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Effects of different finishing processes on some performance characteristics of denim fabrics

VILDAN SÜLAR SIBEL KAPLAN

REZUMAT – ABSTRACT – INHALTSANGABE

Efectele diferitelor procese de finisare asupra caracteristicilor de performanţă ale ţesăturilor denim

În acest studiu este analizată influenţa proceselor de spălare, a diverselor tratamente speciale şi a proceselor de albire asupra proprietăţilor fizico-mecanice şi a tuşeului ţesăturilor denim destinate realizării blugilor. Procesele au fost aplicate în mod sistematic pe articolele de blugi cusuţi, pentru a evidenţia clar efectele utilizărilor practice individuale. Conform rezultatelor, tipul de ţesătură şi toate procesele de finisare aplicate pentru a obţine un aspect uzat, învechit au o influenţă semnificativă asupra proprietăţilor mecanice ale ţesăturilor denim. Spălarea cu piatră în combinaţie cu albirea au fost considerate ca fiind cele mai agresive tratamente pentru ţesăturile denim. Cu toate că, în cazul spălării ţesăturii cu enzime, s-a observat o scădere semnificativă a rezistenţei la rupere şi a alungirii la rupere, aceasta poate fi recomandată ca o opţiune ecologică, mai puţin dăunătoare.

Cuvinte-cheie: ţesătură denim, proprietăţi mecanice, rezistenţă la rupere, rezistenţă la sfâşiere, tuşeul ţesăturii

Effects of different finishing processes on some performance characteristics of denim fabrics

This study investigates influences of some washings, special treatment processes and bleaching on some physical, mechanical properties, and hand evaluations of jeans produced from two types of denim fabrics. Processes were applied systematically on sewn jeans products to see effects of individual applications clearly. According to the results, fabric type and all of the finishing processes applied to obtain worn appearance and aged look have significant influences on mechanical properties of denim fabrics. Stone washing and its combination with bleaching were determined as the most aggressive applications for denim fabrics. Although significant decrease was observed on the fabric in terms of tear strength and breaking elongation, enzyme washing can be recommended as an environmentally friendly and less damaging option.

Key-words: denim fabric, mechanical properties, breaking strength, tear strength, fabric hand

Auswirkung unterschiedlicher Veredlungsprozesse auf den Leistungsmerkmalen der Denim-Gewebe

In dieser Untersuchung wird die Einwirkung der Waschprozesse, der unterschiedlichen speziellen Behandlungen und der Bleichung auf die physisch-mechanischen Eigenschaften und des Griffes der Denim-Gewebe für die Fertigung von Blue-Jeans analysiert. Diese Prozesse wurden systematisch auf genähten Blue-Jeans-Artikel durchgeführt, um die Auswirkungen der praktischen individuellen Anwendungen hervorzuheben. Gemäss den Ergebnissen, hat das Gewebetyp und alle angewendeten Veredlungsprozesse für die Erzeugung eines benutzten, verschleissten Effektes eine wesentliche Einwirkung auf die mechanischen Eigenschaften der Denim-Gewebe. Obwohl im Falle des Enzyme-Waschens der Gewebe, eine wesentliche Verringerung der Reisswiderstandes und der Reissdehnung beobachtet wurde, kann diese als weniger schädliche, umweltfreundliche Option empfohlen werden.

Stichwörter: Denim-Gewebe, mechanische Eigenschaften, Reisswiderstand, Bruchwiderstand, Gewebegriff

Garments made from denim fabric have been one of the rare clothing groups worn by people at any age, any social/professional group and country [1]. It was observed that 50% of people under 60 have preferred denim products during their lives. 90% of the people around 14–19 ages and 70% of the people around 20–29 ages stated that denim products were crucial for their wearing experiences [2]. Its usage has always an increase trend and it is thought that different designs, appearances and colors obtained by various washing and fading processes support the above mentioned trend after 1990's. Denim designers make different applications such as patches, rhinestones and glitter in order to add value to the denim products. Value addition may be either functional or aesthetic. Aesthetic value-addition is a cosmetic treatment and ornamentation that is governed by the latest "trends" and consumer preferences.

Color spray, softeners for a bulky handle, mild washing effects (stone washing, acid washing, distressing), tinting, oxidizing (with ozone or potassium permanganate), enzyme (perlite-cellulase, cellulase etc.) treatments, mechanical fading processes (sand blasting, brushing, destroy) and laser applications are some of the new methods adding value to this legendary outfitter [3]. Nevertheless, washing and fading processes which change aesthetic appearances of denim products deteriorate their mechanical properties, especially strength and durability of the products. Although durability is not one of the main concerns of denim product consumers, wear on fabric because of previously mentioned chemical and mechanical applications may decrease the necessary performance properties of denim products.

As a result of increasing trend about creating worn-look and softer hand on denim products, there have been some studies investigating effects of different mechanical and chemical finishing processes on physical and mechanical properties of denim fabric. Effects of different washing treatments (rinse, stone and enzyme) on pilling and edge deformation [3], on abrasion resistance differing according to the washing parameters [4], on shrinkage, air permeability, bending rigidity, extensibility, breaking force-elongation and shear rigidity [5], on strength and elongation of classical and environmentally improved denim fabrics [6] were investigated. Tarhan and Sariisik [7] studied effects of a combination of chemical and mechanical finishing processes (sand blasting, laser application and enzyme washing) on strength, weight loss and color loss of denim fabrics. Similar studies were conducted about effects of sand blasting with industrial enzyme silicone wash on fabric physical properties, hand, breaking and seam strengths and fabric stiffness [8] and effects of some washings

Table 1

PHYSICAL PROPERTIES OF DENIM FABRICS				
Code	Fabric 1 (F_1)		Fabric 2 (F_2)	
Composition, %	100 cotton		98.5 cotton-elastane	
Yarn linear density, tex	warp weft	76.5 57.1	warp weft	71.4 47.6
Warp-weft/cm	25–20		27–20	
Weight. g/m^2	349.0		328.1	
Weave	3/1 twill			

Table 2

FABRIC CODES ACCORDING TO THE APPLIED FINISHING PROCESSES [1]			
Fabric codes	Special treatments	Washing types	Bleaching
0 (raw fabric)			
1 (S)	sanding	–	–
2 (R)	–	rinse	–
3 (S + R)	sanding	rinse	–
4 (S + R + E)	sanding	rinse + enzyme	-
5 (S + R + Std)	sanding	rinse + stone (dark*)	–
6 (S + R + Stl)	sanding	rinse + stone (light**)	–
7 (S + R + Std + Bd)	sanding	rinse + stone (dark)	bleach (dark*)
8 (S + R + Std + Bl)	sanding	rinse + stone (dark)	bleach (light**)
9 (S + R + E + Bd)	sanding	rinse + enzyme	bleach (dark)
10 (Re)	resin	–	–
11 (Re + S)	resin + sanding	–	–
12 (Re + St)	resin	stone	–
13 (Re + E)	resin	enzyme	_

* was obtained in 10 minutes
** was obtained in 30 minutes

Table 3

DETAILS OF THE FINISHING PROCESSES		
Finishing treatments	Conditions	Obtained effects
Sanding	*Nature:* Manual *No of sand paper:* 220	Natural worm look
Resin treatment	*Nature of product:* Garmon Legaflex Nkr 130°C, 20 minutes	3D, crinkled look
Rinse washing	*Recipe of the treatment:* 50 g/20 lt (Dystar Rotta Amylase 188 RT) *Washing:* 60°C, 15 minutes *Drying:* 80°C, 15 minutes	Removal of size
Enzyme washing	*Recipe of the treatment:* 100 g enzyme/20 lt (Real Stone BJK) 60°C, 15 minutes	Worn look, soft hand
Stone washing (dark and light)	*Recipe of the treatment:* 5 g/lt Stone enzyme (Dystar Rotta Amylase 188 RT) *Washing:* 16 kg (1:2) pumice stone/80 lt dye bath 40°C, 10 minutes (dark), 30 minutes (light)	Destroyed/ worn look
Bleaching (dark and light)	*Recipe of the treatment:* 500 g (1:6) sodium hypochlorite 10 minutes (dark), 30 minutes (light)	Fading, color shades

and special treatments on breaking and tear strength results of different denim fabrics [9]. Radetic et al. [10] observed the change in fiber morphology and strength loss in fabric during decolorization by low-pressure RF plasma and atmospheric pressure industrial corona. Heikinheimo et al. [11] investigated effects of different cellulase enzyme types on color change of denim fabrics (by objective reflectance measurements and subjective evaluations). Özdemir [12] investigated usability of different eco-friendly bleaching techniques for denim products such as ozone, UV/peroxide combination, and enzyme washing with laccase to solve problems such as dimensional stability, color change and yellowing. Ondogan et al. [13] studied effects of laser application on abrasion resistance, strength and elongation characteristics of denim fabric.

The purpose of this study is to determine influences of material and some selected washings and special treatments carried out under industrial conditions on physical properties, breaking and tear strengths besides breaking elongation values and hand evaluation results of denim fabrics. Hand evaluations were carried out as hand has a critical influence on consumer preferences besides mechanical properties influencing performance of the product. Two different materials (100% cotton and 98.5–1.5% cotton-elastane) were used to weave 3/1 twill denim fabrics and mentioned finishing processes were applied systematically on sewn jeans products to see effects of individual applications clearly. It is thought that results will be beneficial for scientists conducting studies on denim finishing. Moreover, results may guide jeans producers in selecting the optimum application for worn-look, different tactile or aesthetic effects creating minimum deterioration on the product.

MATERIALS AND METHODS

Material preparation

Jeans produced from 100% cotton (F_1) and 98.5–1.5% cotton-elastane (F_2) fabrics having 3/1 twill weave and identical physical properties were selected as the test group (table 1). Six different washings, commercially used three different special treatments and two different bleaching treatments constituted the process combinations applied on sewn trouser parts. Table 2 shows fabric codes according to the applied washing, special treatment and bleaching processes. As seen in table 2, selected mechanical or chemical finishes were applied separately or in combinations on jeans samples. The experimental plan is a fractional factorial design as commonly used finishing processes were included in the test plan. Process conditions of the applied finishing processes and obtained effects of the processes are summarized in table 3.

Performance tests and statistical analyses

Thickness values of the fabrics were determined according to ASTM D 1777 by James Heal R&B Cloth Thickness Tester with 5 g/cm^2 pressure. Weight losses of the fabrics after finishing applications were determined according to ASTM D3776. Breaking strength and elongation values of the samples were determined according to ASTM 5034-09 (Grab Test) by an Instron Universal Tensile Tester (Model 4411), tear strength was determined according to ASTM D 1424-09 by Falling-Pendulum (Elmendorf-Type) Apparatus by an Elmetear Digital Tear Tester (Model 455). Hand evaluations were conducted with 10 graduate students of textile engineering department with a

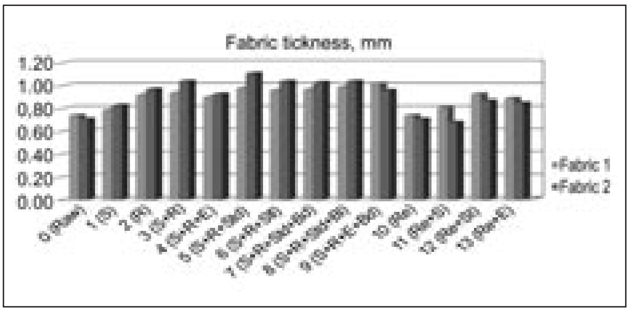

Fig. 1. Effects of finishing processes on thickness value of denim fabrics

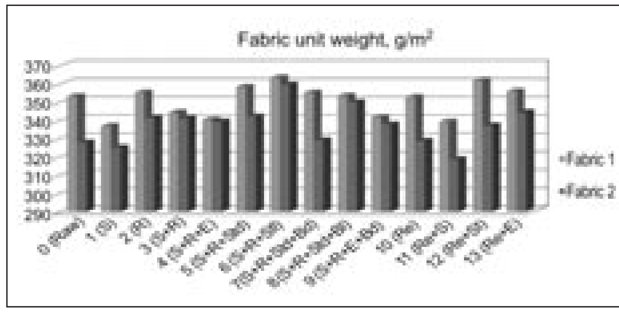

Fig. 2. Effects of finishing processes on fabric unit weight values of denim fabrics

Table 4

SIGNIFICANCE LEVELS OF FACTOR EFFECT ON MECHANICAL PROPERTIES

Mechanical properties	Main factor groups			
	Washing	Special treatment	Bleaching	Fabric type
Breaking strength (warp)	0.046	0.000	0.401*	0.000
Breaking strength (weft)	0.001	0.021	0.410*	0.000
Breaking elongation (warp)	0.000	0.000	0.101*	0.000
Breaking elongation (weft)	0.000	0.000	0.039	0.000
Tear strength (warp)	0.000 0.000	0.000 0.000	0.015 0.015	0.000 0.000
Tear strength (weft)	0.000	0.000	0.014	0.000

* not significant for $\alpha = 0.05$

5-point rating scale (*1* representing the worst and *5* representing the best hand evaluation result). Subjects were not allowed to see the fabric samples during evaluation for not to be affected from the obtained visual appearances of the fabrics.

SPSS 16.0 Statistical Software was used for statistical analyses of the results. Significance of the basic finishing processes (washing, special treatment and bleaching) and type of the material were tested by MANOVA (multivariate analysis of variance). One-way ANOVA was used for analysis of variance with Tukey's Range Test to investigate significant differences between mechanical properties of fabrics treated with different finishing processes.

RESULTS AND DISCUSSIONS

Different chemical and mechanical finishing processes were applied on sewn trousers woven from two types of denim fabrics (totally 26 samples) and their effects on physical, mechanical characteristics and hand evaluation results were investigated to see the changes in performance characteristics of the products.

Changes in physical properties

Finishing processes applied to create different visual or tactile effects surely destroy the fabric mechanically, chemically or in both ways causing changes in its physical properties. For example, during washing processes, garments are affected by different factors such as washing solution, abrasion, creasing, heat, various chemicals etc. Therefore, intensive destruction of polymers that are the components of fibers takes place and leads to intensive wear of articles [5].

Fabric thickness values differing according to the applied finishing processes are compiled in figure 1. As seen from figure 1, there is an increase trend for the thickness values of denim fabrics as the intensity of the application increase except for the one that was resin treated and produced by resin treatment and sanding (codes *10* and *11*, respectively). Stone washing (light and dark) and stone washing combined with bleaching created the maximum thickness gain.

Weight changes of the fabrics vary in a great range according to the applied finishing processes but there is an increase trend for weight values because of shrinkage occurred after washing processes, especially after stone wash (code *6*) (figure 2). Weight loss is observed after sanding and sanding combined with resin treatment for both material types (codes *1* and *11*). This result is consistent with thickness loss of the same fabrics exposed to an intense mechanical effect.

Changes in mechanical properties

Changes in breaking strength-elongation and tear strength values of the fabrics were measured for each application to determine the degree of damage given to the material. According to MANOVA results, *p*-values showing significance levels of factor effects on each mechanical characteristic are compiled in table 4. As seen from table 4, all factors (finishing treatment groups) have significant effects on mechanical properties of denim fabric except for the effect of bleaching on strength values.

Changes in mechanical properties of fabrics were determined by calculating the differences between raw fabrics and treated samples for two types of fabrics (F_1 and F_2). According to MANOVA results, breaking strength values were affected significantly from the main factor groups except for bleaching as seen in table 4.

Changes in breaking strength values of fabrics according to the applied finishing processes are given in figure 3. According to ANOVA results, breaking strength (*N*) losses in warp direction are statistically significant for the fabrics which were stone washed and bleached after sanding and rinse washing (fabric codes *5*, *6* and *8*). This result confirms preceding study results stating that bleach treatment decreased breaking strength for especially if hard bleach is used [9] and stone wash increased edge deformation [3]. Breaking strength loss of resin treated fabric is not statistically significant for both directions because of the extra strength obtained by resin application. This result does not confirm a preceding study [9] result stating resin

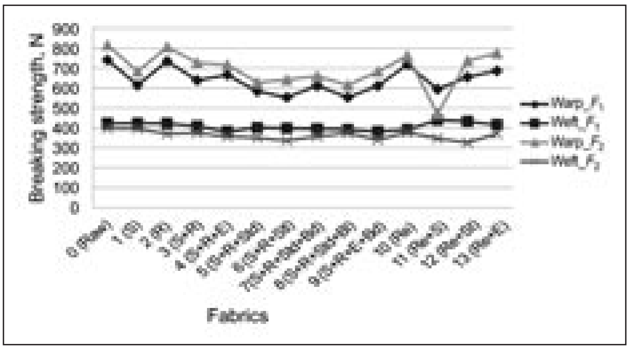

Fig. 3. Effects of finishing processes on breaking strength values (*N*) of denim fabrics

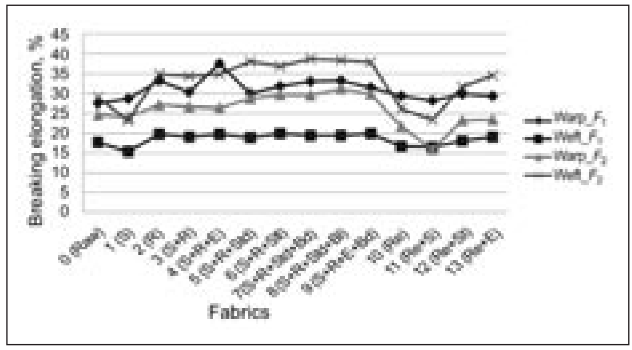

Fig. 4. Effects of finishing processes on breaking elongation values (%) of denim fabrics

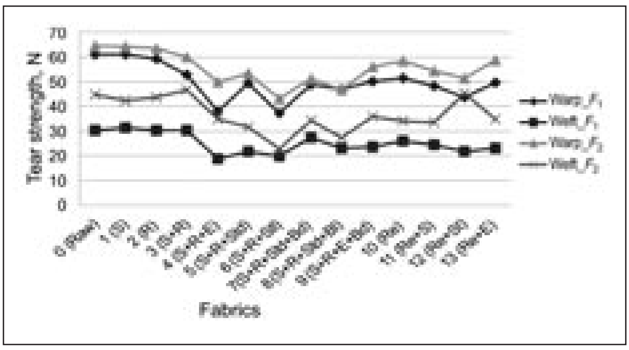

Fig. 5. Effects of finishing processes on tear strength values of denim fabrics

treatment as the most degrading application for mechanical properties (breaking and tear strength results). Although stone and enzyme washings combined with resin treatment (codes *12* and *13*) did not create extra deterioration on the material, sanding conducted after resin treatment (code *11*) created the maximum deterioration on fabric including elastane (*F2*) in warp direction. Breaking strength losses were more apparent for warp direction as the warp yarns are more weakened and worn away than the weft yarns because of 3/1 twill weave of the fabric confirming a preceding study result [9]. The processes especially including mechanical abrasion such as sanding and stone washing are more aggressive for warp yarns that strength loss in warp direction is apparently more than that of weft direction for these processes (fabric codes *1, 5, 6, 7, 8* and *11*). Different finishing processes created more significant differences for the fabric including elastane (F_2). Stone washing and washings carried out after resin treatment (fabric codes *5, 6, 11* and *12*) created significant strength losses for the fabric F_2.

If effects of two types of washings used to create a worn or destroyed look are compared by considering the significance of strength losses, enzyme washing had better results than stone washing for both fabrics in warp direction, meaning smaller damage on the material also when combined with bleaching (codes *4* and *9*). There is a similar trend for enzyme and stone washings for weft direction that stone washing deteriorated, especially the fabric including elastane (F_2). This result does not confirm a preceding study result [9] stating that enzyme damaged the cellulose molecule causing a decrease in mechanical properties.

Different finishing processes generally increased breaking elongation (%) values of denim fabrics except for sanding, resin treatment and their combination (codes *1, 10* and *11*) (figure 4). Increase in elongation values was confirmed by results of a preceding study [5]. Main factor groups (washing, special treatment, bleaching, fabric type) all affected breaking elongation values significantly as seen in table 4. For warp direction, fabric without elastane (F_1) had a significant increase in elongation values after rinse washing combined with sanding and enzyme washing (code *4*). For the fabric including elastane (F_2), breaking elongation increase is more apparent after the applications bleaching combined with stone washing or enzyme washing and stone washing alone (codes *5, 6, 7, 8* and *9*). Breaking elongation increase in weft direction was more differentiated by the applied finishing processes. Increase is more for the fabric including elastane (F_2) than the fabric without elastane (F_1). Stone or enzyme washing combined with bleaching (codes *5, 6, 7, 8* and *9*) created maximum elongation increase for the weft direction confirming the result of this fabric (F_2) for warp direction. Sanding, resin treatment or their combinations (codes *1, 10* and *11*) did not create any elongation increase and they decreased elongation values, especially for the fabric including elastane (F_2). This result can be attributed to the immobilization of the amorphous and flexible zones in the fiber by transverse links of the cellulose cotton that prevents the alignment of the molecular chains and crystallites in the extension direction by resin application [9] besides damage given to the material by abrasion with sand or stone. Increase in elongation as a result of applied treatment-washing combinations may be caused from effects of chemicals on the fiber structures, especially on the structure of elastane.

Fabric tear strength values decreased significantly after most of the applications except for sanding, rinse washing and their combination (codes *1, 2* and *3*) as seen in figure 5. Stone washing in light tones after sanding and rinse washing treatments (code *6*) created the maximum damage in both warp and weft directions. If tear strength in warp direction is considered, enzyme washing, stone washing combined with bleaching in light tones or resin treatment created the maximum tear strength losses (codes *4, 8* and *12*) for both fabrics (F_1 and F_2). Mentioned results show the negative effects of both chemical and mechanical effects included in stone or enzyme washings and sanding on warp yarns of the fabric. Tear strength loss in weft direction had a similar behavior that stone washing in light and dark tones

Table 5

SIGNIFICANCE LEVELS OF TREATMENT EFFECT ON MECHANICAL PROPERTIES OF FABRICS						
Fabric codes	**Breaking strength (warp)**	**Breaking strength (weft)**	**Breaking elongation (warp)**	**Breaking elongation (weft)**	**Tear strength (warp)**	**Tear strength (weft)**
1 (S)				■		
2 (R)				■		
3 (S + R)						
4 (S + R + E)				■	■	■
5 (S + R + Std)	■				■	■
6 (S + R + Stl)	■		■	■	■	■
7 (S + R + Std + Bd)			■		■	
8 (S + R + Std + Bl)	■		■		■	■
9 (S + R + E + Bd)			■	■		
10 (Re)						■
11 (Re + S)					■	■
12 (Re + St)					■	■
13 (Re + E)						■

* Darker cells show significant effects for α = 0.05 for both fabric types (F_1 and F_2)

(codes *5* and *6*) deformed considerably the weft yarns for both fabrics. While enzyme washing (code *4*) created a significant tear strength loss for the fabric F_1, bleaching after stone washing (code *8*) created a similar degree of strength loss for the fabric F_2.

Although resin treatment did not create a significant tear strength loss for warp direction contrary to a preceding study result [9], it decreased the tear strength significantly in weft direction for both fabrics. Regarding the effect of resin treatment, Khedher [9] stated that resin treatment was the most degrading treatment that it reduced breaking and tear strength values to a half. Sanding applied after resin treatment did not create an extra decrease in tear strength values for both fabrics and directions.

Both enzyme and stone washings deformed the fabric significantly for both directions. Damages created by enzyme and stone washings are statistically significant for warp and weft directions. This may be caused from the mechanical damage created by pumice stone in stone washing and surface-active enzymes used for enzyme washing damaging the yarn.

Table 5 summarizes variance analysis results showing significance degree of finishing process effects on mechanical properties of fabrics. Darker areas show significant effects for 95% confidence level for both fabrics. From table 5, the most deteriorating finishing processes for both fabrics (F_1 and F_2) can be seen clearly. Stone washing in especially light tones and its combination with bleaching created the maximum change in mechanical properties of denim fabrics as mentioned in detail before.

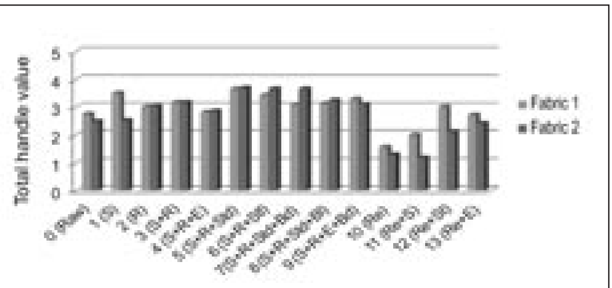

Fig. 6. Effects of finishing processes on hand evaluation results of denim fabrics:
1 is the worst; *5* representing the best hand evaluation result

Changes in hand evaluation results

Hand evaluation results of the fabrics treated with different finishing processes are given in figure 6. As seen from figure 6, there is an increase trend for hand evaluations of fabrics after applications wearing out some of the surface fibers and creating a peached effect (fabric codes *5–9*). The above mentioned structure is obtained after treatments including mechanical effects such as sanding and stone washing. Bleaching also had a positive influence on the previously mentioned softer touch of the fabrics. Additionally, negative effect of resin treatment is also obvious from figure 6, decreasing hand evaluation results because of the film-like surface of the fabric (fabric codes *10* and *11*). Although resin treatment is a popular and commonly used finishing treatment, it did not create a preferred feeling for the respondents according to hand evaluation results. Stone or enzyme washing applications after resin treatment (fabric codes *12* and *13*) cause increment in hand evaluation results to an extent as seen in figure 6.

CONCLUSIONS

Commonly used finishing processes were applied on two kinds of denim fabrics to see their effects on physical, mechanical properties and hand evaluation results of the products, which are crucial for the preference end use performance of the denim products. According to the results, effects of material type and finishing process groups (washing, special treatment and bleaching) on mechanical properties were determined as statistically significant. More detailed conclusions are summarized below:

- Denim fabric thickness increase and weight loss was the maximum for stone washed and bleached fabrics because of mechanical effects raising or wearing out surface fibers.
- Breaking and tear strength values were affected more in warp direction because of 3/1 weave of the fabrics enabling more warp yarns on the surface subjected to mechanical/chemical effects.

- Stone washing combined with bleaching treatments are the most aggressive applications (especially in light tones) when all the mechanical properties are considered because of damage given to the material confirming physical changes of the fabrics.
- If stone and enzyme washings are compared in case of their effects on mechanical properties, it was observed that breaking strength values were not affected significantly from enzyme washing but breaking elongation and tear strength results changed significantly after both stone and enzyme washings.
- Resin treatment did not created a significant breaking strength loss but it decreased tear strength values in weft direction. When sanding is applied after resin treatment, tear and, especially breaking strength values decreased significantly.
- Subjective hand evaluation results were higher after the applications sanding or stone washing, as they wear out some of the surface fibers creating a softer and bulkier surface. Hand evaluations of resin treated fabrics were lower as a result of film-like surface created by resin.

Summing up, among the applications used to obtain worn look and softer hand, enzyme washing can be recommended as an optimum solution creating less deformation on the product, especially for breaking strength. Determination of the optimum finishing process is important as denim finishing is conducted on sewn products and any performance loss will lead to higher economical losses. Although its disadvantages about mechanical properties, stone washing and its combination with bleaching created desirable hand evaluation results. Nevertheless, this is not the case for resin treatment that subjects evaluated resin-treated fabric with lower scores.

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Morphological indicators for characterization of women thorax and basin shape, for garment design in customised system

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REZUMAT – ABSTRACT – INHALTSANGABE

Indicatori morfologici de caracterizare a formei toracelui și a bazinului la femei, pentru proiectarea îmbrăcămintei în sistem individual

La confecționarea îmbrăcămintei în sistem individual, legătura dintre proiectant și utilizator este cel mai frecvent directă, proiectantul având posibilitatea să preia de pe corpul clienților acele mărimi antropometrice care sunt relevante pentru tipul de produs și absolut necesare pentru proiectarea modelului. În scopul caracterizării conturului corpului în plan frontal și în plan anteroposterior, se utilizează corelația dintre diametrul frontal și cel anteroposterior, măsurate la nivelul bustului și al șoldurilor, pentru a evalua caracterul și modul de repartizare a acestor mărimi în cele două planuri menționate. Cercetarea formei corpului în plan frontal, prin intermediul indicatorilor D_1 și D_2, a demonstrat că selecția luată în studiu se poate încadra la tipul echilibrat, deoarece valorile medii calculate au rezultat în intervalul recomandat în literatura de specialitate, pentru acest tip.

Cuvinte-cheie: indicatori morfologici, populație feminimă, îmbrăcăminte, sistem individualizat

Morphological indicators for characterization of women thorax and basin shape, for garment design in customised system

In the manufacture process of clothing in the customised/individual system, the pattern designer and the user connection is most often direct and the designer can measure directly on the body those anthropometric dimensions relevant to the type of product and absolutely necessary for the model design. In order to characterize the body contour in frontal and anterior-posterior plane the correlation between frontal and anterior-posterior diameter is used, measured at the bust and hips levels, to assess the distribution of these quantities in the two plans mentioned. Research on body shape through indicators D_1 and D_2, showed that the studied selection may fit as balanced type because average values have resulted in the recommended range calculated in the literature for this type.

Key-words: morphological indicators, female population, garment, customised system

Morphologische Indikatoren für die Formbeschreibung des Brustkorbes und der Hüfte bei Frauen für den Entwurf der Bekleidung im massgeschneiderten System

Bei der Bekleidungsherstellung im massgeschneiderten System ist die Beziehung zwischen Entwerfer und Endbenutzer meistens direkt, indem der Entwerfer die Möglichkeit besitzt, vom Kunden die bestimmten anthropometrischen Körpermassen zu übernehmen, welche relevant für den spezifischen Produkttyp und absolut notwendig für den Modellentwurf sind. Für die Charakterisierung der Körperlinie in Vorderansicht und Hinteransicht wird die Korrelierung zwischen Vorderdurchmesser und Seitendurchmesser, gemessen auf Höhe der Büste und Hüfte, für die Bewertung des Charakters und der Verteilung dieser Grössen auf den beiden erwähnten Ansichten angewendet. Die Untersuchung der Körperform in Vorderansicht, durch die Indikatoren D_1 und D_2 bewies, dass sich der analysierte Bereich im Typus Gleichgewicht eingliedert, weil die berechneten Mittelwerte dem vorgeschriebenen Intervall der Fachliteratur für diesen Typ angehören.

Stichwörter: morphologische Indikatoren, weibliche Bevölkerung, Bekleidung, massgeschneidertes System

Clothing products must meet the complex requirements as expressed by users. Among them the dimensional correlation and form of the body and clothing products contribute substantially to ensuring the normal state of comfort during wearing the product and at the same time is the determining factor in purchasing the product by users [1, 2, 3, 4].

Currently, in our country and around the world, two important systems of clothing manufacturing coexist:
- clothing manufactured in the industrial system;
- clothing manufactured in the customised system.

For clothing manufactured in the industrial system, the information required in pattern design are offered by normative acts that reflect morphological features of the population that will wear the garments. In this production system the clothing is developed for standard body types, recommended by the dimensional typology available at the moment.

Research carried out by marketing experts have shown that frequently, industrial manufactured products, at a high level of quality, have long periods of stagnation in the shops because they do not meet the demand in terms of dimensional correlation. It appears that many clients are outside from the standard sizes used for pattern design in the industrial system. On trying the industrial products by clients that deviate from posture, proportions and standard conformation, inadequate phenomena appear between the body and the garment manifested by the appearance of surface bumps (folds) and limiting the movement of body segments. It's about reducing aesthetic and functional requirements with negative repercussions on the purchase application, which is reduced considerably.

In the manufacture process of clothing in the customised/individual system, the pattern designer and the user connection is most often direct and the designer can measure directly on the body those anthropometric dimensions relevant to the type of product and absolutely necessary for the model design. In these circumstances clothing match the customers wishes, but the manuafacture has higher costs. Since clothing companies currently have requests to produce models after specific dimension tables from different clients, it is necessary to make the pattern design process more flexible by developing and storing information on the morphological characterization of the human body. The innovative alternative is the 3D scanning of body anthropometric investigation, modern technology which provides a large amount of information about subjects

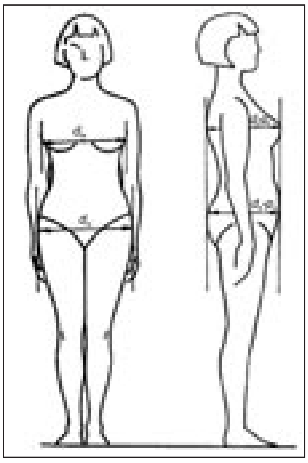


Fig. 1. Diameters measurement

body sizes, information that allows improvement of clothing design in the customised system.

Designing the system requires individual clothing anthropometry research directed towards the morphological knowledge of indicators that characterize the shape and dimensions of the subjects investigated.

In this context, the paper has resolved the following objectives:

- research on proportions in the anterior-posterior and transverse plane at the bust and hips levels, through the diameters analysis that characterizes the upper and lower body for women;
- characterization of the complex shape of women thorax, by introducing a global indicator, called the thorax shape *Ft*, which reflects the link between its development in the anterior-posterior and transverse plane.

EXPERIMENTAL CHARACTERIZATION OF WOMEN PROPORTIONS

In order to characterize the body contour in frontal and anterior-posterior plane the correlation between frontal and anterior-posterior diameter is used, measured at the bust and hips levels, to assess the distribution of these quantities in the two plans mentioned.

Figure 1 shows the way of measuring the diameters by the direct method of measuring human body:

- df_b – front diameter of the bust, size is measured as projection dimension between two verticals drawn through axillary points;
- $df_ș$ – front diameter of the hips, measured as projection dimension between tangents drawn at the most prominent contour of the hips;
- d_a-p_b – anterior-posterior diameter of the bust, measured as projection dimension between the tangent drawn on shoulder blade prominence and the tangent drawn on bust prominence;
- d_a-$p_ș$ – anterior-posterior diameter of the hips, measured as projection dimension between the tangent drawn on buttocks prominence and the tangent drawn on abdomen prominence.

On the basis of specified diameters, the indicators may be established for comparing development in the frontal plane body (front) and anterior-posterior, the bust and hips.

Table 1

AVERAGE VALUES DIAMETERS STUDIED

Age groups	d_{fb}, cm	$d_{fș}$, cm	$d_a - p_b$, cm	$d_a - p_ș$, cm
20–60 years	28.97	35.5	26.49	28.95
20–29 years	27.7	34.4	24.60	26.50
30–44 years	28.7	35.40	25.9	28.70
45–60 years	30.0	36.3	28.1	30.70

Characterization of body shape in the frontal plane was done by placing the indicator D_1, and in the anterior-posterior plane by introducing indicator D_2, for which the literature [5] proposed the following relationships (1) and (2) for calculation:

$$D_1 = df_ș - df_b \quad (1)$$

$$D_2 = d_a\text{-}p_ș - d_a\text{-}p_b \quad (2)$$

To evaluate and compare the body development level in the anterior-posterior plane and in the frontal plane indicators D_1 and D_2 were calculated, with the aforementioned relations.

By introducing the D_1 indicator the body shape is classified as three body types, after the average values calculated [5], as follows:

– superior type, $D_1 < 4.9$ cm;
– balanced type, $D_1 = 5–7$ cm;
– inferior type, $D_1 > 7.1$ cm.

By introducing the D_2 indicator the body shape is classified as three body types, after the average values calculated [5], as follows:

– superior type, $D_2 < 0$ cm;
– balanced type, $D_2 = 0$ to 2 cm;
– inferior type, $D_2 > 2.1$ cm.

Research on global characterization of body shape and its projection in the anterior-posterior and sagittal plane, with indicators D_1 and, respectively, D_2 was performed on total selection and subsections classified on age.

The research was developed using primary data obtained by measuring anthropometric sizes necessary for the study on a selection with a volume of n = 300 women aged between 20 and 60 years in urban areas. The anthropometric sizes were taken by using the direct measurement method, according to the measurement standards available [8].

Based on biological research carried out by specialists, now the adult stage correspond to the chronological age between 20–60 years, thus:

– young age group: 20–29 years;
– average age group: 30–44 years;
– in the age group: 45–60 years.

Evaluation of body shape by indicators D_1 and D_2, calculated with the formulas (1) and (2) was preceded by calculation of statistical parameters for diameters within the specified account relationships.

Table 1 shows the average values calculated for these diameters, the total selection and the selection up by age. Dimensional statistical results of primary data, the average values allow the following considerations:

– for all diameters analyzed there is no significant difference between the average obtained on total selection and sub selection formed by age;

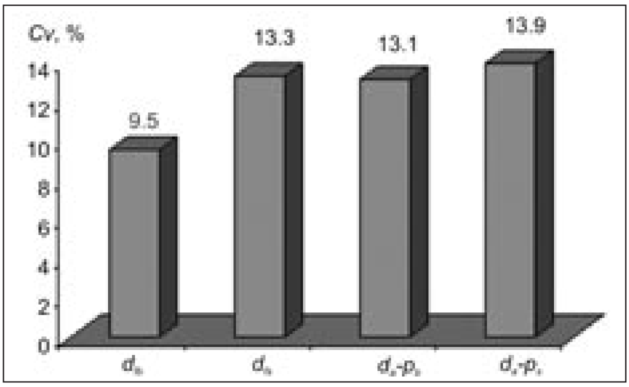


Fig. 2. Values for coefficient of variation, the overall selection, for diameters under study

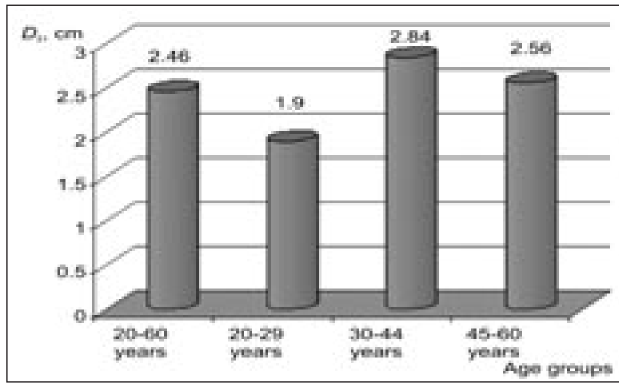


Fig. 4. The average values of indicator D_2, by age group

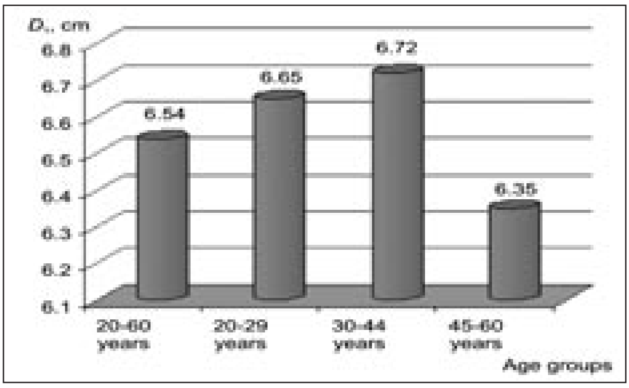


Fig. 3. The average values of indicator D_1, by age group

Table 2

TYPES OF BODIES STUDIED SELECTION

Indicator D_1	Age groups			
	20–60 years	*20–29 years*	*30–44 years*	*45–60 years*
Superior type, $D_1 < 4.9$ cm Balanced type, $D_1 = 5 \div 7$ cm Inferior type, $D_1 > 7.1$ cm	$D_1 = 6.54$ cm balanced type	$D_1 = 6.65$ cm balanced type	$D_1 = 6.72$ cm balanced type	$D_1 = 6.35$ cm balanced type
Indicator D_2	*20–60 years*	*20–29 years*	*30–44 years*	*45–60 years*
Superior type, $D_2 < 0.0$ cm Balanced type, $D_2 = 0.1 \div 2$ cm Inferior type, $D_2 > 2.1$ cm	$D_2 = 2.5$ cm inferior type	$D_2 = 1.9$ cm balanced type	$D_2 = 2.8$ cm inferior type	$D_2 = 2.6$ cm inferior type

– all recorded diameters larger differences (between 2.3 cm and 4.2 cm) between the average values obtained for young women (age group 20–29 years) and older women (45–60 age group), because elderly women perimeters larger values can be explained by greater development of adipose tissue and its distribution mainly on the chest and pelvis.

Evaluation of body shape by indicators D_1 and D_2, calculated with the formulas (1) and (2) was preceded by calculation of statistical parameters for diameters within the specified account relationships.

Table 1 shows the average values calculated for these diameters, the total selection and the selection up by age. Dimensional statistical results of primary data, the average values allow the following considerations:

– for all diameters analysed there is no significant difference between the average obtained on total selection and sub selections formed by age;
– all recorded diameters larger differences (between 2.3 cm and 4.2 cm) between the average values obtained for young women (age group 20–29 years) and older women (45–60 age group).

There were examined the variability of diameters studied, the comparative values of the coefficient of variation, *Cv*, are shown in figure 2. The analysis of this figure shows that the lowest variability presents a trunk diameter of the front (high homogeneity whereas $Cv <$ 10%). Other diameters are characterized by average uniformity because they are more influenced by the degree of muscle development and fat deposition.

Indicators D_1 and D_2 were calculated to assess the variability of statistical parameters, mean that total and resulted in the selection set selection by age is shown in figure 3 and figure 4.

Based on information from the literature [5, 6], after calculating the statistical parameters, to achieve compliance huge selection types studied, reflecting the body development in the foreground, the indicator D_1, respectively in anterior-posterior plane, the indicator D_2. Results presented in table 2.

Looking at table 2 shows the following data:

- the transverse plane between the two diameters ($d_{tş}$ and d_{tb}) there is a difference, D_1, that characterize a balanced development, harmonious body at all age groups;
- values averaged over the entire selection, D_2 demonstrates indicator that women tend to type the lower transverse plane on which development is achieved at the expense of fat deposits mainly on the hip region, on the side of the body;
- D_2 indicator values show that only young women fall to as balanced, the development of anterior-posterior plane torso from the bust and hips is comparable values.

It was considered necessary to investigate, for the selection made in the study, which is the tendency of subjects to the occurrence of body types that have resulted from introduction of indicators D_1 and D_2.

To this end we studied the relative frequency of simultaneous two-dimensional distribution of the indicators characterizing the foreground body shape, D_1, and anterior-posterior or sagittal plane D_2, the results are presented in table 3. Table 3 shows the following:

Table 3

SIMULTANEOUS TWO-DIMENSIONAL DISTRIBUTION OF THE INDICATORS CHARACTERIZING BODY SHAPE IN THE FRONTAL PLANE D_1 AND ANTERIOR-POSTERIOR D_2

Body shape in the frontal plane – D_2, cm	**Body shape in sagital plane – D_2, cm**			
	Bust zone development/ Superior type	Normal development in the hip and bust zone/ Balanced type	Hip zone development/ Inferior type	**Total**
	$D_2 < 0$	$D_2 = 0 \div 2$	$D_2 > 2$	
Bust zone development/ Superior type $D_1 < 4.9$	3.9%	5.7%	9.3% (V)	18.9
Normal development in the hip and bust zone/ Balanced type $D_1 = 5 \div 7$	5.7%	14.7% (III)	22.4% (II)	42.8%
Hip zone development/ Inferior type $D_1 > 7.1$	5.6%	9.4% (IV)	23.3% (I)	38.3%
Total	15.2%	29.8%	55.0%	100%

- the highest frequency of occurrence among the selection are bodies that have investigated a more developed area of the basin, compared to the torso, both in front and in the anterior-posterior plane (23.3%, variant *I*);
- 22.4% of subjects have a balanced development between the trunk and pelvis, in the foreground, while a development of the basin area, higher than that of the torso, the anterior-posterior plane (variant *II*);
- only 14.7% of investigated subjects covered by the balanced type, both in transverse and horizontal anterior-posterior (variant *III*).

In characterizing the body shape as footrest clothing products, the experts [7, 8, 9] attaches great importance to form the thorax. Figure 5*a* presents rib skeleton (which determines decisively shape thorax) and outline its section chest from a transverse plane, drawn over the bulging chest and shoulder blades. This section is characterized by transverse diameter d_{ttor} anterior-posterior diameter, d_a-p_{tor}). Due to the shape of the chest and skeletal muscle, fat deposition and development of mammary glands in women, the relationship between the two diameters can be used in assessing the general shape of the thorax.

Table 4

THE STATISTICAL PARAMETERS CALCULATED FOR THE INDICATOR F_t

Parametri statistici	**Age groups**			
	20–60 years	***20–29 years***	***30–44 years***	***45–60 years***
X med., cm	10.08	10.61	9.72	9.81
Standard error	0.11	0.15	0.20	0.21
Median, cm	10.30	10.70	9.80	10.00
Module. cm	9.50	9.10	10.30	10.70
Deviation S_x, cm	2.78	2.31	2.73	3.18
Dispersion S_x^2, cm	7.72	5.33	7.45	10.08
Coefficient asymmetry	1.37	0.36	0.09	1.69
Coefficient asymmetry	–0.45	–0.05	–0.29	–0.53
Amplitude, cm	25.00	13.70	15.20	25.00
X min., cm	–4.20	3.60	1.80	–4.20
X max., cm	20.80	17.30	17.00	20.80
Volume of selection	675.00	252.00	189.00	234.00
Coefficient of variation *Cv*, %	27.55	21.77	28.08	32.38
Test average selection, $t\bar{x}$	3.63	4.59	3.56	3.09

In the specialty literature [7, 11, 12], where the ratio of two diameters are considered three basic forms:

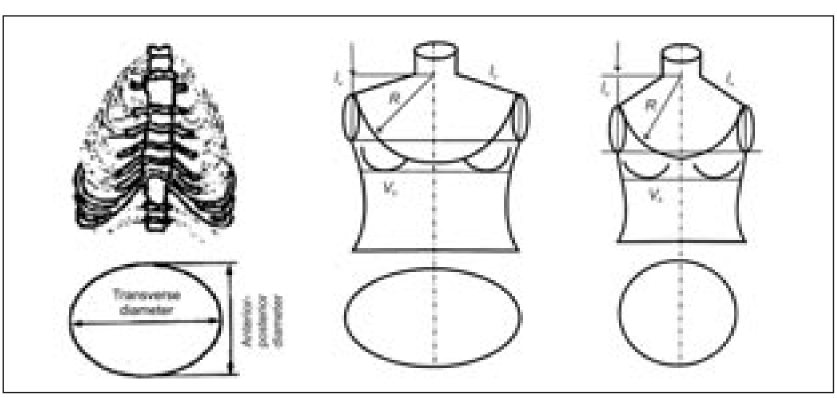
- normal chest with balanced development in the anterior-posterior and transverse plane, with $d_{ttor} > d_a$-p_{tor};
- elliptical-shaped thorax (chest flattened), is characterized by higher values d_{ttor} compared with those of normal chest;
- chest circular development is characterized by an almost identical in the two planes, transverse and anterior-posterior.

In figure 5*b* presents the elliptical thorax and figure 5*c* the circular thorax. Frontal plane view of the chest and upper torso to provide information on indicators that are influenced by the shape dimensional chest:

– shoulder slope;
– bust peak position;
– chest width;
– shoulder length;
– the points previous axillary;
– nipple distance between points.

Thus, for the flat chest:

– shoulder angle is low values (high shoulder position);



a *b* *c*

Fig. 5. Basic forms of the thorax; *a* – normal chest; *b* – thorax elliptical (flattened); *c* – circular thorax

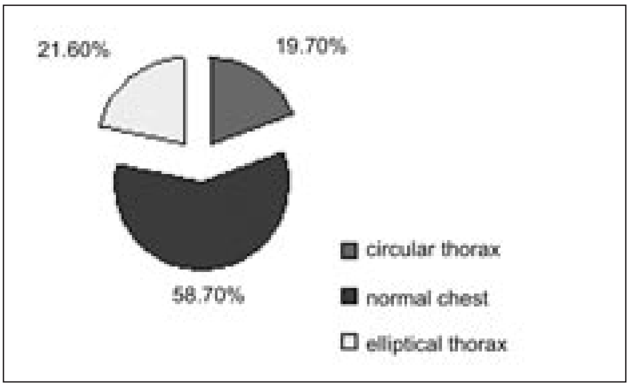


Fig. 6. Relative frequency of subjects in the basic forms of chest

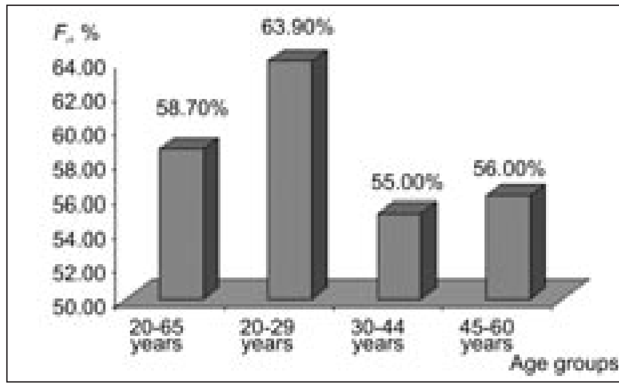


Fig. 7. Relative frequency of subjects showing normal shaped chest

- axillary points earlier projection nipple and shoulder blades have a higher position, compared with those of normal-shaped chest;
- flattened behind;
- bust width increased.

It should be noted that in the literature [13, 14] are presented mean values and variation limits for the three basic shapes of the thorax.

To examine the chest was introduced as an indicator, called the thorax form, F_t, calculated with the equation (3):

$$F_t = d_{ttor} - d_a - p_{tor} \quad (3)$$

For the indicator F_t, the variability was studied by statistical one-dimensional analysis, and the total selection on age sub selections up results are presented in table 4.

The statistical parameters presented in table 4 demonstrate the following:

- average values, the overall selection and are very close sub selections but minimum and maximum values recorded sub selections lead to a high amplitude group of older women, equal to the total registered and selection, the age variability drupe F_t is the biggest indicator, which is reinforced by *Cv* value is the highest (32.4%) and expressing a high variability of this indicator studied;
- for all age groups showed that subjects with balanced development in the thorax transverse and anterior-posterior plane, but persons of middle age and old F_t indicator average is less than the average for the entire selection can be talk to an appearance in this case higher in these age groups to the chest of a circular shape;
- *CV* on total selection and demonstrates a high variability sub selections F_t indicator;
- the entire selection and sub selection arithmetic averages are statistically significant in the report, this statement is based on t test response to that is yes in all cases ($t > t(P, f)$, $t(P, f) = 1962$), in these circumstances selection can estimate the average arithmetic mean μx right to the whole population from which selection was extracted under study.

The bases of selection (*X* avg.) *Sx* parameter and information from the literature [2] established the field will range for the subjects with normal chest (*FTN*) to the relationship (4):

$$FTN = X_{ft} \pm S' x F_t \quad (4)$$

where:

X_{ft} = average value, the overall selection, the indicator F_t;

$S' x F_t$ = limit of detection is calculated with the equation (5):

$$S' = 0.8 S x F_t F_{it} \quad (5)$$

$S x F_t$ = standard deviation of survey for F_t.

Using the reasoning presented above have established the following definition for classifying chest areas, based on indicator F_t:

- chest of circular form, $F_t < 7.9$ cm;
- normal chest, $F_t = 10 \pm 2$ cm (8 to 10 cm);
- chest of elliptical (flattened), $F_t > 10.1$ cm.

The selection made in the study was an analysis of the frequency of subjects meeting the three forms of chest: chest circular (t_{circ}), normal chest (t_n) and flattened thorax (t_{aplt}). Figure 6 presents graphically the relative frequency of selection of subjects in total in the three types of chest. From this figure shows that the most complete selection of subjects in the thorax with a transverse and balanced development of the anterior-posterior (normal chest) but that the overall selection of subjects there were flattened thorax (21.6%) and subjects with circular thorax (19.7).

He did an analysis and the relative frequency (f_i) of subjects meeting, the total selection and sub selections up the age groups in the same type of form of thorax, where the indicator F_t.

Figure 7 shows graphically the relative frequency of subjects meeting thorax normal form. It is seen from figure 7 that middle-aged women and older have lower percentage than the normal form thorax young women. This is explained by the rounded shape of the thorax due to deposits of fat, specific to these age groups.

Figure 8 shows graphically the relative frequency of subjects meeting circular thorax. It is seen from this figure that the middle-aged women and older have higher percentage of women than thorax circular couples. This is explained by the rounded shape of the thorax due to deposits of fat, specific to these age groups.

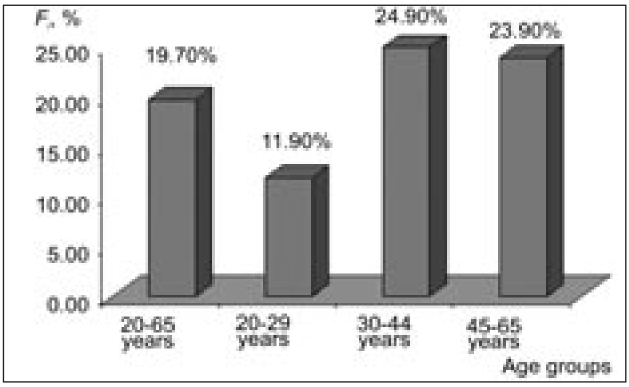


Fig. 8. Relative frequency of subjects showing circular shaped chest

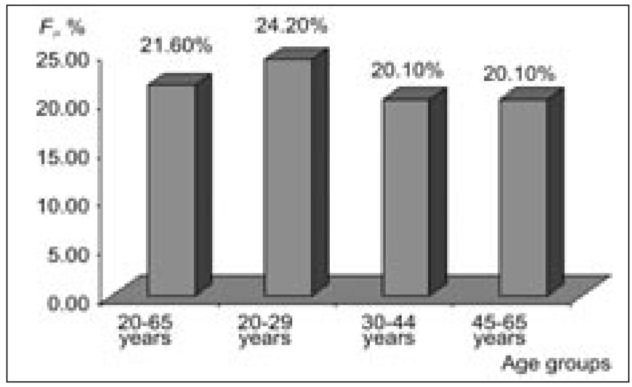


Fig. 9. Relative frequency of subjects who have chest flattened shape

Figure 9 graphically presents the relative frequency of subjects meeting thorax flattened shape. It is seen from this figure that for this form of the thorax showing both the relative frequency and the total selection sand sub selections similar values, which is explained as follows: the shape of the thorax is most influenced by the shape of the rib cage, so the skeleton, which found not significantly different from one age group to another.

CONCLUSIONS

Research body shape in the frontal plane through D_1 indicator, showed that the selection made in the study may fall to as balanced because average values have resulted in the recommended range calculated in the literature for this type.

Research body shape in anterior-posterior plane through the indicator D_2 demonstrated after comparison with similar results provided by literature, that only young women age falls to as balanced. Women in other age groups are type inferior, the development of anterior-posterior body plan in these women is higher in the hips than the bust area, compared with development same region but in young women. It should be noted that the shape of the body in frontal and anterior-posterior, measured by the indicators proposed, D_1 and, respectively, D_2 the results as having an above average variability, which is explained by the influence of these two body regions, thorax and pelvis, a combination of factors among which include: the development of rib bones and pelvic region, muscle development, distribution and degree of development of adipose tissue. These are combined with each other anthropometric character differently from one person to another and this determines the variability of body shape among populations.

The selection of subjects studied showed that the thorax with a transverse and balanced development in the anterior-posterior, but middle-aged people and older average F_t indicator is less than the average recorded over the entire selection. This result leads to the conclusion that these age groups thorax is circular.

The results of this study provides useful information in sizing patterns clothing products based on two constructive lines, bust line, hips that line, taking into account the actual shape of the body.

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DOCUMENTARE

Confecții

MATERIALE TEXTILE 3D DESTINATE ÎNCĂLȚĂMINTEI PENTRU ALPINIȘTI

Alpinismul extrem este un sport desfășurat în condiții foarte dure, de aceea necesită un echipament cu caracteristici excepționale de performanță. La înălțimi de peste 7 000 m, când nivelul de oxigen și presiunea atmosferică scad, mersul devine extenuant. Temperaturile scăzute de până la –50°C, furtunile violente și vântul rece scad rapid temperatura corpului, punând în pericol viața alpiniștilor.

Producătorii de echipamente sportive fac eforturi constante pentru a perfecționa acest sortiment de articole. Bocancii *Batura 2.0 Gore-Tex* sunt un exemplu al noului tip de încălțăminte, cu caracteristici funcționale superioare. Aceștia au o greutate redusă, ambii bocanci cântărind doar 1 800 g, sunt impermeabili și respirabili 100% și izolează împotriva frigului mai bine decât oricare dintre variantele anterioare.

Batura 2.0 Gore-Tex posedă caracteristici optime de performanță, datorită unui design sofisticat.

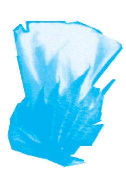
Bocancul este realizat din 11 straturi de materiale diferite, care interacționează între ele, creând caracteristici funcționale excepționale, de exemplu: poliamida Cordura este folosită pentru exteriorul bocancului, conferind un înalt nivel al rezistenței la abraziune, stratul din Gore-Tex ține umezeala la distanță și asigură atât respirabilitate în interiorul încălțămintei, cât și protecție împotriva frigului, iar stratul din tricot elastic asigură protecția membranei funcționale.

Pentru a asigura o protecție optimă, spuma de polietilenă cu diferite densități este combinată cu o structură textilă 3D, tip rețea. De asemenea, gulerul din interiorul bocancului are o răscroială în secțiunea călcâiului și este realizat dintr-un tricot din urzeală, relativ dens, cu tușeu moale, care oferă o bună amortizare, fiind un suport eficient pentru picior.

Celelalte inovații specifice includ: o talpă interioară din carbon, tip fagure tridimensional – care oferă o bună etanșeitate, fermoare impermeabile și o talpă exterioară din Vibram, care absoarbe șocurile.

Batura 2.0 Gore-Tex și-a demonstrat deja trăsăturile excepționale de performanță într-o probă practică de teren: 40 de ghizi montani au testat bocancii high-tech, pe o distanță de 166 km, în Centrul Olimpic Planica, din Slovenia.

Kettenwirk Praxis, martie 2011, nr. 3, p. 11



Effect of yarn twist and loop length on the dimensional characteristics of plain weft knitted fabrics made from spun viscose ring spun yarns

SAKTHIVEL J. C. ANBUMANI N.

REZUMAT – ABSTRACT – INHALTSANGABE

Influența torsiunii firului și a lungimii firului din ochi asupra caracteristicilor dimensionale ale tricoturilor plane din bătătură, obținute din fire de viscoză, filate cu inele

În lucrare au fost studiate proprietățile dimensionale ale tricoturilor plane din bătătură, realizate din fire de viscoză, filate cu inele. Din analizele efectuate s-a constatat că atât torsiunea firului și lungimea firului din ochi, cât și tratamentele de relaxare, influențează caracteristicile dimensionale ale tricotului, obținut din fire filate de viscoză. Torsiunea structurii celulare a tricotului este direct proporțională cu gradul de răsucire în spirală a firului de viscoză, filat în diferite stări de relaxare. Efectul torsiunii indică un coeficient de corelare mai bun în cazul tricoturilor complet relaxate. Desimea ochiurilor, forma buclei și gradul de tensionare sunt dependente, în principal, de lungimea firului din ochi. S-a constatat un efect redus asupra torsiunii firului în cazul diverselor stări de relaxare a tricoturilor realizate din fire filate de viscoză. Cele mai mici valori ale modificării formei buclei în funcție de gradul de torsiune a firului s-au constatat în stare de relaxare totală, datorită faptului că buclele s-au relaxat treptat, trecând de la relaxarea în stare uscată la relaxarea totală, în cazul unor valori minime ale energiei interne.

Cuvinte-cheie: stabilitate dimensională, constante dimensionale, tricot, lungimea firului din ochi, tratamente de relaxare, fir filat de viscoză, torsiunea firului

Effects of yarn twist and loop length on the dimensional characteristics of plain weft knitted fabrics made from spun viscose ring spun yarns

In this study the dimensional properties of plain weft knits made from spun viscose yarns have been investigated. The analysis reveals that yarn twist and loop length as well as the relaxation treatment influences on dimensional characteristics of spun viscose weft knitted fabrics. Twist in structural knit cell (TISL) is linearly correlated with spirality of spun viscose fabrics in all states. The effect of TISL shows better correlation coefficient at fully relaxed knits. Stitch density, loop shape factor and tightness factor has been mainly dependent on loop length and little effect on the yarn twist in all the states of spun viscose knitted fabrics. The lower values of loop shape factor with respect to yarn twist in fully relaxed states are due to the gradual relaxation of loops from dry relaxation states to full relaxation states and reaches with minimal internal energy.

Key-words: dimensional stability, dimensional constants, knitted fabric, loop length, relaxation treatments, viscose spun yarn, yarn twis

Auswirkung der Garnumwindung und der Maschenlänge auf die dimensionellen Eigenschaften der Flachschussgewirke gefertigt aus ringgesponnenen Viskosegarne

In der Arbeit wurden die dimensionellen Eigenschaften der Flachschussgewirke aus ringgesponnenen Viskosegarne untersucht. Aus den durchgeführten Analysen wurde festgestellt, dass die Garnumwindung und die Maschenlänge, als auch die Erholungsbehandlung, die dimensionellen Eigenschaften des Gewirkesaus gesponnenen Viskosegarne beeinflusst. Die Umwindung der Gewirkeinheitsstruktur (TISL) ist im direkten Verhältniss mit dem Spiralverhalten des Viskosegarnes in unterschiedlichen Erholungszuständen. Die Auswirkung der TISL-Umwindung zeigt eines besseren Korrelationskoeffizient im Falle der völlig erholten Gewirke. Die Maschendichte, die Maschenform und die Maschenwarendichte sind hauptsächlich von der Maschenlänge abhängig und haben eine geringe Auswirkung auf die Garnumwindung in allen Zuständen des Viskosegewirkes. Die geringsten Werte der Maschenform mit Berücksichtigung der Garnumwindung wurde im völlig erholten Zustand festgestellt, dank der stetigen Erholung der Maschen vom trockenen Zustand in völlig erholtem Zustand und wurde mit minimaler interner Energie erreicht.

Stichwörter: Dimensionelle Stabilität, Dimensionelle Konstanten, Gewirke, Maschenlänge, Erholungsbehandlungen, Viskosegarne, Garnumwindlung

Consumers consider the dimensional change in a garment to be a critical performance characteristic. The excessive dimensional change of a garment can make that item unwearable. The significance of the problem has been investigated by several researchers [1–13].

Munden and Doyle investigated the dimensional properties of wool and cotton knitted fabrics and predicted that the length of the yarn in the knitted loop plays a major role in determining the dimensions of a knitted fabrics.

Knapton has also studied the dimensional properties of wool knitted fabrics and concluded the importance of K values on the dimensional properties.

Sharma has studied the dimensional properties of acrylic knitted fabrics and concluded that the fabrics made from different yarns and counts, the course/inch and wales/inch vary inversely with the length of yarn knitted into the stitch.

Fletcher reported that, shrinkage in area of all of the viscose knitted gray fabrics and of the finished viscose fabrics increased with knitting stiffness. Parmar reported that, efforts are being made to make a knitted fabric more comfortable by changing the fibers, yarn parameters (twist, bulk, count and finish), knitting parameters (courses/in, wales/in, stitch length and fabric weight) and post knitting finishes (enzyme and chemical).

Kaushik has concluded that course/cm, walse/cm and stitch density, do not change with fibre composition or yarn twist but increase appreciably with the increasing tightness factor irrespective of the relaxation treatments for acrylic-viscose rotor spun yarn plain knitted fabrics.

Hearth concluded that tightness factor is an utmost important factor on dimensional stability of cotton/spandex interlock structures. Banerjee reported that the torsional rigidity of cotton hosiery yarn plays a major role along with the yarn thickness in determining the loop dimensions of cotton rib fabrics.

Alaa Arafa Badr was concluded that key yarn related factors influencing knit spirality are spinning systems, yarn bulkiness, fiber arrangement, yarn twist,

Table 1

PROPERTIES OF SPUN VISCOSE YARN				
No. sample	Properties	Yarn *1*	Yarn *2*	Yarn *3*
1	*TM*	3.0	3.5	4.0
2	Nominal count, tex	14.8	14.8	14.8
3	Actual count, tex	14.59	14.96	14.86
4	Tenacity, g/tex	13.77	14.15	14.06
5	Elongation, %	11.27	11.75	10.23
6	*U*, %	12.52	12.84	12.65
7	Imperfections/km Thin places (–50%) Thick places (+50%) Neps (+200%)	 46 50 138	 63 61 208	 49 48 151
8	*CSP*	2235	2174	2273
9	Yrn twist, tpi	20.69	23.10	25.26

twist direction, yarn mechanical properties, yarn count, doubling or plying effects and yarn conditioning. The appropriate twist level of yarn should be chosen in order to enable the optimal UV protection properties and other wear comfort parameters of cotton knitted fabrics. The amount of yarn twist affects the wicking rate of cotton interlock weft knitted fabrics and by increasing the amount twist the wicking rate decreases.
Most of the research work has been focused particularly on cotton, wool and acrylic knitted fabrics. However, not much has been reported for plain knits of 100% spun viscose rayon. In this work, we investigated the influence of yarn twist and loop length on the dimensional characteristics of spun viscose plain weft knitted fabrics made from spun viscose yarns under dry, wet and fully relaxed states.

EXPERIMENTAL PART

Sample preparation

The fabrics were knitted from 14.8 tex spun viscose rayon yarn (1.5 D and 44 mm stable length) on a circular knitting machine of 24 gauge and 18 in diameter. 1 356 needles and 72 number of feeders were used on a circular knitting machine. The fabrics were knitted on a clockwise rotating circular knitting machine. Three twist multiplier 3.0 (*LT*), 3.6 (*MT*) & 4.0 (*HT*), three loop lengths 0.275 (*LL*), 0.295 (*ML*) & 0.315 (*HL*) cm and dry, wet and fully relaxed treatment were used to produce a fabric samples from a 14.8 tex spun viscose rayon yarn. Table 1 gives the properties of spun viscose yarns used for knitting plain weft knit structures. The yarn evenness tests were done as per ASTM D1425 and yarn tensile strength as per ASTM D2256-2002.

Procedures conducted

Dry relaxation

After being knitting, the knitted fabrics had been taken from the machine and were laid flat freely to relax for about 24 hours at standard atmospheric conditions. The dry relaxed dimensional properties were measured at this stage.

Wet relaxation

Wet relaxation was carried out in water at room temperature, fabric was allowed to lay for 8 hours, hydro extracted and dried naturally for a day. At this stage, the dimensional properties of the sample were measured.

Table 2

TISL OF YARN			
Loop length / Yarn twist	*LL*	*ML*	*HL*
LT	2.238	2.401	2.564
MT	2.499	2.681	2.863
HT	2.733	2.932	3.131

Full relaxation

The fully relaxed condition were obtained by subjecting the samples into gentle agitation at 80°C for 2 hours, tumbles dried at 80°C for 2 hours in a domestic top loading washing machine, and finally dried in the standard atmosphere for 24 hours. The courses/unit length, wales/unit length and stitch density of knitted fabrics were measured as per IS 1963-1981 and spirality as per ASTM D 3882-99.

RESULTS AND DISCUSSIONS

The dimensional properties of plain weft knitted fabrics made from 14.8 tex spun viscose yarn with three different twist and three different stitch lengths has been investigated under three different conditions of relaxation – dry, wet and full relaxation.

Spirality variations

Table 2 gives the values of *TISL*, respectively twist in loop length – i. e number of turns in the length of the yarn used to knit one structural knit cell (SL) of yarn.
Figure 1 show the effect of *TISL* on spirality of the spun viscose knitted fabrics. It is observed that changes in spirality of the spun viscose fabrics are linearly dependent on the *TISL.* It is seen that, in the dry state R^2 = 0.766, wet R^2 =0.597 and full R^2 = 0.831. The effect of *TISL* shows better correlation coefficient at fully relaxed knits. The combination of yarn twist and stitch length has more influence on the spirality of the knitted fabrics. Loops are gradually relax from dry relaxation states to full relaxation states.

Stitch density variations

Figures 2, 3 and 4 shows the effect of yarn twist and loop length on stitch density variations of the spun viscose knitted fabrics. It is observed that changes in yarn twist has no influence in stitch density, however the stitch density increases with a decrease in loop length in all the states. It is also observed that for the different relaxation treatments, the stitch density varies linearly

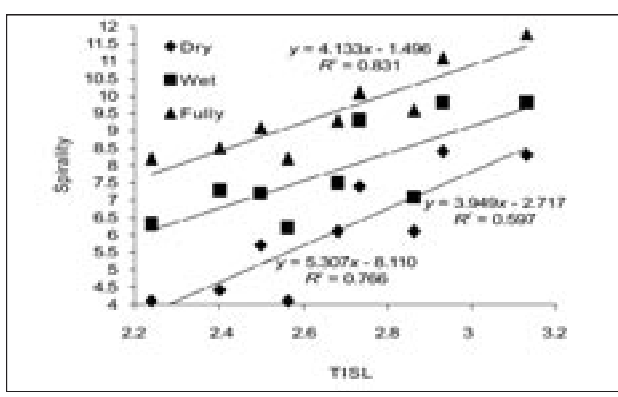


Fig. 1. Effect of *TISL* on the spirality of plain knitted fabrics made from spun viscose ring spun yarns

Table 3

AVERAGE VALUES OF K_c, K_w, K_s, AND LOOP SHAPE FACTOR (K_l) FOR SPUN VISCOSE PLAIN KNITTED FABRICS UNDER DIFFERENT RELAXATION STAGES													
Relax state		LL				ML				HL			
		K_c	K_w	K_s	K_l	K_c	K_w	K_s	K_l	K_c	K_w	K_s	K_l
Dry	*LT*	5.46	3.55	19.38	1.54	5.09	3.40	17.31	1.49	5.20	3.67	19.08	1.42
	MT	5.42	3.52	19.08	1.54	5.04	3.64	18.34	1.38	5.27	3.72	19.60	1.42
	HT	5.38	3.50	18.83	1.54	5.11	3.69	18.86	1.38	5.01	3.76	18.84	1.33
Wet	*LT*	5.26	3.88	20.39	1.36	4.90	3.74	18.33	1.31	4.96	4.03	19.99	1.23
	MT	5.48	3.84	21.04	1.43	5.57	4.10	22.83	1.36	4.89	4.28	20.92	1.14
	HT	5.73	3.82	21.89	1.50	5.66	3.87	21.90	1.46	4.89	3.98	19.46	1.23
Fully	*LT*	5.32	4.20	22.34	1.26	5.03	4.14	20.82	1.21	5.07	4.12	20.88	1.23
	MT	5.26	3.88	20.41	1.35	5.38	3.89	20.92	1.38	5.32	4.07	21.65	1.31
	HT	5.20	4.11	21.37	1.26	5.08	4.19	21.28	1.21	5.27	4.03	21.23	1.31

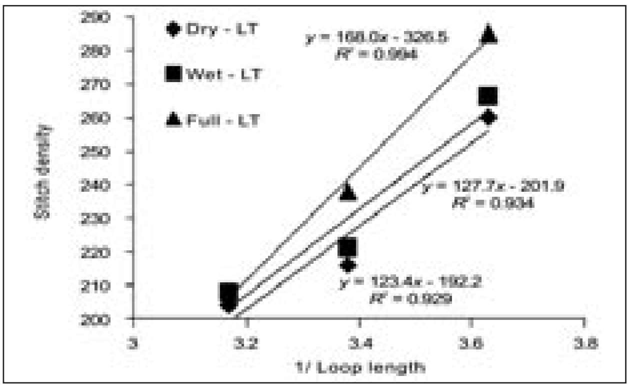


Fig. 2. Stitch density variations of plain knitted fabrics made from spun viscose ring spun yarns with low twist (*LT*)

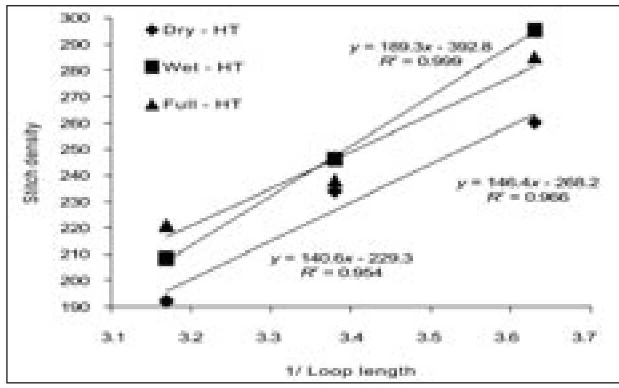


Fig. 4. Stitch density variations of plain knitted fabrics made from spun viscose ring spun yarns with high twist (*HT*)

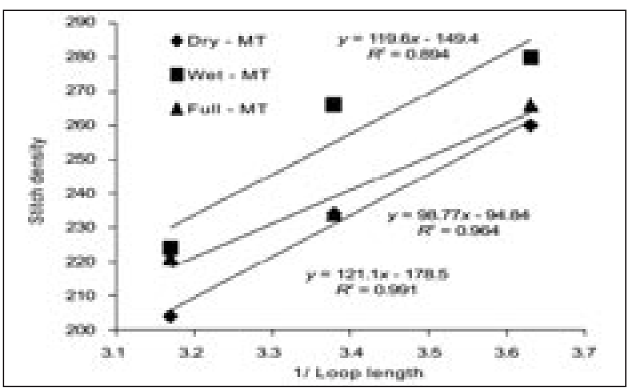


Fig. 3. Stitch density variations of plain knitted fabrics made from spun viscose ring spun yarns with medium twist (*MT*)

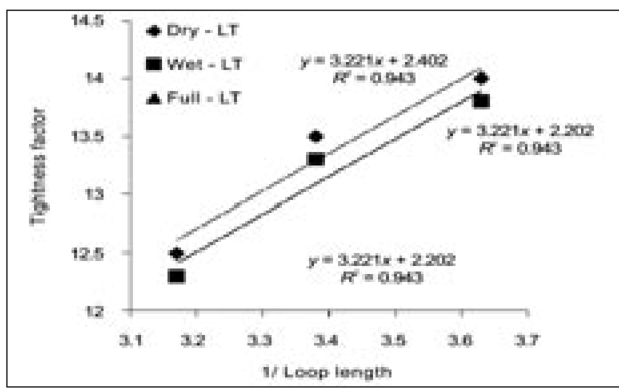


Fig. 5. Tightness factor variations of plain knitted fabrics made from spun viscose ring spun yarns with low twist (*LT*)

with the inverse of loop length. Figure 2, 3 and 4 also shows very strong correlation coefficients at dry, wet and fully relaxed states. It is seen that, in the dry state $R^2 > 0.929$, wet $R^2 > 0.894$ and full $R^2 > 0.954$. It is also observed that, in fully relaxed fabrics, stitch density always higher than that of dry relaxed fabrics irrespective of the change in yarn twist. A possible reason would be, due to the area shrinkage of the fabrics over its dry relaxed fabrics. The better correlation coefficient at fully relaxed knits is due to release of strains imparted to the fabric in knitting, irrespective of the changes in yarn twist.

Dimensional constants (*K*-values)

Table 3 show the dimensional constants of spun viscose plain knitted fabrics under different relaxation stages made from *LT, MT* and *HT* yarns. Dimensional constants are generally used to understand the stability of knitted fabrics under different relaxation states. It is observed that the difference in the values of K_c, K_w and K_s with respect to yarn twist for the all states is noticeable but small. The lower values of loop shape factor (K_l) with respect to yarn twist at fully relaxation state is due to the relaxation of fabrics and reaches an equilibrium state of minimal internal energy.

Tightness factor variations

Figures 5, 6 and 7 shows the effect of yarn twist and loop length on tightness factor variations of the spun viscose knitted fabrics. It is observed that change in yarn twist causes no changes in tightness factor, however tightness factor increases with a decrease in loop length in all the states. It is also observed that for the

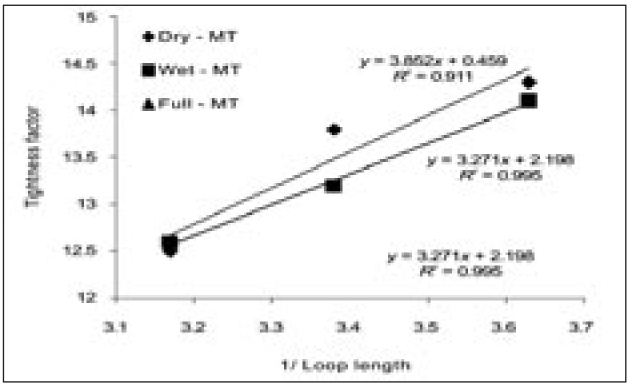


Fig. 6. Tightness factor variations of plain knitted fabrics made from spun viscose ring spun yarns with medium twist (*MT*)

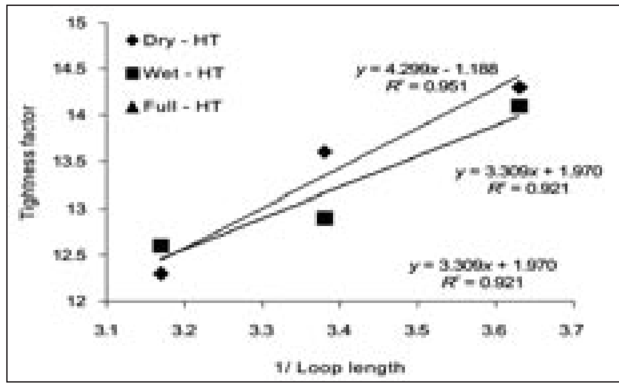


Fig. 7. Tightness factor variations of plain knitted fabrics made from spun viscose ring spun yarns with high twist (*HT*)

different relaxation treatments, the tightness factor varies linearly with the inverse of loop length. Figures 5, 6 and 7 also shows better correlation coefficients at dry, wet and fully relaxed states. It is seen that, in the dry state $R^2 > 0.911$, wet $R^2 > 0.921$ and full $R^2 > 0.921$. The high correlation coefficient at wet and fully relaxed knits is may be due to changes in loop length, irrespective of the changes in yarn twist.

CONCLUSIONS

From the investigations, it is observed that changes in spirality of the spun viscose fabrics are linearly dependent on the *TISL*. The effect of *TISL* shows better correlation coefficient at fully relaxed knits. Therefore, minimum level of loop length and twist combination shows lower level of spirality in the spun viscose plain knit fabrics made from 14.8 tex spun viscose rayon yarn. The stitch density also varies inversely with the loop length and the high correlation coefficient ($R^2 > 0.954$) at fully relaxed knits is due to release of strains imparted to the fabric in knitting, irrespective of the changes in yarn twist. It is seen that, tightness factor variations shows the high correlation coefficient ($R^2 > 0.921$) at wet and fully relaxed knits is may be due to lowest changes in loop length under relaxed states, irrespective of the changes in yarn twist.

It is observed that the difference in the values of K_c, K_w, K_s with respect to yarn twist for dry, wet and fully relaxed states is noticeable but small. The lower values of loop shape factor with respect to yarn twist in fully relaxed states are due to the gradual relaxation of loops from dry relaxation states to full relaxation states and reaches with minimal internal energy. Therefore, we conclude that the *TISL* is an important factor on dimensional stability of the spun viscose knitted fabrics, and the knits manufacturer start measuring this factor additionally in order to control dimensional stability of the spun viscose knitted fabrics.

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Novel approach toward optical sensors based on electrospun nanofibers – quantum dot composits

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REZUMAT – ABSTRACT – INHALTSANGABE

O nouă abordare a senzorilor optici pe bază de nanofibre electrofilate – materiale compozite cu puncte cuantice

Membranele din nanofibre obținute prin electrofilare prezintă o arie specifică de suprafață mai mare decât în cazul peliculelor convenționale subțiri. Această proprietate face ca nanofibrele compozite electrofilate să aibă aplicații inovatoare, precum senzorii. Există câteva mecanisme de detectare a urmelor de chimicale sau vapori toxici, însă cea mai convenabilă este detectarea optică. În ultimii 25 de ani, cercetarea științifică în domeniul detecției optice s-a intensificat. A fost elaborat un senzor performant, bazat pe extincția fluorescenței, folosit pentru detectarea urmelor de vapori de substanțe organice volatile toxice, cum ar fi toluenul. În lucrare, pentru prima dată, sunt introduse, în mod uniform, puncte cuantice de CdTe fluorescent în nanofibre de alcool polivinilic, prin electrofilarea unei soluții PVA cu puncte cuantice, pentru realizarea unui senzor optic. Morfologia și dimensiunile nanofibrelor de PVA/CdTe au fost observate cu ajutorul SEM. Rezultatele experimentale au demonstrat faptul că materialele compozite din nanofibre PVA cu puncte cuantice prezintă nu numai o mare senzitivitate, ci și un răspuns rapid, în cazul expunerii la vaporii de toluen.

Cuvinte-cheie: electrofilare, nanofibre, puncte cuantice, senzor optic, extincția luminiscenței

Novel approach toward optical sensors based on electrospun nanofibers – quantum dot composites

Nanofibrous membranes obtained by electrospinning process enjoy specific surface area approximately several order of magnitude larger than conventional thin films. This characteristic makes electrospun composite nanofibers prominent candidates for novel applications such as sensors. There are several sensing mechanisms that can be exploited to detect the trace of toxic chemicals, the most convenient one being optical sensing. The past 25 years have witnessed a growing research activity in optical sensing. We report the development of a highly sensitive quenching fluorescence based sensor for detecting trace of toxic volatile organic vapors like toluene. In this work, for the first time, fluorescent CdTe quantum dots were uniformly embedded in polyvinyl alcohol nanofibers by electrospinning of quantum dot – PVA mixed solution and used as optical sensor. Surface morphologies and dimensions of PVA/ CdTe nanofibers were observed by SEM. The experimental results demonstrated that the quantum dot – PVA nanofiber composite poses not only high sensitivity but also fast time – response upon the exposure of toluene vapor.

Key-words: electrospining, nanofiber, quantum dot, optical sensor, quenching

Eine neue Ansprechung der optischen Sensoren aus Verbundwerkstoffe elektrogesponnen durch Nanofaser mit Quantumpunkte

Die Nanofaser-Membrannen gefertigt durch Elektrospinnen zeigen eine grössere spezifische Oberfläche als im Falle der konventionellen dünnen Schichten. Diese Eigenschaft bringt innovative Anwendungen für die elektrogesponnene Verbundwerkstoff-Nanofaser, wie Sensoren. Es gibt mehrere Erkennungsmechanismen von Chemikalienspuren oder toxischen Dampf, doch der beste Mechanismus ist die optische Erkennung. In den letzten 25 Jahren verstärkten sich die wissenschaftlichen Untersuchungen im Bereich der optischen Erkennung. Es wurde ein leistungsfähiges Fluoreszenzlöschung-basierten Sensor hergestellt, für die Erkennung der toxischen flüchtigen Dampfes wie Toluen. In dieser Arbeit wurden für das erste mal fluoreszente CaTe Quantumpunkte gleichmässig in Polyvinyl-Alkohol-Nanofaser eingebettet durch Einspinnen von Quantumpunkten – PVA Mischlösung und als optischen Sensor verwendet. Die Oberflächenmorphologie und die Dimension der PVA/CaTe Nanofaser wurden durch SEM beobachtet. Die experimentellen Ergebnissen bewiesen, dass der Quantumpunkt – PVA Nanofaser-Verbundwerkstoff nicht nur grosse Empfindlichkeit sondern auch gute Schnellzeitantwort gegenüber dem Kontakt mit Toluendampf aufzeigt.

Stichwörter: Elektrospinnen, Nanofaser, Quantumpunkte, optisches Sensor, Fluoreszenzlöschung

A number of semiconductor nanocrystals (2–6), known as quantum dots (QD) have been prompted much more attention due to their unique characteristics than organic dyes which suffer from fast photobleaching [1]. Some of promising traits of QD's are resistance to photobleaching, chemical stability, wide absorption, narrow and symmetric emission in visible range and tunable spectral properties [2–3] make them powerful materials used in promising applications like light-emitting diode (LED), nanolaser, solar cells, wave guides, photo sensors, photo catalyst and biological application [4].

On the other hand, it is predicted that solid-state linear array of QD's have a prominent characteristic which will open up new opportunities for novel nanoscale implements like sensors [5, 6] and solar cells [7, 8]. In this regards, polymeric materials which have very good process ability, have provided great opportunity to produce one-dimensional matrices such as nanofibers.

Electrospun nanofibers have specific surface approximately one to two orders of magnitude larger than flat films [9]. This characteristic make them ideal to use in novel applications especially sensors which have received tremendous interest for monitoring the amount of pollution in the environment in the recent years. It is accepted an accurate sensor should enjoy features such as high sensitivity, selectivity, fast time response, stability, durability, reproducibility and reversibility. These properties mainly depend on the characteristic of sensing materials which is used. There are various sensing technique and principles that among the optical sensing have many advantages compared to traditional type of sensors such as absence of electromagnetic interference in sensing and electric contact in the probe and so on literature of speciality [9].

The past 25 years have witnessed the growing research activity in optical sensing. Especially, the measurement of the fluorescence intensity of luminophor which is sensitive to a particular analyte is a common approach for fabricating high sensitive and selective sensors [10].

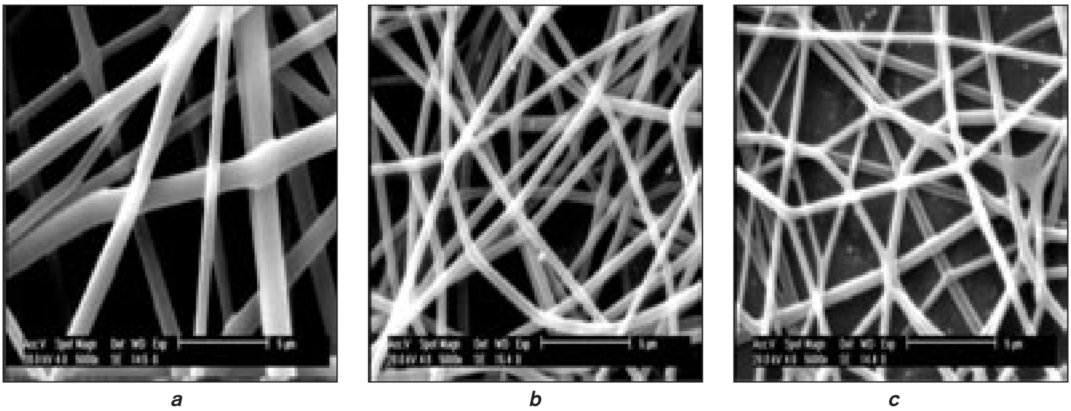

Fig. 1. SEM image of QD – PVA nanofibers produced from solutions with different concentrations of PVA:
a – 10% PVA; ***b*** – 12% PVA; *c* – 15% PVA

Table 1

THE DIAMETERS OF THE FIBERS PRODUCED UNDER DIFFERENT CONCENTRATION OF THE PVA

Sample	Fiber diameter, nm
10% PVA	453
12% PVA	680
15% PVA	996

It is well approved that sensitivity of a sensor that detects analyte by interacting with molecules of analytes on the surface will increase with increasing surface area per unit mass [9].
All of the previous works used fluorescent QD for determining biological substances and chemicals in aqueous solution [11, 12] or they used QD in cast films [13, 14], but here, for the first time, we report the fabrication of highly fluorescence QD-PVA nanofibrous membrane as optical sensor for sensing toxic volatile organic vapor such as toluene.

EXPERIMENTAL PART

Our typical optical sensor were made by dissolving PVA (supplied from Merck company) granules in distilled water and mixing this solution with defined amount of synthetized CdTe nanocrystal solution followed by electrospining of prepared solutions. For the sake of studding the effect of fiber diameter of membrane on the time response of sensor, three different concentration of PVA solutions (10, 12, 15% wt) were prepared. The resulting clear homogenous solutions were used for electrospininig process at 18 kV and fibers gathered on a glass sheet. The distance between nozzle and collector and feed rate were kept 10 cm and 5 ml/hr respectively during electrospining for all the samples.

Table 2

CONDUCTIVITY OF 12% PVA – WATER SOLUTION WITH DIFFERENT AMOUNT OF QD
(The volume of all solutions of QD was kept at 3 ml)

Sample	Conductivity, µS
Pure water	11.2
Pure 10^{-6} molar QD water solution	132.6
12% wt PVA – water solution	2.3
12% wt PVA – water solution with 0.1 ml QD	6.4
12% wt PVA – water solution with 0.5 ml QD	12.6
12% wt PVA – water solution with 1 ml QD	16.1

RESULTS AND DISCUSSIONS

Characterizations of QD-PVA nanofibers

Nowadays electrospining has been widely used to produce fine fibers. Most of the recent study has been dedicated to find optimum conditions to acquire nanofibers without any defects, but it is time to find novel application for prepared fine nanofibers. In this context, for the first time we used highly fluorescence QD-PVA nanofibrous composites as fast time-response optical sensor. Figure 1 displays the SEM image of the fibers formed at 18 kV. With increasing the concentration of the PVA in the solution, we attained nanofibers we smaller diameter.
Table 1 shows the diameter of fibers which are electrospun from 10, 12 and 15% PVA solutions that contain QD.
As QD's are semiconducting, they cause the conductivity of electrospun solution increased. Table 2 shows

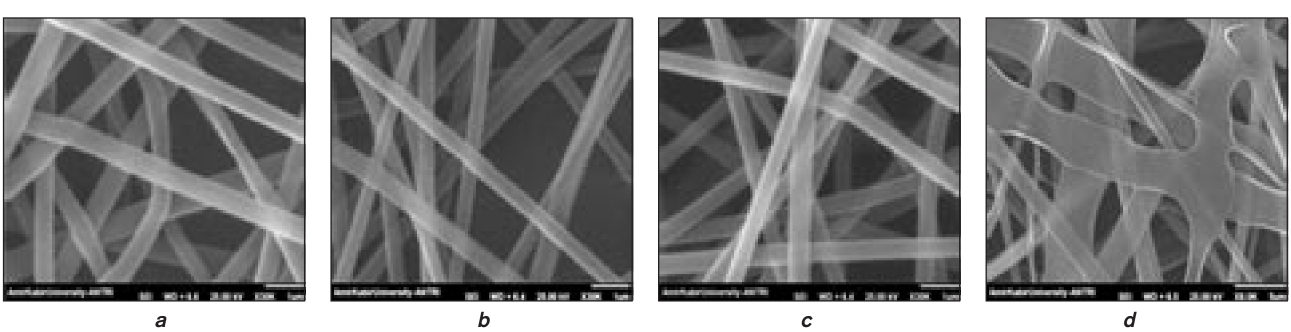

Fig. 2. SEM image of nanofibers contain different amount of QD:
a – 0 m in 3 ml PVA solution 1; ***b*** – 0.1 ml in 2.9 ml PVA solution; ***c*** – 0.5 ml in 2.5 ml PVA solution; ***d*** – 1 ml QD in 2 ml PVA solution

Table 3

THE DIAMETERS OF NANOFIBERS PRODUCED FROM 12% WT PVA WATER SOLUTION WITH DIFFERENT AMOUNT OF QD WATER SOLUTION	
Sample	**Fiber diameter,** nm
Pure PVA	508
PVA/0.1 ml QD	403
PVA/0.5 ml QD	437
PVA/1 ml QD	

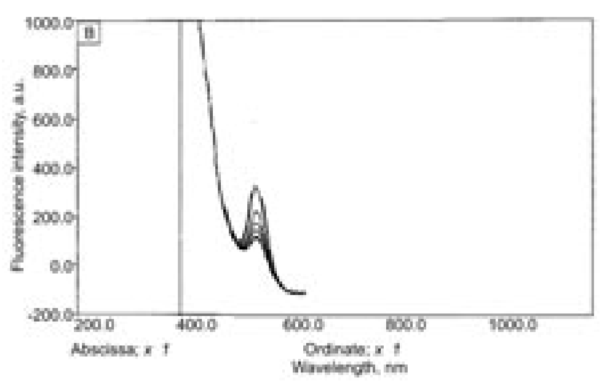

Fig. 3. Fluorescence emission spectra of electrospun membrane upon exposure of toluene vapor

the conductivity of 12% wt solution of PVA which contain different amount of QD water solution.

In order to study the effect of QD addition on morphology and diameter of nanofibers, four 12% wt PVA – water solutions containing 0, 0.1, 0.5 and 1 ml of water solution of QD were also electrospun. It should be mentioned that the volume of all solution with QD were 3 ml. Figure 2 shows SEM image of nanofibers contain different amount of QD. The diameters of the obtained nanofibers with different amount of QD are reported in table 3.

As it is expected with addition of QD in polymer solution, diameter of nanofibers tend to decrease. For example with the addition of 0.1 ml QD diameter of nanofibers decrease from 508 nm to 403 nm that this is mainly due to increase of surface charge which causes the whipping instability of jet increases and consequently the diameter of fiber decrease. On the other hand with adding more amount of QD again the diameter of nanofibers tend to increase because of duality effect of increasing surface charge. With increasing the surface charge the time of soaring is decreased; hence, the fibers reach the collector sooner and there is less opportunity for jet to be stretched during the electrospining process. Furthermore, there is no sufficient time for solvent to be evaporated completely and these phenomenon cause ribbon like nanofibers obtained as it can be seen from figure 2.

Toluene vapor sensing properties of QD-PVA composite nanofiber

For the sake of toluene vapor sensing, 0.5 ml toluene was transferred to a 3 ml cuvette with a cap. A glass slide which is coated with electrospun QD-PVA nanofibers was cut and very carefully placed into this

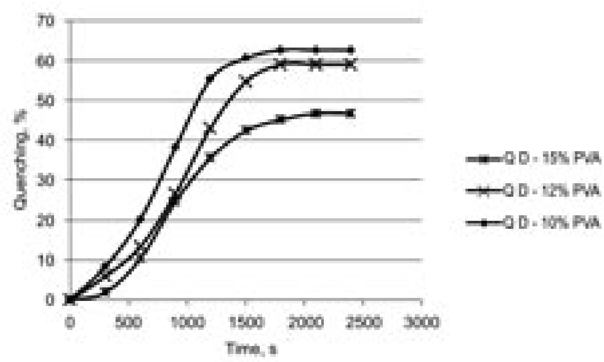

Fig. 4. The time-dependent fluorescence quenching of QD-PVA nanofibrous membrane produce from different concentration of PVA

cuvette. There was no contact between glass slide and toluene surface in the cuvette. These conditions prevent direct contact of fiber-coated glass slide with toluene which causes error. Moreover, a constant saturation vapor pressure of toluene was gained. Afterward, time-dependent fluorescence spectra were measured at an excitation wavelength of 350 nm. Fluorescence quenching was observed for all the QD-PVA nanofibers upon trace of toluene vapor. Figure 3 illustrates changing the fluorescence intensity of nanofibrous upon exposure of toluene vapor with time intervals of 5 minutes. As it can be seen upon the exposure of toluene vapor the fluorescence intensity starts to decrease until toluene vapor was satiated in the close-capped cuvette. Furthermore, membranes with smaller diameter exhibit higher sensitivity (expressed as percent of quenching) upon trace of toluene vapor. Figure 4 displays the time dependence of fluorescence intensity of three membranes produce from different concentration of PVA upon exposure to toluene vapor. Using smaller nanofibers causes more QD's are located at the surface of nanofiber. In this case, more individual QD's are available to be quenched as toluene vapor reach them, but cast films do not have such ability. In fact, cast films abstain vapor permeate inside them effectively.

CONCLUSIONS

In this work, fluorescent QD-PVA nanofibrous membrane was successfully fabricated and used, for the first, time as highly sensitive and fast time response optical sensor to detect toxic volatile organic vapor such as toluene. The results of performed experiment suggest that the morphology and diameter of nanofiber in the membrane have extremely effect on sensing properties of the fabricated optical sensor. Reducing the diameter of nanofibers endows better permeability of vapor into the membrane and results in better and faster vapor sensing. We believe that this kind of sensor will open up new and alternative window toward fabrication of not only high sensitive but also selective sensors. In this regard, our research around this subject will continue very aggressively.

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DOCUMENTARE

Tehnologie chimică

PROCES INOVATIV DE VOPSIRE A BUMBACULUI ȘI POLIESTERULUI

Companiile germane ***Monforts Textilmaschinen GmbH*** și ***Mönchengladbach Co. KG,*** în colaborare cu firma ***DyStar Colours,*** au elaborat un nou proces de vopsire continuă într-o singură baie a amestecurilor de bumbac și poliester, denumit *Econtrol T-CA.*

Noul proces a fost elaborat pentru a satisface cerințele companiilor textile în ceea ce privește scurtarea timpului de producție și lărgirea gamei de culori în vopsirea amestecurilor din bumbac și poliester.

Econtrol T-CA poate fi aplicat pentru materiale textile țesute standard și elastice, dar și pentru diverse materiale tricotate, realizate din amestecuri de bumbac cu poliester.

Acest proces este mult mai eficient din punct de vedere economic, el necesitând un consum de apă mai mic cu până la 60%, un consum redus cu până la 85% de produse chimice, precum și un consum de energie mai mic cu până la 50%.

În comparație cu procesul standard de vopsire, desfășurat în nouă etape, vopsirea într-o singură baie, pe aparatul *Montex Thermex,* oferă o productivitate mult mai mare, datorită faptului că nu sunt necesare reglaje intermediare și nici baie cu abur.

Acest proces de vopsire de laborator simplu asigură o reproductibiltate maximă, oferind astfel o amortizare rapidă a cheltuielilor. De asemenea, se poate obține o gamă coloristică diversă, satisfăcând astfel cerințele actuale ale modei.

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Electromagnetic shielding characteristics of different fabrics knitted from yarns containing stainless steel wire

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REZUMAT – ABSTRACT – INHALTSANGABE

Caracteristici de ecranare electromagnetică a diferitelor tipuri de tricoturi, realizate din fire cu conţinut de conductori din oţel inoxidabil

În acest studiu este analizată eficienţa ecranării electromagnetice a diferitelor structuri tricotate, realizate din fire de bumbac cu miez, obţinute prin sistemul de filare Siro şi având în componenţa lor conductori din oţel inoxidabil. Valorile ecranării electromagnetice a diverselor structuri tricotate sunt determinate în conformitate cu standardul ASTM D 4935, cu ajutorul unui dispozitiv de fixare coaxial. Măsurătorile sunt efectuate în gama de frecvenţă de 30 MHz–1.73 GHz. Rezultatele testărilor arată că materialele tricotate investigate au un efect de ecranare de 10–20 dB în gama de frecvenţă analizată. De asemenea, se observă că anumite tipuri de structuri tricotate influenţează în mod diferit eficienţa ecranării electromagnetice a ţesăturilor.

Cuvinte-cheie: oţel inoxidabil, fir filat cu miez, metoda de filare Siro, ecranare electromagnetică, tricoturi

Electromagnetic shielding characteristics of different fabrics knitted from yarns containing stainless steel wire

In this study, the electromagnetic shielding effectiveness of various knitted structures made of Siro core-spun cotton yarns containing stainless steel wire is investigated. Electromagnetic shielding values of various knitted structures are determined by a coaxial test fixture relating to ASTM D 4935 test standards. Measurements are made in the frequency range of 30 MHz–1.73 GHz. Test results show that knitted fabrics investigated in this study have 10–20 dB shielding effectiveness for incident frequency. Also it is seen that the differences of knitted structure have an influence on the electromagnetic shielding effectiveness of fabrics.

Key-words: stainless steel, core-spun yarn, Siro spinning method, electromagnetic shielding, knitted fabrics

Elektromagnetische Abschirmeigenschaften von unterschiedlichen Gewirksmaterialien, gefertigt aus Edelstahlgarnen

In dieser Arbeit wurde die elektromagnetische Abschirmleistung von unterschiedlichen Gewrikstrukturen gefertigt aus Siro-kerngesponnenen Garnen mit Edelstahlgehalt untersucht. Die elektromagnetischen Abschirmwerte wurden durch eine koaxiale Testvorrichtung, gemäss des Standarts ASTMD 4935, ermittelt. Die Messungen wurden im Frequenzbereich 30 MHz–1,73 GHz durchgeführt. Die Testergebnisse zeigten, dass die untersuchten Gewirke in dieser Arbeit 10–20 dB Abschirmungsleistung im bestimmten Frequenzbereich erreichen. Es wurde gleichfalls festgestellt, dass die Gewrikstrukturunterschiede eine Auswirkung auf die elektromagnetische Abschirmleistung haben.

Stichwörter: Edelstahl, kerngesponnenen Garne, Siro-Spinnmethode, elektromagnetische Abschirmung, Gewirke

Electrical and electronic devices in our daily life are expanding rapidly with the advancement of science and technology. All electronic devices and systems working with different frequency and different power produce different levels of electromagnetic (EM) waves. The usage of electronic devices and systems such as electronic communication networks, radio and television transmitters, satellite, office machines, medical devices, mobile phones, base stations, computers, etc. not only facilitates our life's but also brings electromagnetic interference (EMI) problem.

EMI is electromagnetic energy that adversely affects the performance of electrical and electronic devices by creating undesirable responses or complete operational failure [1]. The hazardous effects of EM waves on human health can also be considered as an EMI problem since the human body is actually an electronic system with a huge nervous system.

Shielding is very popular method to avoid the EMI. Shielding can be described, the isolation a space from external sources of electromagnetic radiation or the prevention unwanted emission of electromagnetic energy radiated by internal sources [1–3]. Various researchers have shown keen interest in providing shielding materials to overcome the EMI problems. Among the various shielding materials offered, textile products have attracted the researchers for their versatility, lightness and lower cost [3–5]. There has been ongoing research interest, in determining the production methods of textile fabrics offering electromagnetic shielding. Several methods are available for shielding properties, such as ionic plating, electro less plating, cathode sputtering, vacuum metallization, zinc paints, zinc arc spraying and conductive fillers, such as copper, stainless steel etc. All this methods can be mainly categorized under two headings: surface treatments and fillers. Surface treatments have some disadvantages such as time consuming, lab our intensive, costly and low washing and abrasion resistance [2]. Conductive fillers such as metal, metalized fibers and fibers manufactured of polymers modified with particles of carbon black, graphite and metallic powders are increasingly being used for production of fabrics offering electromagnetic shielding. Many researchers have attempted to develop woven textile fabrics by using conductive fillers. Attempts by researchers using woven fabrics indicate that the shielding effectiveness of woven fabrics depends on the content of the conductive filler, number of layers, yarn and weaving types [1–9].

Contrary to woven fabrics, where due to the production technique two yarn systems are right-angles crossed in warp and weft direction, the conducting yarns can only be incorporated in one direction in knitted fabrics and consequently a shielding is achieved for electromagnetic wave in just that direction [10]. On the other hand, knitted fabrics are more elastic than the other

Table 1

CODES AND PROPERTIES OF FABRIC SAMPLES			
Fabric codes	Fabric structure	Yarn	Loop yarn length, cm
Y_1C	Single jersey	Ne 24	0.33
Y_1S-*a*	Single jersey	Ne 24-S20	0.33
Y_1S-*b*	Single jersey	Ne 24-S20/elastane	0.33
Y_2C	Rib	Ne 24	0.33
Y_2S-*a*	Rib	Ne 24-S20	0.30
Y_2S-*b*	Rib	Ne 24-S20	0.33
Y_2S-*c*	Rib	Ne 24-S20	0.36
Y_3S	Lacoste	N2 24-S20	0.33

Table 2

FABRIC SPECIFICATIONS					
Fabric codes	cpc, course/cm	wpc, wales/cm	Loop density, loop/cm^2	Fabric thickness, mm	Mass per unit area, g/m^2
Y_1C	13	14.5	188.5	0.69	143.2
Y_1S-*a*	11.75	14	164.5	0.64	142.8
Y_1S-*b*	13	17	221	0.75	191.2
Y_2C	19	12	228	0.94	175.8
Y_2S-*a*	18.5	12.5	231.25	0.77	182.2
Y_2S-*b*	18.5	12	222	0.88	187.6
Y_2S-*c*	18.5	11	203.5	0.92	179.6
Y_3S	10	12.5	125	0.75	142.2

fabric types. Scientific literature indicates that conductive knitted fabrics and knitted fabric-reinforced composites are especially suitable for making complex shaped components and application in electromagnetic shielding [11–13]. In this work, the electromagnetic shielding effectiveness of knitted fabrics made of Siro core-spun yarns containing *SS* wire, with varying structure has been studied.

MATERIALS AND METHODS

Initially, Ne 24 count core spun yarns with *SS* wire or without *SS* steel wire, were produced by means of Siro core spun spinning method under controlled conditions on a sample ring spinning machine. The material to be used for the purpose of shielding must have both good electrical conductivity in order to minimize the penetration of the waves to the material and high magnetic permeability (so as to convert magnetic energy to heat). In this study, 20 micron AISI 316 L type *SS* wire was used as the core part of hybrid yarn. *SS* wire has relatively good electrical conductivity and high magnetic permeability. In the literature, there are many studies about usage of composite yarn containing *SS* wire for electromagnetic shielding especially on the structure of woven fabrics [4–9].
The core spun spinning method in the ring spinning system bases essentially on spinning the natural or synthetic fiber with a core yarn by modified ring spinning machines. In this study, yarns were produced with Siro core spun spinning method since Siro core spun method is better than the other core spun methods in terms of covering effectiveness of core wire [15]. The longitudinal views of 100% cotton and hybrid yarn at the magnification of 45 x are given in figure 1.
Siro core spun hybrid yarns containing *SS* wire are winded with a delivery speed of 1144 m/dk, whereas 100% cotton Siro yarns are winded with a delivery speed of 1198 m/dk on a Schlafhorst Air Spilicer 338 RM winding machine. While hybrid yarns are being winded, the capacitive-based cleaning settings of winding machine are closed due to their metal wire content. Within this study, production of fabric samples has been carried out on the circular knitting machine. The codes and loop yarn length of fabric samples are summarized in table 1.
In this study, single jersey and lacoste samples are fabricated on a Mayer MV 4-3-2II model (19 inch – 28 E) circular knitting machine whereas rib fabric samples are fabricated a Mayer PV 2.0 model (14 inch – 18 E) circular knitting machine. Lycra elastane 44 dtex is used in manufacturing Y_1S-*b* coded fabric samples.

In order to determine the structural properties of knitted samples, course and wale counts of fabrics were measured with a magnifying glass, with ten measurements for each dimension in different places on the fabric samples.

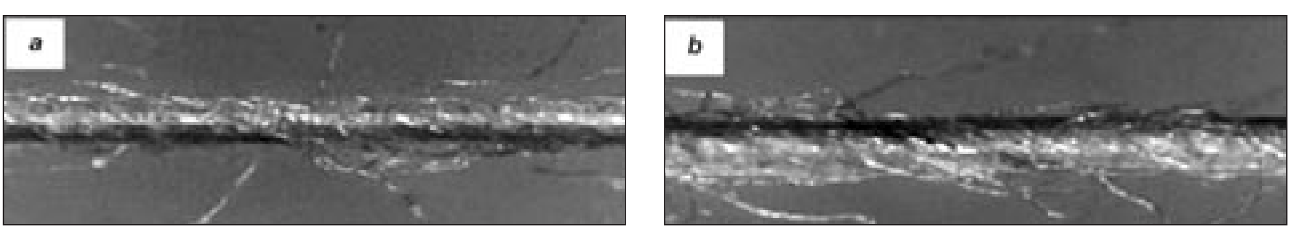

Fig. 1: ***a*** – 100% cotton Siro yarn; ***b*** – hybrid Siro core spun yarn containing *SS* wire

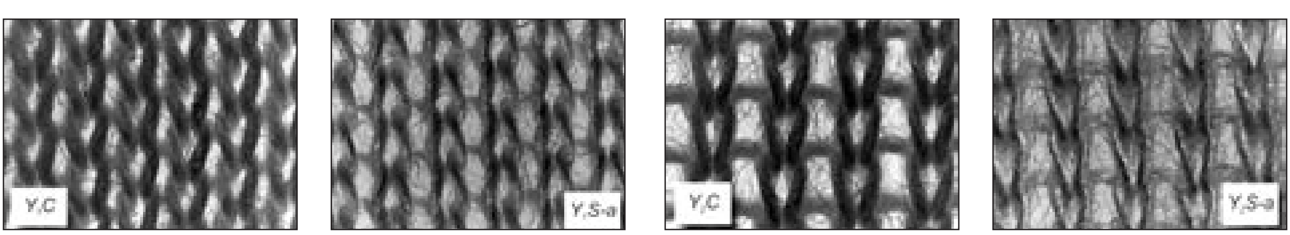

Fig. 2. Images of single jersey and rib fabric were knitted from Siro and Siro core spun hybrid yarns

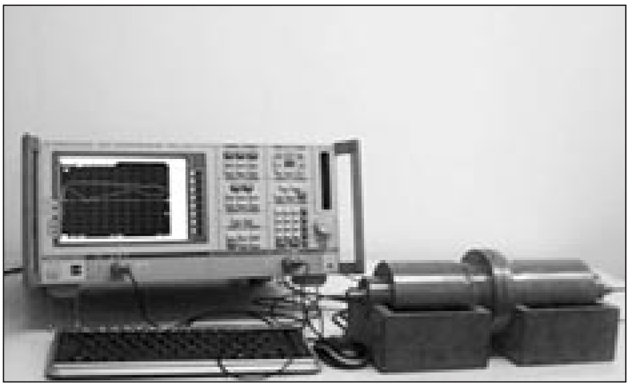

Fig. 3. Set up of *SE* testing apparatus

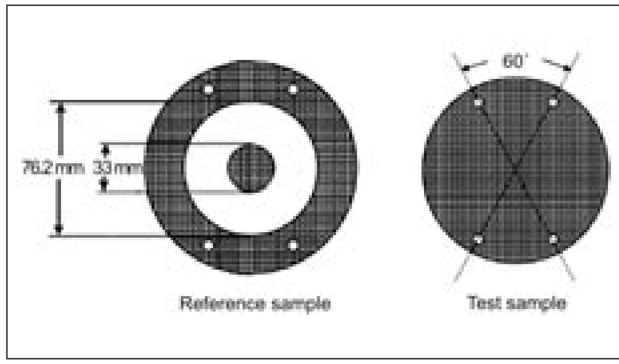

Fig. 4. Reference and test sample geometry complying with ASTM D 4935-99

The thickness value of fabric samples were measured according to ASTM D 1777 standard [16]. The measured mean values of structural properties measured are given in table 2. The images recorded under the microscope of single jersey and rib fabrics knitted from Siro and Siro core spun hybrid yarns are given in figure 2.

Electromagnetic shielding effectiveness (SE) measurements of fabric samples were made with coaxial holder method based on ASTM D 4935 standard [17]. Coaxial test fixture relating to ASTM D 4935 is given in figure 3. This standard determined the shielding effectiveness of fabric using the insertion-loss method. As seen in figure 3, the measurement device consist of a network analyzer (R & S ZVB20) generating and receiving the electromagnetic signals and a coaxial transmission line test fixture.

The shielding effectiveness is determined by comparing the difference in attenuation of a reference sample to the test sample, taking into account the insertion losses. The reference and the test measurement were performed on the same material. The reference sample was placed between the flanges, covering only the flanges and the inner conductors. A test measurement was performed on a solid disk shape which had a diameter the same as that of the flange (fig. 4).

The shielding effectiveness was determined from equation (1):

$$SE_{dB} = 20 \log E_0/E_1 \qquad (1)$$

where:

E_0 is the value of the electrical field component and is measured with the reference samples;

E_1 is measured with the test samples.

The dynamic range (difference between the maximum and minimum signals measurable by the system) of the system was 80 dB.

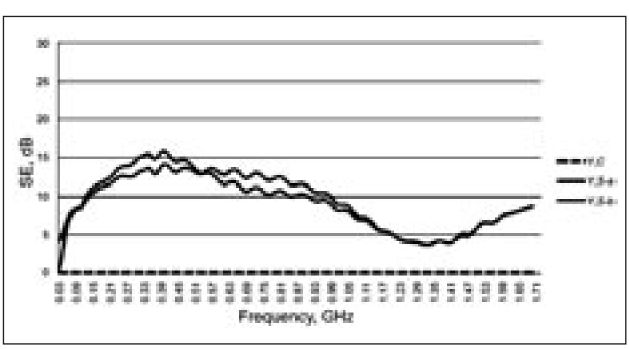

Fig. 5. *SE* values of single jersey fabric samples

In this method, the test adapter to the inner diameter of outer conductor *D* 76.2 mm and the outer diameter of inner conductor *d* is 33 mm. To calculate the maximum value of the upper frequency of the measurement apparatus was used equation (2) [17].

$$f_{max} < \frac{c}{\frac{\pi}{2}(D+d)} \qquad (2)$$

where:

C is light velocity (3 x 10^8 m/s);

D – inner diameter of outer conductor, mm;

d – outer diameter of inner conductor, mm.

According to obtained result with equation (2), maximum value of upper frequency of measurement apparatus should not exceed to find 1.73 GHz. *SE* measurement were taken as the lower frequency value of 30 MHz *SE* values of the samples assessed in the frequency range which should be considered when deciding the thickness of fabric samples. Since doing the thickness of test samples should not be 1/100 of wavelength of electromagnetic wave at the free space. For instance sample thickness should not be thicker than 2 mm for 1 500 MHz test frequency therewithal thicker than 3 mm for 1 000 MHz test frequency [17]. Thickness of all sample fabrics which are less than 2 mm (table 2) were evaluated at 30 MHz–1.73 GHz frequency range of shielding effectiveness of fabrics.

RESULTS AND DISCUSSIONS

SE measurement results, belonging to fabrics coded as Y_1C, Y_1S-*a* and Y_1S-*b* which were knitted on circular knitting machine with supreme knit structure are shown graphically in figure 5.

It can be seen that Y_1C coded single jersey fabric knitted from 100% cotton Siro spun yarn has no shielding effect. Besides this, it can be seen that in 140–920 MHz frequency range Y_1S-*a* coded fabric and in 140–990 MHz frequency range Y_1S-*b* coded fabric can reach 10 dB or more *SE* value. According to these results, it is seen that fabrics can get *SE* property against electromagnetic radiation by using 20 micron stainless steel wire. When the *SE* value of Y_1S-*b* single jersey fabric containing elastane is compared to *SE* value of Y_1S-*a* supreme fabric without elastane, it is seen that the elastane content in the fabric structure does not

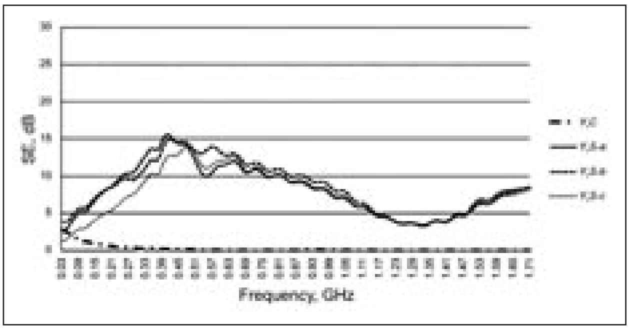

Fig. 6. *SE* values of rib fabric samples

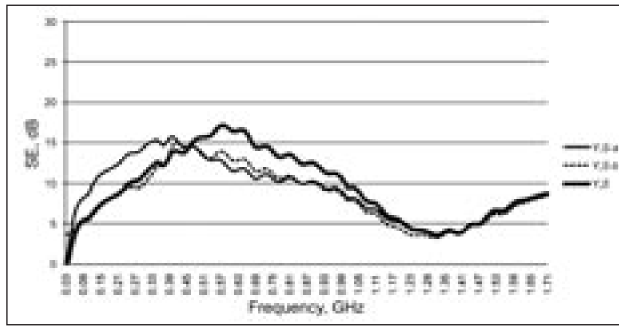

Fig. 7. *SE* values of Y_1S-*a*, Y_1S-*b*, Y_3S coded fabric samples

generally create a big difference in shielding efficiency (fig. 5).

SE measurement results, belonging to fabrics coded as Y_2C, Y_1S-*a*, Y_1S-*b* and Y_1S-*c* which are knitted on circular knitting machine with rib structure are shown graphically in figure 6. It can be seen that Y_2C coded rib fabric knitted from 100% cotton Siro spun yarn has no shielding property against electromagnetic radiation, like Y_1C coded single jersey knitted fabric. In addition, it can be seen that *SE* value of Y_2S-*a* ribbed fabric has reached 15.61 dB at 410 MHz and *SE* value of Y_1S-*b* ribbed fabric has reached 14.87 dB at 410 MHz (fig. 6). The highest *SE* value on knitted fabrics with ribbed structure is obtained on Y_1S-*a* coded fabric as 15.35 dB at 500 MHz. During the evaluation of ribbed structure knitted fabrics, it is seen that the loop density change effects the *SE* values especially at lower frequencies.

SE measurement results, belonging to Y_2S-*a*, Y_2S-*b* and Y_3S coded fabrics which knitted single jersey, rib and lacoste structures respectively at the same loop yarn length, are shown in figure 7. It is seen that Y_3S coded lacoste structured fabric has reached 17.25 dB shielding efficiency value at 580 MHz. It is obvious that fabrics which are knitted on circular knitting machines with yarns containing 20 micron stainless steel wire, can be used for electromagnetic shielding.

The investigated knitting structures show different shielding efficiencies regarding frequency values. On the other hand, it is also seen that different knitting structures show similar screening efficiencies against frequency increases after 1.17 GHz.

CONCLUSIONS

In this study, various knitted fabrics which are knitted from Siro and Siro core spun hybrid yarns on circular knitting machines are comparatively evaluated in respect of electromagnetic shielding effectiveness.

According to test results, fabrics knitted from Siro core spun hybrid yarns containing *SS* wire have shielding efficiency of 10 dB or higher. From the test results of single jersey knitted fabrics, it is seen that the existence of elastane in the fabric structure does not have any significant influence on shielding efficiency. In addition, from the test results of rib knitted fabrics, it is seen that the loop density change effects the *SE* values especially at lower frequencies.

When fabrics which have different knit structures (supreme, rib, lacoste) and the same loop yarn length, are evaluated, it is seen that the lacoste structured fabric has higher *SE* value at certain frequency range comparing to other fabrics. It is also seen that the effect of fabric structure on *SE* values depends on the electromagnetic wave frequency. After 1.17 GHz, all fabric samples knitted from Siro core spun hybrid yarns show similar shielding values.

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DOCUMENTARE

Aparate de măsură și control

SISTEM OPTOELECTRONIC DE CONTROL AL FIRELOR

Compania ***Protechna Herbst GmbH et Co. KG***, din Ottobrunn – Germania, este specializată în producerea, vânzarea și mentenanța sistemelor optoelectronice de control al firelor destinate industriei textile. Ultimele realizări ale companiei în domeniul echipamentelor de control destinate diverselor tipuri de mașini textile au fost prezentate la târgul internațional *ITMA 2011.*

Pentru mașinile de tricotat din urzeală și pentru mașinile Rașel, compania produce:
– *mecanism optoelectronic Laserstop* pentru detectarea ruperilor de fire, prin controlul stratului de fire cu bariere de laser și unitate de control computerizat pentru supravegherea zonei acelor;
– *scaner computerizat 5390* pentru controlul țesăturilor, în special al țesăturilor plane;
– *sistem de bobinat PR 2000* pentru preluarea capetelor de fire simple sau multiple;
– *sistem de camere CCD Procam*, controlate de computer, pentru monitorizarea țesăturii plane în urzeală și bătătură.

Pentru mașinile de țesut, compania Protechna produce:
– *sistem computerizat Laserstop*, cu bariere de laser, pentru oprirea imediată a mașinii de țesut în cazul apariției nodurilor, a ruperilor de fire și a ruperilor de capilare;
– *sistem computerizat Cogastop* de monitorizare a firelor de bătătură;

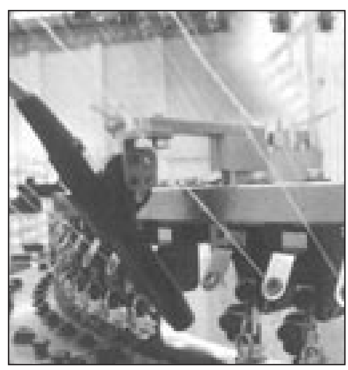

Fig. 1

– *sistem video computerizat CCD Procam,* pentru monitorizarea țesăturii, în urzeală și bătătură.

Pentru mașinile de urzit și încleiat, compania oferă:
– *sistem computerizat Mono Warpstop* de control al firelor, cu un singur cap de inspecție;
– *sistem computerizat Duo Warpstop* de control al firelor, cu două capete de inspecție, pentru eliminarea opririlor false;
– *sistem computerizat Cogastop* de control al firelor filate, cu un singur cap de inspecție;
– *sistem video computerizat Camscan,* de monitorizare a stratului de fire, cu identificarea poziției firului lipsă;
– *sistem automat Tensoscan,* de monitorizare a tensiunii în urzeală, pentru fiecare fir individual din stratul de urzeală.

Pentru mașinile de tricotat circulare, compania produce un senzor digital cu ac 4022 (fig. 1), pentru detectarea și localizarea acelor rupte și îndoite și pentru oprirea imediată a mașinii.

Melliand International, septembrie 2011, p. 221, 243

Researches regarding manufacturing and properties of coated polyester yarns, based on natural and synthetic polymers

COZMIN-TOMA BUDA
DANIELA NEGRU
DORIN AVRAM

REZUMAT – ABSTRACT – INHALTSANGABE

Cercetări privind obținerea și proprietățile firelor din poliester acoperite cu polimeri naturali și sintetici

Lucrarea urmărește cercetarea influenței proprietăților polimerilor de acoperire, în special a materialelor de acoperire pe bază de polimeri naturali, asupra proprietăților firelor obținute. Firele de poliester au fost folosite doar ca fire suport, pentru a permite o analiză comparativă între comportamentul polimerilor naturali și al celor sintetici, ultimii fiind considerați produși de comparație. Comparația s-a făcut pe baza proprietăților tensionale și a scos în evidență faptul că atât polimerii naturali, cât și cei sintetici influențează caracteristicile firelor acoperite. Experimentele au fost efectuate utilizând doar un singur tip de fir suport și, de asemenea, o filieră cu același diametru.

Cuvinte-cheie: rășină poliamidică, poliester filamentar, polimer natural, biodegradabil, material de acoperire, proprietăți mecanice

Researches regarding manufacturing and properties of coated polyester yarns, based on natural and synthetic polymers

The present research pursues the influence of coating polymers characteristics, especially of the coating material based on a natural polymer, on the characteristics of the final coated yarn. Polyester yarns were used only as support, to allow the comparison of the way natural polymer behaviour to the synthetic polymer, the later ones being considered comparison products. The comparison was made based on the tensional properties and highlights the fact that both natural polymer and the synthetic polymer influence the characteristics coated of the yarn. The experiments were made using only a single type of support yarn and also having only one diameter.

Key-words: polyamide resin, fully drawn polyester, natural polymer, biodegradable, coating material, mechanical properties

Untersuchungen betreff der Fertigung und der Eigenschaften der Polyestergarne beschichtet mit natürlichen und synthetischen Polymere

Die Arbeit umfasst die Untersuchung der Eigenschaftseinwirkung der Beschichtungspolymere, insbesondere der Beschichtungsmaterialien aufgrund von natürlichen Polymere, auf die Eigenschaften der gefertigten Garne. Die Poyestergarne wurden nur als Trägergarne angewendet, um eine Vergleichsanalyse zwischen den natürlichen und synthetischen Polymeren durchzuführen, indem die letzten als Vergleichsbasis betrachtet werden. Der Vergleich wurde aufgrund der Spannungseigenschaften geleistet und unterstrich die Tatsache, dass sowohl die natürlichen als auch die syntetischen Polymere die Eigenschaften der beschichteten Garne beeinflussen. Die Experimente wurden durch die Anwendung eines einzigen Trägergarntypes und eines einzigen Durchmesser für die Düse durchgeführt.

Stichwörter: Polyamidharz, Polyester-Filamentgarn, natürlcihes Polymer, bioabbaubar, Beschichtungsmaterial, mechanische Eigenschaften

Synthetic polymers form an integral part of everyday life. They range from high-volume commodity products such as polypropylene and polyethylene; the ubiquitous polyesters such as nylon and poly (ethylene terephthalate) (PET) to low tonnage, specialty products such as poly (ether ether ketone) (PEEK) and carbon fibre reinforced resins.

Synthetic polymers, unlike naturally occurring biopolymers (which are predominately monodisperse), are mixtures with a distribution of molecular size, molecular structure and shape. The details of these distributions taken together with the chemical and physical history of the material and any additives present determine the properties of the polymer [1].

Paul Flory stated that "Polymers are composed of covalent structures many times greater in extent than those occurring in simple compounds and this feature alone accounts for the characteristic properties that set them apart from other forms of matter. Appropriate means need to be used to elucidate their macromolecular structure and relationships established to express the dependence of the physical and chemical properties on the structures so evaluated" [2].

Polymer matrix resins fall into two categories: thermo set and thermoplastic. The difference is in their chemistry. Thermoset resin is chemically comprised of molecular chains that crosslink during the cure reaction (set off by heat, catalyst, or both) and "set" into a final rigid form. Molecular chains in thermoplastic resin are processed at higher temperatures and remain "plastic", or capable of being reheated and reshaped. While the trade-offs between thermo sets and thermoplastics have been debated extensively, engineers will find that material suppliers will tailor matrix resin formulations best for their application [3].

Capable of performing at temperatures up to 370°C, thermoset polyamides are mainly used for advanced composite matrices. Thermoplastic polyamides readily release volatiles under heat and pressure, resulting in more void-free parts.

The use of polyamides as hot-melt resin was found as early as 1959. Polyamide resins are well known for their ability to adhere to many types of fabrics. They have a relatively high and sharp melting point along with high shear resistance. The sharp melting point allows easy application at higher temperatures with faster bonding upon cooling. These resins are excellent in resistance to washing and dry cleaning solvents.

In comparison with ethylene vinyl acetate (EVA), which has widely been used as a hot-melt adhesive, the polyamide resin it has a higher softening point and higher adhesion strength, therefore, its application in hot-melt adhesives is becoming increasingly popular [4].

When applied by melting and cooling the solid the terms "Hot-melt" or "Melt-freeze" are used to describe the method of use. Hot melt applications is the fastest practicable way of sticking parts together and gives higher joint strengths than application of the resin in the form of a solution.

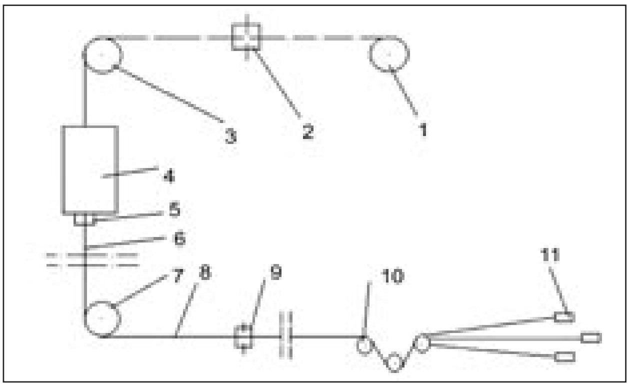

Fig. 1. Schematic installation for producing coated yarns with polyamide resin

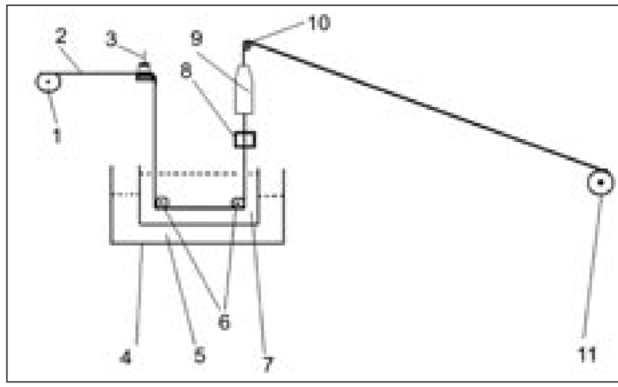

Fig. 2. Schematic installation for producing coated yarns with natural animal polymer

Major application areas for polyamide hot melt adhesive include shoe, automotive, packaging, electrical/electronic, and woodworking. Polyamide adhesives are available in a variety of forms including pellets, cylinders, film, rod, powder and solution [5].

Today many researchers are focusing on producing composites materials from natural fibers and natural resins, like researchers from Sweden who prepared a thermoset composite using acrylate modified soybean oil resin and natural fibers and resulted that it's possible to produce composite with high mechanical properties without adding to the resin a reactive comonomer like styrene [7].

Hailin Lin and Sundaram Gunasekaran obtained and adhesive using cow blood [8] and Keyur P. Somani, and Sujata S. Kansara used for wood bonding an polyurethane based on castor oil [9]. Most tanneries and leather product manufacturers have serious problems regarding waste discharge, with possible harmful effects on the ecosystem. Several options can be used to recycle or reuse organic wastes; gelatin and glue can be obtained from un-tanned leather and untanned wastes [10].

W. Brockmann, mention that natural adhesives including organic polymers obtained from bones and animal skin, have the advantage that they are biodegradable [5]. Animal polymers are protein colloid glues. Proteins are organic compounds made of amino-acids arranged in a linear chain and folded into a globular form. The amino acids in a polymer chain are joined together by the peptide bonds between the carboxyl and amino groups of adjacent amino acid residues and colloid, a type of chemical mixture in which one substance is dispersed evenly throughout another. The particles of the dispersed substance are only suspended in the mixture, unlike in a solution, in which they are completely dissolved. This occurs because the particles in a colloid are larger than in a solution – small enough to be dispersed evenly and maintain a homogeneous appearance, but large enough to scatter light and not dissolve. Because of this dispersal, some colloids have the appearance of solutions. A colloidal system consists of two separate phases: a dispersed phase (or internal phase) and a continuous phase (or dispersion medium). A colloidal system may be solid, liquid, or gaseous. In all animal glue production, the degreased raw material is subjected to the basic reaction of hydrolysis of collagen, a multiple helical chain protein: the rate of this hydrolysis increases with temperature and with stronger acid or alkaline conditions. Hide glues are usually made by an acid process. The production conditions are design to break down the collagen but retain large molecules in the resulting soluble proteins. The resulting dilute protein solutions are concentrated by evaporation and then gelled by cooling [6].

Production of animal glue is considered environmentally "friendly", since it involves conversion of unpleasant waste into useful products, but economic operation depends on satisfactory disposal of residues: some of these are used as slow release nitrogenous fertilizers.

EXPERIMENTAL PART

Installation for producing coated polyester yarn with polyamide resin

The industrial installation for producing coated yarns with polyamide resin is used by the company Adefil Bucharest, and is presented in figure 1. The polyester yarn is un-wind from the stand *1*, than passed through the guide *2* and the roller *3*. From the roller *3* the yarn goes through spinning baths *4*, exits through spinneret *5*. The coated yarn *6* exits the spinning zone in vertical trajectory for 0.15–0.20 seconds, while the yarn travel a setting distance to a roller frame *7*. Next, the coated yarn is in horizontal trajectory for 25–30 seconds, passing through the guide *9*, through tensioning device *10*, after that the yarn is winded on the spindles of the winding machine.

Installation for producing coated polyester yarn with natural animal polymer

Coated yarn with natural polymer was produced using the laboratory installation made for this purpose and is presented in figure 2.

The polyester yarn *2* is unwind from the coil and passed through the guidance rolls *1*, *3*, and with the help of the rolls *6* is immersed in the thermostated bath *4* which contain heated oil *5*, where is placed a basin with the natural animal polymer solution *7* used for coating. After the yarn is immersed, is pulled through the spinneret *8* in the cooling zone *9* and through the guidance roll *10* to the winding mechanism *11*.

Experimental conditions

The polyester yarn 1100/200 produced by Terom S. A., has the following quality characteristics, presented in table 1.

Table 1

POLYESTER YARN CHARACTERISTICS	
Characteristics	**Values**
Linear density, dtex	1 100 f200
Tenacity (min.), cN/dtex	7.5
Elongation, %	13 ± 1.5
Contraction at 160°C, %	1.5–3

Table 2

CONDITIONS USED TO PRODUCE POLYESTER YARN COATED WITH POLYAMIDE RESIN	
Type of yarn used for coating	**Polyester yarn** 1 100/200
Temperature of the thermostated bath, °C	160
Winding speed, m/min.	15
Diameter of the spinneret, mm	0.7

Table 3

POLYAMIDE RESIN CHARACTERISTICS	
Tensile strength, daN/cm^3	480
Elongation, %	60
Melt point, °C	160
Flexural strength, daN/cm^2	740
Compressive strength, daN/cm^2	780

The coated polyester yarn with polyamide is produced industrially by successive forming of the coating material on the polyester yarn. The polyester yarn is passed through a thermostated bath containing the polyamide resin, thermostated bath which have the temperature between 160°C, in a time interval raging between 0.15–0.2 seconds. After the coating forming around the core is passed, the thermoadhesive yarn is vertically moved for 3–5 seconds for producing a uniform coating. Next is a horizontal movement for cooling the coating for 25–30 seconds, preparing the yarn for winding the yarn. The characteristics of polyamide resin and the conditions used to produce coated polyester yarn are presented in table 2 and table 3.

Animal polymer is a protein derived from the simple hydrolysis of collagen, which is the principal protein constituent of animal hide, connective tissue and bones. Collagen, animal glue, and gelatin are very closely related as to protein and chemical composition. Coated polyester yarn with natural animal polymer was produced in the laboratory using the installation presented in figure 2.

Natural animal polymer is considered to be hydrolyzed collagen: $C_{102}H_{149}O_{38}N_{31} + H_2O = C_{102}H_{151}O_{39}N_{31}$

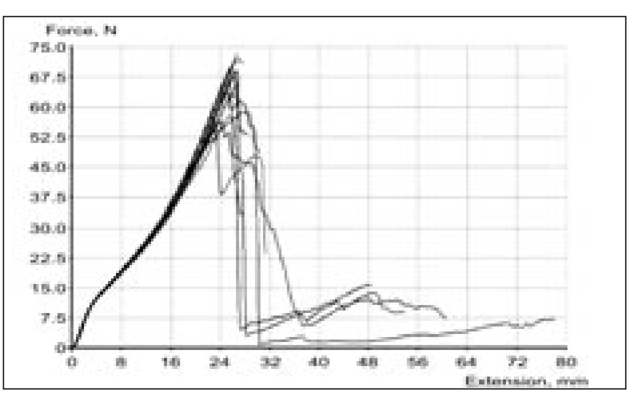

Fig. 3. Force-elongation curves for polyester yarn

Table 4

NATURAL ANIMAL POLYMER CHARACTERISTICS	
Chemical name	Hydrolyzed collagen
Chemical formula	$C_{102}H_{151}O_{39}N_{31}$
Viscosity, mPa s	140–160
Jelly strength, bloom g	300
*p*H	6.2
Water, %	12.6
Fat, %	5.6
Ash, %	1.2

Table 5

PROPORTION OF SOLUTION COMPONENTS	
Solution components	**Proportion, %**
Natural polymer	33
Glycerine	9
Starch	2
Water	56

Table 6

CONDITIONS USED TO PRODUCE POLYESTER YARN COATED WITH NATURAL POLYMER	
Type of yarn used for coating	**Polyester yarn** 1 100/200
Temperature of the water thermostated bath (°C) used for mixing the solution components	65
Temperature of the oil thermostated bath (°C) from the laboratory installation	60
Winding speed, m/min.	5
Temperature of the airflow device, °C	20
Diameter of the spinneret, mm	0.7

which gives an approximate chemical composition of 51.29% carbon, 6.39% hydrogen, 24.13% oxygen and 18.19% nitrogen. The characteristics of natural polymer are presented on table 4.

The coated yarn was obtained from a solution where the components were mixed in a basin placed on a water thermostated bath, at 65°C. Proportions of the components from the coating solution are presented in table 5.

After the solution was produced, it was placed on the other thermostated bath, heated with oil, placed on the laboratory installation which had the temperature set at 60°C to maintain the proper temperature for the solution. After the polyester yarn is immersed in the coating solution, pass through a spinneret which has the role to give the proper diameter of the coated yarn. After the coating material is placed on the yarn, the coated yarn enters a device which blows cold air, the purpose of this operation is that the coating material needs to settle and cool before winding, the conditions used to produce coated polyester yarn with natural polymer are presented in table 6.

RESULTS AND DISCUSSIONS

Physical-mechanical properties

The elongation and breaking force was tested using the dynamometer produced by SDL ATLAS, H5KT. The tests were made according with the standard ISO 2062, breaking strength of the yarns. For the coated yarns were tested 25 samples for each coated of yarn, and 15 samples for the polyester yarn, presented in

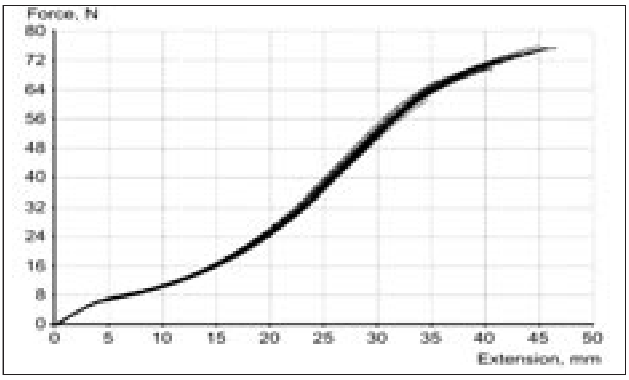

Fig. 4. Force-elongation curves for coated polyester yarn with polyamide resin

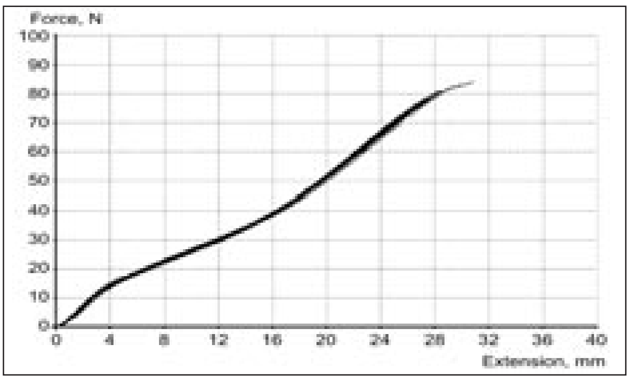

Fig. 5. Force-elongation curves for coated polyester yarn with natural animal polymer

figures 3, 4, 5. The quantity of polymer was determined to see how much polymer was picked up during coating process. Linear density was determined by weighting 25 samples with 250 cm length for the coated yarns, and 15 samples with 250 cm length for polyester yarn after the tensile tests. The results of these measurements are presented in table 7.

Layout features

The microscope OPTIKA, and the program AMCAP was used to take longitudinal and transversal images of

Table 7

PHYSICAL-MECHANICAL PROPERTIES				
Characteristics		**Polyester yarn**	**Polyester yarn coated with polyamide resin**	**Polyester yarn coated with natural polymer**
Linear density, dtex		1 123	3 457	2 049
Proportion of coating polymer, %		–	67.51	45.19
Breaking force, N	Average	65.1	70.3	75
	CV, %	8.84	5.3	9.07
Elongation, %	Average	10.37	16.13	10.71
	CV, %	4.46	8.18	8.09
Tenacity, cN/tex	Average	59.18	21.11	37.5

Table 8

Type of analyzed yarn	**Mechanical work of breaking, J**		
	Minimum value	***Maximum value***	***Mean value***
Polyester yarn	0.805	1.376	0.967
Coated polyester yarn with polyamide resin	0.865	1.684	1.272
Coated polyester yarn with natural animal polymer	0.513	1.29	0.970

Fig. 6. Longitudinal image of polyester yarn coated with polyamide resin

Fig. 7. Longitudinal image of polyester yarn coated with natural animal polymer

polyester coated yarn to see the shape of the coated yarn on longitudinal and transversal direction, presented in figures 6, 7, 8, 9.

Analysis of the breaking mechanical work of breaking

The breaking mechanical work represents the energy necessary for yarn displacement up to the time of breaking. The area enclosed under the force-extension curve is a measure of this energy. Values of the breaking mechanical work for the each yarn are presented in table 8.

Indices for assessing deformability, absolute elongation at breaking

Absolute elongation at breaking represents the value of used energy for breaking the yarn. Values of the absolute elongation at breaking are presented in table 9.

Discussions

After analysing the characteristics of the polyester yarn and coated yarns is observed the following:

- The coated yarn from polyester with natural polymer is thinner because of the evaporation of the water from the coating solution;
- From the longitudinal images from figure 6 and figure 7, the coating layer is uniform;
- Transversal sections of the coated yarns, figure 8 and figure 9, show that, on the polyester yarn coated with polyamide resin the polyester filaments are not situated in the middle of the coated yarn, which means that the coating material is not uniform distributed, in comparison the filaments of polyester from the coated yarn with natural animal polymer are in the middle of the yarn so the coating layer is uniform;

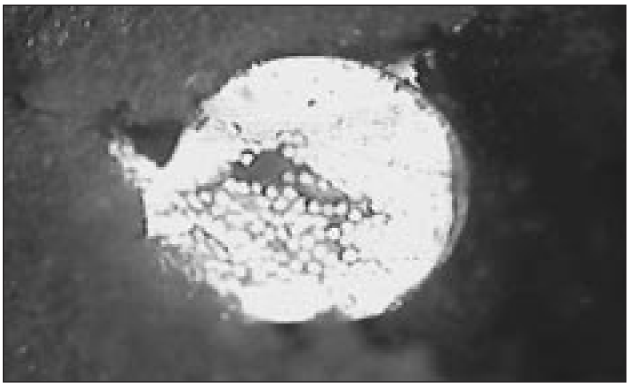

Fig. 8. Transversal section of polyester yarn coated with polyamide resin

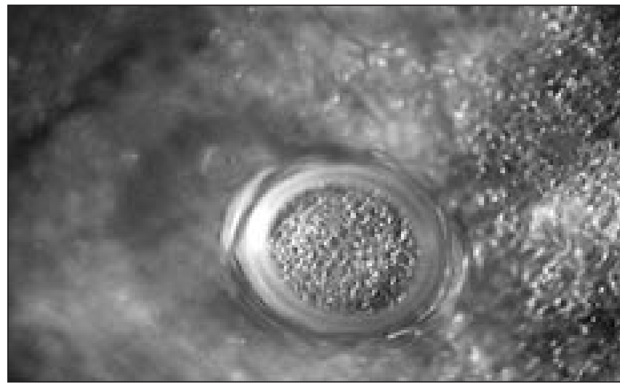

Fig. 9. Transversal section of polyester yarn coated with natural animal polymer

Table 9

Type of analyzed yarn	Absolute elongation at breaking, mm		
	Minimum value	*Maximum value*	*Mean value*
Polyester yarn	25.6	60.6	36.35
Coated polyester yarn with polyamide resin	34.72	46.6	42.16
Coated polyester yarn with natural animal polymer	19.7	30.88	26.77

- Breaking force for the coated yarn with natural polymer is with 13% bigger than the simple yarn while the coated yarn with polyamide resin has an increase only with 7.3% which proves that the bonding of the filaments of the polyester yarn is better with natural polymer because of the penetration of the coating solution through the filaments, while the polyamide resin forms a sleeve on the polyester yarn;
- The elongation is bigger at the yarn with polyamide resin, increases with 5.76% instead of 0.4% on the natural animal polymer that is explained by the fact that natural polymer has smaller elongation;
- If the elongation is small as of the natural polymer, the mechanical work of breaking is small, if the elongation is big as of the polyamide resin, the mechanical work of breaking is bigger;
- Tenacity is bigger at the natural polymer yarn, because the fact that the natural polymer gets easier through the filaments of the yarn, better fixing the filaments in the yarn structure, instead of the polyamide resin which in general apply to the exterior of the yarn;
- From force-elongation curves, see that both polyamide resin and natural polymer consolidates the yarn and acts as a whole, breaking is sudden, in comparison the polyester yarn brakes cascading.

CONCLUSIONS

The behaviour of these two types of coating material, natural polymer and polyamide resin, highlights different behaviours because of the proprieties of each type of coating material and also of the manufacturing conditions of the coated yarns.

In the case of coated yarns studied for polyester yarn coated with polyamide resin the producing conditions are difficult and require high energy consumption because the polyamide resin melts between 155–170°C and needs special installations for producing the coated yarn in comparison to that the condition for producing coated yarn with natural polymer require 65°C, less energy consumption and an installation not so complex. Considering the producing temperature for natural polymer, there is the possibility that in coating solution to add different substances (magnetical substances, anti microbial), which can give to the final product improved characteristics.

Natural polymer can replace the polyamide resin because of better economical aspects like price, lower production temperature, lower energy consumption and when it is aimed biodegradability.

Further researches it will be conducted to establish optimal concentration and manufacturing conditions for the coated yarns with natural polymer.

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DOCUMENTARE

Materii prime

FIRE CELULOZICE IGNIFUGE

Printre noile variante de fibre celulozice promovate la recenta Conferință a Fibrelor Artificiale, desfășurată la Dornbirn/Austria, a fost prezentată și noua versiune ignifugă *Verdi*, produsă de firma ***Kelheim Fibres***, din Germania.

Fibra *Verdi* are performanțe ignifuge intrinseci, datorită structurii sale speciale, iar pe parcursul procesului de fabricare a fibrei în componența acesteia este încorporat, în permanență, un aditiv fără halogeni.

Textilele realizate din aceste fibre pot fi spălate în condiții normale și pot fi purtate în contact direct cu pielea, fără a periclita sănătatea purtătorului.

Fibra are proprietatea de autostingere, după care aceasta continuă să ardă mocnit. Echilibrul dintre ardere și carbonizare înclină mai mult spre carbonizare, generând mai puțină energie.

În comparație cu fibra standard de viscoză, fibra *Verdi* posedă o mare capacitate de absorbție a vaporilor de apă, pe termen scurt, ceea ce conferă un confort sporit în purtare. Peste 99% din aditivii folosiți în tratarea fibrei rămân în structura acesteia, chiar și după 25 de cicluri de spălare, la 60°C.

O altă inovație în domeniul fibrelor a fost dezvoltată de către Edith Classen la ***Institutul Hohenstein***, din Germania. Au fost elaborate noi fibre celulozice cu proprietăți antimicrobiene, în care este încorporat un agent de tratare cu oxid de zinc. Pentru producerea acestora s-a folosit o tehnologie proprie, dezvoltată de institut.

Tehnologia *Alceru* de realizare a fibrelor celulozice este prietenoasă mediului, ea generând o mică cantitate de deșeuri. În procesul de producere a fibrelor, oxizii aminici se combină cu apă și, astfel, celuloza este dizolvată în mod direct, fără modificări chimice. Posibilitatea de a integra omogen aditivii organici sau anorganici în fibre permite producerea diferitelor tipuri de materiale celulozice funcționale.

După fazele de formare și regenerare ale procesului, aceste particule de aditivi sunt ancorate mecanic în matricea fibrelor în timpul uscării, integrarea lor fiind atât de puternică, încât este imposibil să fie îndepărtate.

Aceste fibre sunt folosite de către ***Institutul de Textile din Saxonia*** (STFI) și ***Institutul de Cercetări Textile și Plastice din Thuringia*** (TITK), pentru a produce o nouă gamă de echipamente de lucru cu caracteristici antimicrobiene.

Smarttextiles and nanotechnology, noiembrie 2011, p. 10

The harmony of colors – fundmental postulate in the fabrics design

IULIANA ZEMCIC DANIEL CHINCIU

REZUMAT – ABSTRACT – INHALTSANGABE

Armonia culorilor – postulat fundamental în designul țesăturilor

Lucrarea constă în evidențierea forței culorilor și a combinațiilor de culori cu intensități cromatice favorabile pentru crearea efectelor de legătură-culoare în designul țesăturilor. Pentru diversificarea aspectului țesăturilor, crearea, proiectarea și construcția desenelor de legătură-culoare la țesăturile simple, s-a folosit un design specific, derivat din artele plastice. În acest scop, s-a folosit programul informatic TEX-D (design interactiv), care duce la obținerea efectelelor optice dorite în aspectul final al țesăturilor, prin modificarea raportului de culoare în urzeală și bătătură. Îmbinarea efectului de legătură și culoare, fără restricții cu privire la culori, nuanțe sau tonuri, a permis crearea desenelor de legătură, a desenelor de năvădire și de comandă (cartelă). Bazat pe principiile fundamentale care stau la baza structurii interne a țesăturilor, programul interactiv a furnizat soluții ingenioase de proiectare.

Cuvinte-cheie: legătură, culori, țesături, armonie, contraste, compoziție, structură, design

The harmony of colors – fundamental postulate in the fabrics design

The following paper consists of postulating the force of colors and color combinations with chromatic intensities that create the weave-color effects in the fabrics design. To diversify the aspect of the fabrics, the creation, design and construction of the drawings through weave-color for simple cloths, a specific design, derived from fine arts, was employed. The software that was used, "TEX-D" (interactive design) determines the desired optical effects in the final appearance of the fabrics by changing the ratio of color woven into warp and weft. The combination of the weave-color effect, with no restrictions on colors, shades or tones, allowed us to create weave, pass and command drawings (card). Based on the fundamental principles underlying the internal structure of woven fabrics, an interactive program provided innovative design solutions.

Key-words: weave, colors, fabrics, harmony, contrasts, composition, structure, design

Die Farbanpassung – eine Notwendigkeit im Gewebedesign

Die Arbeit unterstreicht die Bedeutung der Farben und der Kombinationen mit Farbintensitäten bei der Effekterzeugung zwischen Farbe und Bindung für Gewebe. Für die Diversifizierung des Gewebeaspektes, die Schaffung, den Entwurf und den Aufbau der Muster für Bindung-Farbe bei einfachen Gewebe, wurde ein spezifisches Design angewendet, welches dem Kunstbereich entstammt. Im diesem Sinne wurde das Informatikprogramm TEX-D angewendet (Interaktives Design), welches der Erzeugung des gewünschten optischen Effektes im Endaspekt der Gewebe dient, durch die Modifizierung des Farbverhältnisses zwischen Kette und Schuss. Die Kombinierung des Effektes Bindung-Farbe, ohne Beschränkungen betreff Farben, Nuancen oder Töne, erlaubte die Schaffung der Bindungs-, Einzugs- und Kartenmuster. Das interaktive Programm bot besondere Entwurfslösungen, aufgrund der Hauptprinzipien der internen Struktur der Gewebe.

Stichwörter: Bindung, Farben, Gewebe, Farbanpassung, Kontraste, Farbkombination, Struktur, Design

The production of discreet quality and original design fabrics in trend with world fashion requires study and knowledge of several aspects: the graphic motive, color and line style. A textile design for the next season rests primarily on the designer/artist, by creating a work of original art that can be expressed through a floral, geometric, abstract, zoomorphic motive etc. The fabrics designer is that special being with rare artistic sensitivity and creative talent, which always brings the beautiful and enriches the environment in which man lives. Creation represents a unique graphique, a work that can be achieved either by classical methods, using paint brush and special coloring, or by using the computer that generates digital designs, that are also recognized as original art creations. The skill to achieve a fabric consists of combining the following elements: yarn (fineness, structure, density), weave and weave - color combination. A fabric that is missing a ground surface with beautiful colors combination can only be boring and unattractive. When the product is exposed, the human eye should be drawn immediately and directly to that product, because colors interact with each other and reciprocally condition in the succession of their perception, so the order and sequence of chromatic perception is not indifferent to the eye.

The main laws that affect the color effects are as follows:

- The accommodation law. The eye accommodates to the quantitative variation of light through the iris and to the changes in wavelength by crystalline;
- The law of simultaneous contrasts. This law refers to combinations of colors that are adjacent. For example: red is more active and warm near orange and more orange near purple; yellow appears warmer and more red next to the green, colder and more green next to orange;
- The law of successive contrast. The eye tends to bring to each color its main value or complementary contrast;
- The law of reports between the speed of perception and the wavelength of colors. Not all three types of visual cells react with the same speed. For this reason, red is perceived faster than blue. Also the colors in the center of the spectral band are seen better than those from the extremities;
- The irradiation law. A light colored object appears to be larger than a darker one (identical in shape, size and material).

In color harmonization is essential to take into account their instability, because variability or consistency of any color reduces or increases when it results in a certain chromatic context. The same color in two different contexts is not the same. Harmony does not mean annihilation of opposites, but rather makes visible these agreements with strong visual impact. Harmony by contrast created by juxtaposing complementary colors establishes vibration relationships, where colors remain uninfluenced next to each other. The harmony by analogy created with the ratio of two colored surfaces requires different intervals to break the monotony or even create mismatch. These harmonies are extreme aspects of the same series of harmonies, where the color sensation parameters vary. As ordering principle, at the basis of the chromatic harmony there is almost always contrast, the most remarkable phenomenon of colors interaction. Color is the first design element that we perceive on a product, inducing a sense of visual harmony, which attracts and enhances consumer's interest. The effect is immediate, direct, spontaneous and lasting. Each color induces its own emotional and psychological connections and the right color creates the right answer (expected).

The color of the fabric has an essential contribution to the appearance of clothing and appears in the following aspects:

- by staining the entire surface;
- by dominant effect of color, resulting from the appearance or surface ornamentation;
- by polychrome effect, resulting from the decorative elements applied by printing, or weaving.

The colors offered by nature, being mostly chromatic colors with an intensity more or less subdued, formed by analogy the human taste for color harmony.

In nature, colors are not found in pure state, with unmodified color intensity. Besides the physical effect perceived by man, colors have a psychological effect, being able to raise satisfaction and preferences, and in the meantime different mental dispositions.

Generally, on the artistic creation of textile fabrics, color harmony is based on the following laws:

- color composition should be consistent with the idea of designer and reach the goal;
- the linear and defined color pace must be consistent with adjacent colors and help, not complicate the perception of overall composition. Colors in the composition must be mutually supportive, in order to reach color harmony and unity in the textile composition;
- colors forming composition, in combination with one another must become more rich than colors separately.

For striped design fabrics (which may be longitudinal, transverse, oblique etc.) and/or check (various sizes), the harmony of colors can be obtained as follows:

- by color similarity, when drawing on various forms of the same color or shades of color next to the chromatic circle;
- by gradations, when the drawing is formed on more or few contrasting colors, linked together by shades-colors intermediate lying between them;
- by contrast, when the drawing is formed of colors that are at a greater distance from each other on the color circle.

Striped and check design is obtained based on a combination of yarns of different colors. An important role in this type of interaction plays a color interacting with others. For example, gray stripes on a black background appear lighter than the same gray stripes on white background fabric. Also the same gray stripes on a yellow background appear darker and appear lighter on a blue background.

Achromatic colors – white, black, gray – are better associated with chromatic ones, because warm colors are better highlighted in combination with more obscure achromatic colors – black and dark gray, the cold one are highlighted best in combination with achromatic light ones – light gray and white, the intense/saturated increase their value in combination with white and black, and the desaturated/pastel by adding black in combination with various shades of gray. Impressive harmonious combinations can be obtained from monochromatic colors. For example, the solution already known and widely used is to obtain different light gradations (shades) of a color by adding black or white to the base color. There are monochromatic harmonies, side by side, side by side – contrasting and combinations of contrasting – complementary colors.

The fabric color resolution should also keep in mind that by achromatic colors on a chromatic background we obtain a hue, a color tone of the additional background color. For example, a gray on a blue background takes on a yellowish hue, but on a yellow background, instead, a cold – blue. To counteract the unwanted effect of simultaneous contrast, it is necessary to take the color hue fund fiber, which will neutralize the contrast effect. For example, on a blue background, use a cold gray, mixed with a small amount of blue. By chromatic contrast, any color, which is surrounded by a chromatic background – or any other color, changes in the direction of the complementary color, i.e. of the background color (complementary to). For example, on a blue background of a fabric, all colors change in the direction of the complement to blue that is orange. Usually the color contrast is strongest at the boundary between colors; a contrast of separation is observed, whose essence consists in the fact that bright color shades at the limit of the obscure ones are even brighter and vice versa – the obscure ones at the boundary of bright ones become darker. To remove boundary contrast of colors to the design obtained by weaving, additional intermediate thin stripes, consisting of achromatic colors - black, are introduced.

Applications using TEX-D program

Diversifying the fabrics aspect by mixing colors methods. In the theory of color there are two methods of mixing colors:

- optical interference, e.g. simultaneous contrast, occurs when two colors are merged onto the retina in one color. Basic colors – red, green and blue. The combination of colors, seen from a corresponding distance is perceived as points, spots, lines, shading, this method being also called the spatial method.
- mechanical mixing occurs when colors are mixed together or overlap each other in a thin layer. Basic colors – red, blue and yellow [4].

Mixing color methods are used in fabrics design to achieve a maximum visual effect, i.e. to create a colorful impression with minimum consumption of colors. Spatial merging of colors lies on the basis of the fabric

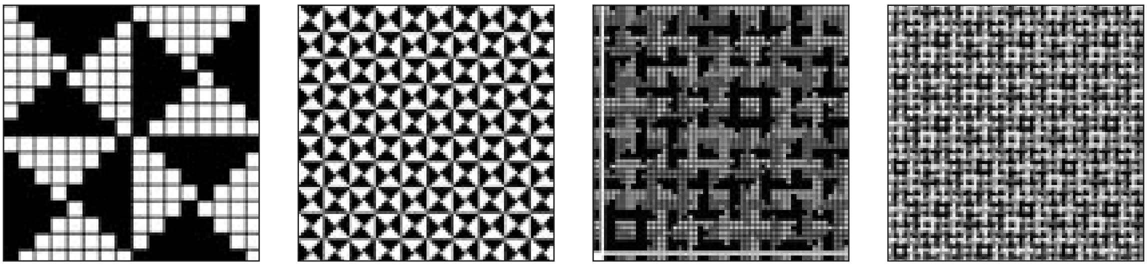

Fig. 1: ***a*** – combination weave; ***b*** – combination weave color ratio in warp and weft: 2 black, 2 gray, 2 white

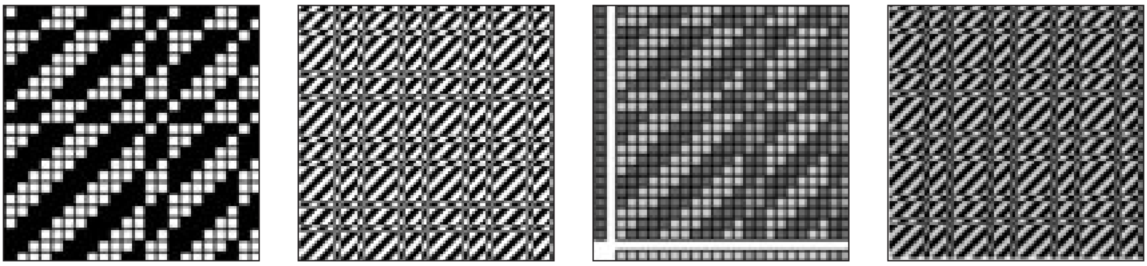

Fig. 2: ***a*** – bastard of jaconet weave $D\frac{3}{3}$; ***b*** – bastard of jaconet weave $D\frac{3}{3}$ color ratio in warp: 12 beeswax, 2 peapod, 6 beeswax, 2 peapod and in weft-regatta

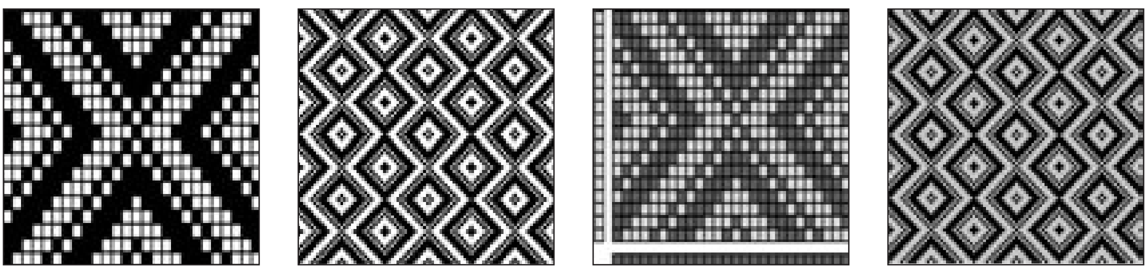

Fig. 3: ***a*** – bastard of jaconet weave $D\frac{31}{13}$; ***b*** – bastard of jaconet weave $D\frac{31}{13}$ color ratio in warp – russet and in weft – beeswax

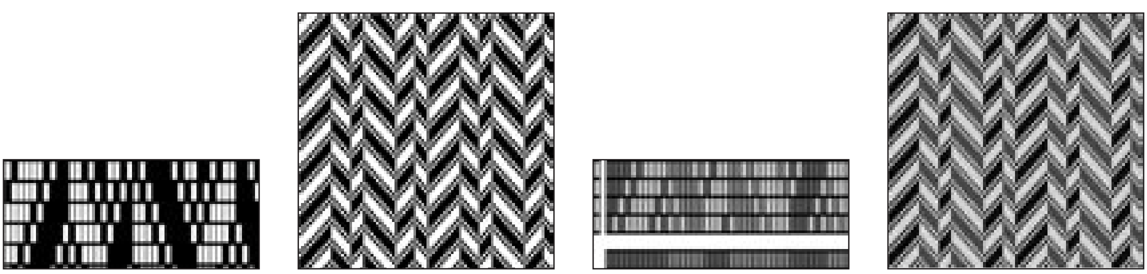

Fig. 4: ***a*** – bastard of jaconet weave $D\frac{411}{114}$; ***b*** – bastard of jaconet weave $D\frac{411}{114}$; color ratio in warp – 10 peapod, 6 blue curaco, 4 peapod, 10 blue curaco, 6 peapod, 4 blue curaco and in weft – besswax

design. Various designs and ornamental solutions made in fabrics as well as dominant colors variants can be obtained by combination and number of colors in the warp and weft.
Spatial merging of the colors into the fabric depends on the following factors:

- size of points, spots and different color shades and contrast between them as brightness, saturation and color tone;
- range between the elements of the design;
- distance at which the fabric is viewed.

These factors can be analyzed in the example of fabrics obtained by combining the effect of color and weave, as this is how spatial fusion of two or more threads of different colors in the fabrics design occurs. The fabric obtained has on its surface, arranged in a specific order, the threads of weft and warp, which being colored determine, by their spatial fusion a certain drawing by the desired color combination.
Depending on the size, the configuration of points and groups of binding points with the warp and weft effect, on the fabric surface appear distinct and visible colored dots, spots of color, shading in various colors.
The “Tex-D” provides complex solutions for designing aesthetic, structural and technological fabrics. Examples presented in figures 1–4.

Elements on choosing the colors of clothing products

When choosing the color of the clothing one should first of all take into account what is right for himself. Approaching orange clothing with shades of blue, we observe that one of the colors "annihilates" natural beauty, while the other highlights it instead.

Everyone has their own combination of shades of skin, eyes and hair. The color of the products should repeat these shades, or in harmony contrast with them. Almost everyone looks good with matching color fabric with eye color. For example, for those with blue-gray eyes, matching products are usually shades of azure, blue, grays. Therefore, one should not simply follow fashion trends, but we must take into account the particularities of the figure, age, height and complexity. On Christian Dior's opinion, "the basis for everything is the figure... the art of modeling is therefore to balance and set all forms, showing this figure". It is known the optical illusion through which a black object seems smaller next to a white one, even if the same size. Therefore, the black and dark color tones reduce the volume of the figure (human body), while white has the opposite effect, increases its volume (irradiations law). The colors you choose will tell a whole story about who we really are, since there is a close link between health and favorite color, emotions, feelings and appearance of each of us.

What color is the best choice? Virtually every person is influenced by a specific color, which influences their behavior without realizing what is happening.

Depending on the color preferences, i.e. how react and/or take colors we distinguish the following categories of individuals:

- leaders in colors: those who accept new with joy and immediately include colors in their entourage (trendy), whether the new color is or is not in harmony with their personality or other objects in their living environment;
- neutral in colors: those that feel comfortable only in their favorite colors are not open to change and even less willing to adopt new colors;
- imitators in colors: those who are too timid in making their own decisions, being interested in or attracted to trends already adopted by the vast majority of current leaders to become consumers or groups to which they belong – beige, khaki, green dark, black. In opposition to leaders in colors, these ones can be considered as trailers [2].

Through conscious education or manipulation by opinion leaders – media, TV, man can change consciously or not the color policy. There are only three basic conditions which any of us who would like to win against his old color habits should follow:

- to convince a person or group of persons that you belong to the group, you have to align to them, i.e. to choose colors and clothing with the same color palette as them;
- to show yourself as a person sensitive to the beautiful (fine arts), dynamic and modern, you should choose colors characteristic to the leaders in colors;
- to demonstrate and induce confidence, positivist, even if you lack these traits you have to choose colors that match the colors of the imitators, see banking officials and ethnic movement [2].

It follows that when choosing of textile colors, an essential contribution is brought not only by the color type, as a representation or impression of the individual, the personal disposition, the occasion to wear one outfit or another, but we must also consider the season.

It can be defined as seasonal trend the category of spring–summer colors, which includes intense and light colors, while the trend in winter–autumn shades include dark, more detained. Typically, fashion houses and designers keep an absolute secret on colors that will determine the trend or color accents for a seasonal product that will become at the right time color vectors. Standardization efforts and the adoption of certain seasonal colors culminated with the founding of the International Color Association, inaugurated in 1967 in Washington, which includes professional colorists around the world: Italy, France, Spain, Scandinavia, England and USA. The Association defines the laws of color that determines the color of today's news. The proceedings of this association made an extraordinary fact, namely leading colors (color vectors) of a season are set up to 24 months before the sale of color for all industrial products including textiles [1].

True knowledge helps us for a long time, but laws are made to break them. We are influenced by fashion all the time, but it should be noted that to live and enjoy the choice of color ranges of clothing products rests ultimately to oneself. If you think too much the joy a color brings will fade [3]. So, never forget your own preferences!

CONCLUSIONS

The visual effects of colors are determined by the following laws: the accommodation law, the law of simultaneous contrasts, the law of successive contrast, the law of reports between the speed of perception and the wavelength of colors, the irradiation law.

The ordering principle, which underlies the chromatic harmony is always contrast and represents the most important phenomenon of the colors interaction.

In the theory of color there are two methods of mixing colors: optical interference (e.g. simultaneous contrast) occurs when two colors are merged onto the retina in one color and mechanical mixing occurs when colors are mixed together or overlap each other in a thin layer. Spatial merging of the colors into the fabric depends on the following factors: size of points, spots and different color shades; contrast between them as brightness, saturation and color tone; range between the elements of the design; the distance at which the fabric is viewed.

The colors you choose characterize the personality of the individual, since there is a close link between health and favorite color, emotions, feelings and appearance of each of us.

It follows that when choosing of textile colors, an essential contribution is brought not only by the color type, as a representation or impression of the individual, the personal disposition, the occasion to wear one outfit or another, but we must also consider the season.

The seasonal trend establishes the category of spring–summer colors, which includes intense and light colors, while the trend in winter–autumn shades include dark, more detained.

For standardization and adoption of certain seasonal colors the International Color Association was inaugurated in 1967 in Washington. It includes professional colorists around the world: Italy, France, Spain, Scandinavia, England and USA.

The Association defines the laws of color and the leading colors (color vectors) of a season up to 24 months before the sale of color.

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INDUSTRIA TEXTILĂ ÎN LUME

NOI LINII DE PRODUCȚIE A FIBRELOR DE VISCOZĂ

Filiala *Lenzing Nanjing Fibers*, din China, a companiei austriece ***Lenzing AG***, a demarat cu succes un nou proiect privind punerea în funcțiune a unei noi linii de producție a fibrelor din viscoză.

Noua linie va avea o capacitate nominală de producție de 60 000 de tone pe an. Ea va produce fibre de viscoză, destinate industriei de materiale țesute și nețesute, în special pentru piața asiatică.

Punerea în funcțiune a noii linii de producție aproape că a dublat capacitatea de producție anuală a filialei *Lenzing Nanjing Fibers,* ajungând la aproximativ 140 000 de tone de fibre de viscoză. Este de așteptat ca, la începutul celui de-al patrulea trimestru al anului 2011, capacitatea nominală de producție să atingă cele mai mari valori posibile. *Lenzing Nanjing Fibers* este cea de-a treia mare locație de producție a *Lenzing Group,* care și-a început producția în anul 2007.

Melliand International, septembrie 2011, nr. 4, p. 182

TENDINȚE GLOBALE ALE PRODUCȚIEI DE FIBRE DIN POLIESTER

Pe baza tendințelor globale privind materia primă pentru producția de fibre de poliester, firma londoneză ***Tecnon OrbiChem*** estimează o creștere a producției de fire filamentare din poliester și de fibre scurte în următorii 5 ani.

După ce, în anul 2010, atât pe plan global, cât și în China, s-a înregistrat o creștere puternică a producției de fibre din poliester, se estimează că, în următorii ani, în China, cifrele vor urma o linie descendentă până în 2015, producția fibrelor de poliester scăzând cu 8%, iar cea firelor filamentare din poliester cu aproximativ 10%.

Firma Tecnon OrbiChem estimează că, în Asia, producția de fibre de poliester folosește 65% din PTA, iar rășina utilizată pentru ambalajele PET aproximativ 30%.

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Activating wool for flame-proof treatments with zirconium and titanium salts

M. SALAMA
A. BENDAK
M. MÖLLER

REZUMAT – ABSTRACT – INHALTSANGABE

Activarea lânii pentru tratamente de ignifugare cu săruri de zirconiu și titan

Pentru a spori cantitatea de săruri de zirconiu și titan absorbite de lână în timpul tratamentului de ignifugare, s-a studiat efectul activării preliminare a fibrelor de lână. Acest lucru a fost realizat cu ajutorul unor metode de pretratare a lânii, fie cu unde ultrasonice, fie cu diverși acizi organici dicarboxilici. Rezultatele arată că, în timp ce utilizarea undelor ultrasonice nu afectează în mod semnificativ cantitatea de zirconiu sau titan absorbită în fibră, pretratarea cu acid carboxilic îmbunătățește absorbția acestora. Comparând efectele utilizării mai multor acizi carboxilici, s-a demonstrat că și cantitatea de sare absorbită de lână scade brusc odată cu creșterea valorilor pKa ale acizilor organici folosiți, acidul oxalic oferind cele mai bune rezultate. Investigațiile termogravimetrice ale materialului tratat indică o creștere a masei reziduale/a greutății uscate a fibrei, odată cu creșterea concentrației soluției de sare de zirconiu sau titan. Temperatura de ardere, definită ca temperatură de vârf a efectului exotermic, arată că, prin aplicarea oricăruia dintre aceste tratamente, se păstrează nealterat efectul de ignifugare a sării de zirconiu și titan pe suprafața lânii. Analiza datelor SEM arată că suprafața fibrelor de lână tratate cu săruri de Zr sau Ti nu se modifică, iar rezultatele OFDA arată că diametrul mediu al fibrei de lână crește ușor, dar nu în mod semnificativ, după utilizarea soluției de sare. Varianta optimă a tratamentului de ignifugare a lânii constă în pretratarea materialului cu acid oxalic, urmată de un tratament cu soluție de sare de zirconiu.

Cuvinte-cheie: lână, sare de Zr, sare de Ti, ultrasonic, acizi organici, absorbția metalelor, SEM, TGA

Activating wool for flame-proof treatments with zirconium and titanium salts

In order to enhance the amount of zirconium and titanium salts uptaken by wool during the flame-proofing treatment we investigated the effect of the pre-activation of wool fibres. This was achieved by pre-treatments with either ultrasonic waves, or with various organic di-carboxylic acids. The results show that, while the use of ultrasonic waves does not affect significantly the amount of zirconium, or titanium exhausted on the fibre, the pre-treating with a carboxylic acid improves it. Comparing several carboxylic acids for their effect has shown that the amount of salt up-taken by wool decreases steeply with the increase of pKa values of the used organic acids, oxalic acid giving the best results. Thermogravimetric investigations of the treated material indicate the increase of the residual mass/dry weight of the fibre with the concentration of zirconium, or titanium salt solution. The burning temperature defined as the peak temperature of the exothermal effect, indicates that any of the pre-treatments keep unaltered the flame retardant effect of zirconium and titanium salt on wool surface. SEM data analysis shows that the surface of wool fibres treated with either Zr, or Ti salt is not altered, and the OFDA results show that the mean fibre diameter of wool increases slightly, but not significantly, after the use of salt solution. It is concluded that the optimum sequence of flame-proofing treatment of wool consists of a pre-treatment of material with oxalic acid followed by the treatment with zirconium salt solution.

Key-words: wool, Zr salt, Ti salt, ultrasonic, organic acids, metal uptake, SEM, TGA

Aktivierung der Wolle für Flammfestbehandlung mit Zirkonium und Titan Salze

Um den Gehalt an Zirkonium und Titan Salze während der Flammfestbehandlung zu erhöhen wurde die Auswirkung der Voraktivierung der Wollfaser untersucht. Dieses wurde durch Vorbehandlung mit Ultrallschallen oder mit unterschiedlichen Carbonsäuren durchgeführt. Die Ergebnisse zeigten, dass während die Verwendung von Ultraschallen den Gehalt an gelagerten Zirkonium oder Titan auf der Faser nicht wesentlich verändert, die Vorbehandlung mit Carbonsäure erfolgreich ist. Wenn man die unterschiedlichen Carbonsäuren gegenüber ihrer Auswirkungen untersucht wurde bewiesen, dass der aufgenommene Salzgehalt der Wolle stetig mit dem Wachstum des pKa Wertes der angewendeten organischen Säuren sinkt, indem die Oxalsäure die besten Ergebnissen erzielte. Die thermogravimetrischen Untersuchungen der behandelten Materialien zeigten einen Wachstum der Restmasse/Trockengewicht der Faser mit der Konzentration der Zirkonium oder Titan Salzlösung. Die Brenntemperatur definiert als Maximalwert der exothermen Auswirkung zeigt, dass jedewelche Vorbehandlung den Flammfesteffekt der Zirkonium und Titan Salze auf der Wolloberfläche nicht beeinflusst. Die SEM Dataanalyse zeigt, dass die Oberfläche der Wollfaser behandelt mit Zr oder Ti Salze nicht beeinflusst und die OFDA Ergebnisse zeigten, dass der durchschnittliche Durchmesser der Wollfaser leicht steigt, doch nicht beträchtlich, nach der Verwendung der Salzlösung. Man kann schlussfolgern, dass die optimale Reihenfolge der Flammfestbehandlung der Wolle in der Vorbehandlung des Materials mit Oxalisäure besteht, gefolgt von der Behandlung mit Zirkonium Salzlösung.

Stichwörter: Wolle, Zr Salz, Ti Salz, Ultraschallen, organische Säuren, Metalllagerung, SEM, TGA

The treatment of wool with metal salt solutions gives rise to metal ions interaction. The attained wool properties depend on the type of interacted metal ions, the conditions of treatment as well as the metal salt concentration. The free carboxyl groups of wool are considered to be the binding sites over a wide range of *p*H value [1, 2]. Several reactions of metal ions with wool effectively improved its flame resistance, shrinkage, abrasion, wrinkle recovery, dyeability [3], deodorizing [4] and antibacterial [5, 6]. The tendency of protein fibre to absorb metal ions is also used for the removal of heavy metal pollutants from industrial effluents and for the purification of contaminated water supplies [7].

The zirconium and titanium treatment (Zirpro process) is a relatively durable and effective flame resistant technique for wool and other protein fibres [8]. The mechanism by which the flame-retardancy is achieved is still under debate, but it was shown that zirconyl and titanyl fluorides are the effective flame-retardants and that the formation of Zr and Ti dioxides in the fibre after rinsing and washing assists the treatment fastness [9]. Thermogravimetric analysis (TGA) is largely used for investigating the thermal decomposition of the polymers and evaluating their thermal stability [10]. TGA data allowed calculating the kinetic parameters of the thermal decomposition of wool [11].

While the effect of titanium and zirconium salts on wool is quite well documented, less is investigated on how the pre-treatment of wool affects the up-take of any of these salts. It is our aim to study whether the ultrasonic waves or various organic di-carboxylic acids may

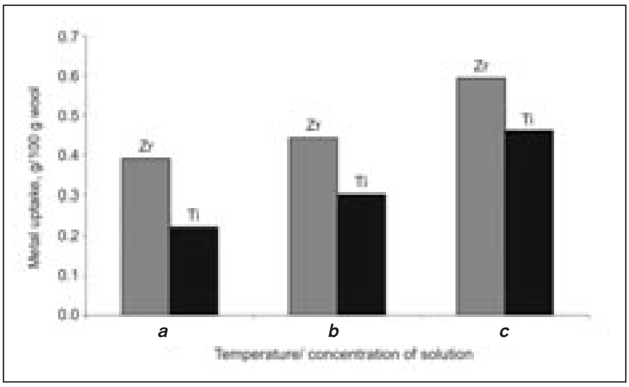


Fig. 1. The effect of temperature and time of treatment on zirconium and titanium salts uptaken by wool: ***a*** – 1.5% solution (w/w), 60°C, 30 minutes, *p*H 2.5, Liquor ratio 1:30; ***b*** – 1.5% solution (w/w), 80°C, 60 minutes, *p*H 2.5, Liquor ratio 1:30; ***c*** – 3.0% solution (w/w), 8°C, 60 minutes, *p*H 2.5, Liquor ratio 1:30

activate wool binding sites for improving the amount of metal uptake. The study compares also the influence of the metal salts on the flame retardancy of wool by means of thermogravimetric analysis.

EXPERIMENTAL PART

Materials and reagents

Wool fabric: White merino wool light fabric was supplied by Misr Company for Spinning and Weaving, Mehalla, Egypt. The fabric was scoured with a solution of 2 g/L nonionic detergent (Egyptol PLM, based on nonyl phenol ethoxylate) at 40°C for 30 minutes.
Chemicals: all chemicals used were of analytical grade, purchased from Aldrich.

Pre-treatments performed

Ultrasonic waves

Wool fabric was treated with ultrasonic waves using Bandelin SONOREX RK 156, Germany. The sample was immersed at 1:30 liquor ratio, and kept in the ultrasonic bath for 30–180 minutes at room temperature. Then it was squeezed and rinsed several times with distilled water, squeezed and left to dry to constant weight at room temperature.

Organic acids

Wool samples were treated with various organic acids, viz.: oxalic, malonic, succinic, glutaric and, respectively, adipic acid, by using corresponding solutions of 0.03 M at 75°C for 90 minutes, in a liquor ratio 1:50 with occasional shaking ≈ 120 rpm. Wool samples were then removed at the prescribed time from the treatment solutions, thoroughly rinsed with distilled water, squeezed and left to dry to constant weight at room temperature.

Metal salts

The aqueous solutions of zirconium and titanium salts were prepared at concentrations of 0.05 and 0.10% (w/w), adjusted to *p*H 2.5 with hydrochloric acid (37%). Wool samples were treated in these solutions for various times (30 to 60 minutes) at temperature ranging from 60 to 80°C. The samples were then removed, squeezed, thoroughly rinsed with distilled water then dryed at room temperature to constant weight. The *p*H values of the solution were also recorded after treatment.

Made measurements

Metal uptake

The amount of metal uptake was determined by using the atomic absorption technique on a Perkin Elmer emission spectrometer (Plasma 400, USA). Wool samples (5–20 mg) were digested in nitric acid solutions (2 mL of 65%) at 95°C for 1 hour. In case of titanium treated samples 1 mL of hydrofluoric acid (HF) was added to the digested solution. After 1 hour 1 mL of hydrogen peroxide was added and further subjected to heating at 95°C for 1 hour. The digested solution was diluted to 10 mL with distilled water before introducing it into the atomic absorption analyzer [12].

Thermogravimetric analysis (TGA)

Thermogravimetric analysis (TGA) of wool samples were carried out using NETZSCH TG 209C, Germany. The weighed samples (10 mg) were heated from room temperature to 750°C with a rate of 10 K/minute, under a draft of 20 mL/minute of air, in alumina crucible. The recorded graphs were analyzed by using NETZSCH software.

Scanning electron microscopy (SEM)

Scanning electron microscopy of wool samples was carried out on a HITACHI S-300N microscope (Japan). The SEM operated at about 3 kV accelerating voltage, equipped with Energy-Dispersive X-ray facility (EDAX). The wool samples were sputtered with gold by using Edwards Sputter Coater S150B.

RESULTS AND DISCUSSIONS

The uptake of metal salts by wool fibres is, primarily, a diffusion process and consequently depends on the temperature and time of the process.
Figure 1 gives the effect of temperature and time of treatment of wool with Zr and Ti salts on the amount of metal uptaken by wool. As it may be noticed, the uptaken of both salts increases slightly upon increasing the time of treatment from 30 to 60 minutes and the temperature from 60 to 80°C (figure 1 – columns *a* & *b*). The amount sorbed by wool increases significantly (figure 1 – columns *b* & *c*) for the concentration of the salt solution changed from 1.5% to 3.0 %, and for the treatment carried at 80°C for 60 minutes.
Overall, under similar conditions wool has a clear tendency to uptake more Zr than Ti salt.
In many cases the activation of the active sites involved in the sorption process helps increasing the uptaken yield of a fibre. We examined this concept for influencing the sorption behaviour of Zr and Ti salt by wool. As a first activating agent we investigated the influence of pre-treating wool with ultrasonic waves. The fibres were kept up to 180 minutes in the ultrasonic bath at room temperature and, after squeezing and drying, they undergo the treatment with Zr and Ti salts for 60 minutes, at 80°C. The results of figure 2 show that the ultrasonic pre-treatment, even run for long period (up to 180 minutes) does not change significantly the sorption tendency of wool.
The experimental points are scattered around the values of 0.45 g Ti/100 g wool and, respectively, 0.55 g

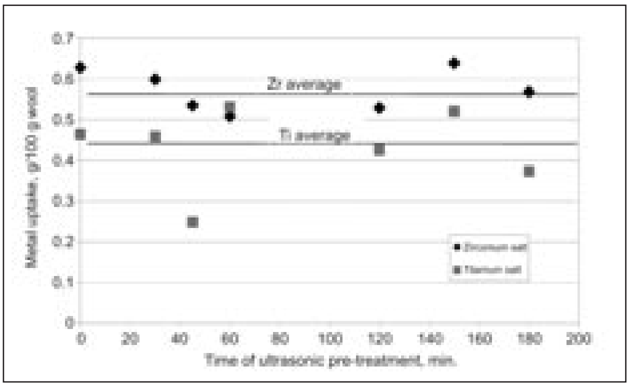


Fig. 2. The effect of ultrasonic pre-treatment

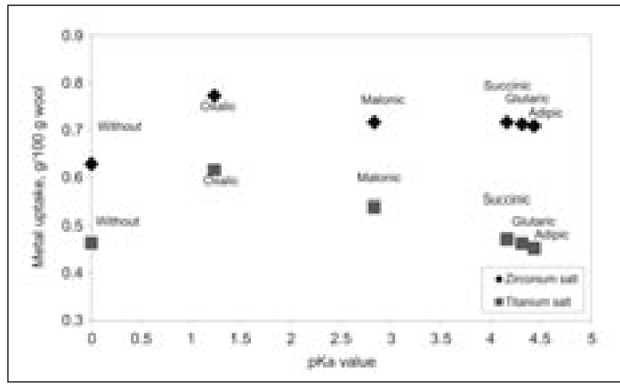


Fig. 3. Effect of pre-treatment with 0.03 M solution of various carboxylic acids

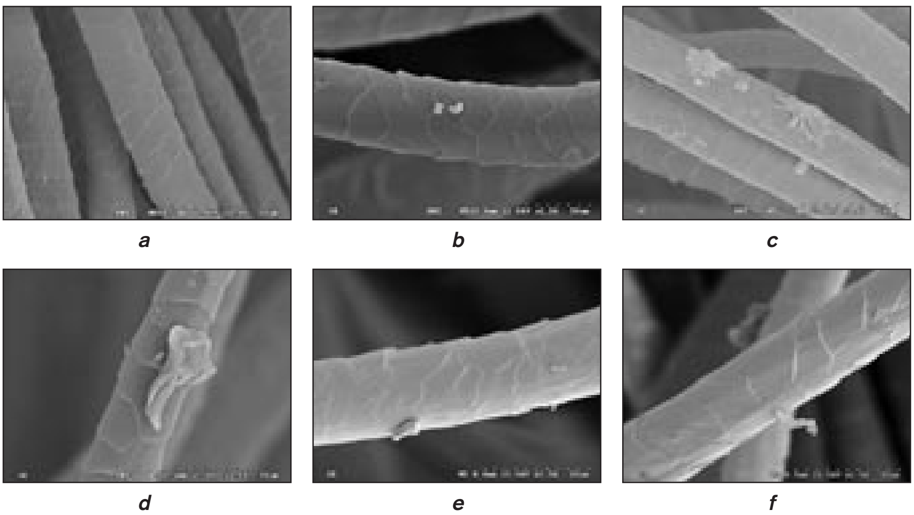


Fig. 4. Scanning electron microscopy (SEM) of wool untreated, or pre-treated with oxalic acid, followed by treatment with Zr, or Ti salt solutions:
a – untreated wool; ***b*** – wool pre-treated with oxalic acid (0.03 M, 75°C, 90 minutes, liquor ratio 1:50); ***c*** – wool treated with Zr salt solution (3.0% w/w, 80°C, 60 minutes, *p*H 2.5, liquor ratio 1:30); ***d*** – wool treated with Ti salt solution (3.0% w/w, 80°C, 60 minutes, *p*H 2.5, liquor ratio 1:30; ***e*** – wool pre-treated with oxalic acid (0.03 M, 75°C, 90 minutes, liquor ratio 1:50), then with Zr salt (3.0% w/w, 80°C, 60 minutes, *p*H 2.5, liquor ratio 1:30); ***f*** – wool pre-treated with oxalic acid (0.03 M, 75°C, 90 minutes, liquor ratio 1:50), then with Ti salt (3.0% w/w, 80°C, 60 minutes, *p*H 2.5, liquor ratio 1:30)

Zr/100 g wool values which have been achieved also without any activation (figure 1 – column *c*).

We have investigated next the pre-treatment of wool with organic acids. The results of the pre-treatment of wool with 0.03 M solution of various organic acids on fibres sorption capacity are summarized in figure 3. As it appears, the amount of metal uptaken by wool is a related to the pKa_a value of the organic acid used for pre-treatment. This effect is quite significant for Ti salt, in which case oxalic acid activates the uptake of 0.65 g Ti/100 g wool compared to the 0.45 g Ti/100 g wool adsorbed without activation. One notices, also, that the increase of the *pKa* value of the acid (from oxalic to adipic acid) reduces the amount of Ti salt uptaken by fibre to the non-activated level.

The effect of oxalic acid is also obvious for the case of Zr salt, the amount of uptaken salt increasing from 0.65 g Zr/100 g wool in case of untreated fibre to 0.77 g Zr/100 g wool. It is interesting to notice that in this case the acids having higher *pKa* values than oxalic acid still assist wool to uptake a larger amount of Zr salt than the untreated fibres (0.71 g Zr/100 g wool).

This is very likely due to the protonation of the fibre by the acid pre-treatment, an effect which enhances the sorption of the complex cations TiF_6^{2-}, or ZrF_6^{2-}, respectively.

The investigated pre-treatments are intended to improve the sorption of zirconium and titanium salts by wool, without damaging the performances of the fibres. Scanning electron micrographs of the samples pre-

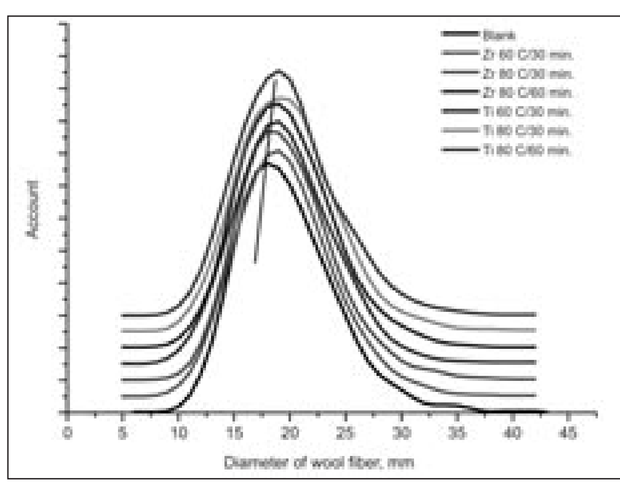
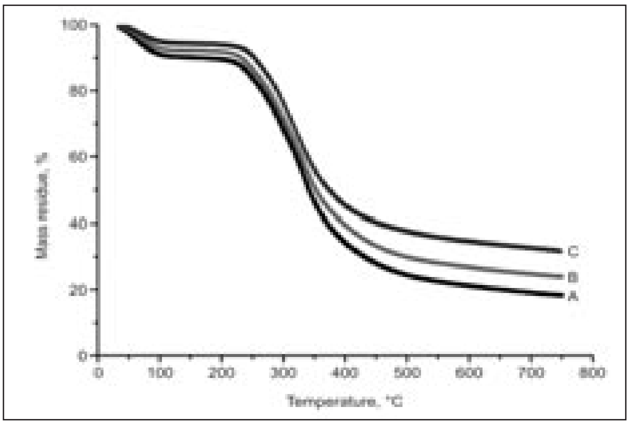
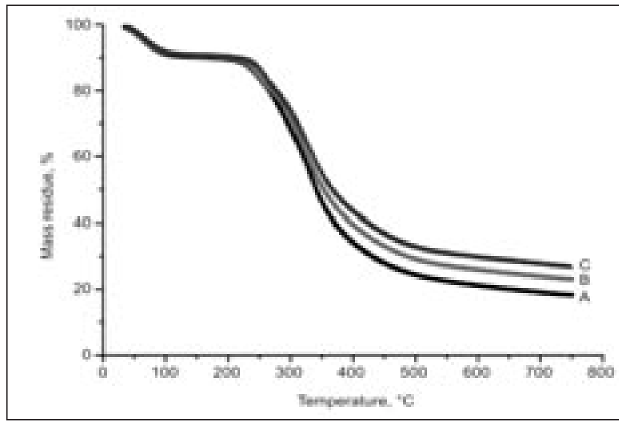


Fig. 5. Diameter distribution of wool fibres after treatment with Zr and Ti salts



a



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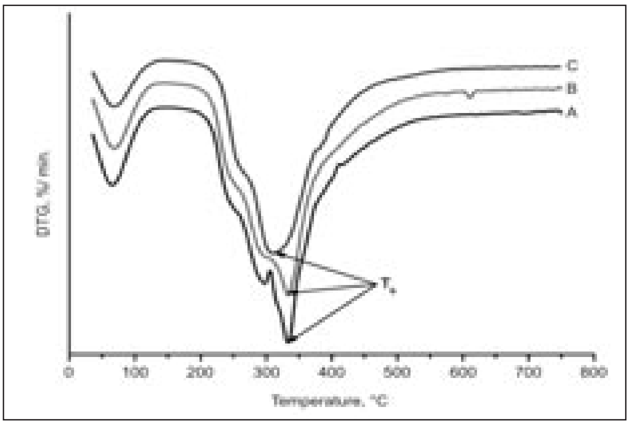

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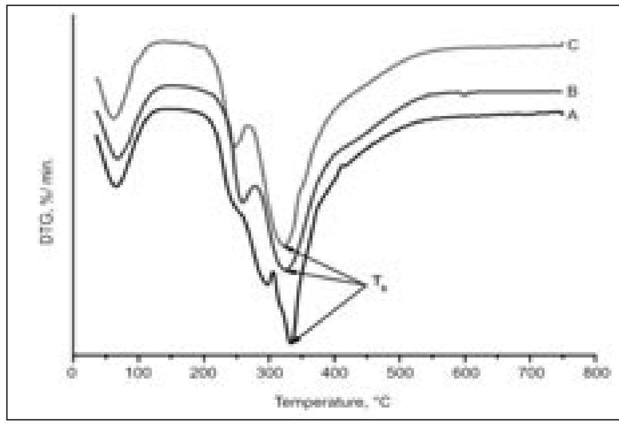

d

Fig. 6. Thermogravimetric analysis (TGA) and the derivatives (DTG) of wool samples treated with Zr, or Ti salt solution: ***a*** – untreated wool, TGA of wool treated with Zr salt; ***b*** – TGA of wool treated with Ti salt solution, 3% (w/w), 80°C, 60 minutes, *p*H 2.5, liquor ratio 1:30; ***c*** – DTG of wool pre-treated with oxalic acid 0,03 M, 75°C. 90 minutes, liquor ratio 1:50; ***d*** – DTG of wool treated with salt solution (3% w/w), 80°C, 60 minutes, *p*H 2.5, liquor ratio 1:30

treated with acids followed by sorption of zirconium and titanium salt solutions are shown in figure 4. The surface of wool treated with Zr, or Ti salt does not appear affected, indicating the fibre cuticle remained intact.

We have been also concerned with the possible effect of salt solution absorption on the diameter of wool fibre, as this may affect the end-product quality. As figure 5 shows the mean fibre diameter as measured by OFDA increases slightly with the amount of up-taken salt but one cannot find a significant variation in any experiment. One may thus conclude that the wool mean fibre diameter is not affected by the treatment operations.

The main use of zirconium, or titanium salts for wool finishing is to impart the flame-retardant effect to the fibre. For this reason we have investigated by the help of thermo-gravimetrical analysis (TGA) the flammability of wool with respect to the pre-treatment conditions. The TGA curves and their derivatives, DTG, are shown in figure 6 for the case of Zirconium and Ti salts.

As figure 6 shows, the mass loss depends on the treatment, being the highest for the untreated fibre and the lowest for the oxalic acid pre-treated samples.

The recorded curves allow defining the temperature of burning, T_b, as the peak temperature of the oxidative decomposition process determined on the derivative of thermo-gravimetric curve (DTG) under a heating of 10 K/minutes. The results indicate that the temperature of burning is not significantly changed by the treatment and is found around 300–330°C in all the cases, without a dependence on the type or intensity of the treatment.

CONCLUSIONS

We investigated the potential of two pre-treatments, namely the use of ultrasonic waves and of carboxilic acids, for activating the ability of wool to absorb Zr or Ti salts. The pretreament of wool with ultrasonic waves before applying Zr or Ti salt does not significantly improve the tendency of wool to take up the metal salts. On the other side the pretreament of wool with oxalic acid leads to the relatively largest amount of salt uptaken by wool. Other carboxylic acids, with higher pKa values, show the same effect but at lower extent in the case of Zr salt, and the effect is almost vanishes for the case of Ti salt. The thermo-gravimetrical investigation put into evidence an increase of the residual mass at 800°C, without significant change of the temperature of burning, T_b. The region of fibre pyrolysis ranges from 230°C to 330°C for Zr of Ti salt/oxalic acid treatment. The SEM examination indicates that the surface of wool fibres treated with Zr, or Ti salt is not affected. The mean diameter of wool fibres before and after treatment with metal salts shows a slight, but still negligible thickening effect of the treatment. One may speculate, only, that increasing the concentration of salt for treatment could increase further the diameter.

Overall we conclude that the use of Zr salts on an oxalic acid pre-treated wool allows a better exhaustion of the Zr salt probably because of fibre protonation, and this way it results in better flame retardant property than the use of the salt on a non pre-treated fibre. Other fibre technological properties (surface, diameter) remains unaltered. Using Ti salt the results are similar, but less evident.

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DOCUMENTARE

Textile nețesute

LINII COMPLETE PENTRU PRODUCȚIA DE NEȚESUTE

Compania franceză ***Laroche***, din Cours La Ville, specializată în producerea și instalarea de echipamente pentru industria de nețesute, fibre scurte și reciclarea materialelor, a prezentat la târgul internațional *ITMA 2011* o linie completă de nețesute.

Compania a elaborat și pune la dispoziția beneficiarilor o nouă tehnologie *Flexiloft plus*, cu o uniformitate îmbunătățită a vălului.

Această tehnologie poate fi aplicată tuturor tipurilor de fibre – sintetice, naturale, reciclate etc., precum și amestecurilor din fibre și particule solide, cum ar fi fragmente spongioase, materiale plastice, așchii de lemn, permițând realizarea de produse inteligente din resurse regenerabile și din deșeuri refolosibile.

De asemenea, au fost lansate liniile tehnologice *Jumbo* de tăiere/rupere automată, cu sistem de transfer îmbunătățit și cu dispozitive speciale de reciclare a îmbrăcămintei și a deșeurilor de covoare, precum și noua mașină de mare viteză pentru desfibrarea și tăierea marginilor *Minitrim HSP 400*.

În plus, compania a prezentat cele mai recente inovații în domeniul prelucrării fibrelor, și anume linii tehnologice de înaltă precizie de dozare și amestecare a fibrelor, linii tehnologice complete de decorticare-desfibrare a fibrelor liberiene – in, cânepă, chenaf etc., care să permită o desfibrare delicată și curățarea la prețuri de cost scăzute, precum și un nou concept de ignifugare a fibrelor celulozice și a fibrelor reciclate.

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Researches on steels destined to actuators specific for textile mechatronics systems

LUCIAN CONSTANTIN HANGANU SEBASTIAN-TITUS DUMA

REZUMAT – ABSTRACT – INHALTSANGABE

Cercetări asupra unor oţeluri destinate organelor de lucru specifice sistemelor mecatronice textile

Maşinile textile ce aparţin domeniului mecanicii fine sunt deosebit de complexe, cu multe lanţuri cinematice şi cu numeroase posturi de lucru, ale căror repere în mişcare necesită un control strict şi precis al dinamicii acestora. Nu există echipament modern textil care să nu conţină în structura sa subansambluri din categoria sistemelor mecatronice, ce oferă atât flexibilitate, cât şi o rapidă adaptabilitate la tehnologia pe care o deservesc. Dar, simplitatea constructivă, robusteţea, fiabilitatea ridicată, siguranţa în funcţionare, preţul accesibil al echipamentelor textile de ultimă generaţie nu pot fi atinse decât dacă, încă din primele faze ale proiectării, sunt luate în considerare cele mai mici detalii specifice tuturor componentelor mecanice din structură şi, implicit, întregul spectru de probleme tehnice privind tehnologiile de realizare a acestora. Lucrarea îşi propune să contribuie la determinarea pe cale experimentală a influenţei unor parametri tehnologici specifici călirii la temperaturi negative asupra structurii, durităţii şi stabilităţii dimensionale a organelor de maşini de mare precizie, realizate din oţel 100 Cr6, care intră în componenţa echipamentelor textile şi a elementelor actuatoare din sistemele mecatronice destinate acestora – came de comandă, diverse tipuri de ace, fuse textile, rulmenţi, roţi dinţate etc.

Cuvinte-cheie: echipament textil, sistem mecatronic, călire la temperaturi negative, duritate, stabilitate dimensională, oţel, tehnologie

Researches on steels destined to actuators specific for textile mechatronics systems

Textile machines from the field of fine mechanics are very complex, with many kinematic chains and many workstations, whose moving parts require strict and precise control of their dynamics. All modern textile machines contain sub-mechatronics sub-assemblies systems, offering both flexibility and rapid adaptability to the technology they support. In order to achieve the constructive simplicity, robustness, high reliability and affordability of the last generation textile equipment, the most specific details of all the mechanical components and all technical issues on production technologies are considered even from the early stages of design. This paper aims to determine experimentally the influence of technological parameters specific to hardening at negative temperature on the structure, hardness and dimensional stability of high precision machine parts made of steel 100 Cr6. These are a component of the textile equipment and actuators of mechatronic systems – cams, various types of needles, textile spindles, bearings, gears etc.

Key-words: textile equipment, mechatronic systems, hardening at negative temperatures, hardness, dimensional stability, steel, technology

Untersuchungen betreff Stahltypen bestimmt für Arbeitsorgane der Textilmechatronischen Systeme

Die Textilmaschinen des Feinmechanikgebietes sind besonders komplex, mit vielen kynematischen Ketten und mehreren Produktionsposten, deren Einzelteile in Bewegung eine sternge und genaue Kontrolle deren Dynamik voraussetzt. Es gibt keine moderne Textilausrüstung ohne Bauteilgruppen der Kategorie mechatronischer Systeme, welche sowohl Flexibilität als auch eine schnelle Anpassung zur entsprechenden Technologie anbietet. Doch, die einfache Baustruktur, die Widerstandsfähigkeit, die hohe Zuverlässigkeit, die Arbeitssicherheit, der kostengünstige Preis der Textilausrüstungen der letzten Generation können nicht erreicht werden, ohne die Berücksichtigung der Einzeldetails spezifisch der mechanischen Strukturkomponenten und gleichzeitig das Gesamtspektrum der technischen Probleme betreff der Fertigungstechnologien, schon während der Entwurfsettape. Die Arbeit nimmt sich vor zur Bestimmung der Einwirkung einiger technologischen Parameter spezifisch der Abschreckung bei negativen Temperaturen der Struktur, der Härte und der dimensionellen Stabilität auf experimenteller Weise beizutragen. Es werden die Maschinenorgane mit feinster Genauigkeit, geferigt aus 100 Cr6 Stahl, welche im Aufbau der Textilausrüstungen und der Aktuatorelemente der mechatronischen Systeme eingegliedert sind, angesprochen – Steuerungsnocken, unterschiedliche Nadeltypen, Textilspindel, Lager, Zahnräder usw.

Stichwörter: Textilausrüstung, mechatronisches System, Abschreckung bei negativen Temperaturen, Härte, dimensionelle Stabilität, Stahl, Technologie

After the quenching treatment (heating in salt baths at $T = 840^{o}$C for a certain amount of time in order to attain the specified temperature on the whole part followed by cooling in oil) the result is a structure formed out of quenching martensite, carbides and residual austenite. The resulting hardness is high (approx. 830 HV_{10}) [1, 2]. It has been experimentally proven that the percentage of residual austenite, in time, leads to reduced hardness, structural and dimensional changes (for example if the hardness after normal quenching was measured at 830 HV_{10}, after two years the same sample suffered modifications bearing a hardness of 724 HV_{10}) [2]. For high precision parts that compile textile machines, these changes may produce problems in time (cinematic modification, jams). This can be avoided by applying the negative temperature quenching treatment.

The thermic treatment of steel for cooling under 0^{o}C represents a continuation of the quenching, interrupted by the fact that the steel did not cool down below the final temperature of the martensitical transformation *Mf*. This procedure has spread and is called treatment at subzero temperatures or treatment at temperatures below 0^{o}C.

With the treatment at temperatures below 0^{o}C an increase of hardness is recorded that varies according to the quantity of residual austenite in the quenched steel (from 1–2 HRC up to 20–30 HRC). The change in the properties is larger when the quantity of martensite increases.

For steels that contain, after quenching an amount of 90% of martensite (the hardness of the steel in a quenched state is close to its maximum) the treatment at temperatures below 0^{o}C must be applied immediately, at no more then 0.5 hour after the quenching treatment. In case of a larger amount of residual austenite the treatment can be applied after 1–2 hours [3, 4].

Tempering is prohibited before the quenching treatment because the austenite stabilizes and, in most cases, martensite does not form at cooling below 0^{o}C.

Table 1

C, %	Mn, %	Si, %	Cr, %	P, %	S, %	Ni, %
1.00	0.33	0.29	1.6	0.014	0.006	0.12

EXPERIMENTAL RESULTS

The experiments have been performed on samples of ∅ 20 x 10 mm out of suplementary refined 100 Cr6 steel. The chemical composition of the sample's material is presented in table 1.

The first experimental lot of samples was quenched at 840°C, optimum temperature obtained from experiments performed before [1] and after this, the low temperature quenching treatment was applied (temperatures of –30, –90, –120 and –183°C). After the treatment, the hardness HV_{10} for each sample has been measured. Each sample has been metal graphically prepared and structurally analyzed using electron microscopy and X-rays diffraction. The structure of through section is homogenous and shows fine martensite, remaining carbides from initial status – globulisation – small and even spread carbides and quantities of residual austenite. The less residual austenite is present the lower the ambient temperature is under 0°C.

To analyse the steel martensite, a few theoretical aspects are presented: it is known that the elementary cell of martensite is characterized by the so called degree of tetragonality, given by the ratio a_3/a_1 which geometrically calculated is $\frac{a}{a\sqrt{2}} \cong 1.43$. This means that in the region where the martensite transforms there is a contraction of the network with 18% along the directions $(a_1)_M$ and $(a_2)_M$ and an expansion of 12% along axis $(a_3)_M$. The degree of tetragonality of the martensite depends mainly on the percentage of dissolved carbon in its cell during the martensitic transformation, that is $c/a = f(\%C)$ and varies between 1.00 and 1.08. The martensite, after the degree of tetragonality is classified in tetragonal martensite when $c/a > 1.00$ and cubic martensite when $c/a \cong 1.00$. In special literature of the dependence of the tetragonality degree c/a and the parameters a and c of the elementary cell from the dissolved carbon content.

The analitical relations (the Kurdinomov relations) of a and c parameters variation of the carbon percentage are given by the following expressions:

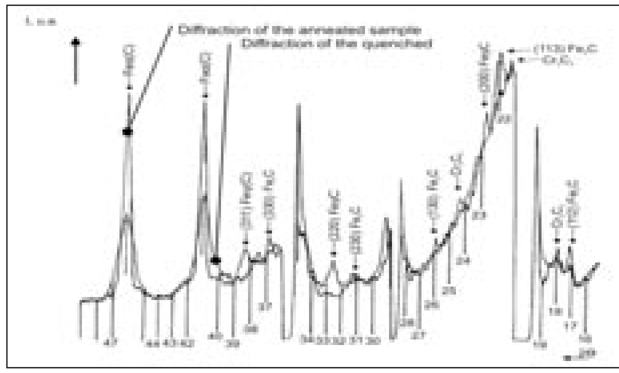
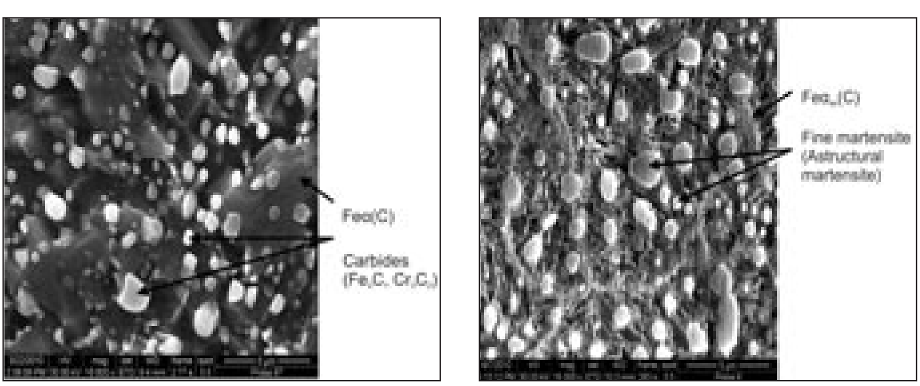


Fig. 1. Difraction overlap for the same annealed and quenched sample

$$c = a_0 + 0.118 \cdot (\%C)$$
$$a = a_o - 0.015 \cdot (\%C) \qquad (1)$$
$$\frac{c}{a} = 1 + 0.0467 \cdot (\%C)$$

The measurement of the dissolved carbon content in martensite is made after the spectrum of diffraction lines. So, when the content of dissolved carbon in the martensite is lower than 0.6% then a series of the spectrum's lines broaden, and when the dissolved carbon content is higher than 0.6% a series of the spectrum's lines split and the others – the ones with equal index like (222), move in the spectrum towards lower angles.

In the project difractometrical curves are presented for different states of thermic treatment. It is observed that everywhere we have a broadening of a line (211) and not splitting. Due to this, the percentage of carbon dissolved in the martensite network is lower (< 0.6%). Under these conditions due to, the lack of another X – rays tube with higher wavelength λ to obtain a better spectral resolution (the diffraction curves were made in the laboratory of the SMTT department – Politehnica Timișoara using the DRON3 device and MoKα radiation) the evaluations of the percentage of carbon dissolved in the martensite will be calculated after the broadness of the diffraction line. The difference will be made between the broadening of the widthened diffraction line and the broadness of the same line of the traced spectrum from the same annealed steel. Depending on this difference expressed in degrees the percentage of carbon disolved in the martensite results from graphics. In figure 1 the overlapping of the diffractograms for the same sample in different stages one annealed and one



a *b*

Fig. 2: ***a*** – annealed sample (globulizated sample); ***b*** – quenched sample

Table 2

PERCENTAGE OF CARBON DISSOLVED IN THE MARTENSITE, THE DEGREE OF TETRAGONALITY OF THE MARTENSITE AND THE HARDNESS					
Quenching temperature, °C	Temperature of subzero treating, °C	Duration of the subzero treatment, minute	Hardness, HV_{10}	Carbon dissolved in the martensite, %	Degree of tetragonality of the $\frac{c}{a}$
840	–30	180	830	0.45	1.015
840	–90	180	835	0.50	1.023
840	–183	180	850	0.58	1.027

Observation: The HV_{10} hardness have been determined at the National Institute of Metrology using the gauge device for determining the Vickers hardness

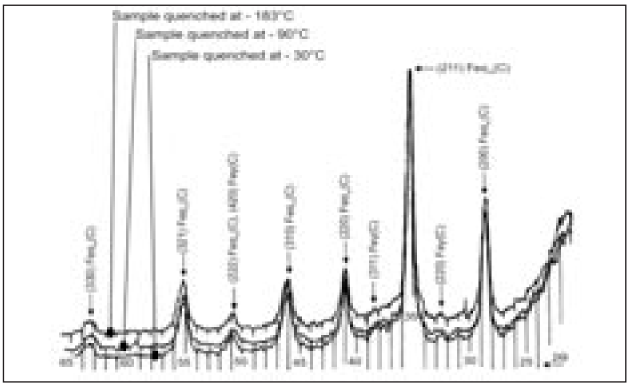


Fig. 3. The overlapped diffractions peaks are presented, in the maximum force point of the martensitical peak (211 $Fe_{\alpha ss}$), for the samples quenched at –30, –90 and –180°C

quenched. Furthermore the nature of the drops and broadening – shrinking of the Feα (C) lines can be observed. For a better view of the nature of the drops from the overlapping above presented, the large ones have been excluded, (211) Feα (C), (200) Feα (C) and in figure 2 their microstructures (electronic microscopy 16 000 X).

In figure 3 the overlapped diffractions peaks are presented, in the maximum force point of the martensitical peak (211 $Fe_{\alpha ss}$), for the samples quenched at –30, –90 and –180°C. The diffraction for the sample quenched at –120°C is not presented because it is easily confused with the one quenched at –180°C. This overlapping helps the observation of how the cooling temperature decreases, the broadness of the martensitical peack grows. This determines a growth of the degree of tetragonality of the martensite and there is more residual austenite transformed, observed sclero-

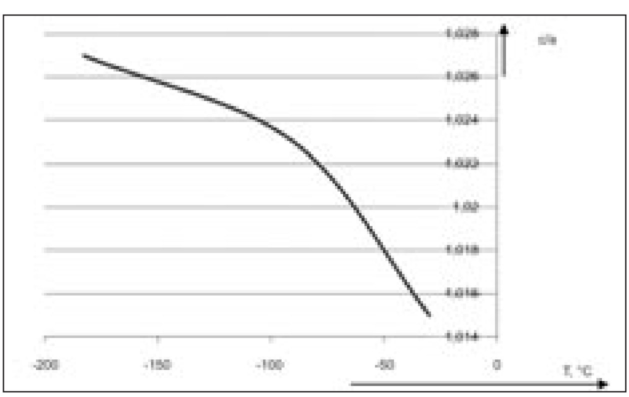


Fig. 4. Dependence of martensitical degree of tetragonality with the subzero treating temperature

Table 3

THE PERCENTAGE OF CARBON DISSOLVED IN THE MARTENSITE, THE DEGREE OF TETRAGONALITY OF THE MARTENSITE AND THE RESULTING HARDNESS					
Quenching temperature, °C	Temperature of subzero treating, °C	Duration of the subzero treatment, minute	Hardness, HV_{10}	Carbon dissolved in the martensite, %	Degree of tetragonality of the $\frac{c}{a}$
840	–183	180	850	0.58	1.027
840	–183	60	824	0.58	1.027
840	–183	30	822	0.45	1.015

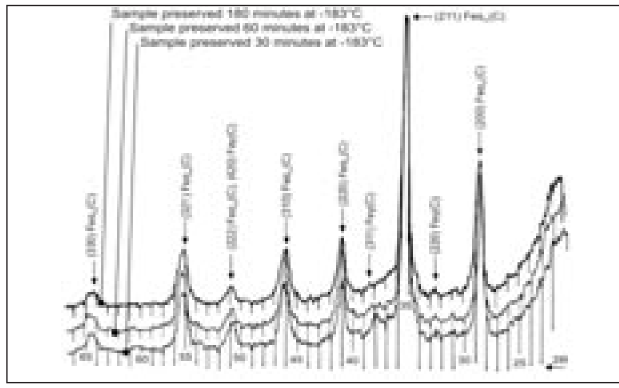


Fig. 5. The overlapped diffractions peaks are presented, in the maximum force point of the martensitical peak (211 $Fe_{\alpha ss}$), for the samples preserved 30, 60 and 180 minutes at –183°C

metrically by a light growth of hardness. Table 2 shows the percentage of carbon dissolved in the martensite, the degree of tetragonality of the martensite and the hardness.

In figure 4 the dependences of the martensitical degree of tetragonality are presented with the temperature of quenching at very low temperatures as to observe the light growth of the degree of tetragonality with the diminuation of the cooling environment temperature.

Analysing the overlapping of the diffractions in figure 3 a decrease of the austenite peaks is noticed with the decrease of the low temperature quenching temperature. Because the determining of the percentage of residual austenite with the diffraction method is not very exact percentages of residual austenite but only the temperature of the subzero quenching environment at which the residual austenite does not influence the evaluation in time of the material.

This can be deduced (based on the figures and the tables presented) based on the fact that after the oil quenching at 25°C the continuation of cooling at temperatures lower then –90°C leads to an increase of the hardness as a result f the growth of the martensitical degree of tetragonality and the low percentage of residual austenite.

Experiments have been made in order to analyse the influence of preserving at the sub-zero treatment upon the martensitical transformation at temperatures of –183°C for 30, 60, 120 and 180 minutes. The time interval between quenching and the treatment at temperatures under 0°C is 0.

In figure 5 the overlapped curves of diffraction are presented at the maximum intensity point of the martensite peak (211) for the samples just mentioned. With this overlapping it can be observed that with the increase of the time spent at subzero temperatures the broadness

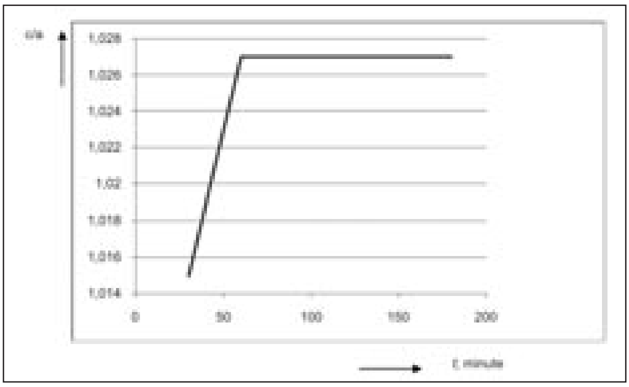


Fig. 6. Dependence of martensitical degree of tetragonality with the duration of the subzero treatment

of the martensitical peak grows (the degree of tetragonality grows, hardness also grows).
In figure 6 it is graphically presented the dependence of the martensitical degree of tetragonality with the time interval of keeping at subzero temperatures. It is observed that with the growth of the time spent at subzero temperatures the degree of tetragonality increases.
Of the things presented we can say that from the point of view of keeping at subzero temperatures like –183°C this duration must be prolonged as much as possible (120, 180 minutes) in order to transform a higher percentage of residual austenite resulted during tempering.

CONCLUSIONS

For some machine parts compiling high precision machines that are found within textile machines an that demand special conditions like high hardness, structural and dimensional stability of their properties, a special thermic treatment is compulsory. Normally quenching of parts made out of 100 Cr6 steel must be followed by negative temperature treatment. The technical parameters of negative temperature quenching experimentally determined are: temperature of the cooling environment is at least –120°C, and a holding period of at least 120 minutes.

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COMPARĂRILE INTERLABORATOARE – INSTRUMENT INTERACTIV PENTRU ASIGURAREA CALITĂŢII REZULTATELOR ÎN LABORATOARELE DE ÎNCERCĂRI

Îmbunătățirea continuă a performanțelor reprezintă nu numai un principiu important al managementului calității, ci și o condiție esențială a supraviețuirii laboratoarelor de încercări într-un mediu competitiv. A identifica ce, unde și cum trebuie aduse îmbunătățiri în funcționarea unui laborator nu este un lucru ușor, dar este realizabil. În ultimii ani, comparările interlaboratoare au căpătat o importanță deosebită, atât ca instrument de asigurare/verificare a trasabilității în procesul de acreditare, cât și ca instrument de validare, respectiv de control al calității activității desfășurate în cadrul laboratoarelor de încercări, acreditate sau aflate în curs de acreditare. Participarea la scheme de comparări interlaboratoare oferă o verificare independentă a competenței unui laborator în ceea ce privește încercările efectuate și respectarea angajamentului de menținere și îmbunătățire a performanțelor sale.

Comparările interlaboratoare, utilizate pe scară largă, în diverse scopuri, sunt în continuă creștere atât pe plan național, cât și internațional și presupun:

- evaluarea performanțelor laboratoarelor de încercări și monitorizarea continuă a performanțelor acestora;
- identificarea problemelor apărute în laboratoare și inițierea de acțiuni corective/preventive;
- stabilirea eficacității și a caracterului comparabil al metodelor de încercare/măsurare;
- evaluarea caracteristicilor de performanță aferente unei metode;
- identificarea diferențelor dintre valorile obținute de diferite laboratoare pentru aceleași masurători;
- furnizarea unui plus de încredere în rândul clienților, prin confirmarea calității încercărilor.

Prin participarea la scheme de comparări interlaboratoare, se demonstrează clienților, organismelor de acreditare, autorităților și conducerii laboratorului că procedurile analitice se află sub control, că rezultatele sunt repetabile și că personalul executant posedă o instruire suficientă, pentru a furniza date corespunzătoare. De asemenea, participarea unui laborator de încercări la scheme de comparare interlaboratoare este o cerință obligatorie pentru acreditarea de către un organism de acreditare semnatar al acordurilor de recunoaștere multilaterală EA/ILAC MLA.

Orice laborator de încercări, indiferent de domeniul de activitate, trebuie să funcționeze conform unui sistem al calității. Pentru aceasta, el trebuie să îndeplinească cerințele standardului SR EN ISO 17025: 2005 „Cerințe generale pentru competența laboratoarelor de încercări și etalonări“. Pentru respectarea acestui standard, laboratorul trebuie să dovedească preocupări pentru menținerea sistemului calității și pentru îmbunătățirea continuă a competenței tehnice. Controlul calității rezultatelor încercărilor obținute într-un laborator implică identificarea și eliminarea cauzelor ce duc la performanțe nesatisfăcătoare, urmată de o atentă monitorizare a acestora. Una dintre modalitățile cele mai eficiente de monitorizare a performanțelor unui laborator de încercări, față de propriile sale cerințe, dar și față de prestația altor laboratoare din același domeniu, este prevăzută în subcapitolul 5.9. al standardului SR EN ISO 17025 „Modul în care este asigurată calitatea rezultatelor încercărilor și etalonărilor“, și anume participarea cu regularitate la scheme de comparări interlaboratoare. Acestea pun în evidență atât performanțele de repetabilitate și reproductibilitate între laboratoare, cât și erorile sistematice și incertitudinea de măsurare.

Odată cu adoptarea standardului SR EN ISO/CEI 17043:2010, de către Asociația de Standardizare din România, au fost reglementate în mod uniform, pentru prima dată, cerințele generale privind competența furnizorilor de scheme de încercări de competență, dar și cerințele privind realizarea efectivă a schemelor de testări interlaboratoare.

Aspecte teoretice

Definirea termenilor specifici

Definirea termenilor specifici, conform SR EN ISO/CEI 17043:2010 „Evaluarea conformității. Cerințe generale pentru încercările de competență“:

- *Compararea interlaboratoare* reprezintă organizarea, efectuarea și evaluarea unor măsurări sau încercări pe obiecte identice sau asemănătoare, de către două sau mai multe laboratoare, în condiții predeterminate.
- *Încercarea de competență* reprezintă evaluarea performanțelor unui participant cu ajutorul comparărilor interlaboratoare, conform unor criterii prestabilite.
- *Runda de încercări de competență* este secvența completă unică de distribuire a obiectelor supuse încercării de competență, precum și evaluarea și reportarea rezultatelor către participanți.
- *Furnizorul de încercări de competență* este acea organizație care își asumă responsabilitatea pentru toate sarcinile de dezvoltare și realizare a unei scheme de încercări de competență.
- *Valoarea atribuită* reprezintă valoarea alocată unei anumite proprietăți a unui obiect supus încercării de competență.
- *Valoarea aberantă* este acea valoare care nu este consecventă cu celelalte elemente ale acelui set.
- *Incertitudinea de măsurare, U,* reprezintă parametrul asociat rezultatului măsurării, ce caracterizează dispersia valorilor care pot fi atribuite în mod rezonabil măsurandului.

Tipuri de scheme de încercări de competență

Există mai multe tipuri de scheme de încercări de competență: *cantitative* – cu rezultate numerice, *calitative* – cu rezultate descriptive, și *interpretative*. Din punct de vedere al modului de desfășurare a încercării de competență, există următoarele situații:

- *Scheme cu participare secvențială* – care presupun ca obiectul supus încercării de competență să fie distribuit secvențial pentru încercare sau măsurare și să fie returnat secvențial furnizorului de încercări de competență. În acest caz, rezultatele măsurării individuale sunt comparate cu valoarea atribuită.

- *Scheme cu participare simultană* – care implică o etapă premergătoare de eşantionare, urmată de distribuirea simultană şi de măsurarea simultană, într-o perioadă de timp definită. După finalizarea încercărilor, rezultatele sunt comunicate furnizorului de încercări de competenţă şi comparate cu valoarea atribuită. Materialele supuse încercării pot fi materiale de referinţă certificate, obiecte supuse unor runde de încercări de competenţă anterioare, un material pentru care s-a stabilit gradul de omogenitate/dispersie a rezultatelor în condiţii de repetabilitate.
- *Schema continuă* – care presupune ca obiectele supuse încercării de competenţă să fie furnizate la intervale regulate. Pentru domeniul medical, se utilizează expresia „Evaluare externă a calităţii“ (External Quality Assessment – EQA). O trăsatură tipică a programelor EQA este aceea de a asigura educarea participanţilor şi de a promova îmbunătăţirea calităţii. În cazul acestor programe, obiectul supus încercării, care poate fi un chestionar sau un studiu de caz, este transmis fiecărui participant de către furnizorul de EQA, pentru a primi răspunsuri specifice. Conform Ghidului Eurachem („The fitness for purpose of analytical methods – a laboratory guide to method validation and related topics“, 1998 şi „Traceability in chemical measurement, 2003), în schemele EQA se poate cere participanţilor să furnizeze eşantioane procesate, rezultate şi/sau rapoarte ale încercărilor curente de laborator sau documentaţie şi înregistrări ale asigurării/ controlului calităţii.

Criterii statistice de evaluare a performanţelor

Pentru a evalua calitatea rezultatelor furnizate de către participantii la încercările de competenţă, se parcurg următoarele etape:

- *Determinarea valorii atribuite măsurândului,* respectiv *valori cunoscute*, de exemplu, în cazul unei încercări fizico-chimice, prin diluarea unei soluţii de concentraţie cunoscută; *valori de referinţă certificate,* obţinute în baza unui certificat emis de producător, pentru care au fost declarate valorile incertitudinii de măsurare; *valori de consens ale laboratoarelor,* care reprezintă, de regulă, media măsurandului, calculată după eliminarea valorilor aberante, utilizând teste statistice precum Dixon, Grubbs, Cochran, Mandel etc., alese în funcţie de numărul de date disponibile.
- *Caracterizarea statistică a rezultatelor,* conform SR ISO 5725:2002 „Exactitatea (justeţea şi fidelitatea) metodelor de măsurare şi a rezultatelor măsurărilor. Părţile 1–5“. În urma observării caracteristicii cantitative x în N probe, se obţin următoarele date primare:

$$x_1, x_2, x_3, \ldots, x_n \qquad (1)$$

– Valoarea medie calculată sub forma mediei aritmetice, având formula:

$$\bar{x} = \frac{\sum_{i=1}^{N} x_i}{N} \qquad (2)$$

– Diferenţa absolută, având formula:

$$D = |X - \bar{x}| \qquad (3)$$

în care:

X reprezintă rezultatul participantului;
$\bar{x}$ – valoarea atribuită.

– Diferenţa absolută, având formula:

$$D\% = \frac{|D|}{\bar{x}} * 100 \qquad (4)$$

– Abaterea standard, adică radicalul mediei pătratice a abaterilor datelor faţă de medie, calculată cu formula:

$$\sigma_x = \sqrt{\frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{N}} \qquad (5)$$

– Valorile scorului z:

$$z = \frac{X - \bar{x}}{\sigma_x} \qquad (6)$$

în care:

σ_x reprezintă abaterea standard.

– Numerele En,

$$E_n = \frac{X - \bar{x}}{\sqrt{U_{lab}^2 + U_{ref}^2}} \qquad (7)$$

în care:

U_{lab} reprezintă incertitudinea extinsă a rezultatului participanţilor;
U_{ref} – incertitudinea extinsă a valorii atribuite laboratorului de referinţă.

- *Evaluarea performanţelor*, care presupune consensul experţilor, evaluarea statistică (scorul z sau criteriul En), utilizarea graficelor pentru compararea rezultatelor. Astfel:

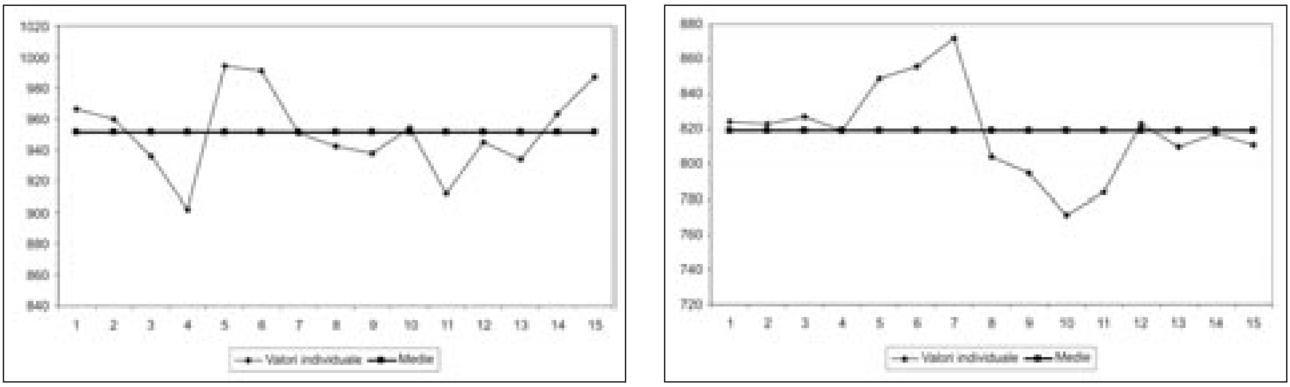
– pentru valorile z,
$|z| \le 2$ indică performanţe „satisfăcătoare“ şi nu generează niciun semnal (8)
$2 < |z| < 3$ indică performanţe „discutabile“ şi generează un semnal de alarmă (9)
$|z| \ge 3$ indică performanţe „nesatisfăcătoare“ şi generează un semnal de acţiune (10)

– pentru numerele E_n,
$|E_n| \le 1$ indică performanţe „satisfăcătoare“ şi nu generează niciun semnal (11)
$|E_n| > 1$ indică performanţe „nesatisfăcătoare“ şi generează un semnal de acţiune (12)

Algoritm de desfăşurare a schemelor de comparări interlaboratoare

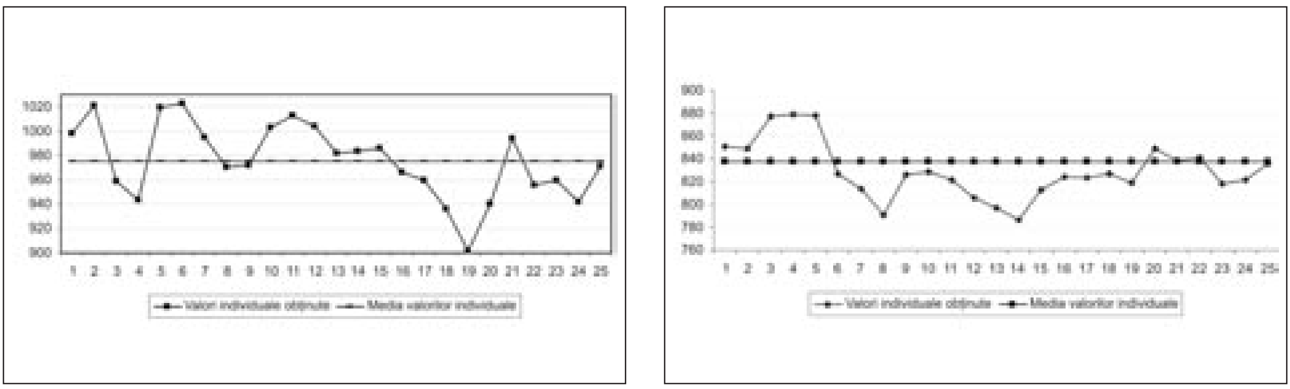
Algoritmul de desfăşurare cuprinde, în ansamblu, următoarele activităţi:

- lansarea invitaţiilor şi comunicarea politicii privind confidenţialitatea rezultatelor;
- selectarea probelor;
- experimentări în vederea determinării omogenităţii loturilor, dacă nu sunt disponibile materiale de referinţă certificate;
- prelevarea şi codificarea eşantioanelor;
- codificarea laboratoarelor participante;
- distribuirea probelor şi a formularelor pentru înregistrarea rezultatelor;
- prelucrarea statistică a rezultatelor comunicate de laboratoarele participante;



a *b*

Fig. 1. Distribuția valorilor rezistenței la tracțiune în:
a – sistemul de urzeală, *U*; ***b*** – sistemul de bătătură, *B*



a *b*

Fig. 2. Graficele de distribuție a valorilor individuale față de medie în:
a – sistemul de urzeală, *U*; ***b*** – sistemul de bătătură, *B*

– elaborarea și completarea formularului de evaluare a rezultatelor;
– transmiterea rezultatelor către participanți.

Având în vedere faptul că, pentru domeniul textil, nu sunt disponibile materiale de referință sau materiale de referință certificate, sunt necesare teste preliminare de determinare a omogenității loturilor.

Experimentări efectuate

Pentru a evidenția pașii algoritmului descris, în cadrul încercărilor de competență organizate de I.N.C.D.T.P., în scopul determinării rezistenței la tracțiune a țesăturilor, în conformitate cu standardul SR EN ISO 13934-1:2002, se folosește o mostră de țesătură având în compoziție 40% bumbac și 60% poliester. S-au efectuat mai întâi teste pentru determinarea omogenității lotului. Cu ajutorul testelor statistice, s-a verificat prezența valorilor aberante, apoi s-a determinat abaterea standard caracteristică setului de valori experimentale obținute. În figura 1 este prezentată distribuția valorilor experimentale viabile, față de valoarea medie calculată. Constatarea neuniformității este un atribut specific al elementelor de structuri textile-fibră, fir, țesătură, tricot. Distribuția valorilor obținute în determinarea tracțiunii, pentru ambele sensuri ale țesăturii, confirmă neuniformitatea materialului utilizat în intercomparare. Pentru a nu descalifica anumite rezultate, cauzate de neuniformitatea probelor, se va opta pentru o abatere standard permisă a rezultatelor de ± 1,5 s.

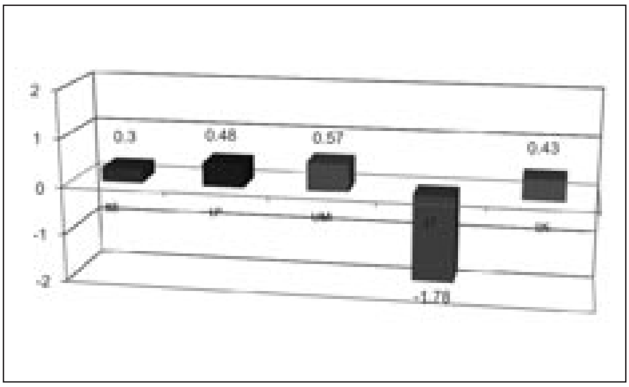
Interpretare statistică

Eșantioanele transmise participanților au fost analizate într-un interval de timp prestabilit, urmărind indicațiile din standardul de metodă specificat. În figura 2 sunt reprezentate grafic distribuțiile valorilor individuale, centralizate de organizator, față de valoarea medie calculată după excluderea rezultatelor aberante, conform testului Dixon. În cazul țesăturii analizate, pentru rezistența la tracțiune în sistemele de urzeală și de bătătură se constată o dispersie semnificativă a rezultatelor, din cauza neuniformității elementelor constitutive ale țesăturii, respectiv a densității de lungime și a caracteristicilor mecanice ale firelor. Rezultatele furnizate de către laboratoarele participante au fost evaluate de către I.N.C.D.T.P., indicatorul statistic utilizat fiind scorul *z*.

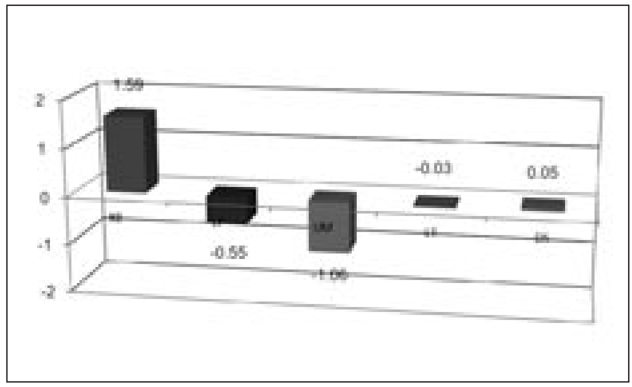
Prin aplicarea scorului *z* asupra datelor analizate, conform relațiilor (6), (8), (9), (10), s-a constatat faptul că, atât pe direcția urzelii, cât și pe direcția bătăturii, valorile determinate ale rezistențelor la tracțiune sunt considerate „satisfăcătoare“, valoarea absolută a scorului *z* calculat încadrându-se sub pragul specific (fig. 3).

CONCLUZII

Comparările interlaboratoare reprezintă un important instrument de asigurare a calității, pe baza cărora laboratoarele de încercări pot să-și stabilească propria performanță și să compare rezultatele obținute cu alte laboratoare similare. Importanța comparărilor interlaboratoare este dată și de faptul că ele determină performanța personalului și contribuie la îmbunătățirea continuă a acesteia, identifică potențialele probleme și stabilesc acțiuni corective și acțiuni preventive referitoare la performanța echipamentului de măsurare, au



a



b

Fig. 3. Distribuția scorului *z* pentru rezistența la tracțiune în:
a – sistemul de urzeală, *U*; ***b*** – sistemul de bătătură, *B*

ca scop validarea unor metode dezvoltate în cadrul laboratorului sau a unor metode de încercare nestandardizate, demonstrează performanța laboratorului de încercări pentru obținerea/menținerea acreditării și furnizează încredere clienților, demonstrând abilitatea de a efectua în mod competent încercările pentru care acreditarea este acordată.

Rezultatele prezentate în acest articol au fost obținute în cadrul proiectului 29009 „Sistem interactiv complex de analiză și control – teste de comparări interlaboratoare“, din cadrul Programunui Național de CDI – Nucleu.

Chim. ADRIANA-IOANA SUBȚIRICĂ
I.N.C.D.T.P. – București

CRONICĂ

PREMIÈRE VISION 2011

În perioada 5–9 octombrie 2011 a avut loc, la Moscova, Târgul Internațional ***Première Vision***, unul dintre cele mai importante evenimente din domeniul modei, din Rusia.
Acest eveniment, esențial atât pentru lumea modei, cât și pentru cea a afacerilor, a reunit producători de țesături din Rusia, Italia, Franța, Turcia, Germania, Bulgaria și Portugalia.
Târgul a fost organizat pe trei secțiuni: *Fabric forum* – axată pe prezentarea unui bogat sortiment de țesături și accesorii, *Colour range* – concentrată pe expunerea unei game de culori diverse și *Trend master class* – structurată pe prezentarea în premieră a tendințelor modei, la nivel mondial, în domeniul țesăturilor.
Première Vision s-a bucurat de apreciere atât din partea vizitatorilor și creatorilor de modă, cât și a producătorilor, care și-au prezentat oferta proprie pentru identificarea de noi parteneri de afaceri, dar și pentru consolidarea imaginii firmei și a relațiilor cu partenerii tradiționali.

Misiunea acestui târg a fost aceea de a informa și de a anticipa așteptările consumatorilor, într-o lume în care produsele nu trebuie să fie doar creative, ci și la un pret acceptabil și reînnoite permanent.
Moda se reinventează constant, de aceea ea trebuie să anticipeze tendințele de mâine, să creeze și să inoveze permanent. Designul țesăturilor influențează în mod direct forma produsului final.
Organizat de două ori pe an în principalele capitale ale lumii, târgul Première Vision este un bun prilej de întâlnire a celor mai buni investitori internaționali.
El urmărește să ofere un cadru propice pentru a răspunde întrebărilor cumpărătorilor, pentru a le prezenta noile tendințe în domeniul materialelor destinate îmbrăcămintei și pentru a le oferi o mare varietate de produse noi.
Fiecare firmă producătoare a fost prezentă în stand cu numeroase cataloage de mostre, cu o paletă cromatică din cea mai diversă, dar și cu o mare varietate de imprimeuri.

De asemenea, li s-a oferit cumpărătorilor posibilitatea de a opta ei înșiși pentru un anumit tip de material pe care să fie realizat imprimeul ales.
Principalii producători de țesături și accesorii prezenți la târg au fost: *Dutel Creation, Belinac, Jero, Artmetal, Framex* – din Franța, *Fuggerhaus, Skai* – din Germania, *Avantgarde* – din Italia, *Karo* – din Rusia, *Blendworth* – din Anglia și *Tkahu Beka* – din Turcia.
Principalele tendințe ale sezonului de toamnă/iarnă 2012–2013 cuprind materiale din lână, bumbac și mătase, într-o abundență de culori, cu finisaje subtile și imprimeuri ordonate, cu contur definit.
Stilul casual, nonșalant continuă să ocupe un loc important, reflectând o eleganță relaxată, de zi cu zi. Predominante sunt și imprimeurile digitale, cu efecte vizuale aparte.
Participarea specialiștilor din I.N.C.D.T.P. la târgul Première Vision s-a concretizat în editarea unui catalog al manifestării care conține indexul tuturor firmelor și datele lor de contact, a unor cataloage de prezentare și cărți de vizită ale principalilor producători mondiali, dar și în prezentarea tendințelor în domeniul țesăturilor și al culorilor, pentru sezonul de toamnă/iarnă 2012–2013.

Artist plastic ***Alexandra Mocenco***
Ing. ***Georgeta Popescu***

DOCUMENTARE

Materii prime

FIRE DIOLEN SAFE® CU CARACTERISTICI OPTIMIZATE

Produsul *Diolen Safe*® a fost lansat recent ca o marcă exclusivă, cu identitate corporativă și cu caracteristici optimizate. Prin încorporarea unui polimer cu proprietăți îmbunătățite, caracteristicile ignifuge ale firelor de poliester au fost sporite semnificativ. Totodată, firele au căpătat o strălucire deosebită a culorii și o bună stabilitate la lumină.
Peste 30 de producători internaționali au decis deja să producă țesături din noile fire *Diolen Safe*®, printre care ***Backhausen interior textiles GmbH, Witteck-Design Weberei GmbH, Kobleder GmbH & Co KG*** – din Austria și ***SR Webatex GmbH*** – specialistul german în suprafețe textile sofisticate.
Backhausen interior textiles GmbH, un important furnizor de țesături de înaltă calitate, cu sediul în Austria, a decis să producă o colecție de țesături moderne exclusive, din fire *Diolen Safe*®, care va fi lansată cu ocazia târgului internațional *Heimtextil 2012*, ce va avea loc în Frankfurt am Main, Germania. Președintele companiei și al Asociației Industriei de Textile, Modă, Încălțăminte și Pielărie, ing. Reinhard Backhausen comenta astfel decizia sa: *„Caracteristicile concludente ale produsului de înaltă calitate, împreună cu conceptul de serviciu unic, ne-au convins să dezvoltăm o colecție exclusivă de țesături Diolen Safe®, care va fi lansată cu ocazia următoului târg Heimtextil 2012. Aceasta este concepută ca o colecție contemporană modernă, cuprinzând aproximativ 40 de mostre de țesături destinate amenajării spațiilor de locuit și birourilor. Avem așteptări mari în ceea ce privește această linie nouă și așteptăm cu nerăbdare o colaborare armonioasă cu Diolen Safe®"*.
FR Safety Yarns GmbH & Co. KG a fost conceput ca o resursă de competență pentru dezvoltarea de produse, suport tehnic, marketing și vânzări, pentru o largă varietate de filamente *Diolen Safe*® și de fire din fibre scurte, în diverse game de finețe și cu diferite structuri, oferind un pachet complet de servicii pentru producătorii de textile de casă de înaltă calitate, care folosesc fire de poliester FR. Clienții internaționali ai B2B primesc consultanță de la specialiștii în domeniu cu privire la produs și la dezvoltarea de produs, suport tehnic complet, teste standard de inflamabilitate și certificate pentru toate tipurile de țesături FR, în vederea acordării licențelor prin intermediul inițiativelor de marketing.
Diolen Safe® se bazează pe principiul eficienței ecologice și pe optimizarea produsului și a procesului de producție, având un impact minim asupra mediului. Aceștia sunt primii pași spre obținerea certificării *Cradle to Cradle*® pentru *FR Safety Yarns GmbH & Co.*
Diolen Safe® nu conține metale grele și halogeni, fiind în conformitate cu Standardul Oeko-Tex 100, clasa I – produse pentru bebeluși.
Țesăturile realizate din fire de poliester *Diolen Safe*® sunt utilizate în aplicații precum: spații destinate birourilor, servicii de ospitalitate și transport – hoteluri, spitale, birouri, interioare de nave de croazieră și cabine de aeronave, precum și multiple aplicații de exterior. Aceste materiale sunt realizate în conformitate cu standardele internaționale și posedă proprietăți excelente, cum ar fi: ușurință în întreținere, posibilitatea spălării în condiții industriale standard, rezistență la șifonare, stabilitate dimensională, rezistență mare la abraziune.

Comunicat de presă. Diolen Safe®, septembrie 2011

O NOUĂ FIBRĂ DIN POLIESTER REZISTENTĂ LA PĂTARE

Compania ***Teijin Fibers Ltd.***, cu sediul în Tokyo, având ca domeniu principal de activitate producerea fibrelor din poliester, a dezvoltat un nou material textil din

poliester rezistent la pătare, care oferă, pentru prima dată în lume, atât proprietăți de absorbție a apei și, prin urmare, de eliminare a aderenței, cât și de respingere a uleiurilor, respectiv de creștere a rezistenței la murdărire.
Acest material este destinat confecționării îmbrăcămintei sport, a uniformelor și a confecțiilor care necesită proprietăți de respingere a uleiurilor și de absorbție a transpirației.
Teijin Fibers a început deja comercializarea țesăturii în vederea realizării confecțiilor și a îmbrăcămintei sport pentru sezonul de primăvară–vară 2012.
Noul material posedă o textură moale, deoarece noua peliculă specială se depune, mai degrabă, pe fiecare fibră individuală, decât pe țesătura finită.
Pentru realizarea acestuia, compania folosește o tehnologie specifică de prelucrare a fibrelor, aplicată conform principiilor nanotehnologice de acoperire a suprafeței fibrelor cu o peliculă de 100 de nanometri, formată din straturi separate, cu caracteristici hidrofile și de respingere a uleiurilor. Atunci când țesătura intră în contact cu transpirația sau umezeala, conținutul de apă este absorbit în mod selectiv și răspândit rapid către stratul hidrofil, în timp ce uleiul este respins și îndepărtat ulterior.
Poliesterul este, în esență, hidrofob, astfel că nu absoarbe apa și nici nu respinge petele de ulei. Materialele cu caracteristici hidrofobe și de respingere a uleiurilor, existente în prezent pe piață, prezintă unele dezavantaje, cum ar fi lipsa respirabilității și a moliciunii, din cauza faptului că peliculizarea se aplică numai pe suprafața superioară a țesăturii și nu pe fibrele individuale.

Melliand International, septembrie 2011, nr. 4, p. 180

NOI FIBRE DESTINATE ÎMBRĂCĂMINTEI DE PROTECȚIE

Fibrele *Ultem*, obținute din polieterimidă de înaltă performanță (PEI), sunt produse de firma ***Sabic Innovative Plastics Holding BV***, din Bergen op Zoom/Olanda. Ele pot fi utilizate pentru producerea îmbrăcămintei de lucru, de calitate superioară, și a îmbrăcămintei de protecție.
Compania ***Japan Wool Textile Co. Ltd.,*** din Osaka/Japonia, utilizează amestecuri din fibre *Ultem* cu lână și alte materii prime pentru a produce fire, țesături și confecții cu caracteristici funcționale superioare.
Acestea conferă o combinație unică de confort și protecție, inclusiv proprietăți permanente de ignifugare, în special cu compuși nehalogenați, și o foarte bună rezistență la radiațiile ultraviolete. Spre deosebire de materialele aramidice tradiționale, fibrele *Ultem* pot fi vopsite cu ușurință, cu costuri reduse, într-o largă varietate de nuanțe, utilizând procesele tradiționale de vopsire a poliesterului.
Materialul oferă o rezistență foarte ridicată la flacără, un conținut scăzut de fum și o toxicitate scăzută, fiind realizat în conformitate cu standardul EN 531/ISO 11612 al Uniunii Europene și cu cel al Asociației de Protecție împotriva Incendiilor din S.U.A. (NFPA) 2112.

Melliand International, septembrie 2011, nr. 4, p. 180

NOI ȚESĂTURI DIN FIBRE OUTLAST

Compania ***Outlast Technologies Inc.***, cu sediul în Bouider/S.U.A., în cooperare cu ***Waxman Fibres Ltd.***, cu sediul în West Yorkshire/Marea Britanie, a dezvoltat un nou sortiment de țesături ignifuge, în care fibra modacrilică *Protex FR* este amestecată cu fibra de viscoză *Outlast*, cu proprietăți de reglare a temperaturii.
Noile țesături FR, fabricate de un renumit producător portughez de tricotaje, conțin 60% MAC Protex și 40% viscoză Outlast. Ele sunt realizate în conformitate cu cerințele standardului Oekotex 100 și ale standardului european EN ISO 14116 Index 3.
Această combinație inovatoare de fibre conferă articolelor realizate din ele un înalt nivel de confort, o reglare optimă a temperaturii și, în egală măsură, un bun control al umidității.
Cu toate că, de obicei, aceste proprietăți nu sunt asociate cu cele ale unei îmbrăcăminți de protecție, ele au o influență benefică asupra capacității de muncă a purtătorilor.
În prezent, compania este preocupată de dezvoltarea unor țesături care să satisfacă cerințele îmbrăcămintei de protecție împotriva căldurii, în conformitate cu standardul EN 11612.

Sursa: www.outlast.com; www.waxmanfibres.co.uk

Nanotehnologie

NANOPELICULIZĂRI INVEXUS ÎN PLASMĂ LICHIDĂ

Triton Systems, cu sediul în Chelmsford/Massachusetts, S.U.A., a realizat nanopeliculizări marca *Invexus*, de mare performanță.
Peliculizările sunt realizate printr-o tehnologie proprie *RCI000*, brevetată, de depunere în plasmă lichidă la presiune atmosferică și au ca scop conferirea unor caracteristici, precum: respingerea lichidelor, proprietăți antimicrobiene etc.
RCI000 este un sistem complet, de tip roll-to-roll, de peliculizare în plasmă la presiune atmosferică și poate fi folosit pentru funcționalizarea textilelor țesute și nețesute, a peliculelor de plastic, hârtie etc.
Sistemul permite conferirea de noi funcționalități, prin modificarea suprafețelor reale, fără modificarea unor proprietăți, cum ar fi permeabilitatea la aer, greutatea specifică sau aspectul substraturilor tratate. *RCI000* permite companiei să aplice imediat peliculizările *Invexus*. În acest sens, Dr. Arjan Giaya, vicepreședinte al Triton Systems și Director al diviziei ASSET, afirma: *„Capacitățile noastre de aplicare a peliculizărilor, îmbinate cu o tehnologie brevetată de peliculizare permit obținerea unor pelicule cu caracteristici superioare, ultrasubțiri, care pot fi aplicate pe aproape orice tip de suprafață, pentru prima dată... Invexus poate fi utilizat pentru o largă varietate de produse, fără a le modifica proprietățile de ansamblu sau caracteristicile generale, dar putându-le transforma în produse funcționale... Inginerii și oamenii de știință din echipă au o experiență unică în chimia peliculizării în plasmă, dar și în procese și echipamente... Centrul nostru de cercetare și*

dezvoltare din Massachusetts și Centrul de Aplicații din Dakota de Nord sunt bine echipate pentru dezvoltarea de aplicații specifice clientului sau de servicii de peliculizare bazate pe familia de produse Invexus".

Piețele care pot beneficia imediat de peliculizările *Invexus* cuprind textile tehnice, respectiv îmbrăcămintea de protecție și textilele medicale, echipamente și consumabile medicale, senzori și afișaje electronice, garnituri și produse de etanșeizare.

Sistemul *RCI000* și procesul *ASSET* au următoarele caracteristici principale:

- sunt adecvate pentru cilindri cu lățimea de până la 1,83 m (72 țoli);
- sunt proiectate pentru o gamă largă de produse rulate, inclusiv materiale textile, hârtie, membrane și pelicule;
- sunt prietenoase mediului, datorită faptului că au consumuri scăzute de energie și de materiale și, nefolosind apă sau solvenți, nu sunt generatoare de ape uzate;
- peliculizarea și polimerizarea se fac într-o singură etapă, nemaifiind necesar un cuptor de uscare.

Smarttextiles and nanotechnology, noiembrie 2011, p. 7

NOI DEZVOLTĂRI ÎN DOMENIUL NANOFIBRELOR

Compania ***South Korea's Toptec*** a implementat un nou sistem comercial de nanofibre, pe baza dezvoltărilor realizate de către ***Universitatea Shinshu***, din Japonia. Noul sistem a fost prezentat la Târgul internațional de mașini textile ITMA 2011, de la Barcelona.

Pe baza unei tehnologii proprii, compania a elaborat un văl nețesut din nanofibre, care, potrivit afirmațiilor reprezentanților companiei, Ick-Soo Kim și Jeon Mi-Na, poate fi produs atât la nivel atât de laborator, cât și la scară industrială. Lățimea benzii fibroase este de 1,8 m, iar viteza de producție poate atinge optzeci de metri pe minut.

Straturile din nanofibre sunt folosite adesea în combinație cu un văl nețesut convențional, oferind, în acest fel, noi oportunități pentru utilizatorii finali. Domeniile de aplicație sunt diverse, incluzând filtrele de mare eficiență, membranele de stocare pentru bateriile cu litiu-ion, straturile fibroase pentru îmbrăcămintea de protecție, produsele medicale avansate.

Smarttextile and nanotechnology, noiembrie 2011, p. 4

Tehnologie chimică

O NOUĂ MAȘINĂ DE VOPSIT

Producătorul francez ***Alliance Machines Textiles***, din Les Echets – Miribel, a elaborat o nouă mașină de vopsit fire și țesături în bucată, care a fost prezentată la târgul expozițional de mașini pentru industria textilă *ITMA 2011*, de la Barcelona.

Mașina *Rotora* (fig. 1), este utilizată, în prezent, pentru vopsirea materialor textile țesute sau tricotate. Prin aplicarea unui nou concept de realizare a mașinii, costurile de producție au scăzut cu 50%.

Fig. 1

Cu ajutorul acestei mașini este posibilă vopsirea firelor în bobină, simultan cu vopsirea materialului textil în sul, obținându-se în acest fel o culoare unică a firului și a materialului.

Echipamentul a fost realizat în colaborare cu un client al firmei, producător de ciorapi.

Astfel a fost obținută o mai mare versatilitate, datorită faptului că, pe aceeași mașină, se pot realiza diferite tipuri de vopsiri, de exemplu: vopsirea unei țesături de dimensiuni mari pe un singur sul, vopsirea unor țesături de dimensiuni mai mici pe două suluri, vopsirea simultană a țesăturii în sul și a firelor în bobină sau vopsirea firelor în bobine.

La *ITMA 2011*, a fost prezentată și mașina *Riviera Eco+*, cu foarte bune performanțe în ceea ce privește raportul de flotă.

Această mașină este utilizată pentru vopsirea de înaltă calitate a țesăturilor din viscoză și din Lycra, fără cute și cu un aspect foarte bun al suprafeței, la un raport de flotă de 1:3. De exemplu, pe mașinile de vopsit cu două suluri, pentru vopsirea a circa 400 kg de țesătură este necesară o cantitate mică de apă – aproximativ 1 000 de litri.

Melliand International, septembrie 2011, p. 190

UN NOU PROCES DE VOPSIRE ECOLOGICĂ

Compania ***Schoeller*** a elaborat un nou proces de vopsire ecologică, *Unic*.

Modelele de țesături create, în mod aleator, prin acest proces imită efectele spectaculoase ale luminilor create în spațiul atmosferic de praful stelar și razele solare.

Fig. 1

Procesul poate fi realizat în diferite combinații de culori și pe diferite tipuri de țesături.

Materialele textile supuse procesului de vopsire *Unic* (fig. 1) oferă o oarecare protecție împotriva căpușelor, țânțarilor și moliilor.

Însă, se poate întâmpla ca această protecție să nu fie totală și materialele să permită pătrunderea insectelor. De aceea, compania Schoeller a elaborat o nouă tehnologie de finisare, denumită *Inzectic,* care oferă o protecție sigură împotriva supărătoarelor insecte.

Tratamentul se aplică doar pe suprafața exterioară a textilelor și este rezistent la spălări multiple. Căpușele aflate pe suprafața textilă sunt imobilizate și, după scurt timp, mor, iar țânțarii sunt îndepărtați încă înainte de a ajunge în contact cu suprafața textilă.

Un test de citoxicitate, efectuat de către institutul Hohenstein și de către alte instituții renumite, a confirmat nu numai înalta eficiență a acestui tratament, ci și o excelentă compatibilitate cu pielea. Datorită faptului că se bazează pe tehnologia 3XDRY, el oferă un management optim al umidității.

Sursa: www.schoeller-textiles.com

Diverse

NOUL CONCEPT 3D DE ÎMPLETIRE HEXAGONALĂ

Institutul german ***Institut für Textiltechnik*** (ITA) din cadrul Universității Aachen RWTH, din Germania, a elaborat un nou concept de împletire 3D, aplicat pe mașina de împletit hexagonală.

Noul mecanism de împletire este capabil să fabrice structuri compozite cu forme complexe bidimensionale și tridimensionale, precum și cu o geometrie structurală 3D. Acest proces 3D de împletire se bazează pe principiul hexagonal.

Alte produse realizate pe baza noilor dezvoltări din cadrul ITA se referă la textilele medicale inovative obținute printr-un proces cvasicontinuu de formare a vălului, textilele Project Profitex-Smart pentru pompieri, colectorul de evacuare fabricat din compozite matriceale ceramice împletite, țesăturile multiaxiale tricotate din urzeală nesifonabile, precum și la noile metode de producere a firelor.

Melliand International, septembrie 2011, p. 200

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