera Zyme C-PE (Roglyr Eco 183) were determined.

Key-words: cotton, enzymes, bioscouring treatment with ultrasound, mass loss, multiple regressions

The bioscouring treatment consists into eliminating natural attendants of the cotton fiber (non-cellulose substances) using a Pectate Lyase (E.C. 4.2.2.2) in phosphate buffer solution of 0.1 molar monosodium/disodium phosphate (*p*H = 7.5) [1], [2].

For enzymatic pre-treatment process the Pectate Lyase treatment in the presence of ultrasound was experienced.

By using ultrasound an intensifying of mass and heat transfer occurs, due to the effects of vibration on hydrodynamics boundary layer both by increasing surface contact area, and by increasing the mass with the advent of molecular diffusion thermal effect due to internal friction and external walls of the unit.

Effects obtained using ultrasound in this process are focused on: changing of layer and boundary substrate at the fabric-solution interface, with the increasing of speed diffusion; dispersion and homogenization of treatment solutions; degassing of solutions and textiles, which ensure a deep penetration of chemical agents in the fabric; an temporary deformation of fiber, which facilitates a more rapid penetration of chemicals in fabric [3].

EXPERIMENTAL PART

For the research 100% cotton fabrics were used, with the following characteristics: width 120 ± 3 cm, mass 200 ± 10 g/m^2, warp sett 220 ± 10 yarns/10 cm, weft sett 180 ± 10 yarns/10 cm.

The bioscouring treatment was performed in the presence of ultrasound under the following conditions: 1-3% Sera Zyme C-PE (Roglyr Eco 183) – Pectate Lyase (E.C. 4.2.2.2); 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 buffer (0.1 molar sodium phosphate/disodium phosphate, *p*H = 7.5); fabric to liquid ratio – 1:10, at temperature of 55ºC and 20–60 minutes duration [1].

After a series of preliminary determinations, to achieve a minimum number of experiments, these were conducted according to a central, rotatable second order compound program with two independent variables [4].

The variation limits and experimental plan are presented in table 1 and table 2.

Table 1

THE VARIATION LIMITS OF INDEPENDENT VARIABLES

Real value \ Cod value	–1.414	–1	0	1	+1.414
x – enzyme concentration, % over 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

Table 3

EXPERIMENTAL MATRIX AND THE MEASURED VALUES OF THE RESPONSE FUNCTION					
Exp. no.	**Independent variables**				**Answers**
	x		***y***		***Y***
	x (cod.)	*x* (real) Enzyme concentration, %	*y* (cod.)	*y* (real) Time, min.	*Y = f(x,y)* Mass loss, %
1	–1	1.70	–1	34.00	1.91
2	1	2.70	–1	34.00	1.53
3	–1	1.70	1	54.00	2.02
4	1	2.70	1	54.00	2.00
5	–1.414	1.00	0	40.00	1.30
6	1.414	3.00	0	40.00	1.64
7	0	2.00	–1.414	20.00	1.95
8	0	2.00	1.414	60.00	1.71
9	0	2.00	0	40.00	1.99
10	0	2.00	0	40.00	1.83
11	0	2.00	0	40.00	1.62
12	0	2.00	0	40.00	1.95
13	0	2.00	0	40.00	1.29

RESULTS AND DISCUSSIONS

Experimental matrix and the measured values of the response function are shown in table 3.

Mathematical model interpretation obtained

In order to assess more accurately the influence of some process parameters (the concentration of enzyme and the treatment time) of the bioscouring treatment of 100% cotton fabric in the presence of ultrasound on the mass 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 – concentration of enzyme, %.
y – time, minutes.
As goal-function the mass loss (*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:

$$Y = b_0x_0 + b_1x_1 + b_2x_2 + b_{12}x_1x_2 + b_{11}x_1^2 + b_{22}x_2^2 \quad (1)$$

For the experimental data a program in MathCAD professional and Excel was used, and a regression equation was obtained [4] – [7]. The regression equation coefficients are presented in table 4. The regression equation obtained after eliminating insignificant coefficients is:

$$F(x.y) = 1.736 + (0.00)x + (0.028)y + (-0.078)x^2 + + (0.103)y^2 + (0.09)xy \quad (2)$$

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 is shown in table 4.
The significance of the regression equation coefficients was tested using Student test with critical table

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 $t_c > t_t$ – term is significant)		
b_0	1.736399	*S* = 0.299476	t_{c0}	104.7538	significant
b_1	0.010095		t_{c1}	0.974421	insignificant
b_2	0.028313		t_{c2}	2.732867	significant
b_{11}	–0.07884		t_{c11}	–6.61496	significant
b_{22}	0.103753		t_{c22}	8.705452	significant
b_{12}	0.09		t_{c12}	4.343629	significant

value for the test $t_{\alpha,\nu} = t_{0,05;6} = 2.132$. The test values and the significance of the coefficients are presented in table 4.

Verification 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.

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 following values shown in table 5. The ratio $F_c = PMrez/S_0^2$ 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. $F_c = 2.419764$ calculated value is lower 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 independent variables and not to an 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 about 29.94%.

The correlation coefficient has the value:

$$r_{x1x2} = 0.048757, \quad r_{x1y} = 0.0345386, \quad r_{x2z} = 0.09686721 \tag{3}$$

The significance of the simple correlation coefficients is checked using the Student test. The calculated values are:

$$tc_{x1y} = 0.11462$$
$$tc_{x2y} = 0.3227902 \tag{4}$$
$$tc_{x1x2} = 0.16190243.$$

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, $t_{x1x2} = 0.16$ 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 coefficient of multiple determination 0.217402 shows that the influence of the two independent variables on the outcome is 21.74%, 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.

Table 5

ADEQUACY CALCULATION MODEL

No.	Y meas.	Y calc.	(Y meas. – –Y calc.)^2	Deviation A	Average square of residuals, PM_{rez}	Dispersion of reproductibility, S_{02}	Ratio $F_c = PM_{rez}/S_{02}$	Statistics $F_c < F_c$ $F'_c = F_{\nu 1,\, \nu 2,\, \alpha} = F_{5;5;0,01} = 6,59$	Fisher test $F_c < F'_t$ $F'_t = F_{\nu 1,\, \nu 2,\, \alpha} = F_{12;12;0,05} = 2,69$
1	1.91	1.8129	0.009427	5.0834					
2	1.53	1.6530	0.015152	–8.0455					
3	2.02	1.6895	0.109209	16.3598					
4	2	1.8897	0.012161	5.5139					
5	1.3	1.5644	0.069958	–20.3458				$F_c = 0.893702$	$F_c = 1.277795$
6	1.64	1.5930	0.002204	2.8630					
7	1.96	1.9038	0.003157	2.8669	0.07407	0.08288	0.893702	0.893702 < 6,59	1.277795 < 2,69
8	1.71	1.9838	0.075008	–16.0161					
9	1.99	1.7363	0.064313	12.7437				Appropriate model	Appropriate model
10	1.83	1.7363	0.008761	5.1147					
11	1.62	1.7363	0.013548	–7.1851					
12	1.95	1.7363	0.045625	10.9538					
13	1.29	1.7363	0.199272	–34.6045					

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

$$F(x.y) = 1.736 + (0.00)x + (0.028)y + \\ + (-0.078)x^2 + (0.103)y^2 + (0.09)xy \quad (5)$$

The canonical form of regression equation and the new center has the coordinate's axes: $x = -0.062$, $y = -0.107$. Value of the dependent variable in the center of the response surface is: $y_c = 1.734$.
The coefficients of the canonical form were calculated and the equation which resulted is:

$$y = 1.734 - 5.54\, z_1^2 + 5.56\, z_2^2 \quad (6)$$

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*. This figure presents contour curves for various values of mass loss 1.30 to 2.02 between. On the response surface from figure 2 which is type "saddle" form, a stationary point of coordinates $x = -0.063$ and $y = -0.109$ can be observed. These encoded coordinates are associated with an enzyme concentration of 1.9 and a treatment time of 40 minutes. The value of the goal-function at this point is $Y = 1.734$.

Interpretation of the obtained mathematical model technology

By analyzing the expression of the obtained goal-function:

$$F(x.y) = 1.736 + (0.00)x + (0.028)y + \\ + (-0.078)x^2 + (0.103)y^2 + (0.09)xy \quad (7)$$

These can be seen:
- the influence of the two independent parameters, *x* (enzyme concentration) and *y* (treatment time) on the dependent variable *Y* (mass loss) manifests different. Variable *x* (enzyme concentration) does not influence the outcome but variable *y* (treatment time) directly influence it, respectively the increase of *y* (treatment time) conduct to increasing of *Y* (mass loss);
- the influence of variable *y* (treatment time), on *Y* (mass loss) is 1.73%;
- 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 terms quantifies the speed of *Y* (mass loss) outcome change variation to the variation of the two parameters; the *y* variable (time of treatment) influences the outcome with 5.8%;

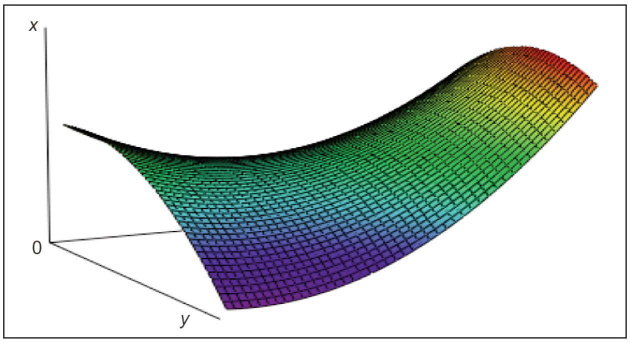

Fig. 1. The dependence of the goal-function on the independent variables:
x – enzyme concentration; *y* – treatment time

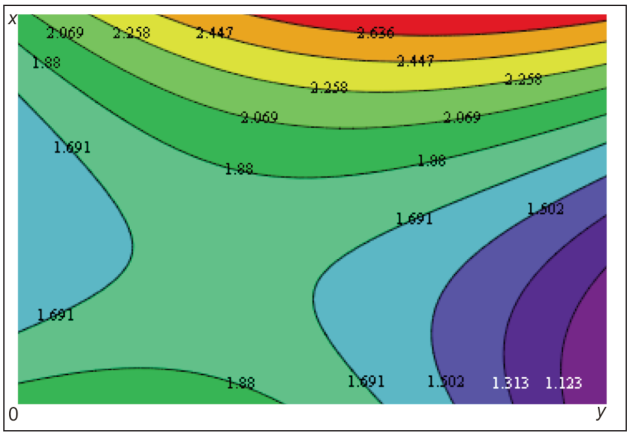

Fig. 2. Contour curves for various values of *Y* (mass loss)

- the influence of the interaction of the two parameters on the dependent variable is 5.177%;
- the concerted increase of the two independent variables leads to an decrease of the dependent variable.

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 x_1 variable – enzyme concentration, the graph representing the variation of enzymes mass loss versus time, indicates for the interval [–1414, 0], (between 20–40 minutes) a decrease in mass loss and the existence of a minimum point, around 40 minutes, which indicates a big influence of this parameter on the mass loss, and for the interval [0, 1414] (between 40–60 minutes) it can be seen that with time increasing to a certain value, the mass loss increases.
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 mass loss, as the curves have not similar forms. For the interval [–1414, –1] mass loss decreases with the increasing of enzyme concentration and for the interval [0, 1414] mass loss increases with the increase of the enzymes concentration up to a certain value and

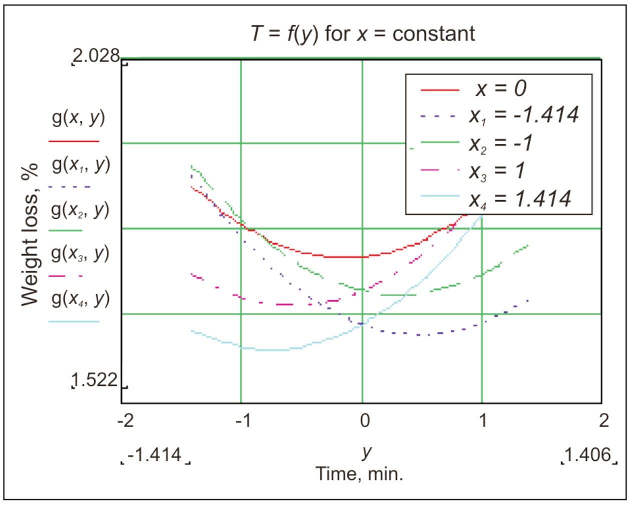

Fig. 3. The dependence of the goal-function on all significant values of *y* parameters for *x* = constant

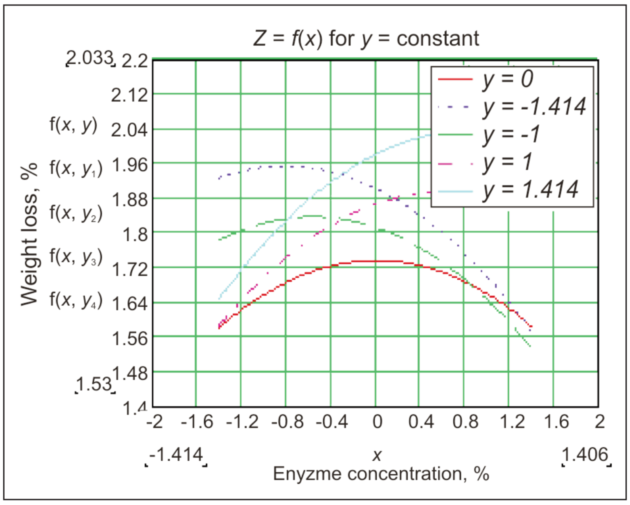

Fig. 4. The dependence of the goal-function on all significant values of *x* parameters for *y* = constant

then decreases. By analyzing the graph it can be observed that conducting the experiment with small values of the variable x_2 (for 10–34 minutes) there is an increase in mass loss with the increasing of enzyme concentration. Conducting the experiment with high values for the variable x_2 (for 54–60 minutes) an increasing of the enzyme concentration can no longer influence the process.

CONCLUSIONS

In this work a central, rotatable second order compound program was used. From statistical analysis presented in the paper it can be observed that the independent variables were correctly chosen because both variables have significant influence on the process. From these two variables the biggest influence on the process has the time treatment. The influence of this variable is 1.73%.

The optimal parameters set by this mathematical modeling of the process, as can be seen from the figures are 1.9% enzyme concentration and treatment time 40 minutes.

Analyzing the presented figures it can be observed that the influence of enzyme concentration and treatment time on mass loss of the fabric treated by bioscouring process in the presence of ultrasound was properly appreciated.

ACKNOWLEDGEMENT

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BIBLIOGRAPHY

[1] Catalog DyStar Textilfarben GmbH, 2007
[2] Iștoc, I. V., Pustianu, M., Bucevschi, A., Dochia, M. A., Sîrghie, C. *Study regarding the optimization of the bioscouring treatment on 100% cotton materials*. Advanced in Environmental Technologies, Agriculture, Food and Animal Science. ISSN 2227-4359, ISBN 978-1-61804-188-3. Proceeding of the 2nd International Conference on Energy and Environment Technologies and Equipment (EEETE '13), series 10, 2013, Brașov
[3] Popescu, A., Grigoriu, A., Zaharia, C., Mureşan, R., Mureşan, A. *Mathematical modeling and the technological process optimization for the bio-scouring of the cotton textile materials.* In: Industria Textilă, 2010, vol. 61, pp. 70-80
[4] Butnaru, R., Stoichițescu, L. *Special finishing procedures of textiles fabrics*. Editura Gh. Asachi, Iași, 1995
[5] Mihail, R. *Introduction to the strategy experimenting with applications in chemical technology*. Ed. Scientific and Encyclopedic, Bucharest, 1976
[6] Akhnazarova, S., Kafarov, V. *Experiment optimization in chemistry and chemical engineering*. MIR publ., Moscow, 1982
[7] *Computational problems numerical and statistical – MathCAD*, no. 29. The series PC, Ed. Blue, Cluj-Napoca, 1995
[8] Schneiber, E., Lixandroiu, D. *MathCAD - Presentation and problems solved.* Ed. Technique, Bucharest, 1994

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Effect of fiber type on hydrogen peroxide stabilization during bleaching

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REZUMAT – ABSTRACT

Influența tipului de fibră asupra stabilizării peroxidului de hidrogen, în timpul procesului de albire

În lucrare este analizată influența tipului de material textil asupra stabilizării peroxidului de hidrogen, în timpul procesului de albire. În acest scop, materialele textile din diferite fibre au fost supuse procesului de albire folosind aceeaşi reţetă de albire. S-a observat că tipul de fibră are efecte diferite asupra descompunerii peroxidului de hidrogen. Prin urmare, este important, pentru procesul de albire, să se analizeze efectul de stabilizare pentru fiecare tip de fibră. Astfel, la fibrele de lână s-a observat un efect de activare mai mare. Și în cazul fibrelor de iută s-a constatat o creștere a procentului de stabilizare, dar la fibrele din bumbac s-a remarcat cel mai mare efect de stabilizare în baia de albire.

Cuvinte-cheie: peroxid de hidrogen, stabilizare, albire, fibră, material textil

Effect of fiber type on hydrogen peroxide stabilization during bleaching

This study aimed to investigate the effect of textile materials on hydrogen peroxide stabilization during bleaching. For this purpose, fabrics made of different fibers types were bleached with the same bleaching recipe. It was found that the fiber type have different effects on the decomposition of peroxide. So it is important to stabilize the bleaching bath considering the fiber type. The highest activation effect was obtained with the wool. Jute fabric also showed the higher rate than the blank bleaching. But cotton fibers had the highest stabilization effect in the bleaching bath.

Key-words: hydrogen peroxide, stabilization, bleaching, fiber, textile

There is historic evidence of chemical bleaching of cloth prior to 300 BC. Usage of soda ash from burnt seaweed was followed by treatment with soured milk to neutralize the fabric and finishing with exposure to sunlight [1].

Today bleaching chemicals are commonly used to bleach paper, pulp, textile materials, and stains. Their common feature is the presence of various chromophores that need to be bleached. A bleaching chemical acts as a substrate through oxidative or reductive processes, either by degradation of the chromophore and so to water-soluble form or by shifting the wavelength of absorbance outside the visible region [2]. Bleaching is a critical textile wet process generally required for the preparation of cotton fibers to remove yellowish natural impurities prior to dyeing and finishing [3]. The chlorine-based bleaches, hydrogen peroxide, ozone, and peracids are the popular bleaching agents used in laundry cleaning, textile bleaching and pulp-paper bleaching. Alkaline peroxygen systems are very popular in our daily lives [3], [4]. The annual world production of hydrogen peroxide is approximately 2.2 million metric tons, of which 50% is used for pulp/paper bleaching and 10% for textile bleaching [2]. The most common bleaching is oxidative in nature; reductive bleaching may be used too, but its use is mainly confined to after-bleaching following peroxide treatment [5].

Peroxy bleaching agents are more extensively used than chlorine bleaches in fabric-washing products because, incorporating chlorine bleaches into formulations during processing is difficult and can cause fiber damage and malodor [1]. Also the conventional chlorine-based bleaching agents, chlorine and hypochlorite, used in aqueous systems can generate chlorinated by-products which are hazardous to the environment. However the usage of hydrogen peroxide has the advantages that the oxidant is cheap, clean [6] and has simplicity in use, eco-friendly nature [7]. As a result, it is a commonly used textile bleaching agent that is considered toxicologically and environmentally acceptable, as its decomposition products are harmless [8] – [11]. However, aqueous solutions of peroxides are unstable, so their activity and bleaching capacity decrease within time. This is especially true of formulations containing hydrogen peroxide, particularly in alkaline media, where their bleaching activity is especially high [8]. But, the bleaching process is conducted in an alkaline bath at *p*H 10 to 12 and at temperatures up to 120°C. Due to high working temperature, a large amount of energy is consumed. The large amount of water used to rinse and neutralize the alkaline scoured and peroxide bleached textiles is ecologically disputable [11]. Stabilizers, which act as buffers, sequestering agents, and dispersants, must be added into the hydrogen peroxide bleaching baths to protect fibers from degradation [10]. Polydentate ligands, generally aminocarboxylic acids and phosphoric acids will sequester many transition metals and reduce their activity as decomposition catalysts, especially in alkaline systems [12]. NTA, EDTA and DTPA form very stable metal complexes. EDTA and DTPA are also poorly eliminated compounds. They could pass non-degraded through the common wastewater treatment system. Their ability to form a very stable complex with metal makes the problem even more serious because they can mobilize those heavy metals present in the waste water, and release them into the receiving water. Additions to them, surfactants with emulsifying, dispersing, and wetting properties are used in hydrogen peroxide bleaching too. These can cause an increase in TOC and COD values of waste water. Upon neutralization of highly alkaline waste baths, large amounts of salts are produced. Consequently, the textile industry is considered one of the biggest water, energy and chemical consumers [11], [13], [14].

EXPERIMENTAL PART

Materials and method

In this study it was aimed to investigate the effect of textile materials on hydrogen peroxide stabilization during bleaching. For this purpose, fabrics produced with different fiber types were bleached with the same bleaching recipe (table 1). The fabrics used in experiments were all unbleached based on 100% cotton, 100% jute, 100% viscose, 100% wool, 100% polyamide, 100% polyester and cotton/lycra fabrics. Moreover bleached 100% linen and linen/cotton fabrics were also used during the experiments too.

During the bleaching process the peroxide remained in the bath was determined at 15 minute intervals. For determination the remained peroxide in bleaching bath iodimetric titration method was used and the remained peroxide was titrated 0.1 N sodium thiosulphate ($Na_2S_2O_3$). The whiteness of the samples was determined by X-RITE spectrophotometer according to Brightness formula.

Table 1

BLEACHING RECIPE
6 ml/l H_2O_2 (35%)
1 g/l NaOH
L.R.: 1:20
85ºC, 60 minutes

RESULTS AND DISCUSSIONS

Hydrogen peroxide bleaching process depends on several factors like *p*H, bath content, temperature, time etc. In the first step of the study it was aimed to identify the decomposition of the peroxide in the bath. For that purpose, the peroxide remained in a blank bath (contains no fabric only NaOH) was titrated in 15 minute intervals. The change of peroxide depending on time was drawn as shown in figure 1. The curve for the decomposition of peroxide perfectly fit with a logarithmic curve (R^2 = 0.9608).

From the figure 1, it is easy to say that during the time period of 1 hour, the amount of peroxide in the bath decreasing. However there is not any permit for estimating the decomposition rate of hydrogen peroxide.

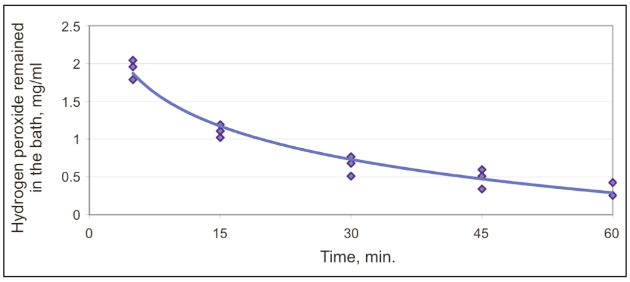

Fig. 1. H_2O_2 decomposition of bleaching bath which contains no fabric

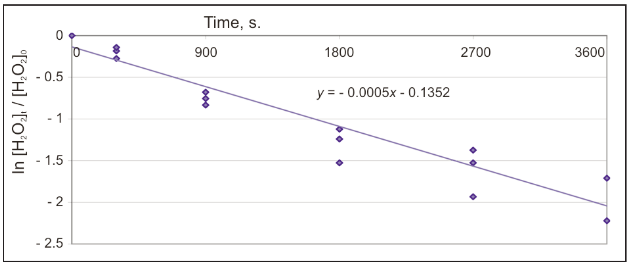

Fig. 2. Determination of the rate constant of H_2O_2 decomposition in bleaching bath which contains no fabric

This decomposition graph of hydrogen peroxide shows that it is not a zero order reaction so it was decided to plot ln $[H_2O_2]_t / [H_2O_2]_0$ against time to see if a straight line can be obtained or not. Finally a linear line with a R^2 = 0.9124 was found which shows that the decomposition of hydrogen peroxide is a first order reaction. Actually the decomposition of peroxide has already been known as a first order reaction. Besides Körlü and Bilgin (2008) have investigated the decomposition of hydrogen peroxide in bleaching bath contains different metal ions and they also declared that it shows a first order reaction even with the metal ions too [15].

The kinetic of a first order reaction can be summarized as equation (1).

$$ln(C_t/C_0) = -k \cdot t \quad (1)$$

C_t means concentration of reactant when $t = t$, and C_0 is the initial concentration that means $t = 0$. So it can be easily told that slope of linear plot shown in figure 2 is $-k$. As a result the decomposition rate constant (k) of hydrogen peroxide in bleaching bath containing no fabric is $5 \cdot 10^{-4}$ s^{-1}.

It is obvious that except in cotton, the decomposition of peroxide has shown first order reactions. During cotton bleaching cotton showed a stabilizing effect on peroxide so the decomposition of peroxide is limited. For example in the start of the bleaching process nearly 2.35 mg/ml H_2O_2 is available however after 1 hour later it decreased to 2.24 mg/ml that is to say a stabilizing effect is available while the whiteness of the fabric increased to 74.6 brightness. However, it was found that the fiber type has different effects on the decomposition of peroxide (fig. 3). When the equations obtained with the $ln(C_t/C_0) - t$ plots were investigated in terms of the first order equation the rate constants can be calculated as in the table 2.

Table 2

DECOMPOSITION KINETIC PARAMETERS OF HYDROGEN PEROXIDE IN BLEACHING BATH OF DIFFERENT FABRICS			
Type of material	**Equation of plots**	R^2	**Rate constant, *k*** (s^{-1})
Wool	$y = -0.0018\ x + 0.0694$	0.9471	$18 \cdot 10^{-4}$
Jute	$y = -0.0009\ x - 0.1266$	0.898	$9 \cdot 10^{-4}$
Polyamide	$y = -0.0006\ x - 0.3084$	0.8918	$6 \cdot 10^{-4}$
Polyester	$y = -0.0006\ x - 0.1628$	0.9195	$6 \cdot 10^{-4}$
Viscose	$y = -0.0003\ x - 0.0789$	0.8988	$3 \cdot 10^{-4}$

Table 2 shows the equations of peroxide decomposition according to the first order reactions in which *y* means $\ln(H_2O_{2t}/H_2O_{20})$ and *x* means *t* (s). Finally the *k* rate constants were calculated for all tested fabrics. The highest *k* was found during the bleaching of wool. It is $18 \cdot 10^{-4}\ s^{-1}$ which is nearly 4 times higher than the blank bleaching (hydrogen peroxide decomposition in bleaching bath in which no fabric is available). When the table 2 investigated step by step it was clearly told that except viscose and cotton which is examined before, wool, jute, polyamide and polyester fabrics accelerate the decomposition of peroxide in bleaching baths. The highest activation effect was obtained with the wool. Jute fabric also showed the higher rate constant $9 \cdot 10^{-4}\ s^{-1}$ than the blank bleaching too. It is thought that this might be caused by the high content of lignin in jute [16] also the other impurities can cause the increase in decomposition of peroxide too. It is well known that the jute is dirtier when compared with the other cellulosic fibers [17]. On the other hand the peroxide has the same rate constant when polyamide or polyester fabrics are in bath. This value is also higher than the $5 \cdot 10^{-4}\ s^{-1}$ of peroxide decomposition rate constant obtained if no fabric is in the bleaching bath.

Finally, it can be concluded that during bleaching process according to the textile material the decomposition of peroxide shows different rates. So it is important to stabilize the bleaching bath considering the fiber type. In general wool shows highly acceleration effect on peroxide decomposition while polyamide and polyester's acceleration effect is considerably limited. On the other hand jute, maybe because of its chemical composition, has also highly accelerated the peroxide decomposition too.

The interesting point is the highly stabilizing effect of cotton. The studies showed that in the bleaching bath without any stabilizing agent the peroxide can stabilize if the fabric is made of cotton. To confirm this result two different cotton fabrics 100% cotton knitted fabric and cotton/lycra fabric were bleached with the same recipe and the peroxide remained in the bath was titrated (fig. 4).

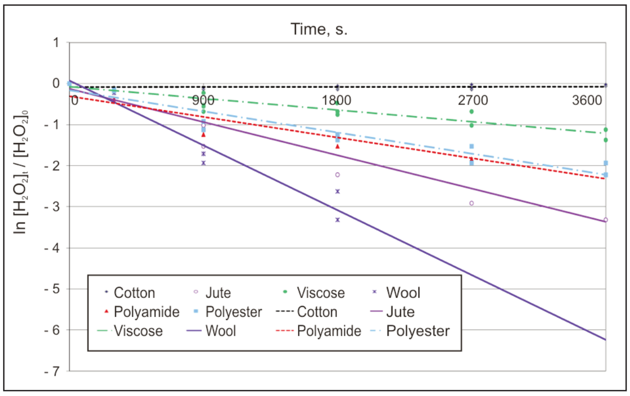

Fig. 3. Determination of the rate constant of H_2O_2 decomposition in bleaching bath which contains different fabrics

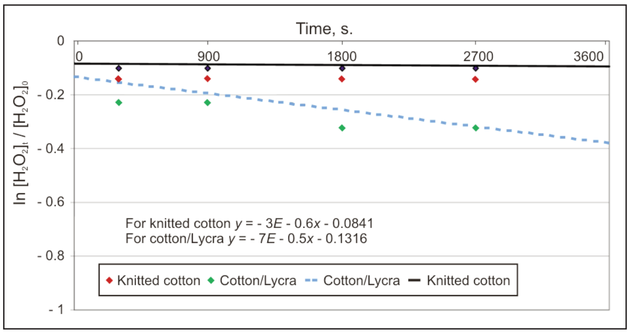

Fig. 4. Determination of the rate constant of H_2O_2 decomposition in bleaching bath which contains knitted cotton and cotton/lycra

For both the knitted cotton and cotton/lycra fabrics, the plots obtained have shown slopes of $-3 \cdot 10^{-6}$ and $-7 \cdot 10^{-5}$ which are equaled $-k$ in first order reactions. Hence the rate constants can be summarized as $3 \cdot 10^{-6}\ s^{-1}$ and $7 \cdot 10^{-5}\ s^{-1}$ for knitted cotton and cotton/lycra respectively. These constant rates are too low that if the bath contains cotton knitted fabric the decomposition rate is decreasing nearly 166 times when compared the bleaching bath contains no fabric. For cotton/lycra fabric this decomposition rate is 7 times lower than the value obtained in bleaching bath contains no fabric. It is obvious that the cellulosic materials, especially cotton has a stabilizing effect on peroxide decomposition. Meanwhile the whitenesses are improving too. For knitted cotton this bleaching period of the whiteness is increased to 74.7 brightness. As a result during cotton bleaching peroxide decomposes more logically and remains in the bath so can it be possible to continue for the second bleaching process with the same bath. In order to answer this question the same bath remained from the bleaching of knitted cotton fabric was used again and the 73.8 brightness was obtained.

From all these results it can be told that there is a stabilizing effect of cotton based fabrics but besides it, it is thought that cellulosic based fabrics have the same results. Although jute behaved differently it is believed that the reason is the chemical structure of jute.

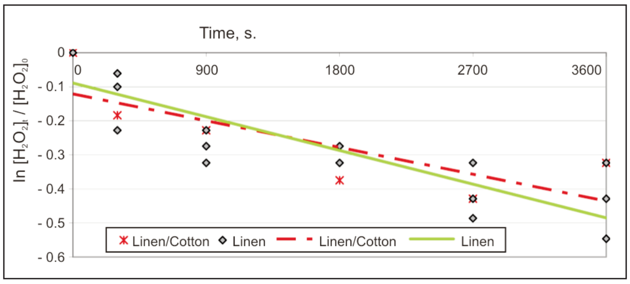

Fig. 5. Determination of the rate constant of H_2O_2 decomposition in bleaching bath which contains woven linen and linen/cotton fabrics

However the previously bleached linen and linen/cotton fabrics showed a stabilizing effect too. In figure 5 it was clearly observed that there is a stabilizing effect of the cotton/linen and linen fabrics when compared the peroxide decomposition in the bleaching bath containing no fabric. From the equations shown in figure 5 the rate constants can be calculated as $1 \cdot 10^{-4}$ s^{-1} for linen fabric and $9 \cdot 10^{-5}$ s^{-1} for linen/cotton fabric. Namely, with the addition of bleached linen fabric the decomposition of peroxide slows down 5 times when compared with the results obtained from the bath containing no fabric. Nearly the same result was obtained if the fabric is linen/cotton based. In this case the decomposition rate is decreasing nearly 5.5 times.

CONCLUSIONS

Hydrogen peroxide is the most popular bleaching agent in the textile finishing. It is considered that peroxide is toxicologically and environmentally acceptable because the decomposition products of it are not dangerous. But, aqueous solutions of peroxides are not stable, so bleaching effect can decrease within time.

The amount of peroxide in the bleaching bath decreases during the time period of 1 hour. It is obvious that except in cotton, the decomposition of peroxide has shown first order reactions.

During cotton bleaching cotton showed a stabilizing effect on peroxide so the decomposition of peroxide is limited. It was found that the fiber type have different effects on the decomposition of peroxide. It was clearly seen that wool, jute, polyamide and polyester fabrics accelerate the decomposition of peroxide in bleaching baths.

The highest activation effect was obtained with the wool. Jute fabric also showed the higher rate constant than the blank bleaching too.

Finally, it can be concluded that during bleaching process according to the textile material the decomposition of peroxide shows different rates. So it is important to stabilize the bleaching bath considering the fiber type.

BIBLIOGRAPHY

[1] Carson, P. A., Fairclough, C. S., Mauduit, C., Colsell, M. *Peroxy bleaches. Part 1 – Background and techniques for hazard evaluation*. In: Journal of Hazardous Materials, 2006, vol. 136, issue 3, p. 438

[2] Hage, R., Lienke, A. *Applications of transition-metal catalysts to textile and wood-pulp bleaching*. In: Angewandte Chemie International Edition, 2006, vol. 45, issue 2, p. 206

[3] Lim, S. H., Lee, J. J., Hinks, D., Hauser, P. *Bleaching of cotton with activated peroxide systems*. In: Coloration Technology, 2005, vol. 121, issue 2, p. 89

[4] Fowles, E. H., Gilbert, B. C., Giles, M. R., Whitwood, A. C. *The effects of chelating agents on radical generation in alkaline peroxide systems, and the relevance to substrate damage*. In: Free Radical Research, 2007, vol. 41, issue 5, p. 515

[5] Carr, C. M. *Chemistry of the Textiles Industry.* Blackie Academic and Professional, Chapman & Hall, Glasgow, UK, 1995

[6] Smith, J. R. L., Gilbert, B. C., Payeras, A., Murray, M. J., Lowdon, T. R., Oakes, J., Prats, R. P., Walton, P. H. *Manganese 1,4,7-trimethyl-1,4,7-triazacyclononane complexes: Versatile catalysts for the oxidation of organic compounds with hydrogen peroxide.* In: Journal of Molecular Catalysis. A: Chemical, 2006, vol. 251, issue 1-2, p. 114

[7] Topalovic, T., Nierstrasz, V. A., Bautista, L., Jocic, D., Navarro, A., Warmoeskerken, M. M. C. G. *Analysis of the effects of catalytic bleaching on cotton.* In: Cellulose, 2007, vol. 14, issue 4, p. 385

[8] Blanco, M., Coello, J., Sánchez, M. J. *Experimental design for optimization of peroxide formulation stability and cost.* In: Journal of Surfactants and Detergents, 2006, vol. 9, issue 4, p. 341

[9] Shao, J., Huang, Y., Wanga, Z., Liu, J. *Cold pad-batch bleaching of cotton fabrics with a TAED/H_2O_2 activating system*. In: Coloration Technology, 2010, vol. 126, issue 2, p. 103

[10] Tavcer, P. F. *Impregnation and exhaustion bleaching of cotton with peracetic acid.* In: Textile Research Journal, 2010, vol. 80, issue 1, p. 3

[11] Hauser, P. J. *Textile dyeing.* InTech, Rijeka, Croatia, 2011

[12] Jones, C. W. *Applications of hydrogen peroxide and derivatives.* The Royal Society of Chemistry, Cambridge, UK, 1999

[13] Hauser, P. J. *Advances in Treating Textile Effluent.* InTech, Rijeka, Croatia, 2011

[14] Puzyn, T., Mostrag-Szlichtyng, A. *Organic pollutants ten years after the Stockholm convention – environmental and analytical update*. InTech, Rijeka, Croatia, 2012

[15] Körlü, A. E., Bilgin, E. *Catalytic influence of heavy metal ions on hydrogen peroxide decomposition during bleaching of cotton*. In: AATCC Review, 2008, vol. 4, issue 4, p. 44
[16] Gärtner, A., Gellerstedt, G. *Oxidation of residual lignin with alkaline hydrogen peroxide. Part II: Elimination of chromophoric groups.* In: Journal of Pulp and Paper Science, 2001, vol. 27, no 7, p. 244
[17] Franck, R. R. *Bast and other plant fibers*. Woodhead Publishing Limited, Cambridge, UK, 2005

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DOCUMENTARE

Noi tehnologii

PIAȚA PLASTURILOR TRANSDERMICI ÎN CONTINUĂ DEZVOLTARE

Conform unor studii de piață realizate de *Kalorama Information*, din New York, piața plasturilor transdermici este în continuă dezvoltare.

Comparativ cu alte căi de administrare a medicamentelor, plasturii transdermici asigură eliberarea controlată a acestora în fluxul sanguin, asigurând vindecarea zonei afectate, ori înlăturarea unor vicii, cum ar fi nicotina. Deoarece pielea este o barieră foarte eficientă, există dezavantajul limitării tipurilor de substanțe active care pot pătrunde în stratul dermic. Pentru a depăși bariera creată de piele la administrarea de proteine, peptide sau vaccinuri, a fost dezvoltată terapia cu microace. Astfel, în 2011, compania franceză *Sanofi Pasteur* a realizat vaccinul Fluzone Intradermal, aprobat de Autoritatea pentru Administrarea Alimentelor și Medicamentelor din S.U.A. Compania *TheraJect*, din California, a dezvoltat două tipuri de plasturi cu microace, realizate dintr-un polizaharid. Un produs similar, plasturele ZP, a fost realizat de *Zosano Pharma*, cu sediul în Fremont. Folosind tehnologia SmartRelief, de administrare transdermică a medicamentelor, compania *NuPathe,* din Philadelphia, a realizat plasturele de unică folosință Zecuity, care funcționează cu baterii și este destinat tratării migrenei la adulți. Prin ionoforeză, sub acțiunea unui curent electric slab, se asigură transportul transdermic rapid al moleculelor, prin două rezervoare – unul cu medicamente ionizate sau încărcate, iar celălalt un contraion, de obicei clorură de sodiu. La aplicarea unui curent de mică intensitate, moleculele de medicamente se deplasează din rezervor în piele, unde sunt absorbite de vasele de sânge și distribuite în întregul corp. Spre deosebire de tehnologiile transdermice pasive, bazate pe difuzie, ionoforeza controlează cantitatea și rata de administrare a unei varietăți mari de medicamente.

Dezvoltatorii de la *Universitatea din Kentucky* au elaborat un prototip de plasture pentru transportul programabil al medicamentelor, cu scopul de a permite medicilor să distribuie dozele de medicament în funcție de nevoile pacienților. Acest plasture inteligent cuprinde trei straturi: un rezervor de medicament – în partea superioară, o membrană din nanotuburi – în mijloc, și un gel care atașează membrana de piele și difuzează medicamente în interior. Dispozitivul mai conține o baterie de ceas – care poate alimenta pompa în mod continuu, timp de 10 zile, și comenzi electronice. Cercetătorii au creat, de asemenea, un prototip de lucru, care este controlat prin tehnologia Bluetooth și pe care rulează un program de smartphone.

În prezent, plasturii transdermici sunt disponibili pentru aproximativ 20 de medicamente, inclusiv pentru cele de substituție hormonală, de tratare a răului de călătorie sau a diferitelor tipuri de dependențe, analgezice etc. În cazul tuturor acestor tratamente, dimensiunile mici și proprietățile chimice ale moleculelor active permit deplasarea acestora în mod pasiv prin piele. În cazul medicamentelor care nu penetrează pielea, adăugarea unei serii de microace poate facilita administrarea acestora.

Tratamentul individualizat este foarte important în tratarea unor afecțiuni cronice, însă necesită monitorizarea atentă a stării pacientului. La persoanele cu diabet zaharat, un dispozitiv ce conține o membrană CNT, combinat cu un senzor de răspuns pentru nivelul glucozei din sânge, ar putea regla administrarea de insulină, fiind mai eficient decât pompa de insulină cu eliberare continuă, folosită în prezent. Ca și în alte aplicații transdermice, medicamentele administrate prin noua tehnică duc la o posibilă evitare a îmbolnăvirii tractului gastrointestinal și a ficatului.

__Smart__textiles and nanotechnology, ianuarie 2014, p. 9

In-situ generation of ZnO on the textile surfaces by hydrothermal method

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REZUMAT – ABSTRACT

Generarea in-situ de ZnO pe suprafața materialelor textile, prin metoda hidrotermală

În prezent, există o gamă largă de tratamente antibacteriene, care se pot aplica diverselor tipuri de materiale textile, pentru a le conferi proprietăți antibacteriene, cum ar fi: Ag^+ coloidal, pulbere de Ag sau particulele de ZnO. În cadrul acestui studiu, s-a analizat modul de combinare a particulelor antibacteriene de ZnO, prin metoda hidrotermală, și de acoperire simultană a țesăturilor textile, obținute din bumbac 100% și din poliester 100%, prin metoda in-situ, cu ZnO. După aplicarea procedeului de acoperire in-situ, particulele de ZnO de pe mostre au fost supuse analizelor SEM și XRD, iar activitatea antibacteriană a fost testată în conformitate cu standardul ASTM E2149-1 (bacteria gram-negativă Escherichia coli și bacteria gram-pozitivă Staphylococcus aureus). În plus, a fost testată rezistența la spălări repetate a mostrelor tratate cu agenți antibacterieni. Rezultatele au arătat că activitatea antibacteriană a mostrelor din bumbac și a celor din poliester nu s-a redus după aplicarea unor spălări repetate.

Cuvinte-cheie: antibacterian, hidrotermal, in-situ, oxid de zinc

In-situ generation of ZnO on the textile surfaces by hydrothermal method

Nowadays, there is a wide range of process giving antibacterial activity to the different kinds of textile materials, used to make the textile fabrics antibacterial such as colloidal Ag^+, Ag powder or ZnO particles. In this experimental study, it was investigated whether it was possible to combine producing the antibacterial ZnO particles by hydrothermal method and coating them with ZnO simultaneously on the textile fabrics (in-situ method) (100% cotton and 100% polyester). After in-situ coating process, the ZnO on the samples were characterized by SEM and XRD analyses, and the antibacterial activity of specimens was tested according to ASTM E2149-1 (gram-negative Escherichia coli, gram-positive Staphylococcus aureus). In addition, the resistance opposite to the repeated washes of these antibacterial samples was investigated. The results showed that either cotton or polyester based samples had sufficient antibacterial activity and this activity did not reduce due to repeated washing treatments.

Key-words: antibacterial, hydrothermal, in-situ, zinc oxide

The researches on the new finishing methods and fabric-forming techniques have led to great advances in the medical and hygienic textiles. The hygienic and health textiles have been used in large quantities in places such as hospitals, theaters, etc., where contact with the skin of the users occurs repeatedly and frequently [1]. These textile materials are desired to have a high antibacterial activity for health considerations [1] – [3].

Textile materials carry micro-organisms such as pathogenic bacteria and odor-generating bacteria [4], [5] and these bacteria can cause health problems [6]. The cotton fibers, which have common usage, provide an excellent environment for micro-organisms to grow, because of their large surface area and ability to retain moisture [7] – [9]. Most synthetic fibers, due to their high hydrophobicity, are more resistant to attacks by microorganisms than natural fibers [10]. Although textiles wholly made of natural fibers or synthetic fibers, neither natural nor synthetic fibers have resistance to bacteria or pathogenic fungi. Thus, various antibacterial finishes and disinfection techniques have been developed for all types of textiles [11], [12]. The antimicrobial finishing of textiles protects users from pathogenic or odor-generating micro-organisms, which can cause medical and hygienic problems, and protects textiles from undesirable aesthetic changes or damage caused by rotting, which can result in reduced functionality [13].

Controlling the growth of bacteria on the fibers or fabrics may be achieved by:

– a finishing process in which an antibacterial additive is fixed on the surface of the material by a resin;
– grafting of antibacterial agents on the cellulose chain;
– incorporating agents into spinning solution of regenerated fibers.

The finishing process is the technique most frequently employed to impart antibacterial activity to textiles [4]. Different finishing agents have been used to improve the anti-microbial resistance of textiles, such as silver, ZnO, TiO_2 [14]. The use of particles of silver and zinc oxide has been seen as a viable solution to stop infectious diseases due to the antimicrobial properties of these particles. The intrinsic properties of a metal particle are mainly determined by size, shape, composition, crystallinity and morphology [15].

In this sense, ZnO is a multifunctional material that has high luminous transmittance and piezoelectric properties, high chemical stability and suitability to doping, good electro-optical characteristics, excellent substrate adherence and hardness, non-toxicity and low cost [16]. In addition ZnO particles have been used for antibacterial and UV-blocking properties in textile [17] – [19].
The ZnO particles on a material can be obtained by various method such as thermal evaporation, chemical vapor deposition, sol-gel method, electrochemical deposition, ion beam assisted deposition, *RF* magnetron sputtering deposition, spray pyrolysis and hydrothermal deposition [20].
Among these methods, the hydrothermal method is promising for fabricating ideal material with special morphology because of the simple, fast, less expensive, low growth temperature, high yield and scalable process.
In general, the hydrothermal method refers to any heterogeneous reaction in the presence of aqueous solvents or mineralizes under high pressure and temperature conditions in order to dissolve and recrystallize materials which are relatively insoluble under ordinary conditions [21].
In the textile applications, several methods were reported in order to obtain ZnO particles which give UV protection, antibacterial activity or antistatic properties etc. to the textile surfaces [22] – [23]. As it is reported in these literatures, the adhesion between the ZnO particles and polymer by a simple wet chemical method is rather poor and these particles may be removed from the surface easily. In terms of this explanation, it can be said that ZnO particles obtained by hydrothermal method has more satisfactory results for coating the textile surfaces because of its morphological properties and high purity [22].
Tanasa et. al. described the in-situ formation of ZnO on the cellulose fibre as shown in figure 1 [22]. The ZnO particles grow in two steps on the fibre. In the last step, ZnO chelate complex forms under hydrothermal treatment and forms ZnO particles-coated cellulose based samples [22].
In this present paper, the zinc oxide particles were firstly growth and in-situ coated by hydrothermal method, and then these particles on the samples were characterized with XRD and SEM analyses. After in-situ coating and characterizing, the antibacterial activity of these samples was tested. In the experimental part, the antibacterial activity and durability of this activity against repeated washes of cotton and polyester samples coated with ZnO particles growth by hydrothermal method were investigated.

EXPERIMENTAL PART

Materials and chemicals

In this experimental study, the zinc nitrate hexahydrate ($Zn(NO_3)_2 \cdot 6H_2O$) and hexamethylen-etetramine (HMTA, $C_6H_{12}N_4$) were purchased from MERC and used for synthesis of ZnO particles. All chemical products were used as received. The water was purified by reverse osmosis method.
Two kinds of pre-treated textile fabrics were used for in-situ coating process. The cotton sample with area mass of 175 g/m^2 was knitted with 100% cotton yarns, and it was single jersey plain knitted fabric. The polyester sample with area mass of 175 g/m^2 was woven with 100% multi filament polyester yarns, and it was 4/1 gabardine woven fabric. The desizing, scouring and bleaching processes were carried with bulk production in the textile mill.

Methods

The precursor solution was prepared by dissolving 0.01 M of zinc nitrate hexahydrate and 0.01 M of hexamethylenetetramine in 100 ml deionizer water. Here, HMTA was used as complexion agent. The *p*H of prepared starting solution was measured and fixed to 6.5 value.
The samples (10 x 20 cm) were wrapped up around the glass plates and horizontally immersed in the prepared precursor solution. The hydrothermal growth was carried out at boiling temperature of about 98°C in a sealed beaker placed on the hotplate during 2 hours for the cotton samples. The experiments were carried out at 200°C in an autoclave placed on the furnace during 2 hours for polyester samples. The working temperature was preferred above 75°C in this study for both cotton and polyester. In the hydrothermal method, the crucial stage is the hydrolysis of HMTA, and the working temperature is the most effective factor on this hydrolysis. Below 75°C, the rate of hydrolysis of HMTA slows down, and particles cannot grow on the fiber surface. Therefore, the boiling temperature (approximately 98°C) and 200°C were chosen for cotton and polyester samples, respectively. In addition, the cotton and polyester samples were studied at different temperatures because of their different morphological structures. As it is mentioned from the literature, cellulosic materials have ability of establishing chemical bonding with growth ZnO particles (fig. 1). However, polyester fiber probably showed chemically inert character because of its rigid structure. Therefore, we needed increasing the working temperature in order to reach and pass the T_g value of polyester fiber, increase the porosity of surface

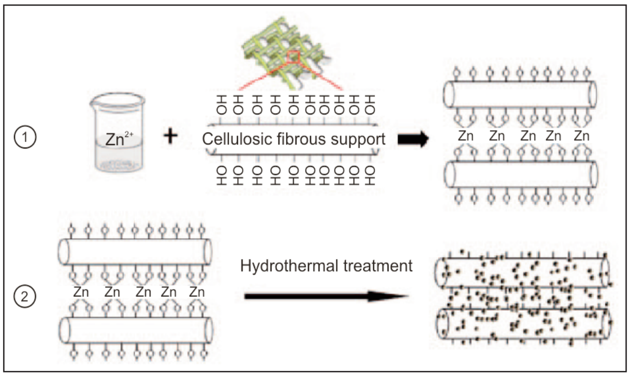


Fig. 1. In-situ formation of ZnO particles on the cellulose by hydrothermal method [22]

and ease the penetration of ZnO particles into these porous and surface. In addition, we thought that increase at the working temperature provided more homogenous surface character especially for polyester fiber.
After in-situ treatments, the process solutions were filtered and the samples were dried at room temperature.

Morphological characterization

Antibacterial activity tests

The antibacterial activity of the samples was tested according to the ASTM E2149-1 against gram-negative *Escherichia coli* bacteria and gram-positive *Staphylococcus aureus*. In addition, five repeated washing treatments were applied to the samples in order to investigate durability of the antibacterial activity against wet processes at 40°C for 30 minutes followed by drying process.

X-ray diffractometry

The crystal structures of ZnO rod arrays before and after washing treatments were investigated by Philips X'Pert Pro X-ray Diffractometer (XRD) with Cu Ka radiation (λ = 1.54 Å) source (applied voltage, 40 kV; current, 40 mA). About 0.6 g of dried samples with ZnO onto a sample container, and the XRD patterns were recorded at 2 θ with a scan rate of 2°/minute.

Scanning electron microscopy

The surface morphologies before and after washing treatments were investigated using a scanning electron microscopy (SEM – JEOL, Tokyo, Japan) which was operated at 10 kV. The analyses have been performed by a high vacuum working mode.

RESULTS AND DISCUSSIONS

Morphological characterization

In order to characterize and show the ZnO particles on the fibre surfaces, the XRD and SEM analysis were carried out with untreated, coated and coated-washed cotton and polyester samples. The spectra of XRD analyses are given in figure 2 and figure 3 for cotton and polyester, respectively. In figure 2, the XRD patterns of coated and coated-washed cotton samples were compared with reference sample and also shows the XRD spectra of the ZnO material on the fiber surface. We determined a dominant peak at 23.65 which characterized the cotton fiber for each sample [22].
The spectra showed well-defined peaks typical of ZnO in the crystal structure of ZnO, according to PDF-2, reference code 01-079-2205. In addition, this characteristic peak could be the indexed the hexagonal Wurtzite structure of the ZnO [23]. According to figure 2, the ZnO particles had peaks at 31.90, 34.49, 36.55, 47.44, 56.65, 62.85 and 67.95 correspond to the (1 0 0), (0 0 2), (1 0 1), (1 0 2), (1 1 0), (1 0 3) and (1 1 2) planes, confirming the formation of hexagonal zinc oxide phase on the cotton fiber.
Also we compared the XRD pattern of unwashed and washed samples in order to determine the durability of ZnO particles on the fiber against repeated washes, and the presence of peak at same position with XRD spectra of washed samples and unwashed samples can be seen in figure 2. It meant that the XRD pattern of washed and unwashed samples matched well with each other, and the intensities of the diffraction peaks decreased when the samples were washed.
The XRD patterns of coated and coated-washed polyester samples compared with reference sample in figure 3. The common diffraction peak of polyester was observed at 17.35, 22.90, 25.55 as mentioned in the literature [24]. In addition, similar peaks were measured for ZnO particles on the polyester that of cotton samples shown in figure 2. According to the XRD spectra given in figure 3, the typical peak of ZnO could be defined on either coated or coated-washed samples. This data was the signal of durability of ZnO on the polyester fiber against repeated washes.
The surfaces of treated samples were observed by SEM microscopy. In figure 4 and figure 5, SEM micrographs show the ZnO particles on the cotton and polyester samples, respectively. According to the both figures, particles placed to the fiber surface in both cases, although some aggregated particles were available. We could easily say that ZnO particles were more well dispersed and placed more homogenous on the polyester surface than cotton sample, because in-situ synthesis temperature of the ZnO on the polyester was higher than cotton. The temperature raised the hydrolysis of the HMTA in the precursor solutions, and this case improves the growing of ZnO on the surface.

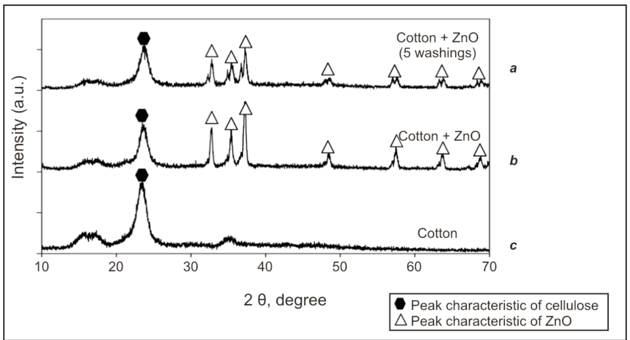


Fig. 2. The XRD patterns of the cotton sample: *a* – untreated sample; *b* – coated sample; *c* – coated and washed sample

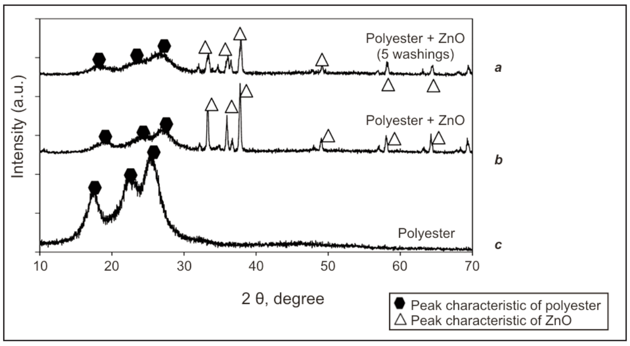


Fig. 3. The XRD patterns of the polyester sample: *a* – untreated sample; *b* – coated sample; *c* – coated and washed sample

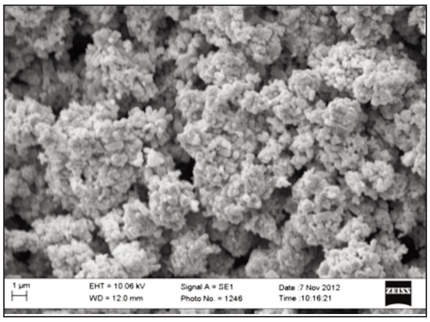
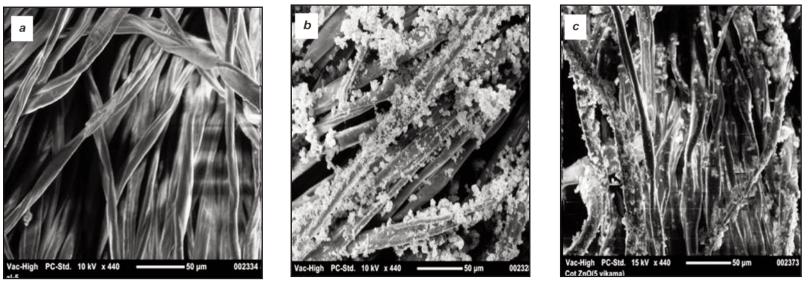
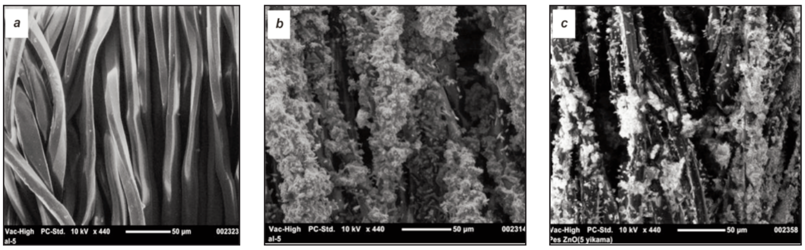


Fig. 4. The SEM images of filtered nano ZnO powder



a *b* *c*

Fig. 5. SEM images of cotton samples:
a – untreated sample; *b* – coated sample; *c* – coated and washed sample



a *b* *c*

Fig. 6. SEM images of polyester samples:
a – untreated sample; *b* – coated sample; *c* – coated and washed sample

As mentioned in the experimental part, the pre-solution was filtered after coating process of fabric. The nano ZnO powder obtained from the filtering stage was analyzed with SEM in order to make comment about morphological properties of material and, according to the figure 4, it could be said that the particles had generally spherical character. In addition we observed that particles sizes showed differences between 300 – 500 nm.

The SEM analysis showed that most of the ZnO particles remained bound to the both cotton and polyester fiber surfaces after repeated washing applications. This case showed high correlation with the XRD spectra shown in figure 5 and figure 6.

It could be said that cotton and polyester samples did not have exact antibacterial property before coating process (table 1). We thought that the reason of little antibacterial activity (26% for cotton and 15% for polyester) of these untreated samples was the bleaching treatment and H_2O_2 used in this wet process.

The antibacterial activity of coated cotton samples can be seen from table 1. The 99.9% antibacterial activity was observed after in-situ generation of ZnO on the surface. In addition, durability of antibacterial activity after repeated washings was another important result obtained in the study. The in-situ generated ZnO by hydrothermal method made solid bound with the surface of fiber.

Similar activity results were measured for Staphylococcus aureus bacteria. According table 2, the growing ZnO nano particles on the polyester samples made the fabrics antibacterial. Besides, it was clear that the antibacterial activity of samples after the washing treatments did not change.

CONCLUSIONS

In the study, in-situ generation of ZnO particles by hydrothermal method from the reaction of $Zn(NO_3)_2 \cdot 6H_2O$ and $C_6H_{12}N_4$ was reported. The process chosen in the present study is cheap, efficient and consists of single application. We also aimed to investigate the antibacterial activity of ZnO on the surface.

The ZnO particles are uniformly placed onto the surface of cotton and polyester fibers. We also found out that the homogeneity of dispersion of ZnO on the surface was better for polyester than cotton due to reaction temperature. We achieved to obtain durable antibacterial activity against two kinds of bacteria with in-situ coating of ZnO to the cotton and polyester textile surface. We also determined the in-situ generation of ZnO on the fiber with XRD and SEM analysis.

Table 1

THE ANTIBACTERIAL ACTIVITY OF THE SAMPLES (*Escherichia coli*)

Type of samples	Reduction of the *E. coli* bacteria number after an hour, %	
	Cotton	*Polyester*
Untreated samples (reference)	26	15
Coated samples	99.9	99.6
Coated samples after 5 washings	99.9	99.6

Table 2

THE ANTIBACTERIAL ACTIVITY OF THE SAMPLES (*Staphylococcus aureus*)

Type of samples	Reduction of the *S. aureus* bacteria number after an hour, %	
	Cotton	*Polyester*
Untreated samples (reference)	34	22
Coated samples	99.9	99.9
Coated samples after 5 washings	99.9	99.9

BIBLIOGRAPHY

[1] Chen, C., Wang C., Yeh, J. *Improvement of odor elimination and antibacterial activity of polyester fabrics finished with composite emulsions of nanometer titanium dioxide-silver particles-water-borne polyurethane.* In: Textile Research Journal, 2010, vol. 80, issue 4, pp. 291-300

[2] Süpüren, G., Çay, A., Kanat, Z. E., Tarakçıoğlu, I. *Antimicrobial fibers*. In: Textile and Apparel, 2006, vol. 2, pp. 80-89

[3] Asanovic, K., Mihailovic, T., Skundric, P., Simovic, L. *Some properties of antimicrobial coated knitted textile material evaluation*. In: Textile Research Journal, 2010, vol. 80, issue 16, pp. 1 665-1 674

[4] Abedi, D., Mortazavi, S. M, Mehrizi, M. K., Feiz, M. *Antimicrobial properties of acrylic fabrics dyed with direct dye and a copper salt*. In: Textile Research Journal, 2008, vol. 78, issue 4, pp. 311-319

[5] Palamutcu, S., Keskin R., Devrent, N., Sengül, M., Hasçelik, B. *Functional textiles II: Antimicrobial textiles*. In: Tekstil Teknolojileri Elektronik Dergisi, 2009, vol. 3, issue 3, pp. 95-108

[6] Büyükakıncı, B. Y. *Investigation of antibacterial activities of tin ions on wool fabric*. In: Industria Textilă, 2013, vol. 64, issue 5, pp. 241-244

[7] Zhang, F., Wu, X., Chen, Y., Lin, H. *Application of silver nanoparticles to cotton fabric as an antibacterial textile finish*. In: Fibers and Polymers, 2009, vol. 10, issue 4, pp. 496-501

[8] Ibrahim, N. A., Gouda, M., Husseiny, Sh. M., El-Gamal, A. R., Mahrous, F. *UV-protecting and antibacterial finishing of cotton knits*. In: Journal of Applied Polymer Science, 2009, vol. 112, pp. 3 589–3 596

[9] Nischala, K., Rao, Tata N., Hebalkar, N. *Silica–silver core–shell particles for antibacterial textile application*. In: Colloids and Surfaces B: Biointerfaces, 2011, vol. 82, pp. 203–208

[10] Gao, Y., Cranston, R. *Recent advances in antimicrobial treatments of textiles*. In: Textile Research Journal, 2008, vol. 78, issue 1, pp. 60-72

[11] Lee, H. J., Yeo, S. H, Jeong, S. H. *Antibacterial effect of nanosized silver colloidal solution on textile fabrics*. In: Journal of Materials Science, 2003, vol. 38, pp. 2 199-2 204

[12] Üreyen, M., Gök Ö., Ateş, M., Günkaya, G., Süzer, Ş. *Evaluation of silver concent and antibacterial activities of silver loaded fiber/cotton blended textile fabrics*. In: Textile and Apparel, 2010, vol. 2, pp. 137-144

[13] Simoncic, B., Tomsic, B. *Structures of novel antimicrobial agents for textiles – A review*. In: Textile Research Journal, 2010, vol. 80, issue 16, pp. 1 721-1 737

[14] Dumıtrescu I., Mocioiu, A. M., Iordache, O. G., Nicula, G. *Antimicrobial functionalization of textile materials with hydrophobins and Ag/ZnO composite nanopowders*. In: Industria Textilă, 2013, vol. 64, issue 6, pp. 303-312

[15] Rajendran, R., Balakumar, C., Mohammed Ahammed, H. A., Jayakumar, S., Vaideki, K., Rajesh, E. M. *Use of zinc oxide nano particles for production of antimicrobial textiles*. In: International Journal of Engineering, Science and Technology, 2010, vol. 2, issue 1, pp. 202-208

[16] Özgür, Ü., Alivov, Y. I., Liu, C., Teke, A., Reshchikov, M. A., Doğan, S., Avrutin, V., Cho, S. J., Morkoç, H. *A comprehensive review of ZnO materials and devices*. In: Journal of Applied Physics, 2005, vol. 98, issue 4, ISSN 041301-041301-103

[17] Wang, R. H., Xin, J. H., Tao, X. M., Daoud, W. A. *ZnO nanorods grown on cotton fabrics at low temperature*. In: Chemical Physics Letters, 2004, vol. 398, issue 1-3, pp. 250–255

[18] Wang, R. H., Xin, J. H., Tao, X. M. *UV-blocking property of dumbbell-shaped ZnO crystallites on cotton fabrics*. In: Inorganic Chemistry, 2005, vol. 44, issue 11, pp. 3 926–3 930

[19] Vigneshwaran, N., Kumar, S., Kathe, A. A., Varadarajan, P. V., Prasad, V. *Functional finishing of cotton fabrics using zinc oxide-soluble starch nanocomposites*. In: Nanotechnology, 2006, vol. 17, issue 20, pp. 5 087–5 095

[20] Bacaksiz, E., Aksu, S., Yılmaz, S., Parlak, M., Altunbaş, M. *Structural, optical and electrical properties of Al-doped ZnO microrods prepared by spray pyrolysis*. In: Thin Solid Films, 2010, vol. 518, issue 15, pp. 4 076–4 080

[21] Byrappa, K., Yoshimura, M. *Handbook of Hydrothermal Technology*. Materials and Processing Technology, Noyes, New Jersey, 2001, pp. 1-13

[22] Tanasa, D., Vrânceanu, N., Nistor, A., Hristodor, C. M., Popovici, E., Bistricianu, L. L., Brânză, F., Chicet, D. L., Coman, D., Pui, A., Grigoriu, A. M., Broască, G. *Zinc oxide-linen fibrous composites: morphological, structural, chemical and humidity adsorptive attributes*. In: Textile Research Journal, 2012, vol. 82, issue 8, pp. 832-844

[23] Shah, M. A. *Growth of zinc oxide nanoparticles by the reaction of zinc with ethanol*. In: Advanced Materials Research, 2009, vol. 67, pp. 215-219

[24] Becheri, A., Dürr, M., Nostro, P. L, Baglioni, P. *Synthesis and characterization of zinc oxide nanoparticles: application to textiles as UV-absorbes*. In: Journal of Nanoparticle Research, 2008, vol. 10, pp. 679-689

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Investigation of the effects of sewing threads on the sewing performance

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REZUMAT – ABSTRACT

Investigarea efectului aței de cusut asupra performanței de coasere

Calitatea țesăturii nu este singurul parametru care influențează confecționarea îmbrăcămintei de înaltă calitate. Conversia țesăturii 2D în 3D depinde de anumiți parametri, cum ar fi: alegerea unei ațe de cusut corespunzătoare, optimizarea parametrilor de coasere, avantajele procesului de producere a îmbrăcămintei şi performanța de utilizare a îmbrăcămintei. Aceşti parametri reprezintă, de asemenea, informații de bază necesare pentru analiza caracteristicilor de coasere a țesăturii. Performanța de coasere reprezintă unul dintre factorii determinanți ai capacității de coasere a țesăturii utilizate în procesul de producție. Scopul acestui studiu este acela de a investiga, prin comparație, performanțele de coasere ale aței de cusut PBT, PES/bumbac filat cu miez şi bumbac mercerizat. În acest scop, patru variabile diferite (tipul de ochi, desimea cusăturii, tipul aței de cusut şi tipul acului de cusut) au fost utilizate în cazul țesăturilor din poplin şi gabardină, pentru obținerea unei performanțe optime a cusăturii. După procesul de coasere, fiecare combinație a fost testată cu ajutorul instrumentului Instron 4411, iar rezultatele testelor au fost comparate cu fiecare tip de ață de cusut.

Cuvinte-cheie: performanță de coasere, PBT, filat cu miez, ață de cusut

Investigation of the effects of sewing threads on the sewing performance

The quality of the fabric is not the only parameter for the production of a high quality cloth. The conversion of two dimensional fabric into the three dimension is related to some parameters such as: selection the proper sewing thread, optimization the sewing parameters, conveniences in the cloth manufacturing process, and the cloth usage performance. These parameters also compose the basic data which are necessary for the analysis of fabric sewable characteristics. The sewing performance is one of the factors that affect the sewability of the fabric which is used in manufacturing process. The aim of this study is to investigate the sewing performances of PBT, PES/cotton core-spun and mercerized cotton sewing threads in a comparative way. For this purpose four different variables (stitch type, seam density, sewing thread type and sewing needle type) were used with the poplin and gabardine fabrics to obtain the optimum seam performance. After sewing process each combination was tested in Instron 4411 instrument and the test results were compared on behalf of the sewing thread type.

Key-words: sewing performance, PBT, core-spun, sewing thread

As a result of some factors such as the increment in the competition, becoming the national market to the international structure, and even the globalization, manufacturers have been conducted substantially for seeking the quality. In this case, to give importance on quality and quality control, to improve the quality and to supply its continuity in ready-made enterprises have high interest on behalf of the increment on the power of competition. Manufacturers that give importance on the improvement of quality, started to produce many kinds of models in small quantity instead of fero models in large at so much quantity.

Each different model means different fabric, yarn properties and seam type. Therefore, the sewing thread should be chosen for the fabric and every sewing machines' adjustments should be changed. The optimization of the seam performance in other words the adjustment of the all sewing variables in order to obtain the best seam performance is very important. A faultless high quality seam is only possible when the sewing machine parameters are coordinated with sewing thread and fabric properties [1]. Sewing performance means that the ratio of seam strength to the fabric strength on sewed fabrics. The sewing performance can change depending on the stretching characteristics and the combination of the fabric and sewing thread, sewing machine, and sewing parameters (stitch type, seam density, seam allowance, sewing needle).

A number of studies have been performed about the sewing performance. For instance, the effect of denim fabric and sewing thread on the seam puckering was investigated and the correlation analysis between the two properties has been done. In another study, the analysis of seam efficiency and slippage was performed dependent on the dimension and tensile properties of fabric and sewing thread on gabardine fabrics. The effects of the cotton/PES fabric properties and sewing thread types (mercerized cotton, cotton/PES, dashed PES, PES/PES) on the sewing performance were analyzed. An on-line seam monitoring system that can evaluate the tightness on the seam thread and the forces on the presser foot, and also can instantly show the faults such as seam puckering and sewing thread breakage during the sewing process was improved [2] – [6].

In this study the effects of cotton, PBT and PES/cotton core-spun sewing threads on the seam performance were investigated. Besides the sewing thread, also some variables such as the stitch type, seam density, sewing needle type were used in order to get the optimum seam performance.

EXPERIMENTAL PART

Materials used

Poplin (weight: 245 g/m^2) and gabardine (weight: 275 g/m^2) fabrics were purchased from Tavsanli Textile Co. Ltd. Fabrics' tensile strength and elongation at break values were measured according to the ISO 13934-1 [7] standard by Instron 4411 instrument. The properties of gabardine and poplin fabrics used in experiments are given in table 1.

The yarn count of 30 tex mercerized cotton, PBT and PES/cotton core-spun sewing threads were purchased from Coats. In core-spun thread, the core part is PES and the outer layer is mercerized cotton. The threads' tensile strength and elongation at break values have been measured according to the ISO 2062 [8] standard by Instron 4411 instrument. The sewing threads' values can be seen in table 2.

For popline fabric SUK and SES, for gabardine fabric SES and SPI needle types have been used. The sewing needle properties can be seen below: SPI: Schmetz, *Nm* 80/12, very acute round point; SES: Schmetz, *Nm* 80/12, light ball point; SUK: Schmetz, *Nm* 80/12, medium ball point.

For chain stitch Pfaff 5488 chain stitch sewing machine, for plain stitch Pfaff 481 plain stitch sewing machine has been used.

Sewing process

By using three kinds of sewing needles (SPI, SES and SUK), two kinds of seam densities (4–6 stitches/cm), two kinds of stitch types (chain and plain) and three kinds of sewing yarns, 24 different sewing combinations have been designed for each fabric type (poplin and gabardine) in order to get the optimum seam performance. The designed combinations can be seen in table 3. After the sewing process, each sample was tested on behalf of the tensile strength and elongation at break of the seam by Instron 4411 instrument. The ISO 13935-1 [9] standard was used to determine the seam strength and elongation at break values.

RESULTS AND DISCUSSIONS

The assessment of sewing performance in gabardine fabric

In the combination of plain stitch, 4 stitches/cm, SPI needle type, the PBT sewing thread showed the highest performance with tensile strength of 25.6 kgF while the mercerized cotton thread showed the least performance of 20.778 kgF. In plain stitch, 4 stitches/cm and SES needle type combination, the PBT yarn showed the highest performance among the three yarn types with 25.586 kgF while the mercerized cotton yarn showed the least performance of 21.75 kgF.

In the combination of plain stitch, 6 stitches/cm and SPI needle type, the PBT yarn showed the highest performance among all of the other combinations with the tensile strength value of 38.97 kgF. The mercerized cotton yarn showed the least performance of 29.23 kgF. With the combination of plain stitch, 6 stitches/cm, SES needle type, the PBT sewing thread showed the highest tensile strength value of 36.996 kgF whilst the cotton thread showed the least performance of 28.08 kgF.

In chain stitch, 4 stitches/cm, SPI needle type, the core-spun sewing thread showed the highest performance of 27.52 kgF, and the mercerized cotton thread showed the least of 23.12 kgF. In the combination of chain stitch, 4 stitches/cm, SES needle type, the core-spun yarn showed the highest performance value of 31.04 kgF, whilst the mercerized cotton yarn showed the least of 23.59 kgF.

In the chain stitch, 6 stitches/cm, SPI needle type combination, the PBT sewing thread showed the highest tensile strength value of 37.57 kgF whilst the mercerized cotton thread showed the least performance value of 30.958 kgF. In the combination of chain stitch, 6 stitches/cm, SES needle type, the core-spun sewing thread showed the highest performance among all of the other results with the value of 42.1 kgF, whilst the mercerized cotton thread showed the least performance of 33.632 kgF, this is also the highest value of cotton among the other results.

The seam tensile strength and elongation at break values of gabardine fabric can be seen in figure 1.

Table 1

THE TENSILE STRENGTH AND ELONGATION AT BREAK VALUES OF POPLIN AND GABARDINE FABRICS

Properties	Gabardine fabric		Poplin fabric	
	Warp	*Weft*	*Warp*	*Weft*
Tensile strength, kgF	106.28	74.4	41.2	26.6
Elongation at break, %	23.3	11.8	10.4	19.38

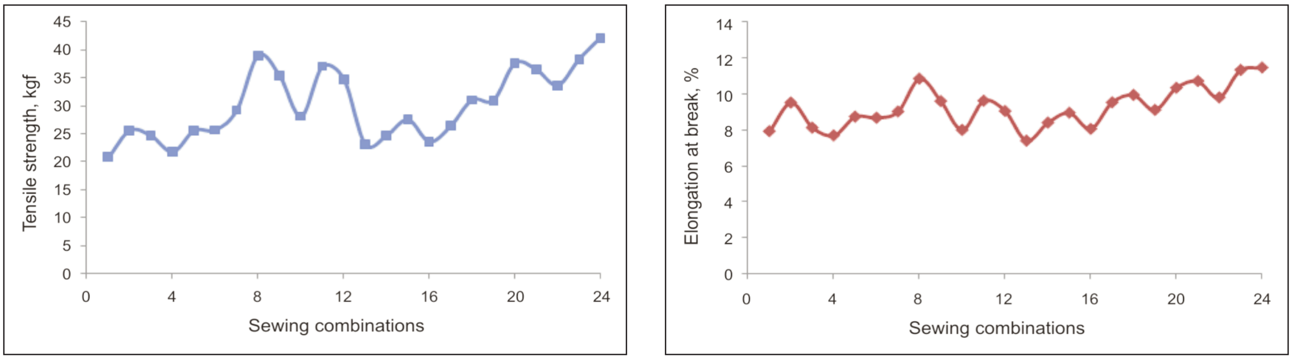
Table 2

THE TENSILE STRENGTH AND ELONGATION AT BREAK VALUES OF MERCERIZED COTTON, PBT AND PES/COTTON CORE-SPUN SEWING TREADS

Properties	Mercerized 100% cotton	PBT	PES/CO core-spun
Tensile strength, kgF	31.8	28.43	43.75
Elongation at break, %	4.29	29.85	19.49

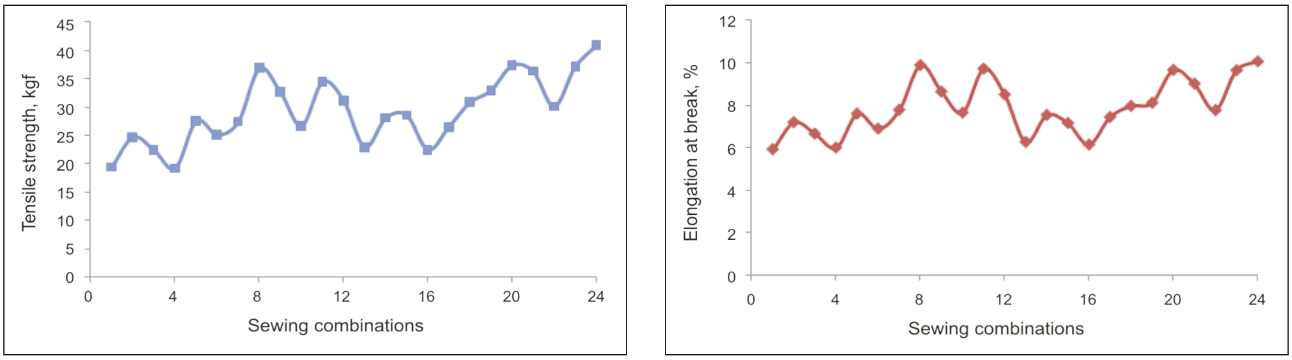
Table 3

THE DESIGNED SEWING COMBINATIONS FOR GABARDINE AND POPLIN FABRICS				
Sewing combinations	**Stitch type** *1* – plain stitch; 2 – chain stitch	**Seam density** 1.4 stitches/cm; 2.6 stitches/cm	**Sewing needle type** *1* – SPI; *2* – SES	**Sewing yarn type** *1* – cotton; *2* – PBT; *3* – core-spun
Gabardine fabric				
1	*1*	*1*	*1*	*1*
2	*1*	*1*	*1*	*2*
3	*1*	*1*	*1*	*3*
4	*1*	*1*	*2*	*1*
5	*1*	*1*	*2*	*2*
6	*1*	*1*	*2*	*3*
7	*1*	*2*	*1*	*1*
8	*1*	*2*	*1*	*2*
9	*1*	*2*	*1*	*3*
10	*1*	*2*	*2*	*1*
11	*1*	*2*	*2*	*2*
12	*1*	*2*	*2*	*3*
13	*2*	*1*	*1*	*1*
14	*2*	*1*	*1*	*2*
15	*2*	*1*	*1*	*3*
16	*2*	*1*	*2*	*1*
17	*2*	*1*	*2*	*2*
18	*2*	*1*	*2*	*3*
19	*2*	*2*	*1*	*1*
20	*2*	*2*	*1*	*2*
21	*2*	*2*	*1*	*3*
22	*2*	*2*	*2*	*1*
23	*2*	*2*	*2*	*2*
24	*2*	*2*	*2*	*3*
Poplin fabric				
1	*1*	*1*	*1*	*1*
2	*1*	*1*	*1*	*2*
3	*1*	*1*	*1*	*3*
4	*1*	*1*	*2*	*1*
5	*1*	*1*	*2*	*2*
6	*1*	*1*	*2*	*3*
7	*1*	*2*	*1*	*1*
8	*1*	*2*	*1*	*2*
9	*1*	*2*	*1*	*3*
10	*1*	*2*	*2*	*1*
11	*1*	*2*	*2*	*2*
12	*1*	*2*	*2*	*3*
13	*2*	*1*	*1*	*1*
14	*2*	*1*	*1*	*2*
15	*2*	*1*	*1*	*3*
16	*2*	*1*	*2*	*1*
17	*2*	*1*	*2*	*2*
18	*2*	*1*	*2*	*3*
19	*2*	*2*	*1*	*1*
20	*2*	*2*	*1*	*2*
21	*2*	*2*	*1*	*3*
22	*2*	*2*	*2*	*1*
23	*2*	*2*	*2*	*2*
24	*2*	*2*	*2*	*3*



a *b*

Fig. 1. The seam tensile strength and elongation at break values in gabardine fabric



a *b*

Fig. 2. The seam tensile strength and elongation at break values in poplin fabric

The assessment of sewing performance in poplin fabric

In the combination of plain stitch, 4 stitches/cm, SUK needle type, the PBT sewing thread showed the highest seam tensile strength value of 24.71 kgF, while the mercerized cotton yarn showed the least performance value of 19.435 kgF. In the plain stitch, 4 stitches/cm, SES needle type combination, the PBT sewing yarn showed the highest result of 27.588 kgF, and the mercerized cotton yarn showed the least result of 19.144 kgF.

In the plain stitch, 6 stitches/cm, SUK needle type combination, the PBT sewing thread showed the highest seam tensile strength value of 36.873 kgF, and the mercerized cotton yarn showed the least performance value of 27.34 kgF. In the combination of plain stitch, 6 stitches/cm, SES needle type, the PBT sewing thread showed the highest performance value of 34.5 kgF whilst the mercerized cotton yarn showed the least value of 26.67 kgF.

In the combination of chain stitch, 4 stitches/cm, SUK needle type, the core-spun sewing thread showed the highest seam tensile strength value of 28.556 kgF, and the mercerized cotton showed the least performance value of 22.91 kgF. In the chain stitch, 4 stitches/cm, SES needle type combination, the core-spun sewing yarn showed the highest seam performance value of 30.1 kgF and the mercerized cotton yarn showed the least value of 22.43 kgF.

In the chain stitch, 6 stitches/cm, SUK needle type combination, the PBT yarn showed the highest seam tensile strength value of 37.38 kgF and the mercerized cotton yarn showed the least performance value of 32.98 kgF. In the combination of chain stitch, 6 stitches/cm, SES needle type, the core-spun sewing yarn showed the highest performance level of 40.9 kgF whilst the mercerized cotton yarn showed the least value of 30.12 kgF.

The seam tensile strength and elongation at break values of poplin fabric can be seen in figure 2.

CONCLUSIONS

Among the mercerized cotton, PBT and core-spun sewing threads, the highest seam tensile strength was obtained by using the combination of chain stitch, 6 stitches/cm, SES needle type, gabardine fabric and core-spun sewing thread, and the value is 42.0975 kgF. The least tensile strength values were seen on mercerized cotton yarn.

When the mercerized cotton thread is used, the highest seam performance, that is 33.632 kgF, can be get in the combination of chain stitch, 6 stitches/cm, SES needle type, in gabardine fabric. The least performance value of 19.144 kgF was obtained in the combination of plain stitch, 4 stitches/cm, SES needle type, poplin fabric.

For the PBT sewing thread, the highest seam tensile strength value of 38.97 kgF was obtained by using

plain stitch, 6 stitches/cm, SPI needle type in gabardine fabric. The least performance value of 24.696 kgF was obtained in the combination of chain stitch, 4 stitches/cm, SPI needle type in gabardine fabric.
When the core-spun sewing thread is used, the least seam tensile strength value of 22.348 kgF was obtained in the combination of plain stitch, 4 stitches/cm, SUK needle type, in poplin fabric.
PBT sewing thread showed a high performance in plain stitch sewing machine whilst core-spun thread showed a good performance in chain stitch sewing machine. The seam tensile strength of PBT yarn in chain stitch sewing machine decreased because of the long distance of sewing yarn inserting unit, the yarn elongates too much, finally it causes to the yarn breakages. The highest elongation at break value was seen on the PBT yarn, because PBT has an intrinsically elastic property.
It can be concluded that in plain sewing machine the PBT sewing thread, in chain sewing machine the core-spun sewing thread should be used. Furthermore the PBT sewing yarn must not be used in chain sewing machine because of the yarn breakages. The increase on the seam density also increased the seam tensile strength to a certain point and after then it causes the fabric teariness.

BIBLIOGRAPHY

[1] Zunic-Lojen, D., Gersak, J. *Thread loadings in different measuring positions on the sewing machine*. In: Textile Research Journal, 2005, vol. 75, pp. 498-506

[2] Yukseloglu, Muge, S., Çitoğlu, F., Çetınkaya, B. *A study on the needle heating in polyester blend upholstery fabrics*. In: Industria Textilă, 2013, vol. 64, issue 5, pp. 246-253

[3] Korkmaz, Y., Cetiner, S. *Investigation of denim fabric and sewing thread parameters affecting seam pucker*. In: KSU Journal of Science and Engineering, 2008, issue 11, pp. 46-51

[4] Yucel, O. *Seam efficiency and slippage in cotton gabardine fabrics.* In: Journal of the Faculty Engineering and Architecture Gazi University, 2006, vol. 21, pp. 533-540

[5] Yucel, O. *Effect of sewing thread and fabric properties to seam efficiency*. In: KSU Journal of Science and Engineering, 2007, issue 10, pp. 36-41

[6] Bayraktar, T., Kalaoglu, F. *On-line seam monitoring system for sewing performance optimization.* ITU dergisi/d muhendislik, 2006, issue 5, pp. 278-288

[7] ISO13934-1 – *Textiles – Tensile properties of fabrics*. Part 1. *Determination of maximum force and elongation at maximum force using the strip method*, 2002

[8] ISO2062 – *Textiles – Yarns from packages. Determination of single-end breaking force and elongation at break using constant rate of extension (CRE) tester*, 2010

[9] ISO13935-1 – *Textiles – Seam tensile properties of fabrics and made-up textile articles*. Part 1. *Determination of maximum force to seam rupture using the strip method,* 2002

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Elongation modeling of nonwoven geotextile materials

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REZUMAT – ABSTRACT

Modelarea alungirii materialelor geotextile nețesute

Proprietățile mecanice ale materialelor geotextile nețesute sunt influențate atât de caracteristicile structurale și de construcție, cât și de condițiile de dezvoltare tehnologică. De asemenea, un rol foarte important îl au proprietățile fizico-mecanice și structurale ale fibrei, masa pe unitatea de suprafață a materialelor geotextile și densitatea de interțesere. În lucrare sunt prezentate rezultatele obținute în urma studierii proprietăților mecanice ale unor materiale geotextile nețesute, având masa pe unitatea de suprafață de 300 g/m^2, utilizate la construcția șoselelor. Au fost analizate proprietățile de rezistență la rupere ale geotextilelor realizate din fibre de poliester, normale și reciclate. Proprietățile de rezistență la rupere ale geotextilelor au fost măsurate cu un dinamometru ZWIK, iar rezultatele au fost analizate cu software-ul testXpert. Rezultatele obținute au fost exprimate prin relația forță-alungire și au fost dezvoltate modele reologice, care pot fi utilizate la simularea comportamentului materialelor geotextile nețesute din fibre poliesterice, normale și reciclate, în timpul procesului de utilizare.

Cuvinte-cheie: deformare, geotextile, limită de elasticitate, model, forță, alungire

Elongation modeling of nonwoven geotextile materials

Mechanical characteristics of nonwoven geotextile materials depend on their structural and constructional solutions, as well as technological development conditions. In addition, a very important role have the structural and physical-mechanical properties of the fiber, mass per unit area of geotextile and density of needle punching in the production process. This paper presents the results of analysis of mechanical properties of nonwoven geotextile materials with mass per unit area 300 g/m^2, intended for road construction. Breaking characteristics of geotextile materials made from regular and recycled polyester fibers are analyzed. Characteristic of breaking strength of geotextile materials was measured on dynamometer ZWIK, the results were analyzed by software testXpert. The obtained results are defined relation between force-elongation and rheological models have been developed which can be used to simulate the behavior of nonwoven geotextile materials of regular and recycled PES fiber during exploitation.

Key-words: deformation, geotextiles, limit of elasticity, model, force, elongation

Geotextile materials have been used for many years at construction sites worldwide. Installation of geotextiles in roads and highways reduces construction costs and ensures longer life for roads. Their application can be cheaper to build roads, railroads, drainage systems, and strengthening coastline.

For road construction is recommended the use of PP and PES geotextile with mass per unit area 300–350 g/m^2, for the rehabilitation of damaged asphalt roads is recommended PES geotextile 120–150 g/m^2 mass. For geotextiles is particularly significant to know the force limit that can cause the occurrence of plastic deformation. So this paper presents a method that can be used to determine the load limits geotextile nonwoven materials. Also we have developed a model that can be used for describing the behavior of regular and recycled PES fibers geotextiles materials.

THEORETICAL CONSIDERATIONS

Combination of basic rheological models, appointed the rheological model – Lethersich body (fig. 1). Lethersich body, *L*, presents a ordinal connection of Newton and Kelvin models [1]:

$$L = N - - - K \quad (1)$$

Speed of Lethersich body deformations is equal to the sum of the speed of deformations of Newton (*N*) and Kelvin *(K)* bodies (2):

$$\dot{\varepsilon}_L = \dot{\varepsilon}_N + \dot{\varepsilon}_K \quad (2)$$

where:

$\dot{\varepsilon}_N$ is speed of deformations of Newton's body;

$\dot{\varepsilon}_K$ – speed of deformations of Kelvin's body.

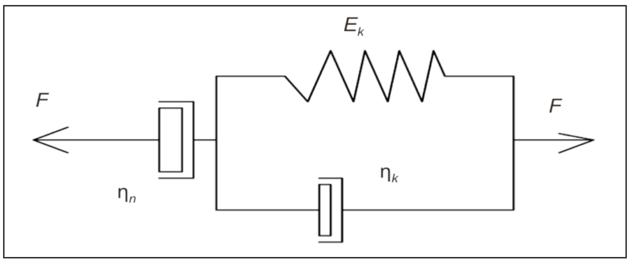


Fig. 1. Model of Lethersich body

Speed of deformations of Newton's body is presented in equation (3):

$$\dot{\varepsilon}_N = \frac{\sigma}{\eta_N} \tag{3}$$

where:
η_N is coefficient of viscosity of Newton's body.

Speed of deformations of Kelvin's model is equal (4):

$$\dot{\varepsilon}_K = \frac{\sigma}{\eta_K} - \frac{E_K}{\eta_K} \cdot \varepsilon_K \tag{4}$$

where:
E_K is modulus of elasticity of Kelvin model;
η_K – coefficient of viscosity of Kelvin's model.
After certain mathematical operations we get the following expression for the speed of Lethersich body deformation, presented in equation (5):

$$\dot{\varepsilon}_K = \frac{\sigma}{\eta_N} + \frac{\sigma}{\eta_k} - \frac{E_K}{\eta_K} \cdot \exp\left(-\frac{E_K}{\eta_K} \cdot t\right) \cdot \left[\varepsilon_0 + \frac{1}{\eta_K} \cdot \int \sigma \cdot \exp\left(\frac{E_K}{\eta_K} \cdot t\right) dt\right] \tag{5}$$

where:
ε_0 is initial relative elongation.
Differentiating by time and rearranging the previous expressions we get the differential equation of rheological models in the following equation (6):

$$\ddot{\varepsilon} \cdot \eta_K + \dot{\varepsilon} \cdot E_K \cdot \eta_K = \dot{\sigma}\,(\eta_N + \eta_K) + \sigma \cdot E_K \tag{6}$$

Since in this case and $\dot{\varepsilon}$ = *const* and ε = 0, equation is reduced to (7):

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

Solution of the differential equation can be searched in the equation (8):

$$\sigma = -C \cdot \exp\left(-\frac{E_K}{\eta_K + \eta_N} \cdot t\right) + \eta_N \cdot \dot{\sigma} \tag{8}$$

The integration constant *C* is determined from the initial conditions, for $t = 0$, $\sigma = 0$. Dependence tension – the time after determining the integration constant has the equation (9):

$$\sigma = \eta_N \cdot \dot{\sigma} \cdot \left[1 - \exp\left(\frac{t}{\tau_r}\right)\right] \tag{9}$$

where:
$\tau_r = (\eta_N + \eta_K) / E_K$ is relaxation time.
Dependence tension – elongation has the equation (10):

$$\sigma = \eta_N \cdot \dot{\sigma} \cdot \left[1 - \exp\left(\frac{l_0}{100 \cdot v \cdot \tau_r} \cdot \varepsilon\right)\right] \tag{10}$$

MATERIALS AND METHODS

For the formation of nonwoven geotextile materials were used regular (PES *A*) and recycled (PES *B*) fibers. The basic characteristics of these fibers are shown in table 1.
In table 2 is shown the parameters of needle punching and characteristics of geotextile materials.
For testing of obtained geotextile materials (Geotextile T-300 *A* and *B*) the following methods were used:
– SRPS EN ISO 9864 – *Geotextile – Determination of mass per unit area*;
– SRPS EN ISO 9863-1 – *Geosynthetics – Determination of thickness at specified pressures*;
– SRPS EN ISO 10319 – *Geotextile – Wide-width tensile test.*

The thickness of the geotextile materials was measured at a 2 kPa pressure, testing of tensile strength and deformation at maximum load were measured at 0.02 kN preload, at a distance between the clamps of 100 mm and a test speed of 20 mm/minute.
Besides that, based on the F-ε curve (fig. 2) the values of forces and relative elongations at the elastic limit were determined. These values are numerical determined in maximum point of first derivative curve $F(\varepsilon)$, where $F''(\varepsilon) = 0$ [2, 3].

Table 1

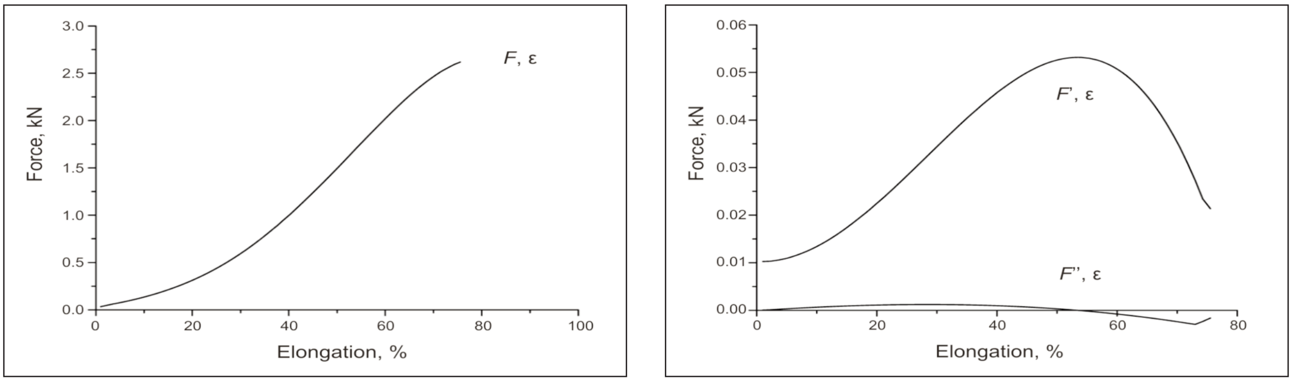
CHARACTERISTICS OF PES FIBERS USED IN GEOTEXTILE PRODUCTION

Type of fiber	**Average fiber length**, l_{fl}, mm	**Fiber fineness**, $T_{t,f}$, dtex	**Relative fiber breaking force**, F_r, cN/tex	***CV***, %	**Breaking elongation**, ε, %	***CV***, %
PES *A*	62.0	6	44.3	8.9	32.7	22.0
PES *B*	83.1	6	37.7	19.4	63.5	24.8

Table 2

CHARACTERISTICS OF PES FIBERS USED IN GEOTEXTILE PRODUCTION

Mark of geotextile material	**Type of fiber**	**Intensity of needle punching**, $min.^{-1}$	**Outlet velocity**, m/min.	**Thickness at pressure**, mm p = 2 kPa	**Width**, cm
Geotextil T-300 *A*	PES *A*	750	1.5	2.72	200
Geotextil T-300 *B*	PES *B*	750	1.5	2.20	200



a ***b***

Fig. 2. Force-elongation graph: *a* – *F*(ε), *b* – first *F'*(ε) and second *F''*(ε) derivate of function

RESULTS AND DISCUSSIONS

Table 3 shows the test results of geotextile materials of regular and recycled PES fibers. The results from table 3 show that at, the same production-technological conditions, nonwoven geotextile materials made of regular PES fibers, have better breaking properties than geotextiles formed from regenerated PES fibers. This difference suggests that the quality of PES fibers largely defines the quality of geotextile materials.

Measurements showed that the limit of elastic deformation along the length ranges from 42.15% to 62.3% relative elongation at geotextile materials from regular PES fibers and from 34.0% to 52.3% relative elongation at geotextile PES material from recycled fibers. Also, the limit of elastic deformation in width ranges from 49% to 67.35% relative elongation at geotextile materials from regular PES fibers, and from 34.2% to 49% relative elongation at geotextile PES materials from recycled fibers. Applying the model of Lethersich derived equations that define the dependence of the force-elongation can predict the behavior of geotextile materials during the exploitation.

In figure 3 are shown the measured and calculated values of *F*(ε) for the nonwoven geotextile material from regular PES fibers.

Figure 4 shows the measured and calculated values of *F*(ε) for the nonwoven geotextile material from recycled PES fibers.

Based on the experimental data and the dependence obtained from the rheological model of approximation was obtained in the following equation (11):

$$\sigma = a\,(1 - e^{-b \cdot \varepsilon}) \qquad (11)$$

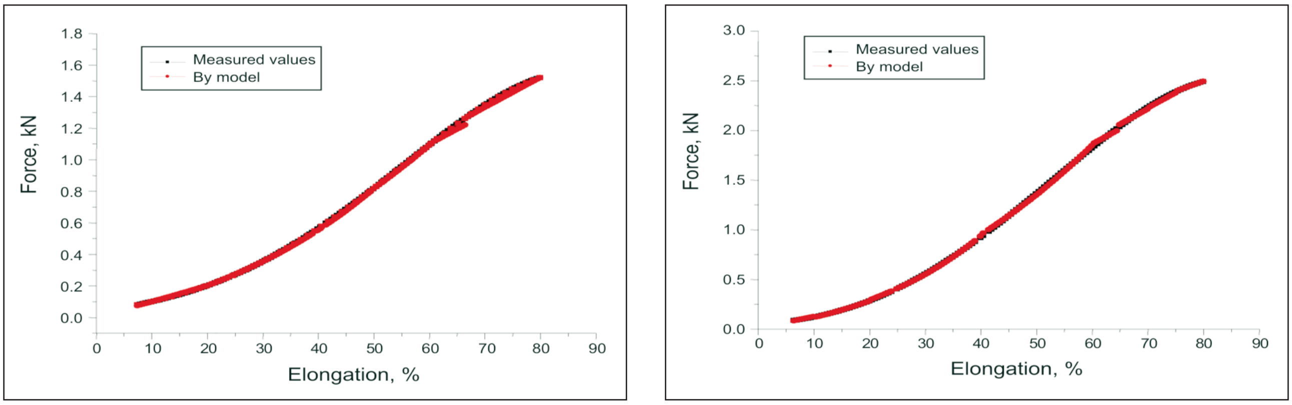
Coefficient of model *a* and *b* are shown in table 4 and table 5. It may be concluded that the rheological

Table 3

THE RESULTS OF GEOTEXTILES MECHANICAL CHARACTERISTIC TESTING

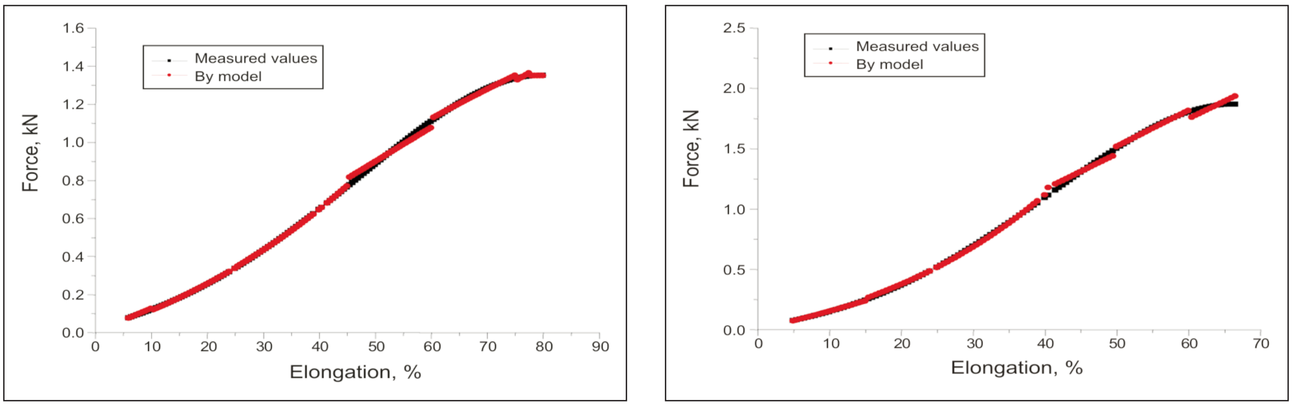
Geotextile		**T-300 *A***					**T-300 *B***				
Number of samples		*1*	*2*	*3*	*4*	*5*	*1*	*2*	*3*	*4*	*5*
Mass per unit area, gm^2		289	294	299	302	310	285	292	297	301	302
Breaking force, kN	*L*	1.6	1.46	1.55	2.24	1.75	1.46	1.31	1.47	1.17	1.48
	CV, %	4.7	4.95	5.91	13.5	4.70	9.39	4.22	6.72	10.4	5.77
	W	2.6	2.66	2.52	2.63	2.75	2.22	1.83	2.01	1.48	2.19
	CV, %	3.7	5.09	6.17	2.98	6.84	11.5	4.97	9.85	35.2	5.00
Deformation at maximum load, %	*L*	84.3	87.8	91.9	66.9	81.6	82.3	82.4	81.1	71.0	74.9
	CV, %	3.4	4.71	3.76	2.02	2.72	6.6	3.27	6.61	4.65	3.55
	W	76.0	76.5	84.2	90.5	67.8	66.9	74.9	66.2	60.6	65.9
	CV, %	4.99	3.71	1.84	3.38	4.86	5.2	1.79	7.40	40.9	434
Force at elastic limit, kN	*L*	0.928	0.865	0.992	1.350	1.156	0.770	0.700	0.825	0.907	0.651
	W	1.570	1.680	1.640	1.810	1.755	1.275	1.023	1.292	1.075	1.120
Elongation at elastic limit, %	*L*	51.78	54.4	62.3	42.15	56.48	47.65	52.3	43.2	49.7	34.0
	W	55.8	53.5	60.35	67.35	49.0	40.07	46.9	41.0	48.04	34.2

Note: L is by length; *W* – by width



a ***b***

Fig. 3. Measured and calculated values by the model Lethersich, T-PES *A*: *a* – by length; *b* – by width



a ***b***

Fig. 4. Measured and calculated values by the model Lethersich, T-PES *B*: *a* – by length; *b* – by width

Table 4

COEFFICIENT OF *a* MODEL *T* - PES *A*

Coefficient of *a* model		**Elongation zone, %**	***a***	***b***
T-PES *A*	*L*	0-5	-219.06464	-0.0000648
		7.5-10	-59.452710	-0.0001715
		11-20	-1.0040600	-0.0088700
		21-30	-0.2353600	-0.0303400
		31-50	-0.2740800	-0.0277000
		51-60	-0.5408500	-0.0184100
		61-67	92.1303500	0.0002049
		68-80	-208.1376700	-0.0000918
	W	0-6.4	-276.03303	-0.0000647
		6.5-10	-63.55061	-0.0001905
		11-20	-0.23212	-0.0391600
		21-40	-0.22804	-0.0406200
		41-60	-0.65971	-0.0222100
		61-65	52.58994	0.0005985
		66-70	65.1901	0.0004926
		71-75	32.21343	0.0010200
		76-80	4.4615	0.0102100

Table 5

COEFFICIENT OF *a* MODEL *T* - PES *B*

Coefficient of *a* model		**Elongation zone, %**	***a***	***b***
T-PES *B*	*L*	0-10	-145.90507	-0.00008510440
		11-25	-0.46852	-0.02162000000
		26-45	-0.50291	-0.02060000000
		46-60	207.39597	0.00008655930
		61-75	3.99057	0.00550000000
		76-77.5	54.15073	0.00032855500
		77.6-80	1.34864	1.55320000000
	W	0-15	-0.7041	-0.01927000000
		16-40	-0.3748	-0.03449000000
		41-50	260.5863	0.00011165600
		51-60	54.1509	0.00056755400
		61-66.5	369.2626	0.00007889120

model correctly describes the behavior of geotextile material during stretch. Also, it can be concluded that, to the limits of elastic deformation, model describes very well the behavior of the material, this being particularly important for the development of nonwoven geotextiles designing methods.

CONCLUSIONS

Study of the mutual connection of mechanical properties of nonwoven geotextile materials, provides a possibility of their proper design depending on the future use, which may help save raw materials and energy.

Knowing the elasticity limits, realized the conditions for the design of a boundary intensity of force, which is the geotextile material is subjected to and at the same time not undermine its quality.

Based on the obtained results was defined the force-elongation dependency and rheological models have been developed, which can be used to simulate behavior nonwoven geotextile materials from regular and recycled PES fibers during the exploitation. Also, it can be concluded that, to the limits of elastic deformation, model describes very well the behavior of the material.

BIBLIOGRAPHY

[1] Stojiljković, D., Petrović, V., Djurović, M. *Rheological modeling of yarn elongation.* In: Tekstil, 2007, issue 9, pp. 551-561

[2] Stepanović, J., Milutinović, Z., Petrović, V., Pavlovic, M. *Influence of relative density on deformation characteristics of fabrics in plain weave.* In: Indian Journal of Fibre & Textile Research, 2009, issue 1, pp. 76-81

[3] Stepanović, J., Djordjić, D., Trajković, D., Skoko, I. *Analysis of deformation characteristics of nonwoven geotextile materials made of PES fibers for road construction.* 5th TexTeh International conference, Bucharest, Romania, 18 – 19.10.2012, Proceedings, pp. 57-64

[4] Stojiljković, D., Djurović, M., Petrović, V., Ujević, D. *Defining the memory function for tension and deformation of linear textile products on the basis of their rheological models.* In: Industria Textilă, 2009, vol. 60, issue 6, pp. 308-312

[5] Rawal, A. *Geotextiles: productions, propertis and performace.* Indian Institute of Technology, 2010, pp. 5-8

[6] Mashroteh, H., Zarrebini, M., Semnani, D. *Prediction of random-velour needle punching force using artificial neural network.* In: Industria Textilă, 2013, vol. 64, issue 3, pp. 141-148

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DOCUMENTARE

Noi tehnologii

ÎNVELIȘ ANTIBACTERIAN PENTRU REDUCEREA INFECȚIILOR CHIRURGICALE

După autorizarea utilizării stimulatorilor nervului vag, compania ***TYRX***, din New Jersey, a primit, din partea Administrației pentru Medicamente și Alimentație din S.U.A., autorizația de comercializare a învelișului antibacterian *AIGISRx N,* pentru a fi utilizat împreună cu neuromodulatoarele prezente în măduva spinării.

Proteza sterilă, complet resorbabilă, a fost concepută pentru a susține un generator de impulsuri (pacemaker) sau un defibrilator, creând un mediu stabil atunci când este implantată în organism. Aceasta este realizată dintr-o plasă multifilamentară tricotată – din polimer din glicolidă, caprolactonă și trimetilen carbonat, acoperită cu un polimer bioresorbabil din poliacrilat. Produsul va ajuta la reducerea infecțiilor chirurgicale, asociate dispozitivelor implantabile în neurochirurgie și cardiologie, deoarece conține agenți antimicrobieni – rifampicină și minociclină, care sunt eliberați local în țesut.

Legat de aceasta, Robert White – președinte și director executiv al TYRX, afirma: „Apariția infecțiilor chirurgicale este mult mai rapidă decât viteza de elaborare a procedurilor chirurgicale, iar pacienții au parte, de cele mai multe ori, de consecințe catastrofale... Securizarea autorizației FDA reprezintă o etapă de referință pentru TYRX, în eforturile de reducere a infecțiilor chirurgicale, acolo unde consecințele clinice și economice asociate acestora sunt deosebit de importante".

***Smart**textiles and nanotechnology, februarie 2014, p. 9*

Legal protection of fashion creations

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REZUMAT – ABSTRACT

Protecţia proprietății intelectuale a creațiilor de modă

În lucrare sunt abordate unele aspecte legate de protecţia proprietății intelectuale a creațiilor de modă în țările care au industrii de modă puternice, cum ar fi Franța, Italia și Marea Britanie. De asemenea, este prezentată situația pe plan național, pentru cazurile în care nici legea dreptului de autor, nici cea privind brevetele de invenție nu includ toate aspectele creației intelectuale, și, ca urmare, a fost nevoie de un serviciu suplimentar "Plicul cu idei".

Cuvinte-cheie: proprietate intelectuală, modă, designer, model

Legal protection of fashion creations

The paper presents aspects of intellectual property protection for fashion creations in countries that have strong fashion industry, such as France, Italy and Great Britain. Furthermore, it presents the situation on national level, in which case neither copyright nor the patent cover all aspects of intellectual creation and it was developed an additional service "Plicul cu idei".

Key-words: intellectual propriety, fashion, designer, model

Over the time clothing functioned as an expression of: functionality, lifestyle, social hierarchy or era. The sequence of the artistic currents from painting, graphics and architecture, the industrial revolutions and then the emergence of new visual techniques have always put their mark on the clothing creation. In addition to practicality, the suit has many aesthetic meanings. In time these are subject to fashion trends related to: color, line and shape [1].

The artist sees in the appearance of a human being an expressive plastic image such as a painting or a statue or any other decorative element that creates for the viewer a scene or daily life, attractive and original ensembles. The way of matching shapes and colors shows us a more or less successful art.

Fashion is a phenomenon that manifest dramatically, especially in clothing. It refers to the changes caused by line, color, or changes of details and accessories, which occur periodically when the shapes become common. Fashion includes a continuous series of experiments, launched by the most prestigious designers of image, which are known by the general public and, if they meet the aspirations of the majority, are widely adopted because, after a while they become common. It functions as a three-stroke engine: coinage, dissemination, obsolescence. Recording trends and preference who seek expression, fashion experience various proposals, from which is going to choose the most viable, that will contour the style of the era. The life of any fashion trend has two moments:

– inventing a new striking and invigorating prototype which brings a touch of fantasy; this is launched by an outstanding person, that goes into the public eye – in the past centuries it was the aristocracy, the opera singers, cinema stars and sports stars;
– imitation of the prototype at large scale until it becomes common and awakens the appetite for something new.

Briefly, "fashion mission is to establish ongoing processes of standardization, to make from something rare or new something general or universal, to move to another rarity or novelty when the other one before ceases to be regarded as it" – Renato Poggioli [2].

Design and product development give rise to new knowledge and intellectual property derived from it. The desire to effectively use and reuse such knowledge, while protecting intellectual property rights (IPR), often lead to conflict and inefficiency. Therefore, important developments are expected by using marking tools, tracking delineation of the origin and ownership models, prototypes and virtual systems, to gather research and reuse the knowledge and the patterns across companies or networks of companies.

THE FASHION INDUSTRY – TRENDS AND DESIGNERS

In one word, fashion refers especially to suit and its annexes. Fashion design is one of applied arts dedicated especially to garments and accessories design. The design is a field of creativity with art, mass production of useful objects designed by the interference between color theory and art shapes with the requirements of science and technology. Clothing falls within the field of designers. It has become a cliché to say that designers create fashion. It is true that many of the fashion trends were introduced by famous designers: the famous woman plaid suit in black and white – Chanel 1920, "the new image" by Dior in 1940 and Yves Saint Laurent tuxedo [3].

Today is unlikely for an industrial designer to generate a new fashion. In a time when, almost every fashion style was created, new designers reinterpret, rediscover and improve, continuing to seek a path to something new.

The designer is a specialist who, through training, technical knowledge, artistic experience and visual sensitivity, is able to solve complex problems related to the choice of fabrics, construction, shape, color, accessories etc., for products which usually are made in series by industrial processes. Through an aesthetic point of view, the authentic designer should never be confused with the person who happened to find the appropriate shape of a product. The new specialist is defined, above all, as the person aware of the social importance of each functional shape he seeks to achieve, of the objects produced in series from a prototype, to bring more comfort, a touch of beauty, even an additional order in people's life. These products must comply with general aesthetic tastes, aspirations cherished by those in possession of which, ultimately, we need to reach.

Sometimes, a mistake is made when design is considered as a profession that can be easily mastered by anyone who wish or who believes that has a calling for that. Even when for a product design are involved other specialists, together with the designer being one team, the designer has the main responsibility. He provides the necessary connections between all these factors that are important in creating a new product.

Besides the fact that he has to be well informed regarding the most successful products on the international market and the latest trends manifested in the creation of industrial forms, the designer remains a specialist whose work is practical.

An appealing design always attracts a creative staff, happy to compete to conquer new markets. Fashion houses and their associated fashion designers, as well as high class consumer (including celebrities), apparently have a role in determining changes in fashion. We can say that ultimately, the real creator of fashion is the customer, the designer being the person who makes real his desires and needs. Often, the tone in fashion is given by the persons with a high social status and by the major events from show-biz, business, politics, sports or art.

Fashion also reflects the response of population to social end economic changes. Therefore, is required a close collaboration between design and economics, between designers and economists. And, because this practice proved it: a considerable amount from modern economic activities depends on the quality of design, not on the technical efficiency or effectiveness of the product. Fashion continues to explore, bringing new fusions between the techniques used in production, industrial and manual. If, until now, the future of fashion was represented by smart clothing with sensors, clothes that change their color, or their temperature, fibers able to convert solar energy into thermal energy, fibers that absorb the perspiration while having deodorant effect, or impregnated with a fragrance, promoting a hi-tech technology, nowadays, due to social and economic events, we notice a return to the past. Certain elements from the past are brought back into focus, transformed and adapted to current fashion, using ecological fabrics and technologies. The focus will be on originality, reinterpretation, functionality, the purpose of the new clothing is going to be the protection of human health, of environment, using environmentally friendly products and services with reduced environmental impact. The work of fashion designers will be faultless, not only visually but also ethical, beside the aesthetic and practical aspects, clothes will respect all of these rules.

"Fashion is an every day art, very volatile, very hard to maintain its essential quality: creativity. A fashion designer is an artist. In this way, art and fashion are based on the sense of proportion, simplicity and, on appeal" – Pierre Cardin [4].

Evolution of the innovation phenomenon in textiles and clothing field, in our century has grown to high complexity. If one age ago we could've talk about protective clothing, today we are talking about smart textiles with conductive wires or sensors. But in addition to practicality, clothing has many aesthetic values. Over time, these were related to fashion trends features: color, line, shape. The clothing creation that the industry is based on is a blend between new-techniques-experiment. Textile innovations, like all innovations regarding products or services, are realized when the trends, needs and demands of society are combined with new scientific, technological or organizational skills developed by the human minds creativity and implemented by the intelligent and ingenious operators and visionary entrepreneurs, willing to take risks.

Speed century and communication era pushed fashion from the last years into an obsession that was unleashed in its entire splendor: obsession on novelty and permanent change. As a paradox, the human being is concerned about the future, that has to be stable and safe as possible, in a time when the abundance of information generated profound changes in lifestyle, when everything around is redefining, and life gain new hierarchies. Fashion raises the question of the future through eco-fashion trends, by emphasizing the need for co-existence of human beings in harmony with nature. At the same time, it seeks the best solutions to achieve timeless goals of warmth and comfort and also the increased need of attention and silence. Fashion solutions tend to follow the latest events from those about climate to socio-economic events.

Fashion includes a continuous series of experiments, launched by the most prestigious image creators, which are known by the general public and, if they meet the aspirations of the majority, are widely adopted and after a while they become common.

LEGAL PROTECTION OF FASHION CREATIONS IN EUROPE

Protection of intellectual property of fashion designs takes place in most countries that have a strong fashion industry, such as France, Italy and Britain. Similarly, other countries that are not known for fashion designs, such as India, also brought intellectual property protection for their designers. Although these forms of protection didn't eliminate counterfeiting or piracy in the world, they helped avoid the loses that fashion houses have.

In Europe double protection is offered for fashion creations under the national laws of individual European countries and, through European Directive regarding the legal protection of designs (EU Directive 98/71). This Directive requires countries to adopt laws to protect the works of fashion under the guidance of standards contained in the Directive. To protect a model under the EU Directive, this must be registered first. But, before the model can be registered, this has to be new and to have an individual character. The novelty item is that it doesn't require an identical model, including one that is different due to some insignificant details, or one that has been made public before the date of registration. The individual character requires the model not to be similar as a model that is already public [5].

Once a model is registered, the owner has exclusive rights, even for similar models. The registration of the model is valid up to 25 years in Member States and, it includes design elements such as: lines, contours, colors, shape, texture and/ or fabrics.

France, the capital of fashion, has the strongest legal protection system of fashion creations. French designers are relying on this protection through the Copyright Law from 1793, which was amended in 1902 and through the Industrial Design Act which was amended in 1909. These documents provide the most liberal copyright protection for fashion designs through the "doctrine of art unity" which prohibits exclusion from copyright protection based exclusive on the utility function.

France offers protection for fashion designs by providing copyright once a design becomes popular with the general public. When the design is made public, French copyright holder receives both patrimonial and moral rights, at the moment they create an original work rather than at the point of public disclosure. Patrimonial rights incorporate the exclusive rights to represent, reproduce, sell or otherwise exploit the copyrighted work of art and to derive a financial compensation there from. A moral right is essentially the author's right to feel the respect for his name and his work. This right goes to the author's heirs or executor after his death, but it can not be otherwise transferred or sold under any circumstances by the author or his legal successors.

a ***b***

Source: *Profils d'Hiver*, L'officiel de la mode, september 1992, p. 211; *Femmes en Smoking*, Jours de france, 7 December, 1992, p. 138

Fig. 1. Fashion creations of: *a* – Yves Saint Laurent; *b* – Ralph Lauren

Copyright infringers in France are subject to both civil suits for damages and criminal penalties, including up to three years in jail and a fine of 300,000 euros.

In 1994 Yves Saint Laurent Couture (YSL) sued Ralph Lauren for infringement of the community law according to French Copyright Law (figure no 1). The court found that an YSL Women's dinner-jacket dress, originally shown in 1970, then updated in 1992 was sufficiently original to give the fashion house property rights in the design. The court also held that Ralph Lauren's subsequent ready-to-wear dinner-jacket dress infringed the YSL design because the differences between it and the original were so slight that the average customer would not be able to distinguish them. YSL received a 385,000 dollars monetary judgment against Ralph Lauren for its theft of the original design.

In a more recent case from 2008, the French court found that a company known as Naf Naf was guilty of copying a dress signed by Isabel Morant, despite the minor differences between the designs. The court decided that Naf Naf had to pay 75 000 euros to designer Isabel Morant. Both of these cases introduced the sever punishments that were enforced by the French government due to the rise in design piracy.

Additionally, Italian copyright law extends protection to works of industrial design displaying creative character and per se artistic value. Although, the Italian standard is much more stringent than the French one in that it requires not only registration, but also novelty, and individual character, it nonetheless provides some level of protection for fashion designers. In 1993, Italy enacted the "Made in Italy" legislation to guarantee that only items made in the country may bear the label and put further laws into effect that fine consumers several times the retail price of the original item for buying copied goods.

Furthermore, Great Britain is another European country that provides stringent protection for fashion designs. This protection applies to artistic works, unregistered design rights, and registered design rights. According to the intellectual property law of Great Britain, if a design is copied, the designer is entitled to damages and injunctions similar to that of owners of other types of intellectual property.

In Spain, the registered designs receive up to twenty-five years of protection in contrast to unregistered designs that are offered three years of protection. Under this scheme, a fashion design is granted copyright protection as long as it can be referenced back to a copyrighted drawing. Infringement of a design right is determined by whether or not the second article, even if still in pieces not yet assembled, is an exact copy or substantially different from the original.

In absence of a real harmonization of these rights across Europe, when a design is protected by copyright under the laws of a country, it doesn't mean that it will be protected by copyright in another country (difference in criteria). For example, in Germany you can not protect a three-dimensional design (dress, shoes or chair) by copyright.

However, the protection given to fashion designs in European countries in which the design was introduced previously is irrelevant once the clothing arrives in United States, because the United States is one of the few countries that do not offer intellectual property to fashion designs. As a result, fashion designers worldwide are affected by this situation [6].

LOOK-ALIKES AND OTHER UNFAIR TRADE PRACTICES

Look-alike products are those with an appearance that intentionally resembles an existing product, or for which the trade mark is made to look like a famous mark, often to benefit from the reputation or fame of the existing product. Such products or trade marks look so similar that consumers may mistakenly think the products are the same or at least made by the same company.

As business owners, you know the success of a product depends on consumer recognition. One way for a trade mark owner to enhance consumer recognition is to use distinctive product appearance or packaging, also known as trade dress or get up, along with its trade mark [7].

Look-alikes harm both the business owner and the consumer. The business owner suffers losses when the consumer buys a look-alike product, mistakenly believing it to be the business's original trade marked product. The consumer suffers because look-alike products are often not of the same quality as the original trade marked product.

In most European countries, trade mark owners can seek protection against the producers of look-alike products through unfair trade legislation when there is a clear attempt by the producer of the look-alike product to benefit from the creative effort and investment of the trade mark owner. Unfair competition includes any act of competition contrary to honest practices in industrial or commercial matters, as well as all acts that create confusion with the establishment, goods or industrial or commercial activities of a competitor. One example of a law against unfair trade practices is the EU's Unfair Commercial Practices Directive (2005/29/EC), which contains provisions that might widen the scope of protection against look-alikes.

Similarly as in the case of look-alikes, consumers may be misled by false descriptions or false origin indications. In these deceptive practices, consumers are intentionally induced into error by an inaccurate indication of a material or of a country of origin for a given product that enjoys a wide reputation. For example, synthetic materials are sold as leather, and shoes or other fashion accessories are marked Made in Italy or Made in France when they are really made elsewhere. These cases do not constitute infringements of IPRs and redress is to be sought under provisions regarding misleading advertising or unfair trade practices.

You can refer to unfair competition rules if the deceptive or wrongful business behavior of a competitor causes you economic losses. There are two broad categories of unfair competition or unfair trade practices:

- business undertakings that confuse consumers as to the origin of the product;
- unfair trade practices, which comprises any other action that may cause damage through unfair competition.

Common concepts that one can refer to are issues such as likelihood of confusion or misappropriation of your reputation in the market. Because the legislation against unfair trade practices is closely related to (but still distinct from) that concerning intellectual property, it is common for companies to file complaints both under intellectual property law and under commercial law. What is considered unfair varies from jurisdiction to jurisdiction, as well as from business case to business case, thus there is no rule of thumb that allows advanced determination of what actions qualify.

Typical examples of unfair trade practices are:

– trade mark infringement;
– wrongful advertisement and peculiar selling tactics;
– theft of trade secrets;
– wrongful representation of goods and services;
– breach of confidentiality agreements by former employees.

The illegal use of any other intangible asset your company owns may also qualify as unfair competition.

"PLICUL CU IDEI" – A ROMANIAN TOOL TO PROTECT FASHION DRAWINGS

Because of the fact that, neither copyright or the patent right cover all aspects of intellectual creations, it was necessary to establish an additional service. In the Monitorul Oficial no. 527 from 14 July 2008, were published the instructions of a new State Office for Inventions and Trademarks service. This service is called "Plicul cu idei" and provides, on the one hand the preservation of an idea or concept, and on the other hand, protection of the author of that idea or concept from countless illegal hunters of the domain. The legislation under the new service works is Order no. 63 from 27 June 2008.

The service "Plicul cu idei" is a way to store and keep safe in a system that is not public (OSIM), all the documents submitted by the developers, individuals or business persons which includes works and designs from various fields that can't be protected by the existing legislation regarding industrial property, copyrights and related rights, in order to certify the filling date according to OSIM Order no. 63/2008.

"Plicul cu idei" is not an intellectual property right and it does not confer exclusive rights. The results of this service are the following:

– evidence of the date on which the author of the intellectual creation filled the document at OSIM;
– certification of the creation or solution existence in the envelope at a certain date.

"Plicul cu idei" can be an evidence of the date on which the author's intellectual creation stored the document at OSIM. It is not a title to property, but is a certain proof in establishing the ownership or priority of an idea or concept. "Plicul cu idei" is an extension of copyright (both industrial and intellectual) and covers those aspects that fall within the regulations of Law 64/1991 on patents, nor those imposed by Law 8/1996 on copyright and related rights.

In accordance with art. 8 of Law 64/91, republished in 2007, regarding patents, the following are not considered inventions: discoveries, scientific theories and mathematical methods, aesthetic creations, schemes, rules and methods for performing mental activities, playing games or doing economic activities, as well as software or disclosures. On the other hand, according to art. 9 of Law 8/1996, the following can not be eligible for legal protection of copyright: the ideas, theories, concepts, scientific discoveries, procedures, methods of operation or mathematical concepts etc. Therefore, it was necessary the extension of intellectual creations protection on many aspects eluded by the Law 64/1991, as well as the Law 8/1996. "Plicul cu idei" reponded to this need, with the understanding that, if the two laws mentioned aim to publish the intellectual creation paternity, this service aims to preserve and classify it.

This service constitutes material evidence in a dispute relating to the theft of ideas and provides a specific date of this elaboration. The service is assumed by the French model, which is called "Envelope Soleau", after the initiator. The provenience is American, but they have a different patent system. In USA, the first who invents has the patent rights. In Romania, the first who register the invention at OSIM has the patent rights.

The documents descriptions that can be stored in a regime that is not public, are the following:

- creations that don't have a patent, such as those mentioned in article 8 of the Patent Law no. 64/1991, republished in M.O. no. 541/2007;
- works of scientific and technical areas, such as: technical creations, technical standards, technologies, discoveries, theories, studies, instructions etc.

The following can not be deposited: technical solutions or other creations that are contrary to public policy, morals, ethics, that are harmful to the health and life of humans, animals or plants and those that can seriously harm the environment, samples of prohibited substances and documents containing classified documents.

CONCLUSIONS

Copyright plays a crucial role in industrial fields such as: textiles and clothing, leather, furniture and shoes, since it is free, fast and easy to obtain, and does not require any formalities (a so-called "self-executing right").

Design and product development give rise to new knowledge, as well as intellectual property derived form it. The desire to effectively use and reuse such knowledge, while protecting intellectual property – IPR, often leads to conflict and inefficiency.

Imitations are harmful both to manufacturer/brand owner and consumer. The first suffer loss when the customer buys a product that is similar to the original one, wrongly believing that is the original branded product. Consumers are affected because the imitations are usually of lower quality that the original branded product.

The service "Plicul cu idei" is a Romanian instrument to store and keep secure, in a regime that is not public, by OSIM, of all documents submitted by developers, individuals and business people, which include works and creations from various fields that can not be protected by the existing legislation regarding industrial property, copyright and related rights, in order to certify the filling date.

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BIBLIOGRAPHY

[1] Grau, F. *Istoria costumului*. Editura Meridiane, București, 2002, p. 103
[2] Poggioli, R. *Teoria dell'arte d'avangardia*. Mulino, Bologna, 1999, p. 102

[3] Pine II, J. *Mass customization: the new frontier in business competition*. Boston, Mass, Harvard Business School, 1992, p. 55
[4] *Magazine "Fashion Trends Styling"*. Ed. Media Company GMBH, Dusseldorf, 2010
[5] *Code de la propriete intellectuelle* [C. Prop. Intell.], art. L111-1 (Fr.), available on http://www.legifrance.gouv.fr/html/codes_traduits/cpialtext.htm
[6] Borukhovich, B. *Fashion design: the work of art that is still unrecognized in the United States*. In: Wake Forest Intellectual Property Law Journal, 2008 – 2009, vol. 9, no. 3
[7] *Intellectual property business tool for SMEs. Guidelines for the mobile industry.* State Office for Inventions and Trademarks

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DOCUMENTARE

Materii prime

BIOCOMPOZITE DIN FIBRE CURRAN

Compania ***CelluComp***, din Marea Britanie, a inventat un proces unic, aflat în curs de brevetare, care permite ca proprietăţile nanofibrelor de celuloză să fie exploatate în totalitate.

Fibrele *Curran* sunt recunoscute pentru proprietăţile lor de performanță, similare cu cele bazate pe tehnologia tradiţională de utilizare a fibrei de carbon. Ele sunt rezistente, rigide și uşoare, putând fi utilizate la fabricarea compozitelor. Aceste fibre sunt obținute din fluxurile de deșeuri rezultate în urma procesării alimentelor. Prin urmare, materia primă este constituită din deșeuri vegetale – morcovi sau sfeclă de zahăr, provenite din industria alimentară, care nu intră în competiție cu cea obținută din culturile alimentare. Pentru a optimiza utilizarea deşeurilor vegetale, compania CelluComp colaborează cu factori de decizie importanţi din industria de procesare a alimentelor. În comparaţie cu alte materiale utilizate pentru fabricarea compozitelor, de exemplu aditivii, această materie primă are o amprentă de carbon scăzută, datorită consumului redus de energie în procesul de producţie.

Biocompozitele realizate din fibre Curran pot avea la bază o varietate de rășini tradiţionale, cum ar fi răşinile epoxidice, poliuretanul și poliesterul.

Datorită structurii specifice, fibrele pot fi modificatori reologici eficienţi pentru anumite destinații finale, cum ar fi: vopsele și acoperiri, beton, fluide de foraj, produse cosmetice și produse de îngrijire personală. Această structură conferă atât vopselurilor și acoperirilor, cât și betonului și produselor de îngrijire personală efecte de consolidare.

Fibra Curran este compatibilă cu diverse sisteme polimerice pe bază de apă, cum ar fi răşinile epoxidice, produsele acrilice și cele pe bază de poliuretan. Conform afirmațiilor Directorul Executiv al CelluComp, Christian Kemp Griffin, „această investiție asigură companiei fondurile necesare și aduce un nivel ridicat de competență și profesionalism, ajutând compania să aibă un succes rapid".

Smarttextiles and nanotechnology, ianuarie 2014, p. 7

Directions for improving management accounting in the textile industry enterprises

TRIFAN ADRIAN

REZUMAT – ABSTRACT

Direcții de perfecționare a contabilității de gestiune în întreprinderile din industria textilă

Eforturile de perfecționare a contabilității de gestiune trebuie orientate către o transformare a acesteia dintr-o evidență ce înregistrează și raportează fapte trecute, cu putere redusă de informare, într-un instrument de conducere necesar informării rapide și corecte, ca etapă premergătoare a procesului de decizie, și creșterii vitezei de răspuns la fenomenele complexe care influențează activitatea întreprinderii. Printre direcțiile de perfecționare a contabilității de gestiune în întreprinderile din industria textilă, fără de care nu se poate realiza un management eficient al activității interne, se impun și cele referitoare la organizarea evidenței și calculației costurilor pe centre de costuri, divesificarea metodelor de contabilitate de gestiune și calculație a costurilor, precum și renunțarea la calculația lunară a costului efectiv, în favoarea calculației trimestriale, și raportarea lunară a rezultatelor la nivelul cheltuielilor directe (variabile) ale centrelor de costuri.

Cuvinte-cheie: centre de costuri, metodă standard-cost, calculația costurilor pe centre, calculația costului efectiv pe produs

Directions for improving management accounting in the textile industry enterprises

The efforts to improve management accounting must transform it from a record of past activities with low informational power into an appropriate managerial tool necessary to inform quickly and accurately as a preceding stage of the decision-making process and therefore increase the speed of response to the complex phenomena that influence an enterprise's activity. For the enterprises in the textile industry among the directions for improving managerial accounting, without which no efficient management of internal work can be achieved, the following ones would be required: the organization of accounting and cost calculation on the cost centres, diversifying the management accounting methods and cost calculation as well as giving up the monthly calculation of the actual cost for quarterly calculation and monthly reporting of the results of the direct (variable) costs of the cost centres.

Key-words: cost centres, method of standard-cost, calculation of costs per centres, calculation of the actual cost per product

The organization and management of the accounting management, under the complexity of todays' economic life, is far from being considered a matter of campaign with a low frequency and a low coefficient of opportunity. To target certain competitiveness, enterprises, including those in the textile industry, must control the main costs which affect their results.

Thus, there is the need to implement some developed, improved variants of management accounting which can afford greater accuracy in cost calculation and particularly generate the emergence of some informational systems better adapted to the needs of the managerial team.

THE NECESSITY OF IMPROVING ACCOUNTING MANAGEMENT WITHIN IN THE TEXTILE INDUSTRY ENTERPRISES

The specific activities in the textile industry enterprises led to the option of a calculation on phases, the variant with half-finished products for determining the actual cost of the production basis [1] – [4].

The method on phases relates the calculation of the cost of the production obtained in a certain stage of manufacturing with the calculation of the production cost from the next stage [5]. Being oriented towards a full cost calculation it focuses on the classification of direct and indirect expenditure, which does not allow their analysis in relation to the output.

From an economic perspective, the costs must be judged in relation to the output, which requires us to group the production and retail costs in variable and fixed.

The actual cost is calculated only after the last phase of production, when it can be compared with the preestablished one for setting deviations, which is late, and information on these deviations can not be used by management while making decisions.

That fact that the half-finished products obtained during the phases of manufacturing are stored for a certain period, after which they are consumed in the process of manufacturing of the next phase, does not allow knowing the actual costs at the end of each management period. Neither the actual cost determined with a delay can be considered real nor the deviations calculated on its base, because many conventional criteria are used to calculate it, for example, the allocation of indirect production expenses, the general administrative expenses etc. [6] – [7].

The efficient organization of the economic activity requires the reconsideration of the cost calculation methods. They must provide appropriate information to the requirements of an efficient management of production.

The modernization and diversification of the cost calculation methods in the textile industry enterprises should also take into account the increased responsibility degree of the cost centres' managers in obtaining operative information on the development of production process and its application in order to make efficient managerial decisions for running the respective centres and the enterprise as a whole.

Besides efficiency, foresight and responsibility it is also necessary to take into account as much as possible to reduce the workload required to obtain information on production expenses and their cost.

Reducing workload in obtaining information has the advantage of freeing the specialized staff of a series of simple registration papers, based on routine work, thus creating the possibility of focusing attention more on analyzing information in order to make full use of its interpretation while making decisions.

The fact of taking into account all these requirements which are imposed by the modernization trend and the diversification of the cost calculation methods may lead to a management accounting that will meet the requirements of an efficient management.

A MODEL OF MANAGEMENT ACCOUNTING REORGANISATION USING THE UNIQUE STANDARD-COST VARIANT PROVIDING MONTHLY SETTLEMENT OF EXPENSES PER COST CENTRES

Organization of management accounting on cost centres

In the textile industry the object of calculation according to which one makes a budget and calculates the cost is the manufacturing stage and within this the half-finished product or the finished product.

The increase of accountability for the expenditure determines, in our opinion, for the companies in the textile industry the organization of management accounting per cost centres as activity centres especially created by bringing jobs together by certain criteria.

Why cost centres? From a theoretical perspective, the following categories of management centres can be met within an enterprise: allocation centres, profit centres, complex management centres, functional centres and cost centres.

The allocation centres are usually specific to the investment activities of the enterprise and the profit ones are created for those activities which, by their nature or purpose, are called upon to contribute directly to the achievement of profit.

The complex management centres correspond to the organizational subdivisions which perform complex activities, such as procurement and management of resources, product launches, link with the market etc., while the functional centres are strictly budgetary sections, created by the leadership's needs, mostly functional.

Instead, the cost centres correspond to the enterprise's production or functional activities which by their nature and purpose are intermediate steps in achieving revenue and profit. They are in the situation where their entire production or activity is included in the internal circulation. The costs of these centres are limited to the budgeted (standard) cost and the financial objective is to minimize these costs.

Among all the above presented categories of management accounting centres, taking also into account the specific activities of the enterprises from the textile industry, we consider that the evidence and calculation of costs per cost centres could be a possible way to improve the management accounting for the enterprises from this industry. In addition, recording and calculating costs per cost centres lead to an increased information capacity of calculation absolutely necessary to achieve an efficient management and to a real promotion of the accountability principle in domestic economic management. This also leads to a simplification of the management accounting by moving the centre of gravity from the costs calculation of the half-finished products on each phase and the allocation of costs between two or more products obtained from the same phase to the calculation on cost centres that offers more efficiency. But the most important effect is the increase of accountability, i.e. the cost centres' managers will focus their full attention on the indicators that they may influence.

An important role in the proper organization of cost centres it has, as we have already mentioned, the specific activity of the enterprise, i.e. the object, the particularities of the production technology and the organizational and functional structure.

If in any case, in terms of the organizational and functional structure, the enterprise is divided into activity departments and within them in sections or functional services and further the departments develop in workshops, group of machines, jobs, while the functional services are divided into offices, not in all cases, the cost centres overlap on this organizational and operational structure of the enterprise. This is not possible because, on the one hand, not all the costs accurately identify with each element of the enterprise's organizational and functional structure, and, on the other hand, following them on each of those elements to the level of jobs would increase greatly the volume of evidence and calculation. For these reasons, for locating the consumption (the costs), several jobs or links of the enterprise's organizational and functional structure join in calculation in a single cost centre at the level of groups of machines, workshops, sections etc. Hence, it can be considered a cost centre any structural unit of the enterprise or the enterprise as a whole where the costs can be identified.

At the division of a company into cost centres, it is necessary to take into account the possibility of accurately estimating the work done by them, both in quantity and value, if possible, or only their value.

Depending on the setting up of the cost centres, there are two types: operational and functional.
The operational cost centres are those in which the technological operations of manufacturing take place, the retail operations as well as the supply ones, so activities that can be accurately measured quantitatively and qualitatively. The operational cost centres can be therefore within the production, supply, and sales activities.
The functional cost centres are those where take place activities of organization, management and administration of the production, supply and sales process. Such centres may be established at the level of a production section, a workshop, the supply department, the administrative department, the retail department etc.
With regard to the administrative and management department, we consider that a greater detail of its cost centres on services or offices should really ensure better information on the general administration expenses, which would increase the efficiency of the budgetary control and of the decision-making by managers, but, at the same time, it will lead to an increase in the occasional costs which are not balanced by the benefits brought. In the case of this activity department, we have to establish the optimal number of cost centres in terms of economic efficiency, given the opposing trends which exist between the information needs and the cost of these pieces of information.
Similar to the administrative and management department one can solve the problems for the enterprises in the textile industry and the retail sector.
The activity of the functional cost centres can not always be measured quantitatively, but sometimes it can be appreciated only qualitatively, and their costs can not be identified in a product, half-finished product, as with the operational centres, but they belong more to the operational centres, but, although they do not identify with the latter, they are directly compared with the first.
According to the above presentation, the functional cost centres will reflect those costs which cannot be given by any criteria to the operational centres, but they are costs included in the production cost.
Once the cost centres being set up, they allow the reflection and follow-up of costs, not only by their nature, as it is done in the financial accounting, but also by the source of formation. In doing so, the managers are supported. Having relevant information they can better appreciate the effectiveness of the various cost centres. For this the production costs should be charged as exactly as possible by the cost centres that made them in relation to the causal relationships established between them and the activities of those centres.
As we have already presented, the operational centres record all direct costs on calculation items. Regarding the indirect costs or expenses (the overheads of the section, the overheads of the administration and the selling costs), they are recorded in the functional cost centres formed at the level of sections, the administrative department and the retail department. At the end of the reporting period (quarter), when the product cost is determined, the indirect costs are going to be allocated on the operational cost centres.
This way of organizing management accounting identifies the equipment maintenance and operation costs, as they are incurred in the normal operation of equipment, with these and as such they become direct costs to the operational cost centres. All direct expenses incurred in the operating costs centres established under the basic sections are collected by using the calculation account 921 "Core business expenses", which in the analytics is developed in departments, in sections and in cost centres within the same section and in products and further in the calculation items. For example, 921.1.1.S10.01. – Core business expenses/Spinning department/Spinning preparation cost centre/Half-finished product thread no. 10 dyed, 100% wool/raw.
Regarding the costs of maintenance and operation of machines, they will be recorded in the accounts using the account 923 "Indirect production expenses", account which will be written in the analytics as 921, except that at the calculation items the structure of the maintenance and operation of machines costs will be used. For example, 923.1.1.S10.04. – Indirect production expenses/Spinning department/ Spinning preparation cost centre/Half-finished product thread no. 10 dyed, 100% wool/Depreciation of equipment.
For the indirect expenses of the operational cost centres from the base sections one functional cost centre is set up at the level of each department. All these expenses are recorded with the account 923 "Indirect production expenses", which in the analytics are recorded per base station and further on different kinds of overheads. For example, 923.1.05. – Indirect production expenses/Spinning department/Department's expenses of general interest.
The auxiliary activity should also be divided on cost centres, as follows: operational cost centres for the workshops from which a work or service come, one that can be accurately quantified, and functional cost centres at the level of each auxiliary section. The reflection in management accounting of the costs made by the cost centres established for auxiliary activities is performed using 922 account "Costs of auxiliary activities". In the analytics it develops on operational cost centres and on calculation items (they are the direct calculation items used in the operational cost centres established at the base departments), in addition, an analytic for the functional cost centre established at the level of the auxiliary department. For example, 922.1.1.01. – Costs of complementary/Steam boiler/Steam boiler cost centre/Raw materials and direct materials; 922.1.05. – Costs of complementary/Steam boiler/General interest expenses of the department.
Regarding the administrative and managerial department of the enterprise, as we have shown, at this level it is necessary to have a single functional cost centre. The expenditure in this department will be

recorded with account 924 "General administration expenses" which in the analytics is developed on different ways of general administration expenses.

Also, the collection of the expenses done by the retail department – a department in which it is one functional cost centre – is performed using the account 925 "Retail expenses" in the analytics on different kinds of expenses specific to this sector. The registration of the expenses per cost centres require that their managers carefully consider any consumption and perform only those expenses according to the results to be obtained.

The method of standard-cost on cost centres

To operatively provide information regarding the production expenses on the one hand and, on the other hand, to develop the management accounting forecasting side is necessary to promote the cost calculation methods based on predetermined expenses. In this direction, for the textile enterprises, it can be considered the experience with the standard-cost taking into consideration the indicators provided by the direct-costing method. This would provide the information on production costs an operative, foreseeing and functional, nature.

The standard-cost method is the first of the methods of calculation which was based on scheduled production expenses, costs being considered simultaneously scientific and real. Therefore, any deviation from them arisen during production is considered "deviation from normal" and it is sent to the results of the enterprise.

Standard costs are costs of production laid down in advance, on scientifically rigorous basis, under the conditions of the technological processes used in the enterprise, by its organizational and functional structures. The starting point for the standard-cost method is the existence of a comprehensive system of standards.

Essentially, the standards represent physical or valuable quantities of standard character set up on the basis of some methods of recording, tracking and analyzing the behaviour of the phenomena taking place in the enterprise.

The quantitative physical standards (natural or quantitative) are standards of measurement of some performances proven in technical or natural units. They can be divided into: material standards, time standards, and stock standards.

The material standards express on types of materials the amount necessary to manufacture a sub-assembly, a half-finished product, a product etc. under given technical and organizational conditions.

The time standards give the time for operations and per total, time required for making a piece, a half-finished product or any product.

Both the material standards and the time standards are determined starting from the product to be made, the required material of the standard quality, the existing equipment, the chosen technological process, the standard conditions for working, the standard labour for the execution of operations etc.

The following standards also fall into the category of physical standards: standard stocks of materials, standard stocks of production in progress, the half-finished ones and the finished products. They are intended to assess other components of the enterprise's productive activity, but their determination is related to the standardization of the costs.

Value standards are standard measurements expressed in money. Among them, we can find:

- the standards that represent in value the quantitative standards – the standard value stocks of raw materials, materials, fuels, production in progress, half-finished and finished products, standard costs of raw materials, materials, energy and labour on the product etc.;
- the value standards that are not based on quantitative standards – the cash that can be kept on hand, the maximum value of the claims against third parties, the maximum payment obligations to suppliers etc.;
- the financial standards describing the relationships between different measurements, for which standards have already been established – the speed of rotation of the current assets, the rate of return and so on.

Besides the existence of this system of the quantitative and value standards with a technical and economic reason, the essence of the standard-cost method lies in the way of calculation, tracking, analysis and reporting of the deviations from the standard costs.

Considering that the basic function of the standard costs is its use as a standard measurement of the actual costs, thereby exerting control over them systematically, using the standard-cost method involves: comparing the actual costs with the standard ones and finding the deviation from these, on the cost centres, on calculation items and on causes, and by centralizing them, on the entire enterprise; the analysis of the deviations in terms of increase and of their causes, establishing the measures to eliminate the negative deviations and framing the effective costs within the established standards.

Tracking the production expenses in the accounting with the standard-cost method can be arranged according to one of the following variants: partial standard-cost, unique standard-cost and double standard-cost. The essential differences between these variants consist in the way costs are recorded, and in the way the deviations are calculated and recorded.

Given the advantages and disadvantages of each of the three variants, we consider that the one that best meets the needs of the enterprises from the textile industry is the unique standard-cost.

In this variant, the account 921 "Core business expenses" – developed in the analytics on sections, operational cost centres and calculation items – works like this: it is debited with the standard costs (raw materials, direct salaries and wages, overheads) of the products manufactured during the reporting period; it is credited with the standard cost of the finished products obtained in correspondence with the debit of the account 902 "Internal settlements on the obtained production", as well as the standard cost of the production in progress through the debit of the account 933 "Cost of the production in progress". In parallel, some analytics function distinct from the account 921 "Core business expenses" for deviations. The deviations from the standard costs are recorded at their establishment (in red the favourable deviations and in black the unfavourable ones). At the end of the reporting period, the recorded deviations shall be allocated to the account 903 "Internal settlements on price differences". This account has distinct analytics both for the deviations of the finished products and for those related to the production in progress. After the operation of allocation, the accounts for deviations are closed.

Monthly determination of results at the level of direct (variable) expenses of the cost centres and the quarterly calculation of the actual cost per product

In the enterprises in the textile industry, enterprises whose production is organized in phases, the cost calculation per cost centres prevails.

The cost calculation per cost centres for monthly settlement can be made on the basis of the known items classification calculation. The monthly settlement of the expenses per cost centres will consider only those expenses that are identified in that centre.

The actual cost calculation per product should also be performed periodically. This is required to be made in the enterprises belonging to the textile industry at the end of each quarter in order to make the profitability analysis of the products obtained.

The quarterly actual cost calculation per product and not the monthly one is also necessary due to the fact that the organization of the management accounting does not only calculate the actual cost of the products, which is a final paper, but it should also consider the way the expenditure is formed in the various cost centres, the way standards are met and the expenditures budgeted in relation to the actual volume of activity.

The management accounting must serve by determining the actual cost of an economic purpose, i.e. control the yields of products. From this point of view, the actual cost calculation per product is justified at longer intervals of time, in our opinion, quarterly.

Thus, at the end of each quarter, after the distribution of indirect expenses, in the analytics of the account 921 "Core business expenses", open for each operational cost centre, are collected all the expenses of the production manufactured at the standard cost, per calculation items, and separately we can also determine the actual expenses deviated from the standard, per calculation items, too. These expenses are the consumptions made during the quarter for the half-finished and finished products derived from the manufacturing process, forming that production cost. The expenses made by the manufacturing process during a quarter refer to both the final production and to the production in progress and, as such, is partitioned between the two categories.

The quarterly calculation of the actual cost is also made per cost centres as the monthly one, but it deepens on the product in the former case, which is not done in the monthly calculation.

It is worth mentioning that, in determining the actual cost of the product, we must take into account the order of the succession of the calculation, as well as the features required by the calculation of the of half-finished products variant used in the textile enterprises. Regarding the order of calculation, it is determined by the way the half-finished products are consumed during the processing phases, as in this series their reimbursement should be made.

RESULTS AND DISCUSSIONS

The above presented method of calculation presents some advantages that we are trying to define succinctly.

The first advantage is the possibility of an operational analysis of the efficiency of the production in the established cost centres, thus fulfilling an important function for the management, i.e. an investigation and forecasting tool.

The application of this method has also the advantage of rationalizing the calculation, as the standard cost determined in advance is considered the real cost and therefore there is no need for calculating the actual cost of the finished production and of the production in progress at the end of each period, and the deviations are considered deviations from normal and are written directly at the results of the enterprise. The finished production and the one in progress may be settled at the standard cost. However, we should note that the possibility of determining the actual unit costs from time to time should not be given up; we propose to determine them quarterly by reporting the deviations of the finished products and of the production in progress by supplementation according to certain criteria, for example, in relation to the standard costs of the respective production.

Another advantage is that, although it has at its basis the concept of total costs using the classification of direct and indirect production expenses, the method also uses the classification of the expenses in fixed and variable, allowing a cost analysis according to the volume of the output and the calculation of some indicators specific to the direct-costing method necessary for making scientifically informed decisions.

With the help of this method one can perform an operational budget control of the way the resources are consumed by pursuing distinctly the deviations during the activity and not at the end of the reporting period, both in the operative records and in the accounting, globally and on causes.

The application of the standard-cost method does not primarily aim the aesthetics and the precision of the calculations determining the cost of products, although they are not neglected, but it refers particularly the increased role of the production costs in ensuring the objectives of the budget, the proper functioning of the enterprise, of each cost centre. The main purpose of such calculations is to provide operational, economic, the information necessary for budgeting, evaluating, coordinating and controlling the enterprise's activity.

The application of the standard-cost method also responds to the concept that the role of the accounting information, its effectiveness, is determined by the degree of its value in the preparation process and the decision making to trigger corrective actions.

CONCLUSIONS

Cost centres should be established for all the activities of an enterprise. All the cost centres within an enterprise form the enterprise as a whole.

Linked to the establishment of the cost centres is also the aspect of determining their optimum number, so that it can be a balance between the amount of information provided, its cost, efficiency and opportunity of making decisions for the efficient management of the business.

The unique standard-cost allows finding the deviations of the actual costs from the standard ones throughout the course of the manufacturing process, both per cost centres and per types of product and per calculation items and causes, which facilitates the budgetary control of the costs and the adoption of effective decisions at all hierarchical levels. The huge workload caused by the inventory process of the production in progress is eliminated as the registration system of consumption and production obtained only at the standard cost allows its determination by the accounting method.

It should not be concluded that there is a contradiction between the cost calculation per centres and that per products. Both calculations are needed to determine the costs of the final expenses bearers. It should just be established if at the end of each management period both calculations are necessary to be performed, since it is known that under certain conditions, the cost of the production of goods can be controlled only by calculating the expenses per cost centres and thus we can avoid finding the cost per product at the end of the month, which would help to save labour. For the calculation per cost centres the entire production is envisaged not only the production of goods, as it happens with the calculation per final bearers (finished products).

BIBLIOGRAPHY

[1] Ionescu, L., Marincu, M. *Textile products finishing.* Didactic and pedagogic publishing house, București, 1972

[2] Trifan, A., Baba, C. M. *Means of calculating the costs in the textile industry using Georges Perrin (GP) method*. In: Industria Textilă, 2009, vol. 60, issue 5, pp. 272-278

[3] Marchiș, O. *General technology of spinning and weaving.* Didactic and pedagogic publishing house, București, 1974

[4] Fleacă, E., Purcărea, A. A. *Raising the competitiveness of Romanian enterprises acting in textile industry based on process management modeling.* In: Industria Textilă, 2014, vol. 65, issue 1, pp. 47-52

[5] Oprea, C., Cârstea, Gh. *Management accounting and cost calculation*. Genicod Publishing House, Bucharest, 2002

[6] Capotă, A., Trifan, A. *Standard-cost accounting in industry.* Infomarket Publishing House, Brașov, 2001

[7] Epuran, M., Băbăiță, V., Grosu, C. *Management accounting and control*. Economic Publishing House, Bucharest, 1999

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Towards a geopolitics of consumers' interpretive uses of fashion discourses

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REZUMAT – ABSTRACT

Geopolitica analizelor interpretative ale consumatorilor privitoare la dezbaterile despre modă

În ultimul deceniu, au existat o serie de studii de caz privind importanța tendințelor modei asupra deciziei de cumpărare a vestimentației, rolul conținutului etichetei îmbrăcămintei în modelarea atitudinilor și comportamentului consumatorilor în raport cu deciziile determinate de responsabilitatea socială, impactul producției asupra mediului, considerarea ca irelevantă a produselor textile la modă și disponibilitatea consumatorilor de a cumpăra produse fabricate sau create pe piața internă. În articol este analizată importanța produselor ecologice și a promovării acestora în rândul consumatorilor, precum și a comunicării promoționale în punctele de cumpărare, în scopul informării consumatorilor cu privire la implicarea companiilor de îmbrăcăminte în practicile de afaceri ce vizează responsabilitatea socială, dar și impactul pe care-l are percepția consumatorilor cu privire la campania ce vizează abordarea ecologică și influența exercitată de publicitatea pe blog asupra comportamentului consumatorilor. Articolul evidențiază impactul designului îmbunătățit și al răspunsului rapid asupra comportamentului de cumpărare al consumatorilor, rolul normelor sociale într-un context de consum, importanța cerințelor de mediu în promovarea îmbrăcămintei și importanța înțelegerii implicării consumatorilor în comerțul cu amănuntul.

Cuvinte-cheie: consumator, comportament, modă, textile, îmbrăcăminte, mediu

Towards a geopolitics of consumers' interpretive uses of fashion discourses

Over the past decade, there has been increasing evidence describing the importance of clothing involvement in the apparel purchase decision, the role of apparel hang tags in shaping consumers' attitudes and behaviors relative to SR patronage decisions, the environmental consequences of production and disposal of fashion textiles, and consumers' willingness to pay for domestically made or grown products. The mainstay of the paper is formed by an analysis of the importance of green products and their promotion to consumers, the use of point-of-purchase promotional communications to inform consumers about apparel companies' engagement in SR business practices, the impact of consumers' perception of green campaign on the acceptance of green consciousness, and blog advertisements' effects on consumer behavior. Our paper contributes to the literature by providing evidence on the impact of enhanced design and quick response on consumer purchasing behavior, the importance of social norms in a consumption context, the effect of environmental claims in clothing promotion, and the importance of understanding consumer involvement in retailing.

Key-words: consumer, behavior, fashion, textile, clothing, environment

The purpose of this article is to gain a deeper understanding of the role of supply and demand mismatch in influencing strategic consumer purchasing behavior, the impact of combining both quick response and enhanced design in a fast fashion system, factors that can affect blogs' abilities to influence consumer behavior, and COO's role in consumers' decision-making processes. This research makes conceptual and methodological contributions to the relationship between consumers and fashion clothing, the importance of labels in the marketplace, the effect that fashion clothing involvement has on various consumer behavior variables, and fashion blogs as a communication tool for marketing products and brands. These findings highlight the importance of examining the relationship that men and women typically have with fashion clothing, the impact of green retailing on consumers' behavior, the consumer's willingness to pay more for green apparel, and the changed market environment and COO rules. Our analysis complements the growing literature on consumer behavior toward green apparel, the impact of advertising on consumer purchase intentions, the socially responsible consumer behavior, and the preference construction process.

THE SOCIALLY RESPONSIBLE CONSUMER BEHAVIOR

Consumers may have insufficient country-of-origin (COO) information when making purchase decisions for domestically produced or made products [1]. Few apparel companies successfully communicate their supply chain activities, including the countries involved and factory locations. If textile and apparel companies provided more detailed COO information to reflect today's fragmented global supply chain, consumers could better evaluate the values of the COO attribute in hybrid or multinational products. Decision makers have limitations on their capacity for processing information (bounded rationality). Consumers make decisions based on the situation in which they are in and with limited information. When asked to

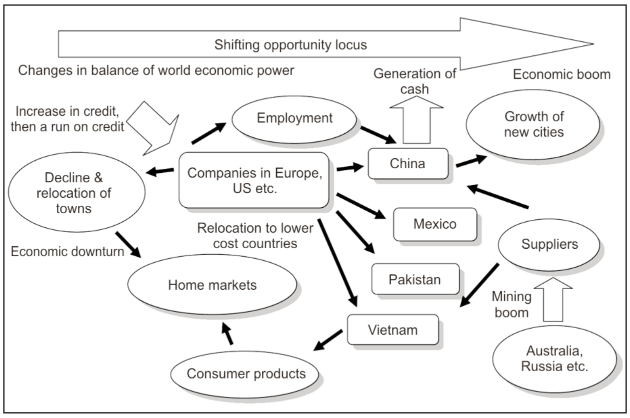

Fig. 1. The shifting global opportunity balance
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make choices, consumers often construct their preferences on the spot as needed, also using a variety of ways to construct their preferences and trying to solve the problems presented in a given environment.

Consumers make explicit trade-offs among attributes before making preference choices. When price is unknown and consumers face new product information, consumers may utilize the newly available information to formulate the value of the product. Both perceived quality and perceived price affect consumers' purchase intentions. the textile and apparel industry becomes fragmented in the global marketplace. Consumers may have different perceptions on being sustainable, affecting different purchase decisions. U.S. consumers consider cotton production or apparel manufacturing in the United States to be more sustainable than that in China. The participants' purchase preferences significantly decrease once participants perceive high prices. Declaring COM and COP matters to consumers as they form different preferences and prices. Price and social responsibility value of U.S.-made products may not be compensatory. Extremely high price overshadows consumers' desire to help domestic economy and local communities (careful pricing strategies are recommended to capture consumers' support for domestic products). Consumers see different values for a different COP even if the product is made in the same country. Consumers highly value apparel products made of U.S. raw materials despite their being manufactured in China. If consumers have knowledge of COO, COO affects their perceived price and purchase preferences [2].

Message explicitness may influence consumers' responses to promotional communications and their attitudes and purchase intentions. Apparel brands often use implicit messages to symbolically communicate meaning to consumers. Concern over or knowledge about (socially responsible) SR business practices may influence consumers' responses to SR marketing claims. Knowledge of industry practices may not be the best predictor of SR apparel purchasing behaviors. Personal characteristics may shape consumers' responses (fig. 1) to promotional communications [3], [4]. Belief strength is the extent to which a person believes a behavior or its outcome to be true or probable. Consumers' responses to hang tags may shape their attitudes toward products and brands. The presentation of information on hang tags may influence consumers' responses to the hang tags themselves, also influencing attitudes and behaviors toward apparel brands. The frequency with which consumers use labels or hang tags to gain information about apparel products may have increased recently. There are gender differences in perceived usefulness of hang tags and the type of information consumers look for when reading apparel hang tags. Apparel companies may benefit from using hang tags that convey intrinsic and extrinsic product information as well as information about a company's SR business practices. Apparel companies that wish to communicate their engagement in varied types of SR business practices should design hang tags that give particular attention to the explicitness of the SR information provided. Apparel companies should develop and implement marketing strategies that accurately and fully convey their engagement in SR business practices. Consumers' clothing involvement and their past SR apparel purchasing behaviors predict their evaluations of apparel hang tags. Clothing involvement may influence consumers' responses to promotional communications, shaping their attitudes toward an apparel brand [5].

Consumers become more interested in and knowledgeable about environmentally friendly products. The different kinds of social normsmake distinct contributions to eco-friendly consumer behaviors [6]. The impact of environmental attitudes and norms on consumer purchase intentions depends on the types of environmental marketing claims made by companies. Many consumers use multiple channels when searching information and purchasing products. Observing the behavior of others is of great importance in decision making in eco-friendly consumption. Eco-friendly behaviors are either stimulated more by extrinsically driven motivation or by intrinsically driven motivation. The impact of descriptive norms on purchase intentions does not differ depending on claim type. The descriptive norms elicited by a shopping situation affect consumers' purchase intentions no matter the type of environmental claim. Social norms have a greater influence on eco-friendly consumer behavior than environmental concern does. Marketers should consider the type of environmental marketing messages they wish to deliver and their specific target consumers. Objective information provided by the policy makers may help environmentally conscious consumers make their purchasing decision. The design and style of clothing are critical attributes when consumers choose apparel products (the perceived aesthetic qualities of environmentally friendly products may affect consumer purchase intentions). The effect of social norms on consumers' purchase intentions may depend on brand reputation [7].

THE PROCESSES ASSOCIATED WITH MAKING PURCHASE DECISIONS ABOUT FASHION CLOTHING

Green retailing is an essential part of the business model. Consumers' awareness of environment increases along with the global demand for green products. Retailers encourage consumption of green products and discourage consumption of nongreen products through green retailing. Managing green products and green campaigns is important for green retailers to fulfill their roles. Product sales and campaigns have both direct and indirect impact on consumer consciousness and behavior. Selecting green products can make a behavioral change by consumers' product experiences. Green product-related activities of fashion retailers have a direct impact on the formation of behavioral attitude toward consumption of green products. The green campaigns can motivate the consumers to participate, serving as effective tools to persuade consumers. Receivers' attitudinal changes are caused by processing cognitive responses. The Elaboration Likelihood Model (ELM) includes both the peripheral and the central routes to persuasion. Green campaigns are expected to persuade consumers through the central route of ELM. The consumer persuasion process can be approached through the central route and persuasion through peripheral route. Consumers' perception of green campaigns will influence changes in their eco-friendly consciousness, reinforcing their green behavior by the mediation of green consciousness. The communication effect of green fashion retailing on green consciousness and behavior may differ according to consumers' communication involvement. The constrained effects of communication involvement may differ depending on the medium: by products and by campaign. Different green retailing activities may affect consumer attitudes through different persuasion effect processes. Higher values perceived by consumers about products have a more positive impact on encouraging consumers' eco-friendly behavior. Highly enlightening green campaigns persuade consumers through the central route that affects their consciousness and their behavior, involving a cognitive attitudinal change process. As their eco-friendly attitude improves, the consumers may turn develop a favorable attitude toward green retailers [8].

Enhanced design capabilities result in products that are of greater value to consumers (fig. 2) eliciting a greater willingness-to-pay [9] – [12]. When customers exhibit strategic behavior, both quick response and enhanced design reduce consumers' incentives to delay a purchase. Short production lead-times should increase the efficacy of creating trendy products by allowing designs to be finalized closer to the selling season. Strategic consumers who choose to delay

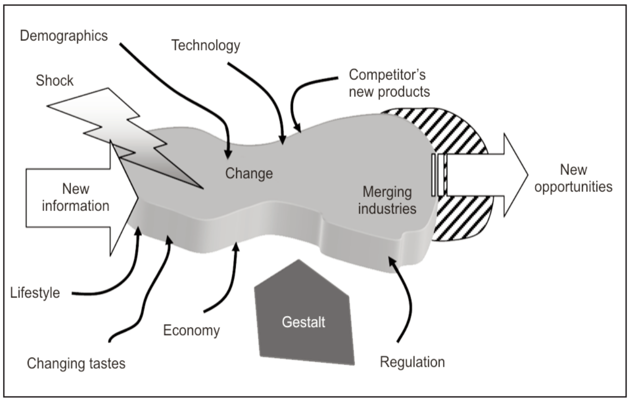

Fig. 2. The opportunity environment
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their purchase are "first in line" in the clearance market. The firm can procure inventory both before and after receiving a forecast update prior to the start of the selling season. In the fast fashion system, the firm is capable of both raising consumer values for the product and reducing supply-demand mismatch. Quick response and enhanced design are operational complements, as the selling price is more valuable to the firm if sales are higher and the marginal increase in price is earned on more units. Enhanced design's behavioral effect increases firm profit if used in conjunction with quick response. The behavioral effect of enhanced design has positive value to the firm. Quick response takes a positive effect of enhanced design and eliminates it, leading to a substitution effect, and the behavioral effect of quick response reduces the impact of the behavioral effect of enhanced design. Fast fashion yields a profit at least as great as the profit in an enhanced design system, being of greatest incremental value when clearance prices are expected to be low. Fast fashion is most valuable for low cost items with high demand variability and low clearance prices. A higher clearance price increases the firm's optimal inventory level, increasing the probability of a clearance sale and consumer incentives to delay purchasing. A consequence of fast fashion product is its impact on consumer purchasing behavior and the operational efficiency of the firm [13].

In Scotland, fashion innovativeness is not related significantly to any specific textile disposal behavior. Consumer awareness of the environment is positively related to donation to charity [14]. Consumers that have a positive attitude towards recycling are more likely to dispose of their clothing in an environmentally friendly manner. Recycling behavior has a positive impact on selling through eBay. In Australia, fashion innovators and consumers that are aware of the environment are more likely to give their clothing away to family and friends, rather than donate to charity or sell it through eBay or second hand shops. Consumers that have a positive attitude towards recycling are more likely to dispose of their clothing by donating to charity organizations. Recycling behavior has a

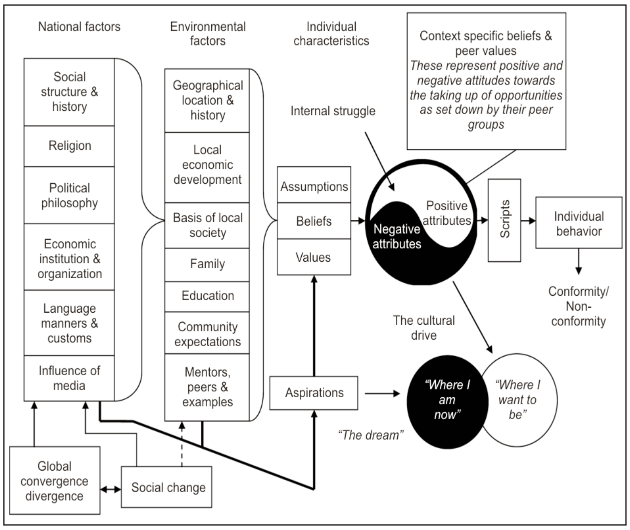

Fig. 3. The cultural process
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negative impact on selling through eBay or second hand shops [15].

THE IMPORTANCE OF CLOTHING INVOLVEMENT IN THE APPAREL PURCHASE DECISION

Fashion clothing is an important part of our human, corporeal existence. Materialism and gender are important drivers of fashion clothing involvement (FCI), whereas recreational shopper identity (RSI), market mavenism, ongoing information search (OIS) and purchase decision involvement (PDI) are its outcomes. Consumer involvement explains many aspects of decision making and consumption. FCI is associated with how important, meaningful and relevant fashion clothing is to the lives of consumers. The more fashion clothing occupies a key position in a consumer's life the greater the FCI experienced [16]. There are clear differences in decision making between those who are high in involvement and those who are low in involvement, and highly involved consumers use a central route to their fashion clothing decision making. High involvement can influence the incorporation of a product or activity into an individuals' self-concept. Consumers who are highly involved in fashion clothing will view recreational shopping as part of their identity. OIS reflects continuing interest or enthusiasm with fashion clothing, being a means of maintaining general fashion awareness. Highly involved fashion clothing consumers are likely to engage in a broad range of OIS activities. Involvement (product category) leads to greater involvement in the purchase decision of a consumer in relation to a product within that category. In high involvement purchase decisions, decision-making processes proceed through the central route. Materialistic values are a significant determinant of high FCI, whereas women are more likely to display high FCI than men. Both market maven characteristics and ongoing information search are significant outcomes of FCI. Highly involved fashion clothing consumers are interested in gathering marketplace information for themselves, and engage in the sharing this information with others. Making information relevant to consumers is the best way to get them to use the central route to persuasion. Highly involved fashion consumers find making purchase decisions within fashion an involving process. RSI is an important consumer identity construct that is greatly affected by consumer involvement. Highly materialistic consumers are more likely to be involved in fashion clothing, and tactics should be employed that nurture such values, and focus on notions of clothing is a part of the self image and identity. Females have a greater orientation to involvement with fashion clothing [17].

Marketers of fashion sometimes use environmental marketing claims to appeal to a broad cross-section of consumers with increasing environmental concerns [18]. Environmental marketing claims provide an effective way to differentiate a company's offerings from the competitor's offerings. Consumers' attitudes have an effect on their behavioral intentions or their willingness to pay more for green apparel, and consumers have decreased price sensitivity for green products. Demographics may have an effect on a consumer's decreased price sensitivity or willingness to pay more for green goods. Apparel firms can use any number of environmental-marketing claims to sell green goods. Consumers who have purchased green apparel in the past may be willing to pay higher prices. Environmental marketing claims may be effective in attracting consumers who have purchased green apparel. Marketers may want to provide incentives at the point of sale to encourage purchase of multiple clothing items. Environmentally conscious customers are often interested in reducing environmental impacts in other areas of their lives. Consumers may experience reduced price sensitivity when they value environmental marketing claims [19].

Fashion blogs may function as a source of influence (a marketing tool) to affect consumer behavior. Fashion can be used as a symbol of how we define ourselves. Word-of-mouth may be more reliable than that received through more formal marketing channels, such as ads and commercials, and the readers look at bloggers as people who have nothing to gain from giving a good product review. Fashion blog readers seek and engage in a relationship with the blogs they follow. Trust and credibility are important factors in bloggers' influence on their readers. Fashion blogs can be influential in terms of affecting consumer behavior. Bloggers are dependent on their readers leaving comments and following their blog, also building relationships with other fashion bloggers in order to expand their network and enlarge their readership. The fashion industry has begun to realize the marketing value of fashion bloggers. Honesty towards their readers regarding advertisements and sponsorship deals is important in order to win readers' trust and loyalty. The line between commercial activity and personal preference (fig. 3) in the blogosphere is vague. In the context of blogs, advertisements can be interpreted as editorial text [20], [21]. Trust in the blogger and their credibility is a crucial factor in influencing consumer behavior, and credibility is an important factor affecting bloggers' influence on their readers and fellow bloggers [22].

CONCLUSIONS

The current study has extended past research by elucidating consumers' attitudes toward environmental-marketing claims, the processes associated with making purchase decisions about fashion clothing, the potential role of hang tags in shaping consumer behavior, and multilevel COO and consumers' perceptions and preferences. The implications of the developments outlined in the preceding sections of this paper suggest a growing need for a research agenda on the direct impact of consumer's evaluation of green products on consumer behavior, consumers' different rationales for purchasing environmentally friendly products, the role of fashion retailers in the area of environment protection, and the moderating role of environmental marketing claims on consumer purchase intentions. The findings of this study have implications for consumers' attitudes toward environmental marketing claims, the increasing consumer demand for product origin information, and the strong power of price as a moderator of purchase preferences.

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BIBLIOGRAPHY

[1] Nica, E. *Organizational culture in the public sector*. In: Economics, Management and Financial Markets, 2013, vol. 8, issue 2, pp. 179-184

[2] Ha-Brookshire, Jung E. *Country of parts, country of manufacturing, and country of origin: consumer purchase preferences and the impact of perceived prices*. In: Clothing and Textiles Research Journal, 2012, vol. 30, issue 1, pp. 19-34

[3] Popescu, G. H. *Macroeconomic policies in the Eurozone*. In: Economics, Management and Financial Markets, 2013, vol. 8, issue 2, pp. 185-191

[4] Hunter, M. *A typology of entrepreneurial opportunity*. In: Economics, Management and Financial Markets, 2013, vol. 8, issue 2, pp. 128–166

[5] Hyllegard, K. H., Ruoh-Nan, Y., Paff Ogle, J., Lee, K.-H. *Socially responsible labeling: the impact of hang tags on consumers' attitudes and patronage intentions toward an apparel brand*. In: Clothing and Textiles Research Journal, 2012, vol. 30, issue 1, pp. 51-66

[6] Nica, E. *The causal impact of brain drain migration on economic development*. In: Contemporary Readings in Law and Social Justice, 2013, vol. 5, issue 1, pp. 94-99

[7] Kim, H., Lee, E.-J., Hur, W.-M. *The normative social influence on eco-friendly consumer behavior: the moderating effect of environmental marketing claims*. In: Clothing and Textiles Research Journal, 2012, vol. 30, issue 1, pp. 4-18

[8] Lee, N., Choi, Y. J., Youn, C., Lee, Y. *Does green fashion retailing make consumers more eco-friendly? The influence of green fashion products and campaigns on green consciousness and behavior*. In: Clothing and Textiles Research Journal, 2012, vol. 30, issue 1, pp. 67-82

[9] Popescu, D. I. *Green fashion – a new possible lifestyle for Romanians.* In: Industria Textilă, 2013, vol. 64, issue 1, pp. 46-54

[10] Popescu, G. H. *The social evolution of China's economic growth*. In: Contemporary Readings in Law and Social Justice, 2013, vol. 5, issue 1, pp. 88-93

[11] Hunter, M. *A typology of entrepreneurial opportunity*. In: Economics, Management and Financial Markets, 2013, vol. 8, issue 2, pp. 128–166

[12] Popescu, D. I., Drăghici, M. S. *Strategic entrepreneurial management – necessity and opportunity.* In: Industria Textilă, 2012, vol. 63, issue 5, pp. 267-276

[13] Cachon, G. P., Swinney, R. *The value of fast fashion: quick response, enhanced design, and strategic consumer behavior.* In: Management Science, 2011, vol. 57, issue 4, pp. 778-795

[14] Nica, E. *Marketing implications of consumer behavior*. In: Economics, Management and Financial Markets, 2013, vol. 8, issue 1, pp. 124-129

[15] Bianchi, C., Birtwistle, G. *Sell, give away, or donate: an exploratory study of fashion clothing disposal behaviour in two countries*. In: The International Review of Retail, Distribution and Consumer Research, 2010, vol. 20, issue 3, pp. 353-368

[16] Popescu, G. H. *Partisan differences in evaluations of the economy*. In: Economics, Management and Financial Markets, 2013, vol. 8, issue 1, pp. 130-135

[17] Hourigan, S. R., Bougoure, U. *Towards a better understanding of fashion clothing involvement*. In: Australasian Marketing Journal, 2012, vol. 20, pp. 127-135

[18] Zaharia, C., Zaharia, I. *The impact of CSR on consumers' attitude and behavior*. In: Economics, Management and Financial Markets, 2013, vol. 8, issue 1, pp. 118-123

[19] Stall-Meadows, C., Davey A. *Green marketing of apparel: consumers' price sensitivity to environmental marketing claims*. In: Journal of Global Fashion Marketing, 2013, vol. 4, issue 1, pp. 33-43
[20] Nicolăescu, E. *Developments in corporate governance and regulatory interest in protecting audit quality*. In: Economics, Management and Financial Markets, 2013, vol. 8, issue 2, pp. 198–203
[21] Hunter, M. *How culture creates and transfers entrepreneurial and innovative potential: a topographical map*. In: Journal of Self-Governance and Management Economics, 2013, vol. 1, issue 1, pp. 28–63
[22] Halvorsen, K., Hoffmann, J., Coste-Manière, I., Stankeviciute, R. *Can fashion blogs function as a marketing tool to influence consumer behavior? Evidence from Norway*. In: Journal of Global Fashion Marketing, 2013, vol. 4, issue 3, pp. 211-224

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DOCUMENTARE

Nanotehnologii

MIXAREA ŞI SELECŢIA NANOPARTICULELOR

În cadrul ***Laboratorului Naţional Brookhaven***, al Departamentului pentru energie al S.U.A., a fost elaborată o tehnologie generală de combinare a diferitelor tipuri de nanoparticule, deschizând noi oportunităţi pentru mixarea şi selecţia unor particule cu diferite proprietăţi magnetice, optice sau chimice, în vederea obţinerii unor materiale multifuncţionale sau cu performanţe mai bune, pentru o gamă largă de aplicaţii. Noua abordare beneficiază de posibilitatea cuplării lanţurilor complementare de acid dezoxiribonucleic sintetic pe molecule ce poartă codul genetic în secvenţele selectate, notate cu A, T, G şi C.
După peliculizarea nanoparticulelor cu o structură standardizată din punct de vedere chimic şi adăugarea unor molecule substituent la care ADN aderă uşor, au fost ataşate lanţuri complementare de ADN sintetizat în laborator la două tipuri diferite de nanoparticule. Cuplajul natural al lanţurilor compatibile asamblează apoi particulele într-o reţea tridimensională, alcătuită din miliarde de particule. Variaţia lungimii linkerilor ADN şi a densităţii lor superficiale permite optimizarea şi controlul materialelor nou formate şi a proprietăţilor acestora. Metodele de asamblare bazate pe ADN permit crearea deliberată a unor nanocompozite "superstructurate" la scară mare, dintr-o gamă largă de nanocomponente disponibile în prezent, inclusiv nanoparticule magnetice, catalitice şi fluorescente. Progresul obţinut se bazează pe cercetări anterioare, care au arătat că cuplajul nanoparticulelor cu diferite funcţii poate afecta performanţa particulelor individuale, dar, în acelaşi timp, poate contribui la realizarea de noi materiale cu funcţii combinate îmbunătăţite sau complet noi.
Viitoarele aplicaţii includ: puncte cuantice a căror fluorescenţă poate fi controlată de un câmp magnetic extern pentru noi tipuri de comutatoare sau senzori, nanoparticule de aur care măresc sinergetic strălucirea fluorescentă a punctelor cuantice, nanomateriale catalitice care absorb "otrăvurile" ce le afectează, de obicei, performanţa.
ADN-ul nu ajută doar la mixarea particulelor, el poate îmbunătăţi ordinea unor astfel de sisteme. Lanţurile mai scurte de ADN sunt mai eficiente în competiţia împotriva atracţiei magnetice. În cazul compozitelor din aur şi a nanoparticulelor magnetice, s-a constatat că aplicarea unui câmp magnetic extern poate comuta faza materialului, afectând ordonarea particulelor. Această demonstraţie s-ar putea aplica în domeniul comutatoarelor magnetice sau al materialelor care-și pot schimba forma la comandă. Ordinea compoziţională a particulelor este importantă pentru punctele cuantice, deoarece proprietăţile lor optice depind de numărul nanoparticulelor de aur din mediul înconjurător. Dacă se creează o dezordine compoziţională, proprietăţile optice vor fi diferite. În cadrul experimentelor s-a constatat că, odată cu creşterea grosimii stratului ADN din jurul particulelor, s-a mărit și dezordinea compoziţională.
Aceste principii fundamentale oferă oamenilor de ştiinţă un cadru pentru proiectarea de noi materiale multifuncţionale.
Desigur, condiţiile specifice necesare pentru o anumită aplicaţie depind de particulele utilizate, dar abordarea generală a asamblării este aceeaşi. Există posibilitatea de a varia lungimea lanţurilor ADN, pentru a modifica distanţa dintre particule, de la aproximativ 10 nm la sub 100 nm, ceea ce este important pentru diversele aplicaţii, deoarece unele proprietăţi optice sau magnetice depind de poziţionarea la această scară.

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Applying causticizing process on bamboo/cotton blended knitted fabrics

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REZUMAT – ABSTRACT

Mercerizarea tricoturilor obținute dintr-un amestec de bambus/bumbac

În acest studiu au fost investigate anumite proprietăți fizice ale tricoturilor obținute din amestecuri fibroase de bambus și bumbac. Pentru a analiza efectul procesului de mercerizare, acesta a fost aplicat pe diverse materiale, folosind diferite concentrații de NaOH și intervale de timp diferite. După aplicarea procesului, au fost evaluate proprietățile de rezistență la plesnire, piling și tușeu. Rezultatele obținute au arătat că proprietățile fizice ale tricoturilor analizate sunt influențate de structura materialului și de concentrația de NaOH. Odată cu creșterea concentrației de NaOH, s-a constatat o îmbunătățire a proprietăților de rezistență la scămoșare și la plesnire și o rigidizare a tușeului.

Cuvinte-cheie: fibră de bambus, finisare, piling, mercerizare, tușeu

Applying causticizing process on bamboo/cotton blended knitted fabrics

In this study, several physical properties of causticized knitted fabrics made of bamboo/cotton blended yarns are investigated. To observe the effect of causticizing, the process has been applied to different knitted fabrics with different NaOH concentrations and different process durations. Then pilling, bursting strength and handle properties of the fabrics were evaluated. The results show that the measured physical properties of knitted fabrics changes depend on fabric structure and NaOH concentration. It was also found that the increase in NaOH concentration resulted in good pilling resistance, low bursting strength and stiff handles.

Key-words: bamboo fiber, finishing, pilling, causticizing, handle

Bamboo fiber is cellulose based fiber with good water absorption capacity, breathability, as well as it is environmental friendly and has a fast drying behavior. It is produced from bamboo plant, which is a renewable, degradable, abundant and cheap natural resource [1], [2].

At present, there are two ways to utilize bamboo in the fiber form. One is to produce natural fiber bundle from bamboo by chemical and physical treatment [1]. The other method is to produce the regenerated cellulose fiber from bamboo pulp. In order to produce bamboo fiber, bamboo pulp is first extracted from the bamboo stem and leaves by wet spinning, including a process of hydrolysis alkalization and multi-phase bleaching. Then bamboo pulp is processed into bamboo fiber and impurities such as lignin and pectin are removed from bamboo [3]. The manufacturing process of regenerated bamboo fiber resembles that of viscose fiber; therefore, regenerated bamboo fiber is also called bamboo viscose in literature [2].

Bamboo fiber is frequently being used in blends with other cellulosic fibers in textile industry. The properties of blended yarns mainly depend on the properties of the constituent fibers and their compatibility. The blending is primarily done to enhance the properties of yarns, as well as to optimize the cost of the raw material [4]. However blending process may cause various problems in some cases such as low tensile strength and cohesion force, fibrillation and pilling.

In the study, causticizing process has been introduced as a method to restrict the pilling problem of fabrics. It has been reported that use of alkali treatment in regenerated cellulose fibers changes the crystallinity, accessibility, unit cell structure and orientation of fibrils [5].

By causticizing, fibrils on the surface of the viscose fibers are stripped, solved and so become smoother. Moreover the fibers swell and as a result of this, fabric gains a more compact structure and as a result pilling tendency is restricted [6], [7]. Also causticizing has recommended achieving high color efficiency after printing [6], [8] and dyeing [6], [9].

In this paper, causticizing process was conducted to bamboo/cotton blended fabric as an alternative process to keep down the pilling tendency. For this aim pilling grades, bursting strengths and handle properties of causticized fabrics knitted from bamboo/cotton blended yarn were investigated.

MATERIALS AND METHODS

The regenerated bamboo fiber was used to produce 70/30 bamboo-cotton blended ring yarn. Plain, double and pique knit structures were produced using these blended ring yarns which are of Ne 30/1 count and with a twist factor of α_m = 107. Plain knit and pique knit samples were manufactured on a Mayer MV 4-3-2II Model (19 inch – 28 E) circular knitting machine whereas double knit fabrics were produced on a Mayer F.V. 2.0 Model (14 inch – 18 E) circular knitting machine. The weights of plain knit, pique knit and double knit fabric were 116, 126 and 157 g/m^2 respectively.

After bleaching of knit samples at 85°C with the use of 0.8 g/L organic stabilizing agent, 5 ml H_2O_2 (35 %), 1 g/L NaOH for 60 minute, the causticizing has been carried out. During the causticizing process the fabrics were treated at room temperature with 3 different sodium hydroxide concentrations (130 g/L, 100 g/L, 70 g/L) for 5, 10 and 15 minutes with a liquor ratio of 1:15. Then, in order to investigate in how extent causticizing processes changing the fabric properties, pilling grades, bursting strengths and handle properties were analyzed.

The pilling tests of the samples were measured with a Martindale Abrasion and Pilling tester after 2000 rubbing cycles according to TS EN ISO 12945-2 (2000) Standard [10]. Moreover, surface modification of samples after causticizing was also evaluated by taking photographs with Olympus Cx31 microscope. The bursting strengths were performed with Truburst James H. Heal test device according to TS EN ISO 13938-2 (1999) Standard [11]. Additionally, handle properties of fabrics after causticizing was subjectively analyzed by 50 panelists chosen from the Department of Textile Engineering students.

The obtained results of causticized fabrics were then evaluated statistically for significance in differences using three-way replicated analysis of variance (ANOVA) and the mean differences subgroups were also compared by the post hoc Duncan test at 95% significance level with use of SPSS statistical package. In this way, the effects of factors (fabric structure, concentration and process duration of causticizing) on the physical properties of causticized fabrics were analyzed.

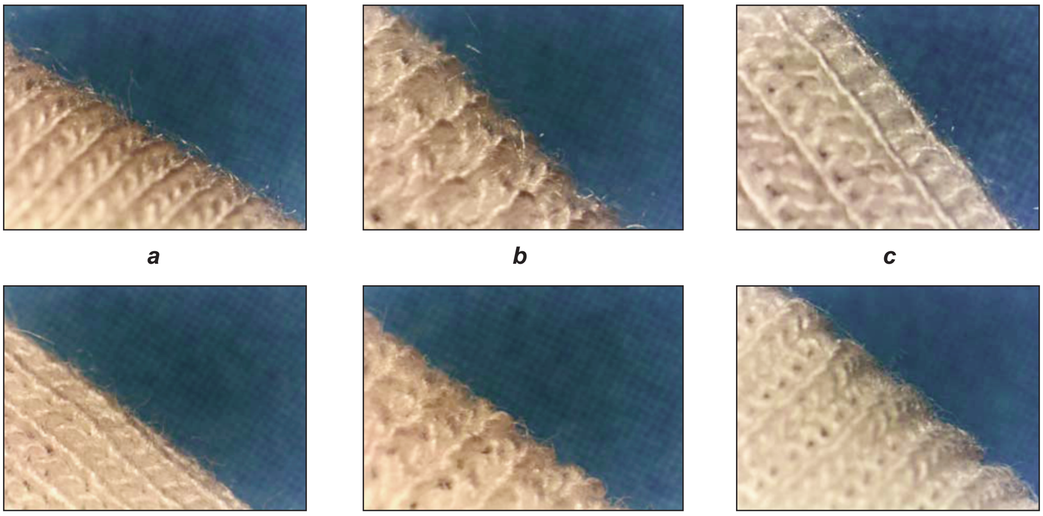
RESULTS AND DISCUSSIONS

Pill formation is a common problem, mainly in knitted fabrics made from natural fibers, man-made fibers and their blends [12]. In the study, the bleached and bleached & causticized knitted fabrics' pilling grades were evaluated by three different observers.

Pilling grades and bursting strengths of the fabric samples are presented in table 1. According to the mean test results, pilling grades of the bleached & causticized fabric samples are better than that of just bleached fabric samples. For instance, after causticizing the bleached plain knit fabrics with 100 g/L NaOH for 15 minutes, pilling grades increased to 3.5 from 1.5. Also, pilling grades increased to 3.5 from 2.5 and 4 from 2 for pique knit and double knit after causticizing process with 130 g/L NaOH for 5 minutes.

In figure 1, the view of some fabrics before and after causticizing has been demonstrated to support the obtained pilling results. It was observed that the surface of the fabrics has been cleaned and become smoother after the causticizing process depending on the fabric type.

ANOVA test results of knitted fabric samples for pilling grades are shown in table 2. According to the ANOVA test results, it is clear that the pilling grades of bamboo/cotton blended knitted fabrics depend on fabric structure and concentration. The effects of the intersection between fabric structure and concentration factors are also found to be statistically significant in terms of pilling grades. In another words, the effect of increase in NaOH concentration did not show same tendency for all fabric structures. For instance, it was determined that the best pilling grade for plain knit fabrics was reached by processing with 100 g/L NaOH, whereas the best pilling grade for pique knit and double knit fabrics was obtained by processing with 130 g/L NaOH. On the other hand, the process duration and intersections of this factor with the other factors did not show any significant effect on the pilling grade of causticized fabrics.



a *b* *c* *d* *e* *f*

Fig. 1. Microscopic views of some fabrics various causticizing processes (mag. x 15):
a – plain knit – just bleached; *b* – pique knit – just bleached; *c* – double knit – just bleached;
d – plain knit – causticization with 100 g/L NaOH for 15 min.; *e* – pique knit – causticization with 130 g/L NaOH for 5 min.; *f* – double knit – causticization with 130 g/L NaOH for 5 min.

Table 1

PILLING GRADES AND BURSTING STRENGTHS OF THE FABRIC SAMPLES					
Code	**NaOH concentration**, g/L	**Duration**, min.	**Fabric structures**	**Pilling grades**, 2 000 cycle	**Bursting strength**, kPa
1	130	5	Plain	2.5	100.6
2	130	10	Plain	2.5	98.0
3	130	15	Plain	2.5	93.3
4	100	5	Plain	2	121.3
5	100	10	Plain	2	110.1
6	100	15	Plain	3.5	105.3
7	70	5	Plain	2	131.9
8	70	10	Plain	2	169.5
9	70	15	Plain	2	66.6
10	Just bleached		Plain	1.5	131.2
11	130	5	Pique	3.5	93.7
12	130	10	Pique	3.5	97.9
13	130	15	Pique	3.5	86.5
14	100	5	Pique	4	105.6
15	100	10	Pique	3	99.6
16	100	15	Pique	3	109.9
17	70	5	Pique	3	115.5
18	70	10	Pique	3.5	113.1
19	70	15	Pique	2.5	116.6
20	Just bleached		Pique	2.5	124.3
21	130	5	Double	4	98.3
22	130	10	Double	4	110.6
23	130	15	Double	3.5	111.0
24	100	5	Double	2	109.0
25	100	10	Double	2.5	115.2
26	100	15	Double	2.5	110.7
27	70	5	Double	2.5	133.7
28	70	10	Double	2.5	140.0
29	70	15	Double	2.5	124.8
30	Just bleached		Double	2	124.7

Duncan post hoc test results of knitted fabric samples for pilling grade are given in table 3. According to Duncan test results, it was found that the best pilling grade can be obtained, if the fabric structure is pique knit. This thought to be due to relatively strict knit structure. Also, it can be seen from Duncan test results, pilling grades increase with the increasing caustic concentration.

The bursting strength test was also carried out for bleached and bleached & causticized fabrics. According to mean test results, bursting strength of the bleached & causticized fabric samples are lower than that of just bleached fabric samples. For example, bursting strength decreased to 98.0 from 131.2 for plain knit and 110.6 from 124.7 for double knit after causticizing process which was applied with 130 g/L NaOH for 10 minutes (table 1).

The results of the ANOVA test for bursting strength values of fabric samples after caustizcizing process are given in table 4. According to this ANOVA test results, it was found that all factors as well as intersection of these factors are statistically significant in terms of bursting strength.

From the Duncan test, it is clear that the bursting strength of double knit fabrics is better than other fabrics. This situation is explained by the weight of double knit fabric. On the other hand as expected, bursting strength of the fabrics decreases with increasing caustic concentration, as shown in table 5.

We found that, there aren't significant differences between 10 and 5 minutes process duration in terms of the bursting strength values. When results of bursting strength test were analyzed, it was seen that the lowest bursting strength loss can be obtained after causticizing process which was applied with 70 g/L NaOH for 5 minutes of the double knit fabrics (table 1). Also, bursting strength loss of fabrics after causticizing process are not the same for each structures. For example, strength loss of pique knit fabric was approximately 20% after treatment with 100 g/L NaOH for

Table 2

ANOVA TEST RESULTS OF KNITTED FABRIC SAMPLES FOR PILLING GRADES					
Source	**Sum of squares**	***df***	**Mean square**	***F***	**Sig.**
Model	53.222[a]	26	2.047	2.456	0.003
Intercept	802.778	1	802.778	963.333	0.000
Fabric structure, *F*	20,352	2	10.176	12.211	0.000
Concentration, *C*	7.167	2	3.583	4.300	0.018
Duration, *D*	1.407	2	0.704	0.844	0.435
*F*C*	16.259	4	4.065	4.878	0.002
*F*D*	1.630	4	0.407	0.489	0.744
*C*D*	2.759	4	0.690	0.828	0.513
*F*C*D*	3.648	8	0.456	0.547	0.816
Error	45.000	54	0.833	-	-
Total	901.000	81	-	-	-
Corrected total	98.222	80	-	-	-

Table 3

DUNCAN POST HOC TEST RESULTS OF KNITTED FABRIC SAMPLES FOR PILLING GRADE			
Process	***N***	**Subset**	
Fabric structure	-	1	2
Plain	27	2.7222	-
Double	27	2.8704	-
Pique	27	-	3.8519
Significance	-	0.553	1.000
Concentration, g/L			
70	27	2.8148	-
100	27	3.0926	3.0926
130	27	-	3.5370
Significance	-	0.269	0.079
Duration, min.			
15	27	3.0370	-
10	27	3.0741	-
5	27	3.3333	-
Significance	-	0.267	-

Table 4

ANOVA TEST RESULTS OF KNITTED FABRIC SAMPLES FOR BURSTING STRENGTH					
Source	**Sum of squares**	***df***	**Mean square**	***F***	**Sig.**
Model	18 534.615[a]	26	712.870	14.125	0.000
Intercept	961 423.828	1	961 423.828	19 049.785	0.000
Fabric structure, *F*	2 674.063	2	1 337.032	26.492	0.000
Concentration, *C*	5 115.474	2	2 557.737	50.679	0.000
Duration, *D*	1 564.337	2	782.168	15.498	0.000
*F*C*	1 643.124	4	410.781	8.139	0.000
*F*D*	3 023.320	4	755.830	14.976	0.000
*C*D*	1 985.220	4	496.305	9.834	0.000
*F*C*D*	2 529.077	8	316.135	6.264	0.000
Error	2 725.327	54	50.469	-	-
Total	982 683.770	81	-	-	-
Corrected total	21 259.942	80	-	-	

10 minutes and strength loss of plain knit fabric was approximately 16% in the same causticizing process (table 1).

Touching a fabric is the first action that buyers perform in order to evaluate the fabric quality [13]. Handle, the term given to properties assessed by touch or feel, depend upon subjective assessment of the fabrics by a person. Handling the fabric is one of the ways of assessing certain of properties such as luster, smoothness, stiffness and draping qualities [14]. The handle of the fabrics can be chanced according to the finishing processes applied. Also the raw material of the fabrics is important in terms of the fabric handle. But beyond this in the study, in order to investigate the relationship between handle properties and causticizing process, the handle properties of the bleached and bleached & causticized knitted fabrics were evaluated subjectively. For the subjective handle evaluation of fabrics, 50 panelists were selected and their impression on fabrics was collected in table 6. The plain knit fabric just bleached was introduced to the panelists as the very soft (V) fabric for their comparison and pique knit fabric causticized with 130 g/L NaOH for 15 minutes was introduced as the stiffest handle (I). During the period of the evaluation, the introduced fabrics were again analyzed by the panelists too. Results imply that causticizing fabric samples display stiffer handle than just bleached ones.

The handle results were also analyzed statistically for cleaner understanding of results. Table 7 shows ANOVA test results of knitted fabric samples for handle properties. According to the ANOVA test results, fabric structure and caustic concentration were found statistically significant factors for handle properties of fabric samples, while the process duration was statistically insignificant. Also, the intersections of fabric structure/concentration (*F*C*), concentration/process duration (*C*D*) were statistically significant for handle properties, while the intersection of fabric structure/process duration (*F*D*) was not significant for the 95% confidence level. The triple intersection of factors (F*C*D) was statistically significant too.

Duncan test results showed that the softest handle properties were obtained from the plain knit, double knit and pique knit fabrics respectively. As shown in table 8, there is a significant correlation between each of concentration and handle properties. Handle properties get better with the decreasing caustic concentration of the process and interestingly no difference between the handle properties of knitted fabrics causticized 5, 10 and 15 minutes were observed.

Table 5

DUNCAN POST HOC TEST RESULTS OF KNITTED FABRIC SAMPLES FOR BURSTING STRENGTH				
Process	***N***	**Subset**		
Fabric structure	-	1	2	3
Pique	27	104.2778	-	-
Plain	27	105.5222	-	-
Double	27	-	117.0407	-
Significance	-	0.523	1.000	-
Concentration, g/L				
130	27	98.8889	-	-
100	27	-	109.6333	-
70	27	-	-	118.3185
Significance	-	1.000	1.000	1.000
Duration, min.				
15	27	102.7333	-	-
10	27	-	111.9407	-
5	27	-	112.1667	-
Significance	-	1.000	0.907	-

Table 6

HANDLE TEST RESULTS OF THE FABRIC SAMPLES								
Code	**Concentration**, g/L	**Duration**, min.	**Fabric structures**	**I**	**II**	**III**	**IV**	**V**
1	130	5	Plain	9	29	12	-	-
2	130	10	Plain	18	22	8	2	-
3	130	15	Plain	-	10	23	15	2
4	100	5	Plain	-	3	19	20	8
5	100	10	Plain	-	3	18	20	9
6	100	15	Plain	1	6	17	20	6
7	70	5	Plain	-	1	9	18	22
8	70	10	Plain	-	-	4	23	23
9	70	15	Plain	-	3	20	23	4
10	Just bleached		Plain	1	-	-	12	37
11	130	5	Pique	9	31	8	1	-
12	130	10	Pique	17	28	4	1	-
13	130	15	Pique	37	11	1	-	1
14	100	5	Pique	5	26	17	2	-
15	100	10	Pique	1	11	29	9	-
16	100	15	Pique	2	11	28	8	1
17	70	5	Pique	-	9	32	7	2
18	70	10	Pique	2	22	16	8	2
19	70	15	Pique	-	15	26	7	2
20	Just bleached		Pique	-	6	12	21	11
21	130	5	Double	16	25	6	3	-
22	130	10	Double	9	31	8	1	1
23	130	15	Double	6	22	15	7	-
24	100	5	Double	1	3	16	25	5
25	100	10	Double	-	8	8	25	9
26	100	15	Double	3	12	25	6	4
27	70	5	Double	-	3	26	13	8
28	70	10	Double	-	4	21	21	4
29	70	15	Double	-	-	17	26	7
30	Just bleached		Double	-	1	-	6	43

Note: I is very stiff; II - stiff; III - normal; IV - soft; V - very soft

Table 7

ANOVA TEST RESULTS OF KNITTED FABRIC SAMPLES FOR HANDLE PROPERTIES					
Source	**Sum of squares**	***df***	**Mean square**	***F***	**Sig.**
Model	838.226[a]	26	32.239	50.396	0.000
Intercept	11 744.124	1	11 744.124	18 358.233	0.000
Fabric structure, *F*	189.872	2	94.936	148.403	0.000
Concentration, *C*	514.234	2	257.117	401.921	0.000
Duration, *D*	0.093	2	0.047	0.073	0.930
*F*C*	11.073	4	2.768	4.327	0.002
*F*D*	1.618	4	0.404	0.632	0.640
*C*D*	24.724	4	6.181	9.662	0.000
*F*C*D*	96.660	8	12.082	18.887	0.000
Error	846.349	1 323	0.640	-	-
Total	13 430.000	1 350	-	-	-
Corrected total	1 684.575	1 349	-	-	-

Table 8

DUNCAN POST HOC TEST RESULTS OF KNITTED FABRIC SAMPLES FOR HANDLE PROPERTIES				
Process	***N***	**Subset**		
Fabric structure		1	2	3
Pique	450	2.4467		
Double	450		3.0556	
Plain	450			3.3467
Significance		1.000	1.000	1.000
Concentration, g/L				
130	450	2.0911		
100	450		3.2422	
70	450			3.5156
Significance		1.000	1.000	1.000
Duration, min.				
5	450	2.9400		
15	450	2.9467		
10	450	2.9622		
Significance		0.698		

The softest handle was obtained from plain knit structure after causticizing process applied with 70 g/L NaOH for 10 minutes. It was determined as very soft by 23 panelists, as soft by 23 panelists and as normal by 4 panelists (table 6).

CONCLUSIONS

In this study, bamboo/cotton blended fabrics in plain, double and pique knit structure were subjected to a causticizing process after bleaching. Then, the pilling, bursting strength and handle properties of the bleached and causticized knitted fabrics were investigated.

According to the test results, even though the higher pilling grades were obtained with causticizing process, bursting strength and handle properties of fabrics were adversely affected by causticizing process.

The fabric structure is a significant factor for pilling grade of fabric samples subjected causticizing processes. The best pilling grade was obtained from pique knit fabrics since its more compact structure. Pilling grade of the fabrics increases with increasing caustic concentration.

Bursting strength of the fabrics also decreases with increasing caustic concentration. It is seen that lower strength loss after causticizing process, was obtained from double knit fabric. The difference between bursting strength values of fabrics for 15 minutes processes duration were found to be statistically lower than that of fabrics for 5 and 10 minutes process duration. Moreover, it can be concluded that handle properties of fabrics change depending on the fabric structure and NaOH concentration. Stiffness of the fabrics increases with increasing caustic concentration. As expected, the best handle was obtained from plain knit structure, followed by double and pique knit structure.

Finally, in the study it was planned to introduce a method for bamboo/cotton fabrics to restrict the pilling tendency with a limited strength loss and limited handle change. It was found that depending on the fabric structure causticizing with a proper NaOH concentration for a short time can be a way to minimize this drawback of the bamboo blended fabrics.

For further studies, it is though that physical properties of causticized knitted fabrics after dyeing and repetitive washings will be interesting and hope that this study will contribute to these further studies.

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BIBLIOGRAPHY

[1] Yueping, W., Ge, W., Haitao, C., Genlin, T., Zheng, L., Feng, X. Q., Xiangqi, Z., Xiaojun, H., Xushan, G. *Structures of bamboo fiber for textiles*. In: Textile Research Journal, 2010, vol. 80, issue 4, pp. 334-343

[2] Erdumlu, N., I. Özipek, B. *Investigation of regenerated bamboo fibre and yarn characteristics*. In: Fibres & Textiles in Eastern Europe, 2008, vol. 16, issue 4, pp. 43-47

[3] Özgen, B. *New biodegradable fibres, yarn properties and their applications in textiles: A review*. In: Industria Textila, 2012, vol. 63, issue 1, pp. 3-7

[4] Majumdar, A., Mukhopadhyay, S., Yadav, R., Mondal, A. K. *Properties of ring-spun yarns made from cotton and regenerated bamboo fibres.* In: Indian Journal of Fibre & Textile Research, 2011 vol. 36, pp. 18-23

[5] Colom, X., Carrillo, F. *Crystallinity changes in lyocell and viscose-type fibres by caustic treatment*. In: European Polymer Journal, 2002, vol. 38, pp. 2 225-2 230

[6] Bahtiyari, M. İ., Duran, K., Körlü, A. E., Bahar, M., Özerdem, A., Perincek, S. *Causticizing of viscose fabrics, journal of textile and apparel.* In: Technology and Management, 2009, vol. 6, issue 1, pp. 1-7

[7] Bahtiyari, M. İ., Duran, K., Körlü, A. E. *The effect of causticizing processes on the pilling values of viscose fabrics.* In: AATCC Review, 2007, vol. 7, issue 4, pp. 40-45

[8] Özgüney, A. T., Tarakçıoğlu, I., Körlü, A. E., Özerdem A., Bahtiyari M. İ. *Effects of different pretreatment processes on viscose fabrics in different types and properties*. In: The Journal of The Textile Institute, 2005, vol. 96, issue 5, pp. 319-327

[9] Bahar, M., Körlü, A., Bahtiyari, M. İ., Özgüney, A.T. *Effects of pretreatment processes on reactive dyeing of viscose fabrics.* In: Industria Textila, 2010, vol. 61, issue 6, pp. 265-270

[10] TS EN ISO 12945-2. *Textiles – Determination of fabric propensity to surface fuzzing and to pilling – Part 2: Modified Martindale method* (ISO 12945-2:2000)

[11] TS EN ISO 13938-2. *Textiles – Bursting properties of fabrics – Part 2: Pneumatic method for determination of bursting strength and bursting distension* (ISO 13938-2:1999)

[12] Okubayashi, S., Bechtold, T. *A Pilling mechanism of man-made cellulosic fabrics – effects of fibrillation.* In: Textile Research Journal, 2005, vol. 75, issue 4, pp. 288–292

[13] Özçelik, G., Supuren, G., Gulumser, T., Tarakcioğlu, I. *A study on subjective and objective evaluation of the handle properties of shirt fabrics*. In: Fibres & Textiles in Eastern Europe, 2008, vol. 16, issue 3, pp. 56-62

[14] Saville, B. P. *Physical testing of textiles.* Cambridge: The Textile Institute, Woodhead Publishing Ltd., 1999, pp. 256-294

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ERATĂ / *ERRATUM*

Redacția menționează că, la articolul "Compozite polimerice pe bază de deșeuri din fibre de in și cauciuc natural", publicat în revista Industria Textilă, nr. 1/2014, la paginile 1, 2, 53 și 60, a fost omis autorul ANA MARIA VASILESCU.

The editorial boards mentions that in "Polymeric composites based on flax and natural rubber Wastes" published in Industria Textila no. 1/2014, pages 1, 2, 53 and 60, ANA MARIA VASILESCU was omitted as author of the afore mentioned paper.

ANUNŢ

Suntem lider de piață în domeniul textilelor tehnice. Fiecare dintre produsele noastre reprezintă puterea de inovație și gândirea vizionară pe care le utilizăm pentru a oferi soluții originale. Tehnologia noastră unică pentru producția eficientă a aproape oricărei structuri textile ne asigură un avantaj competitiv pe piața textilelor. Intenționăm să consolidăm acest avantaj cu ajutorul dumneavoastră.

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