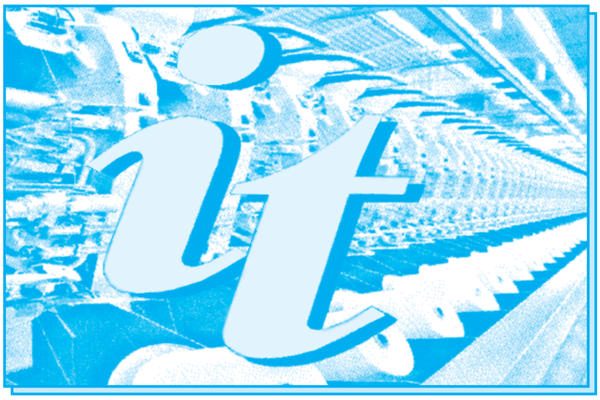

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Sumar

Contents Inhalt

Effect of hardness caused by using salts in dye houses on the yield of reactive dyes coloring

RIZA ATAV

ABBAS YURDAKUL
E. PERRIN AKÇAKOCA KUMBASAR

REZUMAT – ABSTRACT – INHALTSANGABE

Efectul durității, cauzat de utilizarea sărurilor în vopsitorii, în creșterea randamentului vopsirii cu coloranți reactivi

În cadrul acestui studiu, a fost investigat efectul durității, apărut ca urmare a utilizării sărurilor în procesul de vopsire, asupra calității vopsirii. Potrivit rezultatelor experimentale, s-a constatat că, deși se utilizează apă moale în procesul de vopsire, ar putea fi necesară utilizarea unui agent de sechestrare, pentru a preveni durizarea provocată de săruri.

Cuvinte-cheie: colorant reactiv, sare, sechestrant, duritatea apei, randamentul vopsirii

Effect of hardness caused by using salts in dye houses on the yield of reactive dyes coloring

In this research, the effect of hardness, which arises from using salts in the dyeing process, on color yield was investigated. According to the experimental results, it was determined that even if soft water is used in the dyeing process, a sequestering agent usage could be necessary in order to prevent the hardness caused by salts.

Key-words: reactive dye, salt, sequestering agent, water hardness, color yield

Der Härteeffekt auf der Farbstoffausbeute beim Reaktivfärben als Folge der Anwendung der Salze in Färbereien

In Rahmen dieser Untersuchung wurde der Härteeffekt, verursacht durch die Anwendung der Salze im Färbeprozess, auf die Farbstoffausbeute analysiert. Es wurde gemäss den experimentellen Ergebnissen festgestellt, dass ein Komplexionsmittel für die Vorbeugung der Härte verursacht durch Salze notwendig ist, obwohl weiches Wasser im Farbprozess angewendet wird.

Stichwörter: Reaktivfarbstoff, Salz, Komplexionsmittel, Wasserhärte, Farbstoffausbeute

Although the share of synthetic fibers used in textile production has increased in recent years, cellulose fibers still have a share exceeding 50% [1]. As generally known, reactive dyes is the dye class most commonly used in dyeing and printing cellulose fibers and blends of these [2]. This dye class has got a 62% share in cellulose fibers dyeing [3]. When reactive dyes are investigated in terms of the application method, it is understood that reactive dyes are applied by using the exhaust method in more than 50% cases [1].

One of the most important properties of the water to be used in the textile finishing processes is that it should not contain metal ions, which cause hardness. The usage of hard water causes some problems in various steps of finishing treatments from pre-treatment to finishing [1, 8]. Metal ions can come from water, cellulose fiber and machinery. Furthermore, salts and other auxiliaries can also release metal ions into the medium [4]. Depending on the origin of cotton, 1 kg of cotton contains approximately 1.094 mg CaO, 1.037 mg MgO, 47 mg Fe_2O_3, 12 mg CuO and 4 mg MnO [5].

The limits for some ions that can be found in the water used for dyeing are as follows:

- Hardness < 5^odH;
- Fe^{++} < 0.1 ppm;
- Mn^{++} < 0.02 ppm;
- Cu^{++} < 0.005 ppm;
- NO_3^- < 50 ppm;
- NO_2^- < 5 ppm.

If these limits are exceeded, dyeing reproducibility decreases. The most important problem in dyeing and printing treatments, which is caused by hard water, is the change in dye structure. In this case, colors can change; solubility and diffusion properties of dyes are decreased. As a result, uneven dyeing occurs and fastness values decrease [6].

In case of dyeing cellulose fibers with reactive dyes, dyeing reproducibility is affected negatively by the hardness arisen from water, salt and the cotton fiber. Although soft water is used in the dyeing treatments, the hardness of this water varies between $1–5^odH$. Furthermore, hardness amounting to $3–5^odH$ comes into the dyeing liquor from the salts used by the dyeing mills.

The aim of this study was to determine the effect of hardness, that arises from water and salts used by mills, on the color yield and to show the importance of the sequestering agent usage, even if soft water is used in the dyeing process. In this study, color yields of dyeings carried out by using pure water and pure salts (supplied from Merck) were compaRed with dyeings carried out by using soft mill water and ordinary salts (supplied from dye houses).

MATERIALS AND METHOD

Materials used

In this study, 100% cotton knitted fabric (169 g/m^2, Ne 30/1) was used. Experiments were carried out by using pure and soft (1.5^oF) water. Remazol Yellow RR, Remazol Red RR, Remazol Blue RR and Remazol Turquise G 133 dyes were used in experiments, representing the vinylsulphone based reactive dye group. Besides, Procion Yellow H-EXL, Procion Crimson H-EXL and Procion Navy H-EXL dyes were

Table 1

DYES USED IN EXPERIMENTS (MCT: MONOCHLOROTRIAZINE, VS: VINYLSULPHONE				
Product	**Functio-nality**	**Reactive**	**Reactivity**	**Substan-tivity**
Remazol Yellow RR	Monofunc-tional	VS	Medium	High
Remazol Red RR	Bifunctio-nal	MCT/VS	Medium	High
Remazol Blue RR	Bifunctio-nal	VS/VS	Medium	Medium
Remazol Turquoise G 133	Monofunc-tional	VS	Low-Medium	High
Procion Yellow H-EXL	Bifunctio-nal	MCT/ MCT	Low	Medium-high
Procion Crimson H-EXL	Bifunctio-nal	MCT/ MCT	Low	Medium-high
Procion Navy H-EXL	Bifunctio-nal	MCT/ MCT	Low	Medium-high

Table 2

ANALYSIS RESULTS OF SALTS USED IN EXPERIMENTS				
Hardness	**Na_2SO_4 (Merck)**	**NaCl (Merck)**	**Na_2SO_4**	**NaCl**
Ca^{++}(°dH)	–	–	1.68	1.4
Mg^{++}(°dH)	–	–	1.68	3.19

used, representing the heterocyclic reactive dye group. Properties of dyes used in experiments are given in table 1. Dyeings were carried out in two different concentrations, as 0.5% and 2%.

In the dyeing treatments, both pure (supplied from Merck) and ordinary (supplied from dye houses) NaCl and Na_2SO_4 were used as salt. The analysis results of these salts are given in table 2.

Method used

- *Dyeing procedure.* The liquor ratio for the dyeing treatments was 1:15. All experiments were carried out in HT-type laboratory dyeing machine. The starting pH of dyeing was 6.5–7. As a dyeing procedure, the temperature rise method was used: for Remazol Dyes 25°C → 60°C (for Remazol Turquise G 133 30°C → 85°C), for Procion Dyes 50 → 85°C. Dyeing graphs are given below (fig. 1). The salt and soda ash amounts used in experiments are given in table 3. Codes related to the experiments are given in table 4. Hardness caused by calcium and magnesium ions arisen from the fabric (cellulose material) was not taken into consideration, as the same fabric was used for all experiments. Furthermore, soda ash was supplied from Merck in order to avoid hardness that could come from alkali;
- *Washing procedure:* washing treatments were carried out at liquor ratio 1 : 20;

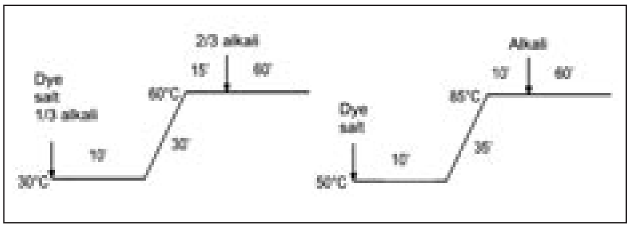

Fig. 1. Dyeing procedures for Remazol and Procion dyes

Table 3

SALT AND SODA ASH AMOUNTS ACCORDING TO DYE CLASS AND DYEING DEPTH	
0.5% Remazol Yellow/Red/ Blue RR 35 g/l Salt 7.5 g/l Soda ash	2% Remazol Yellow/Red/ Blue RR 50 g/l Salt 13 g/l Soda ash
0.5% Remazol Yellow RR + 0.5% Remazol Red RR + 0.5% Remazol Blue RR 45 g/l Salt 11.5 g/l Soda ash	
0.5% Remazol Turquoise G 1333 5 g/l Salt 4 g/l Soda ash (1/3 ve 2/3)	2% Remazol Turquoise G 133 50 g/l Salt 8 g/l Soda ash (1/3 ve 2/3)
0.5% Procion H/EXL (Yellow/ Crimson/Navy) 45 g/l Salt 10 g/l Soda ash (1/3 ve 2/3)	2% Procion H/EXL (Yellow/ Crimson/Navy) 80 g/l Salt 15 g/l Soda ash (1/3 ve 2/3)
0.5% Procion Yellow H/EXL + 0.5% Procion Crimson H-EXL + + 0.5% Procion Nacy H/EXL 60 g/l Salt 15 g/l Soda ash	

Table 4

CODES RELATED TO THE EXPERIMENTS		
Code	**Dyeing depth, %**	**Water and salt used in dyeing**
1	0.5	Pure water + NaCl (Merck)
2	0.5	Soft water + NaCl
3	0.5	Pure water + Na_2SO_4 (Merck)
4	0.5	Soft water + Na_2SO_4
5	2	Pure water + NaCl (Merck)
6	2	Soft water + NaCl
7	2	Pure water + Na_2SO_4 (Merck)
8	2	Soft water + Na_2SO_4
9	1.5	Pure water + NaCl (Merck)
10	1.5	Soft water + NaCl
11	1.5	Pure water + Na_2SO_4 (Merck)
12	1.5	Soft water + Na_2SO_4

- *Remazol dyes:* over-flow cold rinsing (10 min.) → neutralization at 60°C (with 0.5–1 g/l acetic acid 10 min.) → rinsing at 80°C (10 min.) → rinsing at 95°C (15 min.)* → rinsing at 80°C (10 min.) → over-flow cold rinsing;
- *Procion dyes:* over-flow cold rinsing (10 min.) → rinsing at 70°C (for dark shades 3 times; for light shades 2 times) → rinsing at 95°C (15 min.) → rinsing at 70°C (10 min.) → over-flow cold rinsing.

For color measurements, X-rite spectrophotometer (D 65/10°) was used and color yields (K/S) of dyed samples were calculated, according to the Kubelka Munk equation:

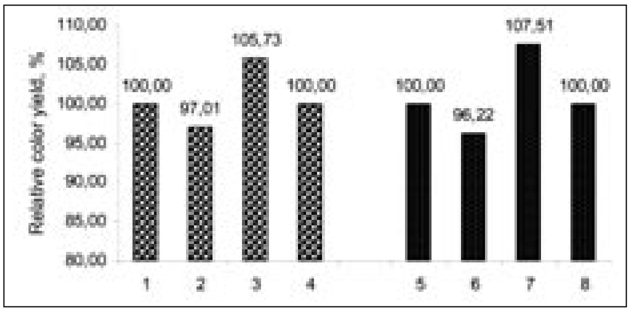

Fig. 2. Relative color yield (%) values of samples dyed with Remazol Yellow RR

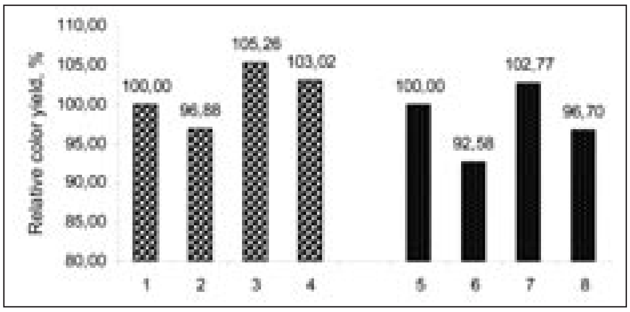

Fig. 3. Relative color yield (%) values of samples dyed with Remazol Red RR

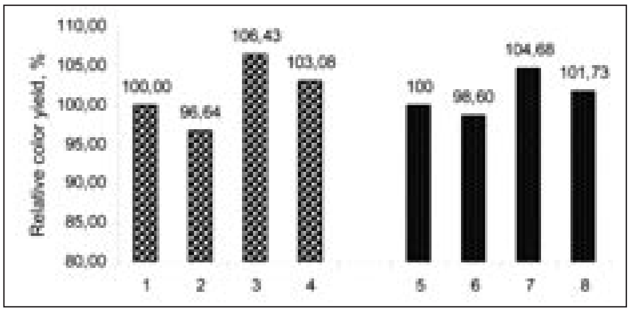

Fig. 4. Relative color yield (%) values of samples dyed with Remazol Blue RR

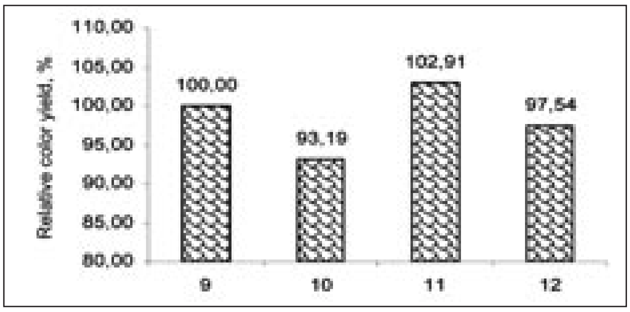

Fig. 5. Relative color yield (%) values of samples dyed with Remazol Yellow/Red/Blue RR

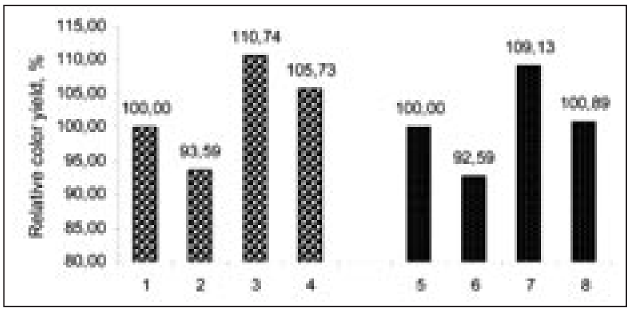

Fig. 6. Relative color yield (%) values of samples dyed with Remazol Turquoise G 133

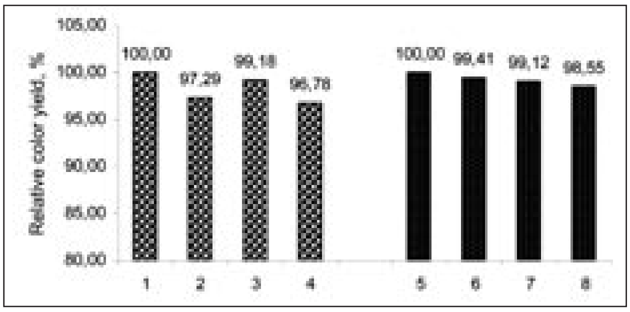

Fig. 7. Relative color yield (%) values of samples dyed with Procion Yellow H-EXL

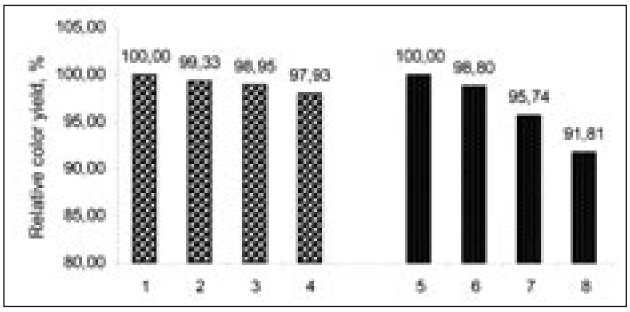

Fig. 8. Relative color yield (%) values of samples dyed with Procion Crimson H-EXL

$$K/S = (I - R)^2 2R \qquad (1)$$

where:

R is reflectance value in maximum absorption wave length, nm;

K – absorption coefficient;

S – scattering coefficient.

By taking 100 as the *K/S* value of materials dyed by using pure water and pure natrium chloride (Merck), the relative color yield (%) values of dyed samples were calculated as fallows:

$$\text{Relative color yield } (\%) = \left[\left((K/S)_s * 100\right) / \left(K/S\right)\right] \qquad (2)$$

where:

(K/S) is *K/S* value of dyed material;

$(K/S)_s$ – *K/S* value of samples dyed by using pure water and pure natrium chloride (Merck).

RESULTS AND DISCUSSIONS

Relative color yields of dyed samples can be seen in figures 2–10. As can be seen from figures 2–10, color yields of dyeings carried out by using soft water and salt supplied from dye houses are 2–9% and 1–5% (depending on dye), lower than for dyeing carried out by using pure water and pure salt (Merck), respectively for vinylsulphone and heterocyclic ring based reactive dyes. The reason of this is thought to be the negative effect of Ca^{++} and Mg^{++} ions on the reactive dye's diffusion properties.

When vinylsulphone and heterocyclic ring based reactive dyes are compared, it can be said that heterocyclic ring based dyes are less sensitive (especially Yellow and Red color) to ions that cause hardness in water. Furthermore, when vinylsulphone reactive dyes are compared among themselves, it can be seen that Remazol Turquise G 133 is the most sensitive dye to hardness. Remazol Turquise G 133 has a big molecule; for this reason, its solubility is already problematic. In the presence of Ca^{++} and Mg^{++} ions, its solubility completely decreases and it starts to collapse in the dyeing liquor and, hence, dye uptake and color yield decrease. By comparing Merck salts among themselves and common salts among themselves, the effect of salt type on the color yield can also be seen. When the effect of salt type for vinylsulphone based reactive dyes is examined, it can be seen that the color yield obtained with natrium sulphate is approximately 3–10% higher than for the equal amount of natrium chloride. In the case of dyes

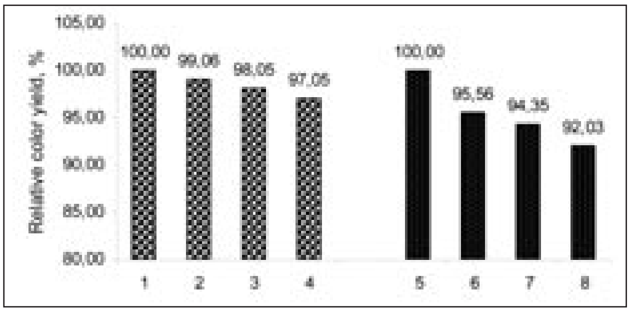

Fig. 9. Relative color yield (%) values of samples dyed with Procion Navy H-EXL

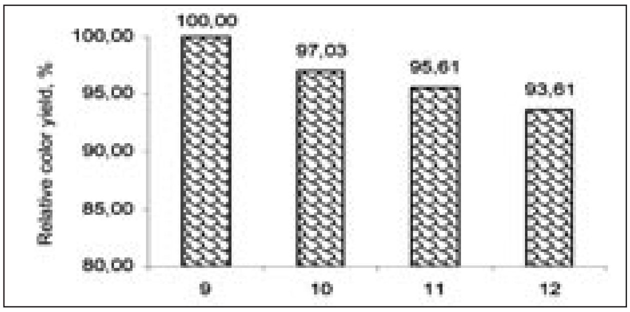

Fig. 10. Relative color yield (%) values of samples dyed with Procion Yellow/Crimson/Navy H-EXL

that have a heterocyclic structure, the color yield of dyeings carried out with natrium chloride, conversely to vinylsulphone based dyes, are 1–6% higher than for dyeing carried out by using natrium sulphate. These results are compatible with our previous study and the reasons of these observations have already been explained [7, 8].

CONCLUSIONS

In this research, effects of hardness, which arises from various sources, like water, salt and fabric, were investigated on color yield. According to the experimental results, it was found that: color yields of dyeing carried out by using pure water and pure salt (Merck) are higher than for dyeing carried out by using soft water and salts supplied from dye houses. The decrease in color yield is higher for vinylsulphone dyes, and Remazol Turquise G 133 is the most sensitive dye to salt type and quality. According to these results, it can be concluded that even if soft water is used in the dyeing process, sequestering agent usage could be necessary in order to prevent the hardness caused by salts.

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Optimization of the processing variables to produce the elastic core-spun yarn by Siro spinning system, using SOM neural network

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DARIUSH SEMNANI
A. SHIASI

REZUMAT – ABSTRACT – INHALTSANGABE

Optimizarea variabilelor de prelucrare în producerea firelor elastice filate cu miez, prin sistemul de filare Siro, utilizând rețeaua neurală SOM

Lucrarea este o încercare de optimizare a sistemului de filare Siro, pentru producerea firelor elastice filate cu miez, prin rețele neurale. Diverși factori, cum ar fi poziția de alimentare a firelor cu miez dintre două fascicule de fibre, distanța dintre două fascicule, unghiul de alimentare a firelor cu miez, corespunzător axei fasciculului, nivelul de torsiune a firului și raportul de tensionare a firului elastic cu miez afectează, în mod semnificativ, proprietățile fizice și mecanice ale firelor filate cu miez. Două semitorturi din bumbac-poliester (1,05 jurubițe) și fire elastice (40 dtex) au fost supuse prcesului de laminare și au fost produse fire Ne 20. Pentru a distribui firele produse în clasele corespunzătoare de finețe, a fost utilizată o rețea competitivă Kohonen. Rata de învățare și perioada finală au fost alese de 0.2 și 105. Prima clasă este formată din firele cu proprietăți optime.

Cuvinte-cheie: fire filate cu miez, proprietățile fizice și mecanice, sistem de filare Siro, rețea neurală SOM

Optimization of the processing variables to produce the elastic core-spun yarn by Siro spinning system, using SOM neural network

The present paper is an attempt to optimize the condition of Siro spinning system for producing the elastic core-spun yarns by neural networks. Various factors such as feeding position of core yarn between two strands, distance between two strands , feeding angle of core yarn corresponding to strand axis, yarn twist level and tension ratio of core- elastic yarn affect significantly the physical and mechanical properties of core-spun yarn. Two cotton-polyester rovings (1.05 hank) and elastic yarn (40 dtex) were fed to drafting system and 20 Ne yarn was produced. To distribute the produced yarns in the appropriate classes, Kohonen net that is a competitive net was used. The learning rate and the final epoch were chosen on 0.2 and 105. First class is the class of the yarns that have the optimum properties.

Key-words: core-spun yarn, physical and mechanical properties, Siro spinning system, SOM neural network

Optimierung der Prozessvariablen für die Produzierung von elastischen, SIRO-kerngesponnen Garnen durch das SOM-Neuronalnetz

Die Arbeit präsentiert ein Optimierungsversuch durch Neuronalnetze des Siro-Spinnsystems für die Produktion der elastischen Kernwindegarne. Unterschiedliche Faktoren, wie die Kernwindegarn – Zufuhrposition zwischen zwei Faserbündel, die Distanz zwischen zwei Faserbündel, der Winkel zwischen Kernwindegarn-Zuführung und Faserbündelaxe, der Garnzwirngrad und das Spannungsverhältniss des elastischen Kerngarnes beeinflussen wesentlich die physischen und mechanischen Eigenschaften des Kernwindegarnes. Zwei Vorgarne aus Baumwolle-Polyester (1.05 hank) und ein Elastikgarn (40 dtex) wurden dem Streckwerk zugeführt und 20 Ne Garn gefertigt. Um die gefertigten Garne in den entsprechenden Klassen zu verteilen, wurde ein performantes Kohonen-Netz angewendet. Der Lerngrad und die Endperiode wurden für 0,2 und 105 festgestellt. Die erste Klasse ist die Garnklasse mit den besten Eigenschaften.

Stichwörter: Kernwindegarne, physische und mechanische Eigenschaften, Siro-Spinnsystem, SOM-Neuronalnetz

Core yarn has a structure in which one of the component, usually a synthetic filament, either a mono or multi filament is covered by another component, a staple fiber sheath. These yarns are commonly used as industrial and household sewing threads, special military and industrial textile products, light-weight apparel fabrics, industrial clothing, tents, underwear, sportswear and outerwear [1, 2, 3, 4].

There are many methods for merging elastane with other textile fibres, such as core spinning, cover spinning, Siro spinning, and air entangling. The basic requirement for producing a core-spun yarn containing elastane is to stretch an elastane thread before it enters the spinning unit, so that the elastane thread is situated in the centre of the core-spun yarn and is covered completely by the staple fibres. The core-spun yarn containing elastane can be extended to the point where the non-elastic part is stretched to its limit [5]. Core-spun yarns containing elastane have been the subject of limited research [6–8]. Su et al. investigated the effects of draw ratio and feed-in angle of the elastane on the core-spun yarns' structure and performance at the modified ring spinning frame. They concluded that a higher feed-in angle provides a better cover effect, and a draw ratio of 3.5 yields better dynamic elastic recovery [6]. Babaarslan showed that elastane positioning has a direct effect on the properties, structure and performance of core-spun yarns produced on a modified ring spinning frame [7].

A common problem in the production of core-spun yarns on the ring spinning frame is the slippage of the staple fibers as sheath fibers relative to the core. This effect may lead to an incomplete core coverage and results in end-breaks in subsequence processing. In order to avoid this problem, core spun yarns can be produced with some modifications on the Siro spinning system. Different parameters in Siro spinning system such as distance between two strands, twist level of produced yarns, draw ratio and feed-in angle of the elastane and elastane position in the space between two strands can affect the physical and mechanical properties of core spun yarns.

An artificial neural network (ANN) is one of the intelligence technologies for data analysis which has been employed extensively in various textile disciplines ranging from yarn manufacturing, fabric formation and fabric properties. This technique is useful when there are a large number of effective factors on the specific process. In the literature, three are many researches using the artificial neural network algorithm such as the

Table 1

SPECIFICATIONS OF THE FIBERS		
Fiber type	Fiber fineness	Mean length
Polyester	1.44 denier	38 mm
Cotton	3.5 mg/inch	28 mm

research of Beltran et. al. on the pilling tendency of wool knits using ANN model [8]. A study was carried out by Tokarska for predicting the permeability features of woven fabrics [9]. The performance of ANN model was compared with statistical regression and fuzzy regression to develop the predictive models for polyester dyeing [10–11]. ANN model has also been used to predicting cotton yarn hairiness [12, 13]. This study focuses on the optimization of the processing variable to produce the core spun yarn containing elastane on Siro spinning system using a neural network.

MATERIALS AND METHODS

In this study, thirty-three different types of yarn samples were produced on the Siro spinning machine modified with an elastane feed device to optimize the different parameters on the mechanical properties of core-spun yarns containing elastane. The cotton and polyester bales were processed on the traditional short-staple carded system using standard mill procedures, adjustments and practices. The specifications of the cotton and polyester fibers are shown in table 1.

Two cotton/polyester rovings of 1.05 hank were fed to drafting system of a Siro spinning frame in order to produce an Ne 20 yarn. Table 2 shows the particularities of machine settings for producing cotton/polyester spun yarn.

Spandex should be pre-drawn before it enters front roller. The velocity difference between Spandex positive feed roller and front roller results in the pre-drawing of spandex. As shown in figure 1, a V-groove guide is used to control the position of spandex and change the angle into front roller.

In order to determine the effects of delivery speed, nozzle pressure and elastane content on the mechanical properties of core-spun vortex yarns, three levels of yarn twist (450, 550 and 650), three levels of elastane drawing ratio (0.50, 0.55, 0.60), three levels of elastane feed in angle (tangential, 70° and 50°), three levels of distance between two strands (3, 6, 9 cm) and three levels of position of elastane between two strands (left, middle and right) were selected. The trials were run in a commercial spinning mill. The selected elastane count (40 dtex) is widely used in the industry for such core-spun yarns. Ten cones were prepared under each set of experimental conditions. In addition, the yarn

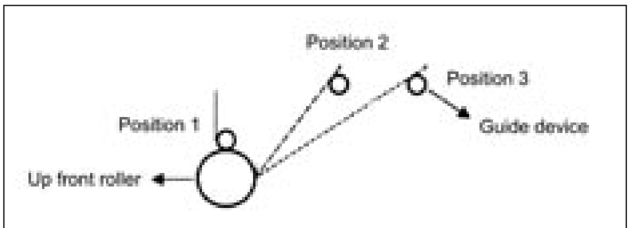

Fig. 1. Feed – in angle of the elastane

Table 2

SETTING PARAMETER OF SIRO SPINNING SYSTEM	
Setting parameters	Value of variable
Spindle speed, RPM	7 000
Total draft	22
Twist per meter	450, 550, 650
Ring diameter, mm	60
Traveler no.	0.16
Roving no., Hank	2 x 1.05
Elastane no., dtex	40
Yarn no., Ne	20
Drawing ratio of elastane	0.5, 0.7, 1.1
Feed-in angle of elastane, °	0, 70, 50
Position of elastane between two strands	Left, right and moddle
Distance between two strand, mm	3, 6, 9

samples with different parameters were spun at the same position of Siro spinning system to avoid any variations.

The tensile testing machine was used to measure the tenacity, elongation at break, stress and strain of yarns with gauge length of 20 cm. For measuring hairiness (number of hairs longer than or equal to 3 mm), a Shirley hairiness tester (model SDL096/8, UK) was used. Measurement was carried out on 25 m of each yarn sample with a speed of 60 m/min. Coefficients of mass variations of yarns were determined by Uster tester III on 25 m of yarn at a test speed of 25 m/min. Statistical analysis was carried out by SPSS software, ANOVA (analysis of variance) test and error bar charts at 95% confidence level.

RESULTS AND DISCUSSIONS

The list of the yarn samples, process parameters and experimental results are given in table 3. The Self Organizing Map (SOM) neural network has been applied to investigate the various mechanical properties and evenness of yarn samples. The regular statistical tests are not applicable to study the kinds of various dependent properties of our yarn samples because we can not use three or more condition for ANOVA test or multiple regressions. Therefore, it is necessary to choose other methods for analysis, grading and classification of multiple dependent data. The ANN model involves certain technical parameters such as number of hidden layers, or nodes, in each layer and adaptive learning rate, which have to be optimized as they have direct effects on predicting the results. There is no systematic method for determining the values of these parameters. Therefore, researchers have determined their values by trial and error; hence, they may not be necessarily the universally optimum ones. In other words, there is only one global optimum and there can be one or several local optimal values in the search space. It is after optimization that the best values for these parameters should be found. These considerations make the solution of such a multi-objective problem and the selection of the best options so difficult.

To distribute the yarns in the appropriate classes, a Kohonen net, which is a competitive net was used. During the self-organization process, the cluster unit whose weight vector matches the input pattern most closely (typically, the square of the minimum Euclidean

Table 3

LIST OF THE YARN SAMPLES, PROCESS PARAMETERS AND EXPERIMENTAL RESULTS															
Yarn no.	Distance, mm	Position	Twist per meter	Tension ratio	Feeding angle	F max., cN	Elongation, mm	Stress	Strain	Um, %	CVm, %	Thn/km (–50%)	Thk/km (+50%)	Neps/ (+200%)	Hairines, m
A_1	12	L	450	2.2	70	548.8	60.8	18.5	30.45	10.9	14	4	96	36	4.22
A_2	12	L	450	3.2	70	571.9	66.0	19.3	33.03	10.7	13.9	2	108	26	4.28
A_3	12	L	450	4.2	70	581.5	68.5	19.7	34.26	11.5	14.6	2	140	24	4.47
A_4	12	L	600	2.2	70	598.7	73.7	20.2	36.89	10.6	13.5	0	108	22	3.16
A_5	12	L	600	2.2	0	667.4	82.3	22.6	41.19	10.4	13.7	6	96	38	3.11
A_6	12	L	600	3.2	70	584.6	72.4	19.8	36.23	10.6	13.9	2	84	26	3.38
A_7	12	L	600	4.2	70	573.9	61.6	19.4	30.80	11.4	14.6	4	166	34	3.47
A_8	12	L	750	2.2	70	519.4	73.7	17.5	36.85	10.3	13.	0	98	30	3.05
A_9	12	L	750	3.2	70	571.8	76.2	19.3	38.14	10.5	13.8	0	110	38	3
A_{10}	12	L	750	4.2	70	615.4	81.9	20.8	40.99	10.8	13.8	2	76	20	3.07
A_{11}	12	M	600	2.2	0	629.9	78.8	21.3	39.44	10.7	13.6	2	94	34	3.15
A_{12}	12	R	600	2.2	0	646.8	79.8	21.9	39.94	10.2	14.0	0	180	54	3.12
A_{13}	4	L	600	2.2	0	660.4	73.5	22.3	36.76	10.9	13.4	2	82	32	3.8
A_{14}	4	M	450	2.2	0	532.7	62.7	18.0	31.39	10.7	13.5	2	102	26	4.31
A_{15}	4	M	450	3.2	0	519.4	62.5	17.5	31.29	11.2	14.3	4	136	30	5.05
A_{16}	4	M	450	4.2	0	625.4	71.6	21.1	35.82	11.9	14.3	2	124	30	5.47
A_{17}	4	M	600	2.2	0	590.7	73.2	20.0	36.60	10.5	13.6	0	96	26	3.84
A_{18}	4	M	600	3.2	0	570.9	68.6	19.3	34.33	11.5	14.0	0	130	44	3.88
A_{19}	4	M	600	4.2	0	643.3	77.5	21.7	38.77	11.3	14.1	2	126	38	3.97
A_{20}	4	M	750	2.2	0	576.4	75.1	19.5	37.58	10.1	12.9	0	76	26	3.61
A_{21}	4	M	750	3.2	0	540.6	64.0	18.3	32.03	10.8	13.5	0	88	22	3.44
A_{22}	4	M	750	4.2	0	613.0	70.9	20.7	35.47	10.6	13.5	0	92	30	3.58
A_{23}	4	M	600	2.2	0	569.1	65.6	19.2	32.84	10.8	13.2	0	88	40	3.41
A_{24}	8	M	600	2.2	0	588.4	74.5	19.9	37.25	11.7	14.5	6	88	32	3.18
A_{25}	8	R	450	2.2	50	649.6	73.9	22.0	36.96	9.9	12.6	0	56	18	4.47
A_{26}	8	R	450	3.2	50	597.3	74.1	20.2	37.07	10.5	13.1	2	72	30	4.71
A_{27}	8	R	450	4.2	50	602.1	78.5	20.3	39.26	10.3	13.5	2	108	36	4.62
A_{28}	8	R	600	2.2	50	638.2	80.9	21.6	40.46	10.6	12.8	2	66	24	3.54
A_{29}	8	R	600	2.3	0	629.6	73.6	21.3	36.80	10.7	13.1	0	98	26	3.32
A_{30}	8	R	600	3.2	50	602.5	83.2	20.4	41.61	10.9	13.2	2	68	36	3.67
A_{31}	8	R	600	4.2	50	671.5	86.7	22.7	43.39	10.7	13.3	0	82	30	3.78
A_{32}	8	R	750	2.2	50	592.2	86.0	20.0	43.02	9.6	12.2	0	24	26	3.23
A_{33}	8	R	750	4.2	50	607.0	79.1	20.5	39.57	10.9	13.9	0	102	32	3.2

Table 4

RESULTS OF KOHONEN NET		
Yarn no.	Yarn class index	Yarn class
A_1	0.9840	3
A_2	0.9858	2
A_3	0.9765	3
A_4	0.9912	2
A_5	0.9965	2
A_6	0.9981	2
A_7	0.9610	2
A_8	0.9897	2
A_9	0.9854	2
A_{10}	1.0078	1
A_{11}	0.9962	2
A_{12}	0.9630	3
A_{13}	0.9983	2
A_{14}	0.9848	3
A_{15}	0.9700	3
A_{16}	0.9829	2
A_{17}	0.9932	2
A_{18}	0.9716	2
A_{19}	0.9840	2
A_{20}	1.0012	2
A_{21}	0.9913	2
A_{22}	0.9926	2
A_{23}	0.9867	2
A_{24}	0.9952	2
A_{25}	1.0098	1
A_{26}	1.0017	1
A_{27}	0.9899	2
A_{28}	1.0094	1
A_{29}	0.9938	2
A_{30}	1.0058	1
A_{31}	1.0039	1
A_{32}	1.0250	1
A_{33}	0.9925	2

distance) is chosen as the winner. Kohonen net can cluster the sample perfectly through its general algorithm but in this research they are not in same sign and it is necessary that the original Kohonen algorithm be modified. To make the difference between the distances, it was supposed that if two input parameters were not in the same sign, it is obvious that the following value is bigger than the Euclidean distance value ($D = \Sigma\ (x - y)^2$) where x is the yarn diameter reduction gradient and y is the abrasion destruction index variation gradient [14–15]. The learning rate and the final epock were chosen on 0.2 and 105. Ten distinct classes were defined in this condition. First class is the class of the yarns that have the optimum properties. To cluster the samples in each class, properties of yarn defined as advantage and disadvantage parameters. In table 3, from the first parameter (F_{max}) to the forth parameter (Strain) there are advantage parameters and the others are disadvantage parameters. Advantage parameters have been inserted regularly to the net and disadvantage parameters have been introduced inversly. Table 4 shows the results of the net used in this research. According to the findings shown in table 3, the yarns were classified in three classes. Seven yarns which were used in different conditions lie in first class. Thus, these yarns have the optimum properties.

CONCLUSIONS

In this study, thirty-three different types of yarn samples were produced on the Siro spinning machine modified with an elastane feed device to optimize the different parameter on the mechanical properties of core-spun yarns containing elastane.

To distribute the yarns in the appropriate classes, Kohonen net, which is a competitive net was used. The learning rate and the final epock were chosen on 0.2 and 105. First class is the class of the yarns that has the optimum properties. To cluster the samples in each class, properties of yarn defined as advantage and disadvantage parameters. According to the findings the yarns were classified in three classes. Seven yarns which were used in different conditions lay in first class. Thus, these yarns have the optimum properties.

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Comparison of properties characterization between CHES-F, KES-F and FAST

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REZUMAT – ABSTRACT – INHALTSANGABE

Compararea caracteristicilor materialelor, folosind sistemele CHES-F, KES-F și FAST

Scopul lucrării îl constituie prezentarea unei tehnici de măsurare a mai multor caracteristici ale materialelor, printr-un singur test (MPST). Cu ajutorul sistemului CHES-F, se pot măsura rigiditatea la încovoiere, coeficientul de frecare și indicele de elasticitate la tracțiune. Pentru a verifica eficacitatea sistemului CHES-F în măsurarea proprietăților mecanice ale țesăturilor, acesta a fost comparat cu alte două sisteme cunoscute la nivel internațional, și anume sistemul KAWABATA de evaluare a țesăturilor, KES-F și sistemul FAST. Pentru o evaluare obiectivă a materialelor, s-au efectuat testări pe 19 țesături din lână, privind manifestarea unor caracteristici atributive ale acestora, precum masa, comportamentul la încovoiere, frecare și tracțiune. Prin această metodă pot fi îmbunătățite reproductibilitatea și stabilitatea măsurătorilor.

Cuvinte-cheie: proprietăți mecanice, comportament, aparat, țesături, in situ

Comparisons of properties characterization between CHES-F, KES-F and FAST

The purpose of the paper is to present a complex in-situ measuring principle of multiple properties through single test (MPST). By means of CHES-F system can be measured the bending rigidity, frictional coefficient and tensile elastic index. To verify the effectiveness of the CHES-F system in measuring mechanical properties of fabrics, comparisons between CHES-F and the two well-known international systems, i.e., Kawabata Evaluation Systems for Fabrics (KES-F) and Fabric Assurance by Simple Testing (FAST), have been made. For a proper fabrics evaluation 19 tests were performed on wool weavings, regarding their major properties such as weight, bending, friction and tensile behavior. Generally, tester can obtain single property through single test or measuring multiple properties through multiple tests, which is time-consuming and cuts many specimens and increases cost of instruments. Current method can measure multiple properties through single test.

Key-words: mechanical properties, behavior, apparatus, fabric, in-situ

Vergleich der Materialeigenschaften durch Anwendung der Systemen CHES-F, KES-F und FAST

In dieser Arbeit wird ein komplexes in-situ Messprinzip vorgestellt, wobei mehrere Materialeigenschaften durch einen einzigen Test (MPST) gemessen werden können. Mit dem CHES-F System kann man die Biegesteifigkeit, den Reibungskoeffizient und den Zugelastizitätindex messen. Um die Leistungsfähigkeit des CHES-F- Systems in der Messung der mechanischen Eigenschaften der Gewebe zu untersuchen, wurde dieses mit zwei anderen international anerkannten Systemen verglichen, und zwar das KAWABATA Bewertungssystem der Gewebe – KES-F und das FAST System. Für eine objektive Bewertung der Materialien wurden Teste auf 19 Wollgewebe durchgeführt, betreff spezifischen Eigenschaften, wie Masse, Biegeverhalten, Reibung und Zug. Mit dieser Methode kann die Reproduzierbarkeit und die Stabilität der Messungen verbessert werden.

Stichwörter: mechanische Eigenschaften, Verhalten, Apparat, Gewebe, in situ

Tactile sense and extensive applications of fabrics are dependent on the mechanical properties, which are tension, bending, friction, and compression and shear properties. Thereof, it is necessary to conduct quantitative measurement and characterization for meeting requirements of special products. Then, many corresponding apparatuses have been developed and can be divided into three categories, which focus on measuring the bending, friction, tensile, compression, shear and weight properties of textile materials.

One principle is to obtain single property through single test. The principle (briefly called SPST) is very convenient and routine such as the Instron tensile instrument, compression meter (Taylor and Pollet, 2002) and bending tester (Owen, 1968). For multi-mechanical properties measurements, however, it needs to cut more specimens, to change the measuring unit or even apparatus, which is time-consuming, and to cut many specimens and to increase the cost of instruments.

The second principle is capable of measuring multiple properties through multiple tests; the principle (briefly MPMT) is actually the SPST principle from the measurement principle. The typical and commercially popular instruments are KES-F (Kawabata, 1980) and FAST (Postle, 1989; Ly, 1991). The formal system includes four apparatuses and measures six basic mechanical properties, which include tensile, shear, bending, compression, friction and surface coarseness. The latter system includes four apparatuses and measures four basic mechanical properties, which includes compression, bending, tensile, shear, and size stability. Both systems are accurate and effective in measuring the above mechanical properties and characterizing the handle of fabrics, however, the two systems are very expensive, timeconsuming and not all suitable for the measurement of fabric and yarn based on the same measurement principle and the same sample. For example, it is obvious that the KES-FB2 bending tester is not suitable for yarn because it is based on the pure horizontally bending in principal, while the FAST-2 bending meter based on the cantilever bending in principal easily results in deviations from the effect of the free end of yarn.

The third principle is briefly named MPST that can measure multiple properties through single test based on the same apparatus in situ based on the same

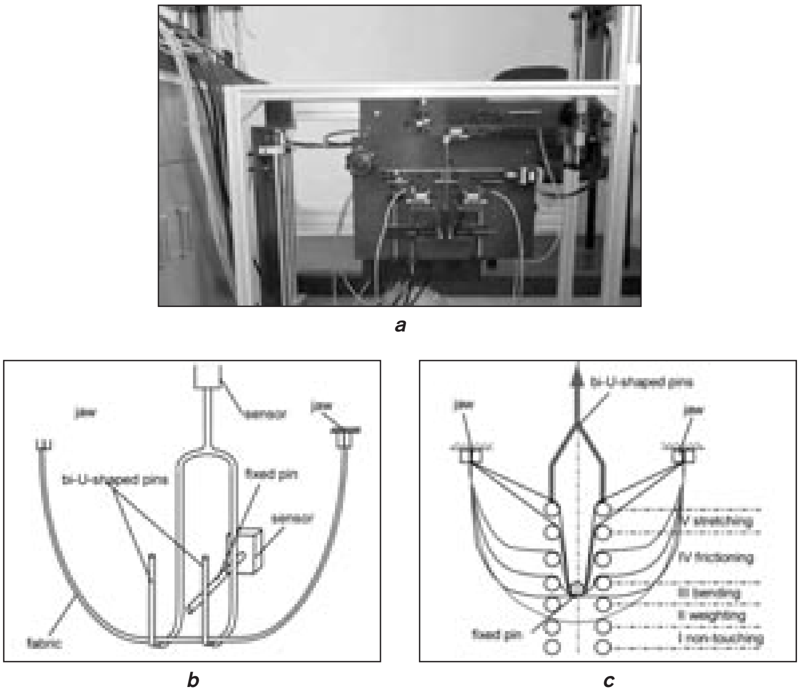

Fig. 1. Schematic diagram and whole pulling-out process of CHES-F system:
a – CHES-F system; ***b*** – schematic diagram; ***c*** – whole pulling-out process

measuring principle and the same sample for textile material (Pan and Yen, 1992; Kim and Slaten, 1999; Raheel and Liu, 1991; Gong and Mukhopadhyay, 1993; Grover et al., 1993; Kim and Slaten, 1999; Strazdiene et al., 2003). The corresponding apparatus based on the MPST in principle can improve the reproduction, stability, in situ and is helpful to better conduct analytical investigation and comparison between corresponding mechanical properties of fabric and yarn. An apparatus based on the MPST in principle was developed and could be used to measure weight, bending, friction and tensile behavior, and can be utilized to characterize the handle properties of textile materials (called CHES-F) (Du and Yu, 2005; Yu and Du, 2006). The object of the present paper is to have comparisons between CHES-F, KES-FB and FAST so as to present an effective method and apparatus for quantitatively measuring mechanical properties of fabrics.

MEASUREMENT PRINCIPLE AND STRUCTURE OF CHES-F

The CHES-FY system is illustrated in figure 1 *a*, and the fundamental structure and principle of CHES-F system are listed in figure 1 *b*. It shows that the CHES-FY system is composed of a fixed pin and a bi-U-shaped pins as well as a pair of jaws, which are driven up or down by motor and sensed force acquired by sensor. Sample is mounted on the two jaws, hung between the fixed pin and the bi-U-shaped pins and lifted up by the bi-U-shaped pins. With the bi-U-shaped pins moving up, measurements for multiple mechanical properties' combinations are constructed so as to pick out individual behavior.

By analyzing the mechanism of the deformation, the individual mechanical property can be selected from the force-distance curve. The testing procedure can be divided into five steps, seen in figure 1 *c*. The first step is non-touching movement of the bi-U-shaped pins, that is "I" region. The second step is the movement of the bi-U-shaped pins touching to the sample, but not touching to the fixed pin, thus the dominant action of the step "II" is to weigh the sample, i.e. weighting step. The weight per square meter of fabric can be found in the region. Step "III" is called bending because the sample begins bending due to the actions of both the bi-U-shaped pins and the fixed pin so that the line with the maximum bending slope can easily be drawn out. The bending range of "III" is from three points touching to the maximum bending force in physics. The bending work can be integrated out from the curve in step "III". When bending force reaches maximum, the sample passes out the bi-U-shaped pins and starts to slip under overcoming friction, so that "IV" step takes into action and is called friction step, and stops at the sample stretching. If the sample begins stretching, it is called stretching step "V", so that the tensile modulus can be derived from the tangent with the maximum slope.

EXPERIMENTAL PART

Materials and methods

The wool fabrics with the warp x weft gauge length of 15 x 2 cm were selected from a wool textile mill, and all samples were conditioned in (20 ± 2), (65 ± 3)% RH for above 24 h before testing, and all the experiments mentioned in present paper were conducted on the above standard condition. The specifications of the selected nineteen wool fabrics were listed in table 1.
Then, the parameters of the CHES-F instruments were set as follows, the diameters of the fixed pin and the bi-U-shaped pins are 0.6 mm; the space distances of the bi-U-shaped pins and the two jaws were 8 mm and 5 cm, respectively; the vertical distance from the hanging point of the jaw to the fixed pin was 6 cm; the speed moving up of the bi-U-shaped pins was 6 mm/

Table 1

THE SPECIFICATIONS OF 19 WOOL FABRICS							
No.	Thickness, mm	Weight, g/m²	Linear density of warp yarn, g/km	Linear density of weft yarn, g/km	End/ 10 cm	Pick/ 10 cm	Warp crimp, %
1	0.327	154	68	68	228	214	6.2
2	0.33	166	58	58	244	214	6.5
3	0.299	139	76	76	246	252	7
4	0.253	134	80	48	252	274	5.6
5	0.35	188	68	46	246	252	8
6	0.375	187	68	46	246	252	4.2
7	0.328	162	58	58	256	220	2.9
8	0.413	201	94	52	380	371	6.6
9	0.383	178	68	52	246	346	9.9
10	0.344	181	74	50	316	328	3.1
11	0.321	173	82	48	360	364	3.9
12	0.266	138	94	94	228	214	4.1
13	0.255	131	94	94	228	238	3.2
14	0.367	165	74	74	358	350	6.7
15	0.32	181	68	46	263	238	5.2
16	0.343	172	76	48	368	366	5
17	0.315	158	94	58	418	384	7.8
18	0.323	173	84	52	368	366	4.8
19	0.346	174	74	48	360	320	5.0

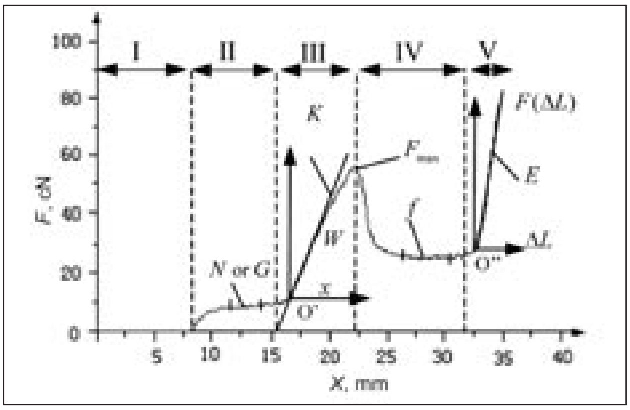

Fig. 2. Typical extraction force and distance curve

min; and the sampling frequency of the A/D Convector was 100 Hz. Finally, the bending, friction, tensile, shear and compression experiments of fabrics measured by KES-FB and FAST systems were carried out under standard condition mentioned above and were listed one by one through comparisons with CHES-F system.

Typical extraction force – distance curve

The force F(X) in a whole deformation is sensed by sensor and recorded with the shift, X, of the bi-U-shaped pins, and the typical extraction force and distance curve of a fabric by using the CHES-F is shown in figure 2.

According to the mechanism of the deformation in this measuring system, the characteristics corresponding to mechanical property can be derived according to five steps.

The first step is non-touching movement of the bi-U-shaped pins, that is "I" region that can be used as the calibration for force zero point. In "II" region, the weight per square meter of fabric can be found in the region;

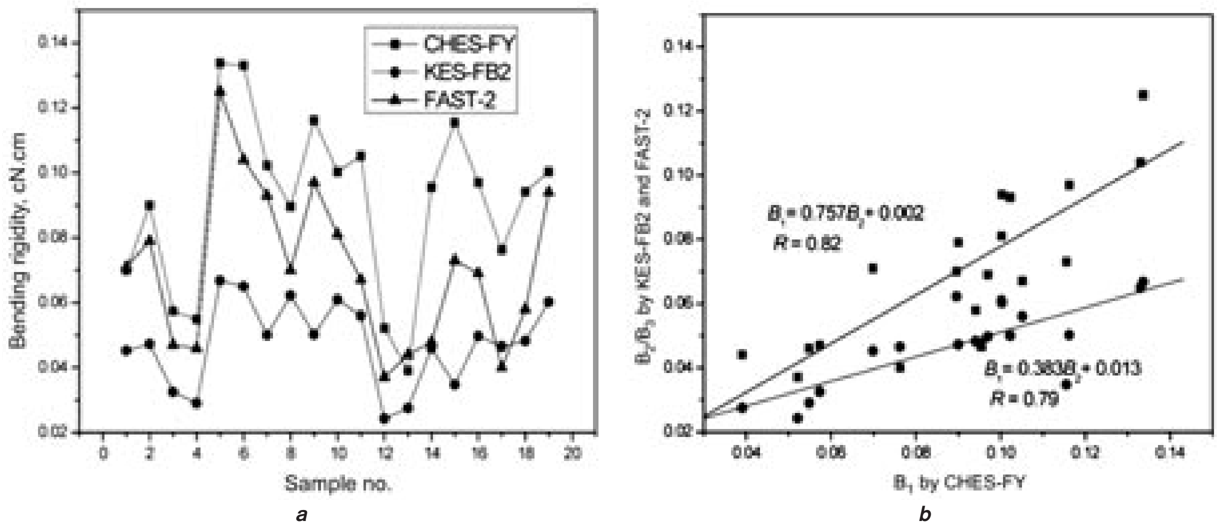

Fig. 3. Relations of bending property between CHES-F, KES-F2 and FAST-2:
a – bending comparisons curve; ***b*** – bending correlations curve

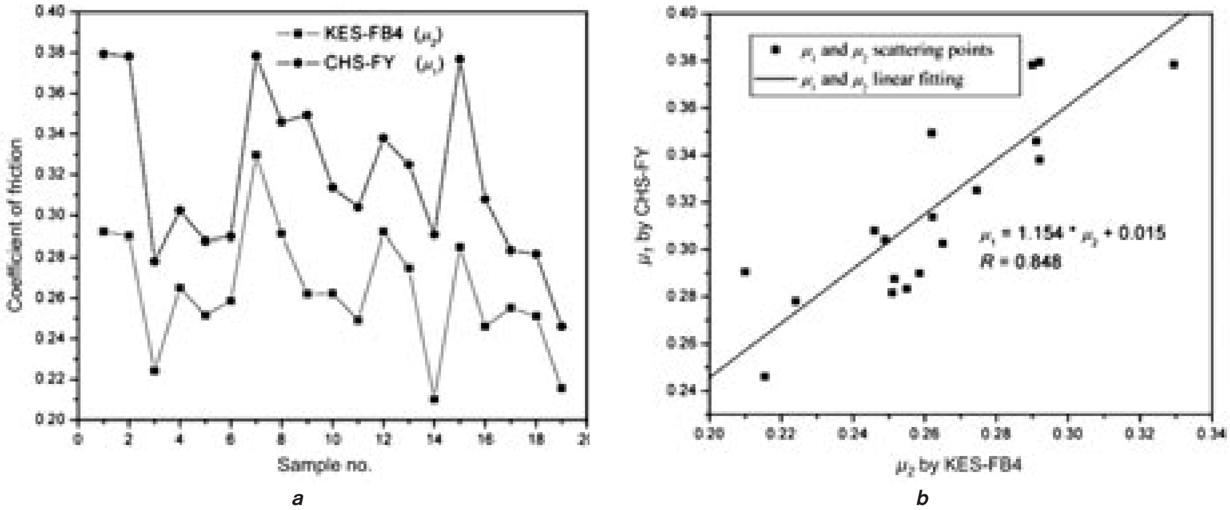

Fig. 4. Relations of friction property between CHES-F, and KES-FB4:
a – friction comparisons curve; ***b*** – frictional correlations curve

and step “III”, i.e., bending step, bending rigidity can be calculated from bending slope. With sample slipping on the surface of bi-U-shaped pins, frictional coefficient is found in the friction step, i.e., “IV” step. In step “V”, the tensile elastic index can be solved or shearing rigidity by bias extension. Therefore, it’s evident that characteristic parameters, i.e. weight, bending, friction and tensile of fabrics, can be evaluated by means of the Force-distance curve and will be presented in the following sections.

RESULTS AND DISCUSSIONS

Correlations of bending property between CHES-F, KES-F2 and FAST-2

The results and correlations of bending rigidity of fabrics measured by CHES-F, KES-F2 and FAST-2 were illustrated in figure 3. It can be concluded from figure 3 *a* that there exists good correlations in characterizing bending behavior between CHES-F, KES-F2 and FAST-2, and the results of CHES-F is highest, then decreasing results of bending rigidity are FAST-2 and KES-F2. Moreover, the good correlation coefficients in figure 3 *b* between CHES-F and KES-F2, CHES-F and FAST-2 are 0.79 and 0.82, respectively, which prove the three systems to be feasible in characterizing bending behavior, while the higher correlation coefficient (0.82) between BES-FY and FAST-2 shows the two systems have much in common. It’s explained that bending models of CHES-F and FAST-2 both bend a fabric with the gravitation based on cantilever and quasi three points bending in principle, while KES-F2 bends samples by avoiding the effect of gravitation through pure horizontal bending in principle. Thereof, the CHES-F system is feasible and accurate in measuring the bending behavior of fabric.

Correlations of frictional property between CHES-F and KES-F4

The friction coefficient μ_1 and μ_2 of fabrics measured by CHES-F and KES-F4, respectively, was illustrated in figure 4 *a*, and the correlations of frictional properties between CHES-F and KES-F4 in figure 4 *b*. It exhibits from figure 4 that μ_1 from CHES-F is larger than μ_2 from KES-F4. The main reason is that the normal load of frictional step in CHES-F is unevenly distributed along the contour of the bi-U-shaped pins and smaller than the applied normal load in KES-F4, and the coefficient of friction decreases with the increase of normal load in Morton (Morton, 1993). It can be concluded from figure 4 that the correlation coefficient between CHES-F and KES-F4 is as high as 0.848, which proves that the measurement of friction coefficient is accurate and the two measurements are feasible in characterizing the frictional behavior of fabrics.

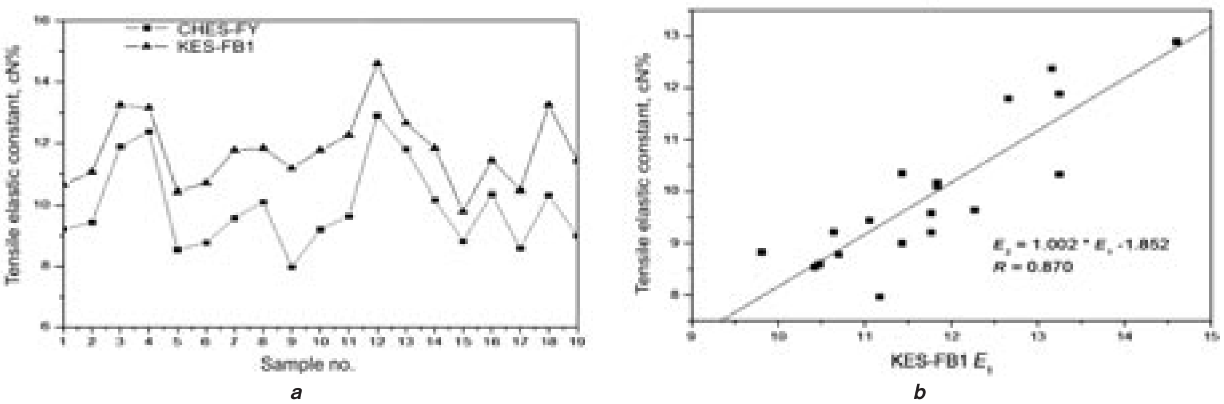

Fig. 5. Relations of tensile property between CHES-F and KES-F1:
a – tensile comparisons curve; ***b*** – tensile correlations curve

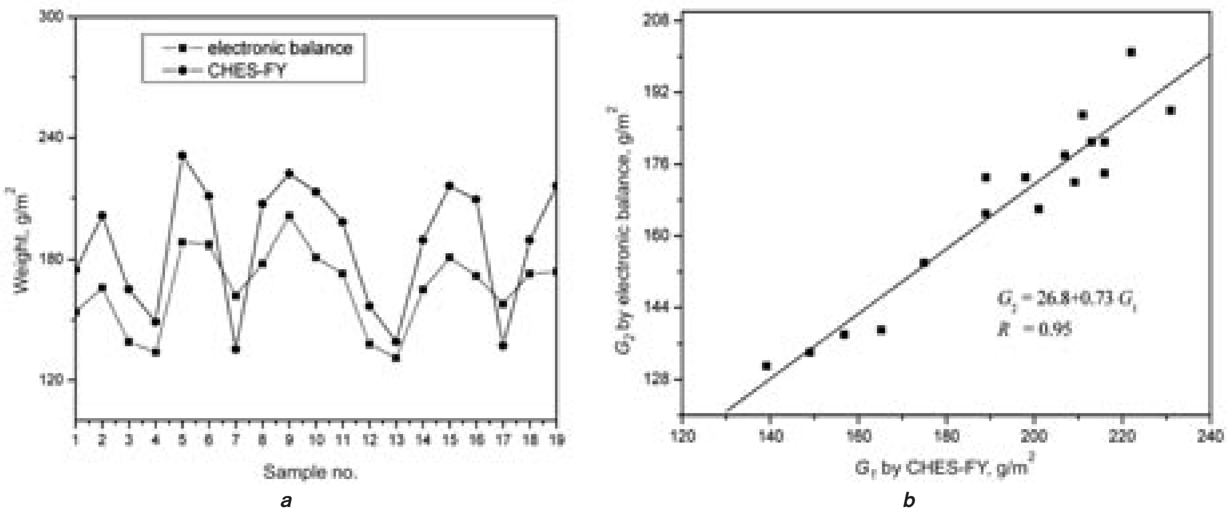

Fig. 6. Relations of weight between CHES-F and balance:
a – weight comparisons curve; ***b*** – weight correlations curve

Correlations of tensile property between CHES-F and KES-F1

The correlations and comparisons of elastic constants between KES-F1 and CHES-F systems are illustrated in figure 5. It is obvious from figure 5 that tensile elastic constant results by CHES-F are smaller than that by KES-F1. In addition, correlation coefficient between E_1 and E_2 is as high as 0.87, which reveals that the tensile elastic constant E_1 measured by CHES-F is effective; the linear regression slope coefficient of E_1 and E_2 is 1.002, which further expresses that tensile elastic constant E_1 is accurate. Thereof, the tensile test of CHES-F system is accurate and effective in measuring tension property of fabric.

Correlations of weight between CHES-F and electronic balance

The weight results of fabrics and correlations measured by CHES-F and electronic balance were shown in figure 6 *a*. Figure 6 indicates that G_1 from CHES-F is larger than G_2 from balance except for two samples. It can be attributed to the bending action of sample, which is also reflected in figure 6 *b*. The high correlation (0.95) between CHES-F and balance explained that the measurement of weight is accurate and feasible in characterizing the weight of fabrics, which can not be obtained by KES-FB and FAST systems.

CONCLUSIONS

In the present paper, the CHES-F system was analyzed and developed suitable for measuring and characterizing weight, bending, friction and tensile properties. Based on the extraction force and distance curve of CHES-F system, the corresponding index and characteristics of the four steps, i.e., weight, bending, friction, tensile were separated and obtained. Fabric weight per square meter, bending rigidity, friction coefficient and tensile elastic index can be obtained from corresponding mechanical property steps. The comparisons of mechanical property indexes between CHES-F, KES-F and FAST systems indicate that the CHES-F system is effective and accurate in measuring and characterizing weight, bending, friction and tensile properties of fabrics based on MPST principle.

Acknowledgements

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RECENZII

MANAGEMENTUL DEŞEURILOR TEXTILE. GHID

Autori: ***Eftalea Cărpuş, Emilia Visileanu, Valeria Gribincea, Alexandru Popa***
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Lucrarea este editată de Institutul Naţional de Cercetare-Dezvoltare pentru Textile şi Pielărie şi are ca obiectiv promovarea unei producţii curate, prin permanenta aplicare a strategiei integrate preventive de mediu atât proceselor şi produselor industriale, cât şi serviciilor, în vederea siguranţei economice, sociale şi de sănătate, precum şi a beneficiilor pentru mediu înconjurător, în conformitate cu legislaţia internă şi cu reglementările U.E. Industria textilă afectează mediul atât prin consumul mare de apă, energie şi substanţe chimice, cât şi prin cantitatea mare de deşeuri rezultate din procesele tehnologice.

Managementul deşeurilor este un proces prin care aceste produse suplimentare, rezultate din activitatea industrială, sunt reduse, refolosite, reciclate, depozitate sau eliminate, în acord cu cea mai bună opţiune practicabilă de mediu.

Lucrarea este structurată în 5 capitole şi cuprinde: *introducere*, *termeni de referinţă, clasificarea deşeurilor textile*, cuprinzând criteriile de clasificare în funcţie de gradul de uzură a materiilor prime, natura materiilor prime, procesul tehnologic din care rezultă şi modul de prezentare, *structura managementului deşeurilor textile*, respectiv forma de prezentare – fibre, fire, ţesături, tricoturi şi netesute din diferite materii prime, caracteristicile de calitate impuse şi modul de valorificare a acestora – şi *tehnologii-cadru de valorificare a deşeurilor textile*, cuprinzând fişe de identificare a diferitelor tipuri de materiale textile recuperabile.

Acest ghid este util specialiştilor în domeniu, producătorilor şi furnizorilor de materiale textile, precum şi studenţilor.

Redacţia

Comparative study on the properties of yarns produced by modified ring spinning methods

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SINEM BILGIN

REZUMAT – ABSTRACT – INHALTSANGABE

Studiu comparativ al proprietăţilor firelor obţinute prin metode de filare cu inele modificate

Proprietăţile firelor, care depind în principal de tehnica de producţie, sunt elementele de bază care influenţează calitatea produsului textil final. În articol se prezintă un studiu comparativ între proprietăţile firelor de bumbac pieptănat, obţinute prin metode de filare cu inele, şi a celor realizate cu inele modificate. S-a constatat că firele filate Siro au o pilozitate mai mică şi proprietăţi de uniformitate mai bune decât firele filate cu inele sau decât cele compacte RoCoS. În plus, la firele Siro şi la cele compacte RoCoS, s-au obţinut rezultate mult mai satisfăcătoare în ceea ce priveşte rezistenţa.

Cuvinte-cheie: bumbac, metode de filare, fir compact RoCoS, fir Siro, filare cu inele

Comparative study on the properties of yarns produced by modified ring spinning methods

The properties of yarn which mainly depend on production technique are the basic elements that influence the quality of the textile end product. The article presents the comparison of properties of cotton combed yarns produced with ring and modified ring spinning methods. It was found that Siro spun yarns had lower hairiness and better evenness properties over ring and RoCoS compact yarns. Furthermore Siro and RoCoS compact yarn showed more satisfactory results in terms of yarn strength.

Key-words: cotton, spinning methods, RoCoS compact yarn, Siro yarn, ring spinning

Garneigenschafts – Vergleichsuntersuchung der Spinnmethode mit modifizierten Ringen

Die von der Produktionstechnik abhängigen Garneigenschaften sind die Basiselemente, welche die Qualität des Textilendproduktes beeinflussen. Im Artikel wird eine Vergleichsuntersuchung der Garneigenschaften aus gekämmter Baumwolle worgestellt, gefertigt durch die übliche Ringspinnmethode und die Spinnmethode mit modifizierten Ringen. Es wurde festgestellt, dass die Siro-Spinngarne eine geringere Haarigkeit und bessere Gleichförmigkeitseigenschaften als die RoCoS Kompaktgarne aufweisen. Mehr, bei Siro-Garnen und bei RoCoS Kompaktgarnen, wurden bessere Ergeblisse erhalten was der Widerstand betrifft.

Stichwörter: Baumwolle, Spinnmethodes, RoCoS Kompaktgarne, Siro-Garn, Ringspinnen

The properties of yarns have significant influence on the performance of subsequent manufacturing operations as well as the quality of the textile end-products. Yarn properties mainly depend on two factors, fiber properties and fiber arrangement in yarn structure. The knowledge of fiber arrangements is based on yarn production technique [1, 2].

Ring-spinning technology is the most widely accepted yarn production method; it is capable of spinning nearly all sorts of natural and synthetic fiber types within a very wide count range [3]. So far, there are a lot of researches with subjected to optimization and improvements of the ring spinning methods in order to increase productivity and to improve yarn properties. In spite of technological development in the field of ring spinning, the mechanism ring-traveler spindle has remained almost the same.

Certain techniques have been introduced onto the spinning market which offer improved quality and/or reduced costs for yarn production by inducing some sort of modifications on ring-spinning technology. Siro and compact spinning methods are just two of these modifications on the conventional ring spinning technique. The spinning triangle represents the most problematic and weakest spot in the yarn formation process using the ring-traveler system. Some peripheral fibers at the spinning triangle escape twist insertion and are lost as fly. This causes lower exploitation of fiber tenacity in yarn, higher hairiness and poorer appearance of yarn. In addition most of the fly in the spinning departments originate from the spinning triangle [4].

In compact spinning, the fiber stream coming out of the drafting unit is condensed by means of pneumatic or any other mechanical compaction [3]. As a result of this compaction, the structure of yarn changes along with its various characteristics. Due to the condensation of fiber flow, all the fibers lay close to each other and because of the absence of spinning triangle all fibers are twisted to the yarn body [3, 4].

One of the novel compact methods is RoCoS compacting system which narrows the strand of fibers through a compression chamber between ceramic compactor and bottom roller. The ceramic compactor is pressed by permanent magnet over the bottom roller. The specially designed path in the ceramic compactor has wider opening at the entry point which gradually narrows down at the exit [5]. RoCoS compact system has got some advantages over first generation air-based compact systems in terms of adaptation to ring spinning machines and lower yarn production cost.

Another modification of conventional ring spinning technique is Siro spinning. The Siro system enables to produce a special spin-twisted yarn directly on a conventional ring spinning machine [6]. In this process, two roving per spindle are fed to the drafting system within specially developed condensers separately and are drafted simultaneously. Emerging from the nip point of front rollers, the two strands are twisted together, as in the case of normal single ring-spun yarn by the ring and traveler system. This results in a two-ply yarn with the same twist direction as that of the component single yarns [7–8].

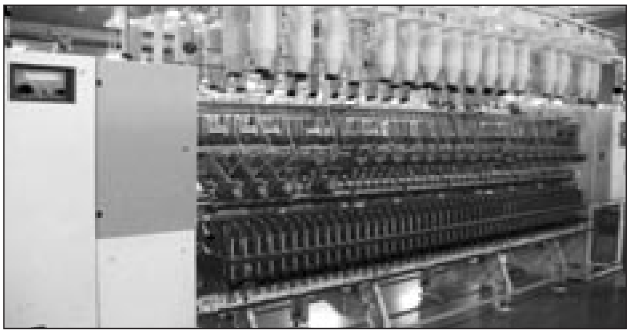

Fig. 1. EJM 168 – Ring spinning machine

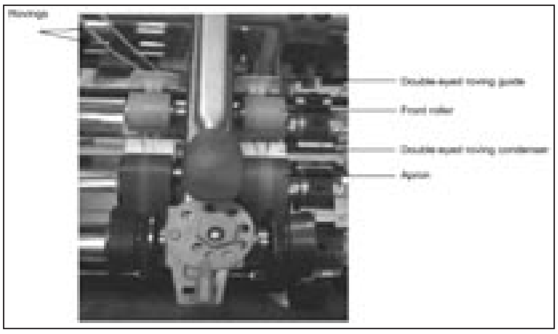

Fig. 3. Pinter Siro spun equipment

The aim of the research was to compare the properties of cotton combed yarns produced by modified ring spinning methods with those of the conventional ring yarns.

MATERIALS AND METHODS

In order to examine the changes of yarn properties depending on the different ring spinning methods for different yarn counts, 9 different types of cotton combed yarn samples were produced on EJM 168 type sample ring spinning machine. The photograph of the EJM 168 ring spinning machine is given figure 1.
We used the same lot of Urfa St-1 type cotton had the various properties when comparing the specifications of yarn samples. These properties are 4.59 micronaire reading, 28.93 mm UHML, uniformity index of 84.5, 7.32 % breaking elongation and 30.61 cN/tex strength. Selected cotton bales were processed on the traditional short staple combed system using standard mill procedures, adjustments and practices. Ring and compact spun yarns were manufactured from Ne 0.85 count roving whereas Siro spun yarn was produced from two Ne 1.7 count roving. In order to produce compact yarns, RoCoS compact equipments from Rotorcraft were assembled on EJM 168 ring spinning sample machine. Figure 2 shows the RoCoS compact device.
Pinter Siro spun equipment was assembled to the drafting system of sample ring spinning machine (fig. 3). Siro yarns were produced with 8 mm strand spacing. To minimize any possible variation, we used same 10 spindles of EJM 168 ring spinning machine for producing all yarn samples.
The yarn tests were carried out on a Premier Tester 7000, Premier Tensomax 7000, and a Zweigle MT-G 567 Hairiness Tester. The results were also evaluated for significance in differences using two-way repeated measures analysis of variance (ANOVA). The mean differences of subgroups were also compared by post hoc test of Tukey at 95 % significant level in the SPSS statistical package.

Table 1

COUNT AND TWIST VALUES OF YARNS

Yarn code	Yarn count, Ne	Count, *CV*, %	Twist, tpm	Twist, *CV*, %
18-R	17.9	1.5	622	1.3
24-R	24.0	2.2	723	1.5
30-R	29.7	1.8	811	1.8
18-S	17.9	1.6	617	1.2
24-S	24.3	0.9	708	3.4
30-S	29.5	1.5	810	2.5
18-C	18.4	1.5	608	1.1
24-C	23.6	1.9	706	2.1
30-C	29.9	1.2	817	2.1

Note: *R* – Ring yarn, *S* – Siro spun yarn, *C* – RoCoS compact yarn

Table 2

ANOVA TABLE OF YARN PROPERTIES

Yarn properties	Statistical value	Factors		
		Yarn count, *YC*	Spinning method, SM	YC-SM
Unevenness, *CV*, %	*F* value	258.766	12.334	16.042
	Significance	0.000	0.000	0.000
Hairiness index, *H*	*F* value	7.167	21.384	2.622
	Significance	0.000	0.000	0.034
S_3 hairiness value	*F* value	0.885	60.202	0.359
	Significance	0.417	0.000	0.837
Rupture of km, *Rkm*, kgf · Nm	*F* value	7.694	21.719	2.511
	Significance	0.001	0.000	0.048
Breaking elongation, %	*F* value	11.444	5.797	4.537
	Significance	0.000	0.004	0.002

RESULTS AND DISCUSSIONS

Table 1 presents the codes, count and twist values of yarn samples. For producing all the yarn samples we used the same lot of cotton fibers which were a great advantage when comparing the physical properties of yarn samples.
The results of the ANOVA for yarn properties are given in table 2. According to the ANOVA, the effect of spinning method, yarn count and interaction of these two

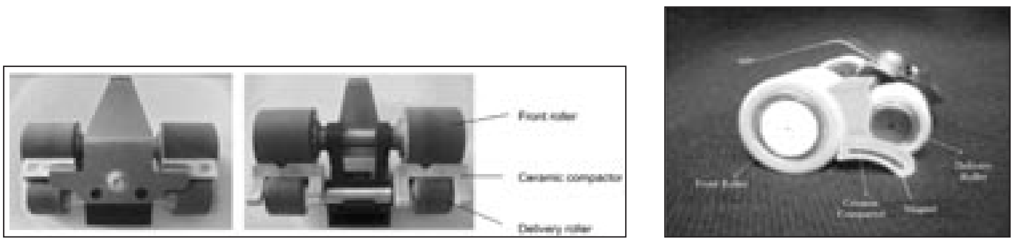

Fig. 2. RoCoS compact device

Table 3

MULTIPLE COMPARISONS OF SUBGROUPS FOR *CVm* VALUES			
Yarn count (*I*)	Yarn count (*J*)	Mean difference (*I–J*)	Sig.
Ne 18	Ne 24	–0.858*	0.040
	Ne 30	–2.421*	0.000
Ne 24	Ne 18	0.858*	0.040
	Ne 30	–1.563*	0.020
Ne 30	Ne 18	2.421*	0.000
	Ne 24	1.563*	0.020
Spinning method (*I*)	**Spinning method (*J*)**		
Ring	Siro	0.495*	0.000
	Compact	0.425*	0.000
Siro	Ring	–0.495*	0.000
	Compact	–0.070*	0.039
Compact	Ring	–0.425*	0.000
	Siro	0.070*	0.039

Table 4

MULTIPLE COMPARISONS OF SUBGROUPS FOR HAIRINESS INDEX VALUES			
Yarn count (*I*)	Yarn count (*J*)	Mean difference (*I–J*)	Sig.
Ne 18	Ne 24	0.1907*	0.040
	Ne 30	0.4017*	0.000
Ne 24	Ne 18	–0.1907*	0.040
	Ne 30	0.2110*	0.020
Ne 30	Ne 18	–0.4017*	0.000
	Ne 24	–0.2110*	0.020
Spinning method (*I*)	**Spinning method (*J*)**		
Ring	Siro	0.9483*	0.000
	Compact	0.7570*	0.000
Siro	Ring	–0.9483*	0.000
	Compact	–0.1913*	0.039
Compact	Ring	–0.7570*	0.000
	Siro	0.1913*	0.039

Table 5

MULTIPLE COMPARISONS OF SUBGROUPS FOR S_3 HAIRINESS VALUES			
Yarn count (*I*)	Yarn count (*J*)	Mean difference (*I–J*)	Sig.
Ne 18	Ne 24	171.2667	0.717
	Ne 30	291.1333	0.386
Ne 24	Ne 18	–171.2667	0.717
	Ne 30	119.8667	0.849
Ne 30	Ne 18	–291.1333	0.386
	Ne 24	–119.8667	0.849
Spinning method (*I*)	**Spinning method (*J*)**		
Ring	Siro	2157.4667*	0.000
	Compact	2016.4333*	0.000
Siro	Ring	–2157.4667*	0.000
	Compact	–141.0333	0.798
Compact	Ring	–2016.4333*	0.000
	Siro	141.0333	0.798

Table 6

MULTIPLE COMPARISONS OF SUBGROUPS FOR *Rkm* VALUES			
Yarn count (*I*)	Yarn count (*J*)	Mean difference (*I–J*)	Sig.
Ne 18	Ne 24	0.4860	0.099
	Ne 30	0.9133*	0.001
Ne 24	Ne 18	–0.4860	0.099
	Ne 30	0.4273	0.165
Ne 30	Ne 18	–0.9133*	0.001
	Ne 24	–0.4273	0.165
Spinning method (*I*)	**Spinning method (*J*)**		
Ring	Siro	–1.5087*	0.000
	Compact	–1.0247*	0.000
Siro	Ring	1.0247*	0.000
	Compact	–0.4840	0.106
Compact	Ring	1.5087*	0.000
	Siro	0.4740	0.106

factors are all statistically significant for the unevenness properties of yarns.

The mean differences of subgroups were compared and interpreted for only statistically significant factors by using Tukey test. If the mean difference is positive, the value of factor *I* is higher than that of factor *J*. In contrast, if the mean difference (*I–J*) is negative that means the value of factor *J* is higher compared to the value of factor *I*. According to the Tukey test results, the differences between mean CVm values are statistically significant for all levels of two factors as seen in table 3. The comparison of mean CVm values of ring, Siro and RoCoS compact yarns is also given in figure 4. The yarns produced by modified ring spinning methods,

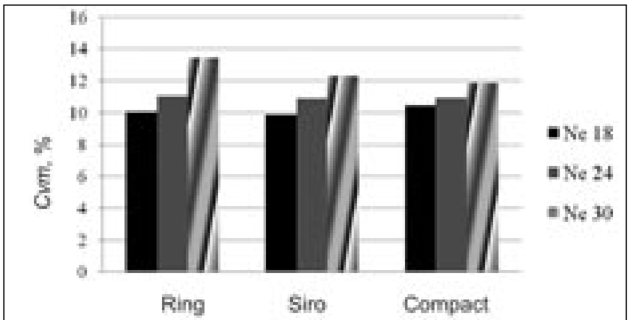

Fig. 4. Unevenness value of ring, Siro and RoCoS compact yarns

Siro and RoCoS compact, show the lower unevenness results than ring yarn.

Also as expected, when the yarn count increased, the unevenness of yarns increased for all yarn types. The lowest CVm value was obtained from Ne 18 Siro yarn whereas the worst result was obtained from Ne 30 ring yarn.

According to the ANOVA, it is seen that the effect of spinning method, yarn count and interaction of these two factors on the hairiness index values of yarns, are all statistically significant. Table 4 shows the multiple subgroup comparisons for hairiness index values. The differences between mean hairiness index values are statistically significant for all levels of two factors as seen in table 4.

In general, hairiness index value decreased when the yarn count increased as seen in the figure 5. It is an expected result due to the fibers in the cross section of yarn decreases when the yarn count increases. In another words when the fibers in the cross section of yarns decrease, the protruding fibers from the yarn surface decrease. The lowest hairiness index value was obtained from Siro yarns. It is followed by RoCoS compact and ring yarns.

The number of hairs in 12 length zones of 1, 2, 3, 4, 6, 8, 10, 12, 15, 21 and 25 mm can be measured on Zweigle hairiness tester. In addition, it is possible to see

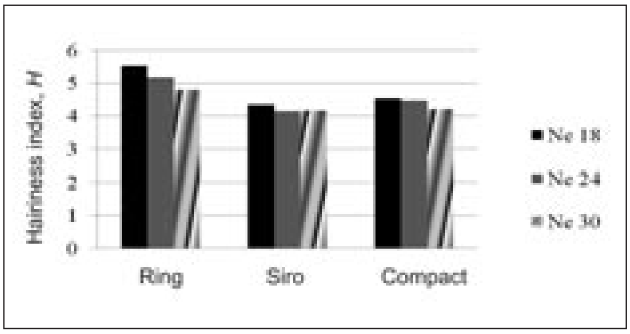

Fig. 5. Hairiness index values of ring, Siro and RoCoS compact yarns

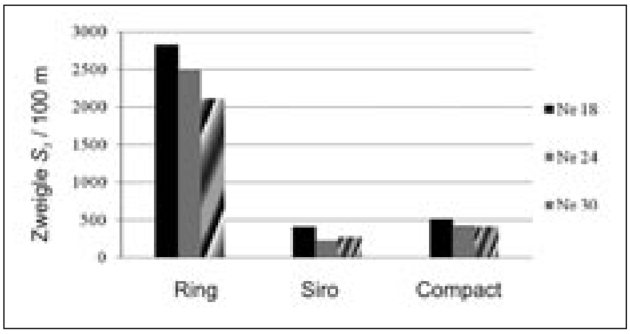

Fig. 6. S_3 hairiness values of ring, Siro and RoCoS compact yarns

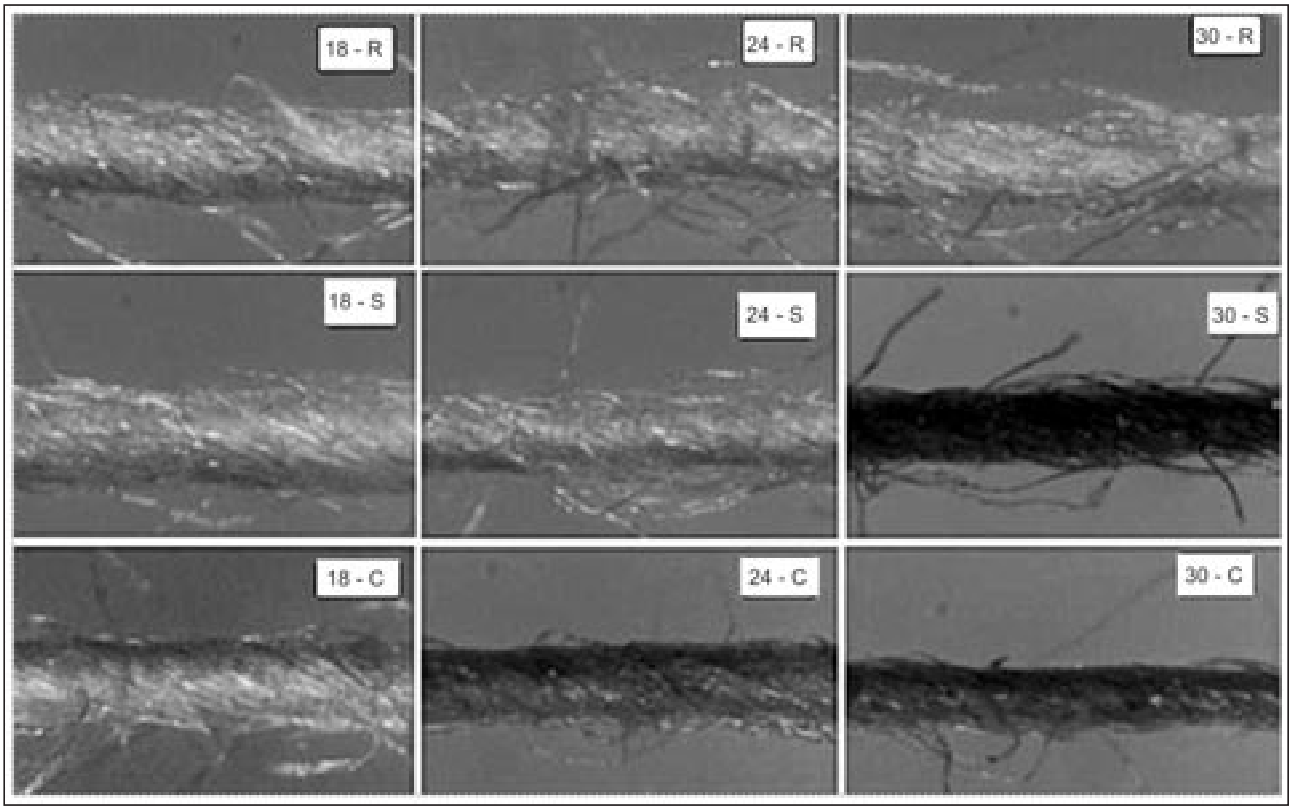

Fig. 7. S_3 longitudinal views of ring, Siro and RoCoS compact yarns

S_3 value after per test from Zweigle hairiness tester. The S_3 values represent the total number of hairy ends that rise 3 mm or more from the yarn surface.

According to the ANOVA, the effect of spinning method on the S_3 values is statistically significant, whereas the effect of yarn count and interaction of yarn count and spinning method are not statistically significant as seen in table 2. The statistical analysis results for S_3 value are different from the results for hairiness index value. This case is related to the difference between two hairiness measurement methods. While S_3 value only represents the number of fiber ends that protrude 3 mm or more from the yarn surface, H value represents the all of fiber ends that protrude from the yarn surface.

Figure 6 shows the comparison of mean S_3 value of yarn samples. The lowest S_3 value was obtained from Ne 24 count Siro yarns. Whereas the mean S_3 value of ring yarns is statistically higher than that of Siro and RoCoS compact yarns, the difference of mean S_3 hairiness values of Siro and RoCoS compact yarns is not statistically significant, according to the Tukey test as seen in table 5.

The better hairiness results obtained from the modified ring spinning methods, Siro and compact RoCoS can also be seen from the visual assessment of yarn types which is given in figure 7.

The effect of spinning method, yarn count and interaction of these two factors are all statistically significant for Rkm values of yarns according to the ANOVA. The difference of mean Rkm values of Siro and RoCoS compact yarns is not statistically significant, according to the Tukey test as seen in table 6.

The comparison of mean Rkm values of yarn samples is given in figure 8. The Rkm values of ring yarns are lower than that of Siro and compact counterparts. The highest Rkm values were obtained from the Siro spun yarns for all yarn counts. The lowest Rkm value was obtained from Ne 30 ring yarn as seen in figure 8.

The comparison of mean breaking elongation values of yarn samples is given in figure 9. According to the ANOVA, there is statistically significant effect of

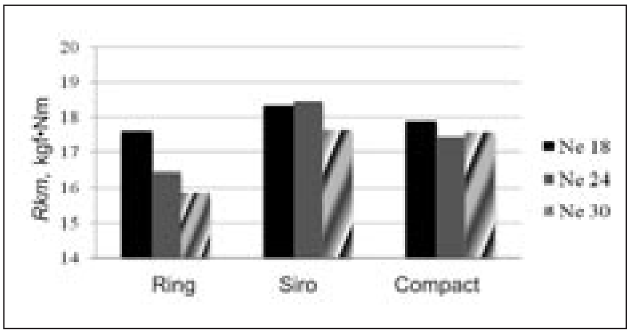

Fig. 8. *Rkm* values of ring, Siro and RoCoS compact yarns

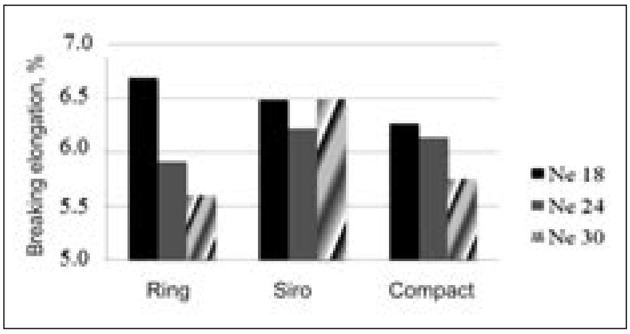

Fig. 9. Breaking elongation values of ring, Siro and RoCoS compact yarns

Table 7

MULTIPLE COMPARISONS OF SUBGROUPS FOR BREAKING ELONGATION VALUES

Yarn count (*I*)	Yarn count (*J*)	Mean difference (*I–J*)	Sig.
Ne 18	Ne 24	0.3897*	0.003
	Ne 30	0.5337*	0.000
Ne 24	Ne 18	–0.3897*	0.003
	Ne 30	0.1440	0.429
Ne 30	Ne 18	–0.5337*	0.000
	Ne 24	–0.1440	0.429
Spinning method (*I*)	**Spinning method (*J*)**		
Ring	Siro	–0.3327*	0.014
	Compact	0.0150	0.991
Siro	Ring	0.3327*	0.014
	Compact	0.3477*	0.010
Compact	Ring	–0.0150	0.991
	Siro	–0.3477*	0.010

spinning method, yarn count and interaction of these two factors, on the breaking elongation values of yarns. Even though, it is stated that breaking elongation values of RoCoS compact yarns are better than that of ring yarns in the different studies about air compact system [9–11], we found that the difference between mean breaking elongation values of ring and RoCoS compact yarns is not statistically significant according to Tukey test as seen in table 7. It may be resulted from RoCoS mechanically compacting device which was used in this study.

Although the highest breaking elongation value was obtained from Ne 18 ring yarn, in general, Siro yarns show the better breaking elongation properties over ring and RoCoS compact yarns as seen in figure 9.

CONCLUSIONS

This study was carried out to determine the significant differences in yarn properties obtained by the ring and modified ring spinning methods. Ne 18, Ne 24 and Ne 30 count 100% cotton yarns were produced in controlled conditions using ring, Siro and RoCoS compact spinning techniques. The results revealed that Siro spun yarns have lower hairiness, better evenness and elongation properties over ring and RoCoS compact yarns. Furthermore Siro and RoCoS compact yarn show more satisfying results in terms of yarn tenacity.

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Significance and perspectives of textile industry in Republic of Serbia, in transitional environment

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RADMILO NICOLIĆ

REZUMAT – ABSTRACT – INHALTSANGABE

Semnificaţia şi perspectivele industriei textile din Serbia, în perioada de tranziţie

Industria textilă din ţările în curs de tranziţie are o tradiţie îndelungată. Aceasta a reprezentat sau reprezintă încă o ramură importantă a economiei, dar a fost neglijată în timpul epocii socialiste, în favoarea industriei grele şi a producţiei de materii prime şi semifabricate. Industria textilă era promotorul economiei naţionale din Serbia. Aceasta nu numai că a ajutat oamenii în satisfacerea propriilor nevoi, dar a avut şi o importantă influenţă asupra creşterii standardelor de calitate şi de viaţă şi, ceea ce este şi mai important, a redus şomajul. Starea industriei textile din Serbia, în perioada 2003–2008, a fost analizată în ceea ce priveşte numărul de angajaţi, suma medie a veniturilor, dinamica producţiei industriale, dinamica volumului fizic al producţiei, precum şi valoarea exporturilor, participarea industriei textile în crearea produsului intern brut. Pe baza acestor indicatori, se poate concluziona că, în momentul de faţă, industria textilă nu are o mare importanţă în economia Serbiei şi nici nu există perspective, dacă nu se va face uz de avantajele ei şi dacă nu vor fi depăşite cu succes problemele-cheie existente.

Cuvinte-cheie: industria textilă, dezvoltare, perspective

Significance and perspectives of textile industry in Republic of Serbia in trasitional environment

Textile industry in the countries undergoing transition has a long tradition, it represented or still represents important branch of economy, but it was neglected during socialism because of heavy industry and production of raw materials and semi-products. The textile industry used to be the main industry initiator of the national economy in Serbia country. It did not only help people directly in meeting their needs but also significantly had an influence on the growth of quality and living standards and what is more, it reduced unemployment. The status of the textile industry of Serbia in the period of 2003 up to 2008 has been presented in terms of analysis of a number of employees, an average net of earnings, the dynamics of the industrial production the dynamics of the physical volume of production as well as the value of exporting, the textile industry participation in creating GDP. On the base of these indicators, it can be concluded that the textile industry, at the time being, has neither great significance in the economy of Serbia, nor will it have any prospects if it does not make use of advantages and overcome the key problems successfully.

Key-words: textile industry, development, perspectives

Bedeutung und Perspektive der Serbischen Textilindustrie in der Wirtschaftsübergangsperiode

Die Textilindustrie in den Ländern der Wirtschaftsübergangsperiode hat eine langjährige Tradition. Diese repräsentierte oder representiert noch heute ein wichtiges Wirtschaftszweig, doch es wurde während dem Sozialismus vernachlässigt indem die Schwerindustrie und die Produktion von Rohstoffen und Halbfabrikate bevorzugt wurde. Die Textilindustrie war die Hauptindustrie der Serbischen Nationalwirtschaft. Es traf nicht unbedingt die Kundenbedürfnisse, hatte aber einen grossen Einfuss auf dem Qualitätswachstum und dem Lebensstandard und es reduzierte die Arbeitslosigkeit. Es wurden Zahlen betreff der Serbischen Textilindustrie in der Periode 2003–2008 vorgestellt, die Angestelltenanzahl, der Durchschnittslohn, die Dynamik der Industrierproduktion und die Dynamik des Produktions- und Exportvolumens, der Textilindustrieanteil beim BSP. Aufgrund dieser Indikatoren kann man schlussfolgern, dass die Textilindustrie keine grosse Beudeutung und auch keine Perspektive für die Serbische Textilindustrie hat wenn man die nötigen Massnahmen nicht erfolgreich trifft.

Stichwörter: Textilindustrie, Entwicklung, Perspektive

In many countries, the textile industry represents one of the most important industrial sectors, and along with proper restructuring it is anticipated to stay the most important industrial sector in the future. The textile and clothing sector in developed countries is experiencing series of radical changes due to technological growth, increase of production costs and appearance of important international concurrence. Textile and clothing industry in developed countries has started long term process of restructuring and modernization by applying technological development. The companies have improved their competitive advantage by shutting down large companies and massive production and by eliminating the production of simple fashion items, in order to focus themselves on wide range of various productions with higher value added.

The textile and clothing industry belongs to the traditional branches of light industry and it is one of the greatest industry branches in the world. As a rule, it usually employs a great number of cheap and low-skilled labour forces, manly female, whose work has always been paid less than in other branches of light industry. Therefore, the social aspect of this branch is especially important for all countries as in the majority of countries it is the main industrial branch in terms of the number of employees. In Serbia, as anywhere else, the clothing industry has been the so-called female (women's) industry, as it employs more women than men. As for the structure of the employees in the textile industry, the female labour force is predominant, and it amounts to 80%. The Serbian textile industry, taken as a whole presents a typical example of the working-intensive sector of the economy with the traditional low wages employing the increasing number of female work force.

The textile industry took an important place in the local economy in the past in terms of number of enterprises, the volume of a foreign trade scope as well as its identification on the foreign markets. The textile industry had been one of the leading export branches of former SRJ before the UN introduced sanctions. The textile industry of Serbia had significant production capacities and it was a very important factor in the industrial production. Before 1991, the textile industry took part some 11% of GDP (Gross Domestic Product) of Serbia, in export with some 20%, with the favourable balance of $ 450 million, having the 16% of employment rate [8]. If fact, the point was in additional jobs for the foreign partners at that time (even 90%). For the sake of dealing with intensive foreign trade scale, the enterprises of textile industries had been working all in accordance with the world's standards as well as the market tendencies. However, after the sanctions had been introduced, the steady trend of the whole economy dealings, referring to the textile industry too, was abruptly stopped.

Some of the problems the textile industry faced with, and is still facing with, are common for every economy branch in Serbia. It includes problems with labour force restructure, disloyal concurrence in grey economy, difficult or impossible access to sources of financing and alike. However, the specificity of the textile industry in comparison to other economy branches and drastic changes at international market caused the textile industry to face with additional problems it could not adjust to. The incurred troubles unsettled the business of the economy branch in so far as it can be said that Serbian textile industry is one of the greatest losers during the 1990's, as well as during the transition period. Shortly, the largest number of companies in this branch, faced with market loss and drastic decrease of domestic market, along with heavy burden of large number of labour force, could not continue doing business in a way it used to, so many previously successful large companies failed. At the same time, the private sector dynamically developed, and it produced and traded beyond official channels. However, nowadays many of these companies are facing with harsh competition from import since they have transferred into official channels, what jeopardised their business. A very small number of the textile companies in Serbia has still relatively good works, has concluded arrangement and perspective, while large number of companies does not work or is bankrupt.

Modern market business of Serbian textile companies is characterised by unfavourable aspects, especially during the economy crisis, which can be seen in bad position of textile companies at the international market, decreased competitiveness, lack of technology, insufficient training of employees, lack of standard and other. Even before economy crisis emerged, this sector had the smallest net earning in Serbia and it had difficulties in doing business due to great disloyal concurrence (grey economy in the textile sector is 44% of entire volume of business at Republic level, and 50,5% on the south of Serbia).

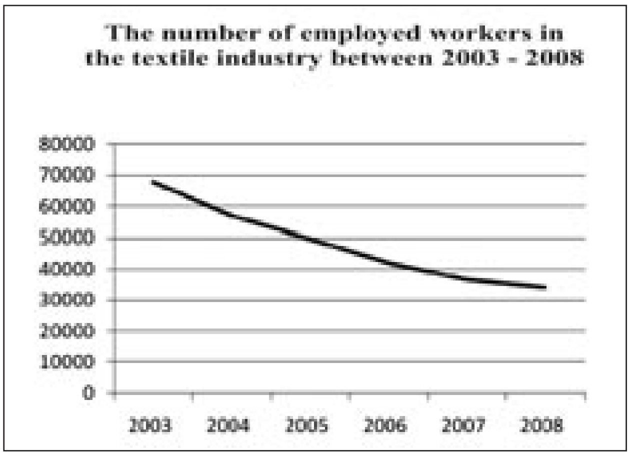

Fig. 1. Record of workers employed in the textile industry between 2003–2008

A STATE ANALYSIS OF THE SERBIA TEXTILE INDUSTRY

For a longer period of time, the textile industry of Serbia has been on the turning point: whether to develop in a branch which would be competitive on the international market or to stay in the phase of survival and become a branch of a minor importance, even within the borders of our own country. The textile factories organized into big systems got into crises, so these consequences were inevitable: redundancy; reduced sale volume; problem of supplying raw materials because of sanctions; the impossibility to enter the international market and curtly and naturally impossibility to supply and keep up pace with new technologies, which had already been adopted by the surrounding countries, by which they had increased their competitiveness [10].

During these critical twenties, a great number of labour force disappeared through different social programmes, and the textile industry was broken into pieces. Once so powerful and one of the leading branches of our local industry experienced heavy losses reflected in the following ways:

- technical – technological backwardness of enterprises (almost 90% of the imported equipment and the automatization level was extremely low compared to those of other industrial branches);
- backwardness in keeping up pace with advanced trends on the market as well as valid standards in this field (the textile industry is of the most global in the world);
- the economic-social status of employees in the textile industry was very bad, taking into consideration the fact that the wages in this branch were far lower than the republic average was;
- a great influence of disloyal competition (unfair competition) as well as "grey market";
- unfavourable classifying structure of employees (the particular problem is the lack of skilled labour force);
- unsolved property relations and inefficient process of property transformation;
- illiquidity of enterprises and the impossibility of debt collection (a great number of former giants were closed and there were a great number of enterprises which have been in the bankruptcy proceedings).

The situation in the textile industry can be best seen by taking into consideration the following indicators:

- number of employed workers;
- net (earnings) wages;
- dynamics of industrial production;
- physical volume and value of exporting;
- participation of textile industry in creating GNP (in permanent prices and by indexes);
- realized investments into the fixed assets (according to the technical structure).

The number of employees

Because of a very hard situation, the textile workers had to face in the previous decade, the number of employees in the textile industry was reduced a great deal. However, if the negative trends continue, and which

Table 1

THE NUMBER OF EMPLOYEES IN THE TEXTILE INDUSTRY BETWEEN 2003–2008						
Indexes	2003	2004	2005	2006	2007	2008
Production of textile yarn and fabric	29 644	24 344	21 775	18 240	17 178	15 424
Production of dressing items and fur coats	37 994	32 437	27 814	24 047	19 720	18 851
In total on the level of the textile industry	**67 638**	**56 781**	**49 589**	**42 287**	**36 898**	**34 275**
In total on the level of the state	**1 611 632**	**1 580 140**	**1 546 471**	**1 471 750**	**1 432 851**	**1 428 457**

Source: Federal Department for Statistics

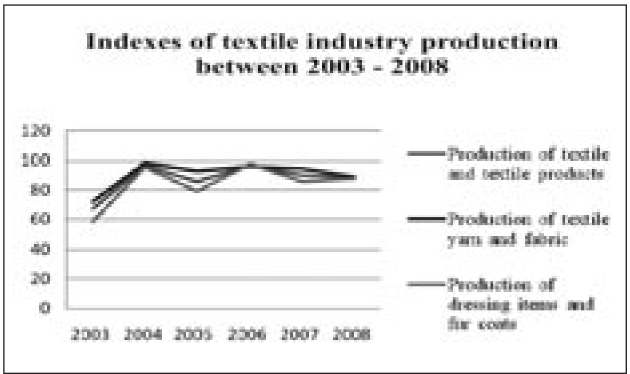

Fig. 2. Indexes of textile industry production in the period from 2003 to 2008

has been going on since 1989, the number of employees could be cut down to some 15–20 000 [1].

The number of employees in the period from 2003 to 2008 was constantly decreasing (table 1). From the number of 67 638 workers who were employed in the textile industry in 2003, the number of the monitored period was reduced to 34 275 workers, that is, even 49.33%. It is the result of the permanent decrease of business activities in this field, as well as the closing of a great number of enterprises within this field.

The participation of employees in the textile industry in relation to the total number of employed workers in Serbia in 2003 amounted to 4.2%, in 2004 it amounted to 3.59%, in 2005 to 3.2%, in 2006 to 2.87%, in 2007 to 2.58% and 2008 to 2.4% (fig. 1).

Earnings of employees

The economic-social position of employees in the textile industry was much jeopardized taking into consideration the fact that the earnings in this branch were the lowest within the processing industry in general. What is more, they were even lower compared to the average earnings in the Republic. The earnings within the textile industry, during the whole period of time from 2003 up to 2008, were four-five times less in comparison to the Republic average. More precisely said, in 2003 the average net earnings in the division of producing textile yarn and fabric were 3.56 times less in relation to the Republic average, while in the division for producing dressing items and fur coats they were even 5.3 times less in relation to the Republic average. During 2008, there was a slight improvement so that the average net earnings in the division for producing textile yarn and fabric were 2.66 times less in relation to the Republic average, while in the division for producing dressing items and fur coats they were 2.88 times less relating to the Republic average.

Table 2

RECORDED TEXTILE INDUSTRY PRODUCTION BETWEEN 2003–2008 (INDEX)						
Indexes	2003	2004	2005	2006	2007	2008
Production of textile and textile products	67.3	96.9	85.8	98	90.2	88.7
Production of textile yarn and fabric	71.9	98.3	92.8	95.9	94.5	88.8
Production of dressing items and fur coats	58.7	95.8	79.6	98.1	85.9	88.5

Source: Federal Department for Statistics

Production achieved

If we look at each year individually, we see that the indexes of the textile industry production vary, having the tendency of slow decrease (table 2). In 2003, that production decrease is the most obvious. The higher instability in the production is expressed with the production of textile and textile products as well as the production of dressing items and fur coats (fig. 2).

Foreign exchange trade

The most important foreign trade partners of our country are the countries of the European Union (Italy and Germany), then the markets of Southeast Europe as well as the regions of former republics of the Socialist Federal Republic of Yugoslavia. The participation of the textile industry export, within the total export in the period from 2004 to 2008, was very low and it recorded a slight increase from year to year, so that in 2004 it amounted to 5.5%, in 2005 to 5.93%, in 2006 to 6%, in 2007 to 6.13% and in 2008 to 5.98%. In the period from 2004 to 2008, the indexes of the textile industry volume export significantly varied from year to year, having the tendency of slight increase (table 3). The turning point in the further development of the textile industry was 2003, as it was then that the Agreement on Textile between the member states of STO was terminated, taking also into consideration the fact that it was also the year when The Agreement on Textile products Trading, between Serbia and European Union was adopted so that all limitations referring to the textile products import from Serbia were abolished. On the other hand, this Agreement anticipated that Serbia should decrease the customs rates in phases during the transition period, according to the types of products. Besides, it was also very important that in the mid of 2006, the Republic Serbia signed CEFTA. The aim of the Agreement of states belonging to Central and East Europe, was to intensify the

Table 3

THE VALUE OF THE TEXTILE INDUSTRY EXPORT IN THE PERIOD FROM 2004 TO 2008, IN MIL. USD					
Indexes	2004	2005	2006	2007	2008
Textile yarn and fabric	80	107	173	263	321
Dressing items and fur coats	116	151	213	278	336
In total on the level of the textile industry	**196**	**266**	**386**	**541**	**657**
Total export on Republic level	**3 523**	**4 482**	**6 428**	**8 825**	**10 973**

Source: Federal Department for Statistics

Table 4

GDP IN PERMANENT PRICES IN 2002 (INDEX)						
Indexes	2003	2004	2005	2006	2007	2008
Production of textile and textile articles	65.2	97.2	86.9	96.8	90.9	88.7
Production of textile yarn and fabric	71.9	98.3	92.8	95.9	94.5	88.8
Production of dressing items and fur coats	58.7	95.8	79.6	98.1	85.9	88.5
GDP on the Republic level	**102.4**	**108.3**	**105.6**	**105.2**	**106.9**	**105.5**

Source: Federal Department for Statistics

enterprise cooperation in the region as well as to prepare more appropriately for the process of European integration.

Participation in GDP

Unlike the period before the sanction were introduced, when the textile industry took a great part in creating GDP, the share of the textile industry in the total GDP, between 2003–2008, was insignificant having the tendency of permanent decrease (table 4). In 2003 the textile industry took part in creating GDP with the sum of 10884.1 so that in 2008 the contribution of the textile industry in creating GDP amounted to only 7 172.6 million dinars. If we consider the percentage share of the textile industry in GDP in the taken period of time, we can conclude that in 2003 it amounted to 1.04%, in 2004 to 0.93%, in 2005 to 0.76%, in 2006 to 0.7%, in 2007 to 0.63% and in 2008 to 0.53%.
Although the GDP on the republic level always increases from year to year, the GDP in the textile industry varies with the decreasing tendency, the consequence being the constant decrease of business activities in this branch of industry.

ANALYSIS OF TEXTILE INDUSTRY POSITION WITHIN THE COUNTRIES IN REGION

This sector suffered great changes in global proportions since 1970, which concur with the structural crisis in the developed countries, the globalisation process and speed liberalisation of the world's market. The present uncertainty in the textile industry of the developed countries – especially in Europe, is the consequence of continuous and sudden changes in the areas in the last few years. The changes led to the production and entire industrial sector restructuring and reorganisation. The result is significant decrease of the employees in the developed countries [12].
Countries in the region, new members of the EU form Central and Eastern Europe (CIE) are in the different transitional processes, and some of them have gone far enough with the reforms. What is characteristic for these countries is that the textile industry represented or still represents very important industrial sector in certain phases. The textile industry has long tradition in these countries, but it was neglected in the socialism because of heavy industry, raw material industry and semi-manufactured goods industry. When socialism broke down, it was obvious that the loss of market and growing import of cheap textile products form the Asian countries presented the big blow for the textile industries of these countries. Only job processing with the EU contributed the slower degradation of the textile industry in these countries.
The foreign partners form Western Europe abandoned the companies from the ex Yugoslavia republics because SFRY broke down and war destructions began, and turned toward the companies in newly democratised countries of the ex eastern block. The existing situation in these countries is no longer prospective, because of stagnation and negative trends that the textile industries of the countries are faced with. The textile industry recovery, especially the Bulgarian and Romanian one, happened after SFRY breakdown and due to job processing with the EU countries. Therefore, Bulgaria and Romania recorded the growth of the textile industry participation in the entire processing industry production, since the production moved from Serbia.
Countries such as Slovenia and Hungary are highly productive in the textile sector, and highly above the EU average in their prices and quality, and are famous for their brands. They do not pose concurrence to the Bulgarian and Romanian textile producers, and especially Greek, which are the same or above the EU average in quality, but far more competitive in prices. That is why Slovenia, Hungary and Czech Republic as industrialised countries slowly give in the production in the textile industry to the less developed countries, orienting themselves on the production with higher added value.
The privatisation process in the countries in region is finished in almost every new EU member states. In these countries, the privatisation process was the main source of foreign investments in the textile sector. In addition, the restructuring process and technical modernisation process of the capacities took place along with privatisation process.
The textile production in the countries in the region practically does not exist and it is in dire crisis, as is the case with the textile industry in Croatia. The main problem is that there is no primary production and that clothing industry makes 75% of textile industry, which is not competitive in modern conditions of the EU market. The salaries of the textile workers are the lowest in the country – 400 EUR in average, and managers say it is due to large part of female workforce and average sick leave and seasonal work extent. Serious problems for the companies are the filling the production capacities between two seasons, small

Strengths	Weaknesses	Opportunities	Threats
S_1 = experience in production S_2 = appropriate technology S_3 = identification of the brand S_4 = cooperation with other big companies	W_1 = the most experienced workers leave W_2 = a high level of charging of the equipment for primary processing W_3 = small investment possibilities W_4 = redundancy, conflicts in the company, enterprises	O_1 = small average consumption O_2 = constant decrease of city inhabitants O_3 = protection from foreign competition	T_1 = reduction of wage fond T_2 = small private workshops T_3 = a long-term interruption of business activities on the foreign market

Fig. 3. SWOT analysis

order volume and market openness, which caused constant commodity exchange deficit over 510 million American dollars in the last year. The companies, which invested and modernised technology in the last years or specialised for specific production have the largest survival potential. The Strategy for textile and clothing industry development for period 2008–2012 was presented last year to the public, which plans to invest 200 million EUR in restructuring and development of the industry. The Strategy plans development of small and middle companies, professional specialisation and employment, environment protection, energy saving and assistance in development and research.

Important political changes in Slovenia, which started in 1989, had drastic influence on Slovenian economy structures. Slovenia has lost most of the Yugoslavian market, while eastern European markets have undergone the essential restructuring. At the beginning of the Slovenian industry restructuring, the textile and clothing industry kept an important position. In 1992, the textile industry makes 14% of entire employed human resources in the industrial sector, which was composed of 13% of Slovenian industry shares and represents 10% of industrial export. Until 2006, the personnel fell to 8.7%, Slovenian industry share fell to 4.2% and export share fell to 3.5% [6].

The fact that Slovenia became member of the EU in May 1st did not stop the share in clothing industry export, and introduction of Euro had no effect on the competitive position and development on the international market. Employee reduction in Slovenian clothing industry was the consequence not only of clothing industry companies' bankruptcy but also of constant employees' reduction in order to optimise production potential and decrease costs [2]. Dynamics in production degradation led to the human resources reduction, but the human resources reduction was slower that production, which caused the weakening of Slovenian textile industry in global concurrence. Besides, textile and clothing industry had undergone restructuring more slowly than other processing industries [3]. The same situation is in ex-Yugoslavian republics. Macedonian textile companies are in crisis due to low prices on European markets, shortage of money and expensive and unavailable credits. 30% of textile industry in Macedonia shut down, while the rest of it is barely alive.

PERSPECTIVES OF THE TEXTILE INDUSTRY IN SERBIA

There are enough conditions and space to encourage the revival of the textile industry in Serbia despite slow recovery due to economy stoppage and capital shortage.

Textile industry has real chance to join again in industrial flow because is has: well-built existing infrastructure, installed capacities in all sectors, cheap and experienced workforce, production experience and business experience with foreign partners.

Long-time crisis in Serbia hit production and caused development delay. Serbian government initiated drafting of The Industrial Development Strategy until 2010 with desire and need for active relation in directing future development of Serbia. The Strategy should point out the industrial development potentials in Serbia and require national product increase, international concurrence and life standard increase [7]. Strategy for textile industry development should point out the development potential of the industrial sector in Serbia in order to spot those industrial sectors that can lead the development and that our developmental potentials are valorised in the market in the best possible way. The development strategy aim is creating international competitive and open economy that will mainly join the globalisation process of world's economy in a way to provide faster and sustainable development. Textile industry is because of the working circumstances mainly oriented on export. That is why the factory experts want to adopt new technologies and working procedures. It is necessary to provide an insight in market trends for the domestic experts providing textile fairs, samples and fashion tendencies. It is very important to significantly increase quality level, product or model diversity.

Domestic textile industry made a large pause in investments, therefore partly lost pace with modernisation. Still, it is possible to introduce new products working procedures in textile industry. First, it is necessary to repair machine stock with small investments and to introduce automatics. In order to provide increase in professional level it is necessary to educate personnel and to provide specialisation for the existing personnel. There is a risk of having machines but lack of experts [11].

Perspectives of the future development of the textile industry of Serbia lie, first of all, in the need for making changes in the production and it is preconditioned by the need to improve the production programmes. The changes should take place in the direction of producing products accompanied by a higher additional value. We mean the products the customers are not primarily interested in because of their prices but because of some other better known characteristics of the products. This identification can be achieved in various ways: by promotion activities which would create a specific brand, a direction towards satisfying specific needs of the definite parts of markets; an exceptional quality of products, the reliability and a due time delivery, offering the post paid services etc. [1].

A simple presentation of the exposed matrix for enterprises of the textile industry is given in figure 3 [4]. As the time goes on, the opportunities can turn into threats and vice versa. Besides, the detailed interrelationships of the exposed strategies, tactics and actions have not been considered here at all; it is only said that they can be used in a scheme (mix), but they also can be exclusive mutually so that successful companies tend, on the base of strengths, to take advantage of opportunities. The sequence depends on whether there is or not a synergy (positive synergy) between the inside and outside factors, that is, a more precisely asked question should be: is it possible or not to meet the opportunities and threats with the existing strengths and weaknesses? In case that there is some positive synergy, the greatest priority is given to opportunities within SO position, and therefore strengths get priorities in the same field.

Advanced marketing business of the textile companies in Serbia, especially during the economic crisis, is characterized by unfavourable aspects which are reflected by: a low position of the textile industry on the global marketing scene; reduced competitiveness; lack of technology, insufficient training of the employees; non-existence of standards etc. The economic growth of Serbia is not based on the growth of productivity, which derives from the advanced technological base of production, but on the growth which is the result of decreasing the number of unemployed workers. There is relatively a small number of capital-intensive products with which the economy of Serbia can compete equally on the world market. Competitive products of textile industry of Serbia are, first of all, labour-intensive.

As it with all other countries being in the process of transition, the production of clothing has got greater importance than the production of yarn and fabric. The reason for that is that the greatest number of enterprises for the production of yarn and fabric has got the obsolete equipment and they lag behind the advanced technological achievements. The yarn and fabric production has been more technologically intensive than the clothing article production so it is more sensitive to the differences in terms of the level of technological equipment capacity. In the last fifty years in the world, in the field of yarn and fabric production, the equipment has been improved a great deal in terms of productivity and more efficient usage of operating supplies and raw materials as well as the introduction of new materials. Therefore, an important level of investment into the fixed assets is necessary so that it would be possible to increase the yarn and fabric production in Serbia in order to make it more competitive on both the local and international markets. When we talk about the dressing article production, there is the quality of equipment as well as the level of unused capacities which offer the possibility to increase the production in this branch in a very short period of time. The mere problem of equipment modernization in this field could be solved by purchasing additional machines, which would be connected to the existing ones [9].

Briefly, the basic developing characteristics of the textile division in Serbia should be:

- reorganization of enterprises in terms of founding joint-stock companies as well as stronger market positioning through the increased productivity and competitiveness;
- development of own trade marks and marketing;
- the export-oriented companies should be stimulated by the state;
- investment in great capacities, equipment, new models;
- giving up the exclusive orientation on lohn jobs;
- geographical and productive diversification of the export.

In the foreseeable future, it could be expected the textile industry to achieve the considerable level of export again in relation to other branches of the economy and to re-establish the former splendour and importance of one of the most important economy branches. The real expectations are quite evident and the majority of enterprises can be very quickly joined, as very reliable partners, by a great number of companies. The opportunity of the textile and garment industry lies in the liberalization of the world's market, textile and their fresh involvement into the international flows as well as in increasing the export, in the first place, of ready-made clothing (garment industry).

CONCLUSIONS

Nowadays, the textile industry in Serbia as in other countries in transition has been in a very difficult position. If the negative trends continue, it could become one of the marginal branches of Serbian economy. In the observed period of time there has been a considerable decrease of the number of employees taking part in the textile industry relating to the total number of employed workers in the Republic.

The average net earnings are far less in comparison to the Republic average, although the difference has been decreasing in the last few years. The production volume has been decreasing; its share in the GNP has also decreased, and the share of the textile product export within the total export of the country, has been increasing gradually. The greatest problem of the textile production has been the industrial inefficiency in using the capacities and the obsolete equipment. However, there has been noticed some positive shift in this field. In fact, the Government and the businessmen in our country seem to have overviewed the perspective of this branch of the processing industry quite carefully so that, in that sense, the investment in the fixed assets has been increased, the aim being the improvement of the technical equipment of the production in this field. Weather or not this investment is going to achieve the planned effects, it remains to be seen in the forthcoming period. Experts feel that this low-accumulative branch still has the strength to overcome the accumulated debts, the technological lagging and to re-establish the markets lost during the long lasting years of the country's isolation.

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RECENZII

FIBRE ȘI PĂRURI ANIMALE NOBILE

Autori: ***Carmen Ghițuleasa, Emilia Visileanu, Vasile Mirciu***
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Cartea este editată de Institutul Național de Cercetare-Dezvoltare pentru Textile și Pielărie și este structurată în 5 mari capitole.

Lucrarea prezintă aspecte comparative privind: stadiul actual al producerii și utilizării fibrelor de lână și al părurilor animale nobile, pe plan mondial; indicatorii macroeconomici obținuți în industria de textile-confecții din România; producerea și prelucrarea fibrelor de lână; producerea și utilizarea fibrelor mohair, precum și principalele caracteristici ale fibrelor mohair românești și ale celor din alte țări; alte tipuri de păruri animale – cașmir, alpaca, cămilă, lamă, viguña, guanaco, yak, caracteristicile acestora, principalii producători, recoltarea, procesarea și prețul acestora, utilizări finale și piețe de consum, precum și aspecte privind identificarea fibrelor de lână, a părurilor și fibrelor animale nobile.

Cartea este utilă specialiștilor în domeniu, producătorilor și furnizorilor, precum și studenților de la facultățile cu profil textil.

Redacția

Modeling and 3D simulation of the garment product

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MIHAI CIOCOIU

REZUMAT – ABSTRACT – INHALTSANGABE

Modelarea şi simularea 3D a produselor de îmbrăcăminte

Modelarea 3D a produselor de îmbrăcăminte se foloseşte din necesitatea simplificării procesului de proiectare şi a designului de produs. Simularea este necesară atât pentru vizualizarea aspectului şi a formei produsului proiectat, cât şi pentru analiza comportamentului şi a răspunsului acestuia la diverse solicitări. Preocupările în acest domeniu s-au concretizat prin definirea unor tehnici de modelare discretă sau continuă, statică sau dinamică, pentru simularea aspectului suprafeţelor textile utilizate la produsele de îmbrăcăminte. De asemenea, s-a realizat simularea dinamică a comportării produselor de îmbrăcăminte pe modele virtuale, folosind metoda elementului finit. Lucrarea prezintă aspecte generale privind modelarea şi simularea numerică a produselor de îmbrăcăminte în mediul virtual, evidenţiind atât avantajele realizării şi verificării prototipurilor în mediul virtual, cât şi contribuţiile personale pentru rezolvarea acestei probleme.

Cuvinte-cheie: modelare 3D, simulare, discret, continuu, suprafaţă textilă, tipar, manechin, prototip virtual

Modeling and 3D simulation of the garment product

The 3D modeling of the clothing products is used from the need to simplify the design process and product design. The simulation is required to view the layout and shape of the product design and to analyze its behavior and response to various demands. Concerns in this area have resulted in the techniques establishment of discrete or continuous, static or dynamic modeling for the simulation of the surfaces texture used in the clothing product. Also, it was tried to simulate the dynamic behavior of the clothing on virtual models, using the finite element method. The paper presents the general aspects of the modeling and numerical simulation of apparel products in the virtual environment, highlighting the benefits of implementation and verification of the prototypes in the virtual environment and the personal contributions to solving this problem.

Key-words: 3D modeling, simulation, discrete, continuous, textile surface, pattern, mannequin, virtual prototype

Modellierung und 3D-Simulation der Bekleidungsartikel

Die 3D-Modellierung der Bekleidungsprodukte wird aus der Notwendigkeit der Vereinfachung des Entwurfsprozesses und des Produktdesigns angewendet. Die Simulation wird benötigt sowohl für die Visualiserung des Aussehens und der Form des Entwurfsproduktes, als auch für die Analyse des Verhaltens und der Antwort bei unterschiedlichen Auslastungen. Die Arbeiten in diesem Bereich wurden durch die Bestimmung einiger Modellierungstechnicken konkretisiert – diskret oder kontinuirlich, statisch oder dynamisch – für die Simulation des Aussehens der Textiloberflächen bei Bekleidungsprodukten. Es wurde gleichsfalls eine dynamische Simulierung des Verhaltens der Bekleidungsprodukte auf virtuellen Modellen durchgeführt, durch die Anwendung der Methode des Finiten Elementes. Die Arbeit präsentiert generelle Aspekte betreff der Modellierung und Numerischen Simulation der Bekleidungsprodukte, indem sowohl die Vorteile der Fertigung und Verifizierung der Prototype in virtuellen Umwelt als auch der persönliche Beitrag in dieser Problemlösung vorgestellt wurden.

Stichwörter: 3D-Modellierung, Simulation, diskret, kontinuirlich, Textiloberfläche, Muster, Mannequin, virtuelles Prototyp

"The truth is too complicated to allow anything but approximation"
John von Neumann

Textile surface of a garment is made, affects the appearance of the product both at static and in using operation – the dynamic aspect. Textile surface can be described as both the geometry and physical properties and can be approached as a two-dimensional body moving in a plane three-dimensional space. The textile garments suffer various distortions due to multiple stresses, bending, stretching, and rubbing-in different directions during the using process.

For accurate modeling of the textile material it is required in advance the setting of physical and mechanical properties emphasized by Kawabata evaluation system. With the evaluation results available, the textile material can be modeled as a continuous or as a particle-system model. Always, the continuous and the particle-system model were in competition. Although the two models are different, they lead to similar results. The modeling technique is based on the theory of elasticity [3]. For modeling, the textile material is considered to have a homogeneous structure. Numerical modeling of a garment textile surface is carried out numerically using the finite element method. Finite element methods divide the surface or textile in a representative set of triangles and find the appropriate functions that satisfy the balance elements equations.

Because the textile surface is not homogeneous, the continuous model can not play the reaction to requests for stretching or bending the textile surface, which is why it is used for discrete modeling. Discrete modeling technique describes textile material as a scratchy system, generically called "mass-spring" and consists of nodes-masses and arcs that resist to deformation structure. Textile material is viewed as a mechanism and not as a substance, and the dynamic properties of macroscale derived from micro-mechanical interactions between components. Thus, the fabric is presented as an interacting system of wires and threads that together form a surface due to friction between them [6].

Dynamic modeling used clothing moving models for simulation of clothing solicitations in using. It uses fixed-length constraints to maintain a certain distance between particles. This model takes into account the internal and external forces action on it.

Unfortunately, like many real phenomena, it is difficult to accurately model and to simulate the deformations of the clothing while wearing it. This would require modeling at the quantum level.

Its aim is to highlight the surface behavior of apparel textile products for various static and dynamic

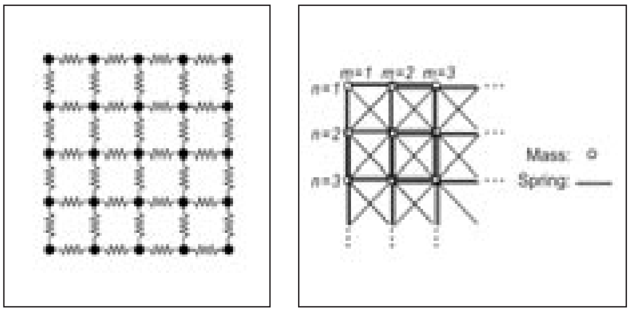


Fig. 1. Simple section mass – spring model for textile surface discrete modeling

conditions. Static or dynamic behavior can be predicted by the knowing forces acting on the surface of the textile product, taking into account the constraints imposed by the type and combination of parts of clothing (fig. 1).
Using discrete surface modeling to simulate textile clothing products in the virtual environment we have the following characteristics:

- fidelity, with the dynamic and static product of real clothing;
- efficiency, in terms of computational;
- elegance, which can be explained, understood and implemented with minimal difficulty.

THE CURRENT STATE OF SIMULATION PROCEDURES

Virtual simulation of the behavior of clothing has preoccupied many specialists. To achieve this goal, in many research centers around the world it has been experimenting, trying to modeling and simulating 3D clothing products.
In 1990, the group MIRAlab [4], University of Geneva, Switzerland began solving simulation clothing in virtual models (fig. 2). They started from the model of Terzopoulos et al. [3], adapting it especially for clothing by improving amortization and response to the impact with

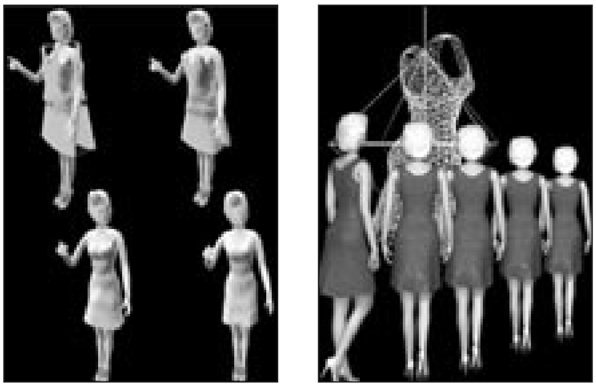


Fig. 2. Assembly simulation by stitching the parts of clothing, around a virtual body

various solids. For modeling products there are used virtual models created by the 3D body shape scanner captures and the development of new bodies by changing parameters. The main contributions in the research of the modeling and 3D simulation are the engineering design software for virtual clothing, the self-collision and the textile material response to the collision study, geometrical representation of textile material folds during simulation, and studies in efficiency and behavior of different numerical methods.
In the University of Hong Kong, China, it has been doing research on the simulation and 3D modeling based on mass-spring model. The 3D bodies are obtained through a scanner. The 3D modeling of the clothing (fig. 3) is made directly on the virtual models and uses the finite element method for the representation of 3D templates. The 3D clothing products are separated in the component parts and in this way 2D patterns are obtained. Also, it has been studied also the variant to getting 3D clothing modeling from 2D patterns.
A main contribution to simulate mechanical behavior of textile material is provided by the behavior analysis of each type of tissue because the micro-structure

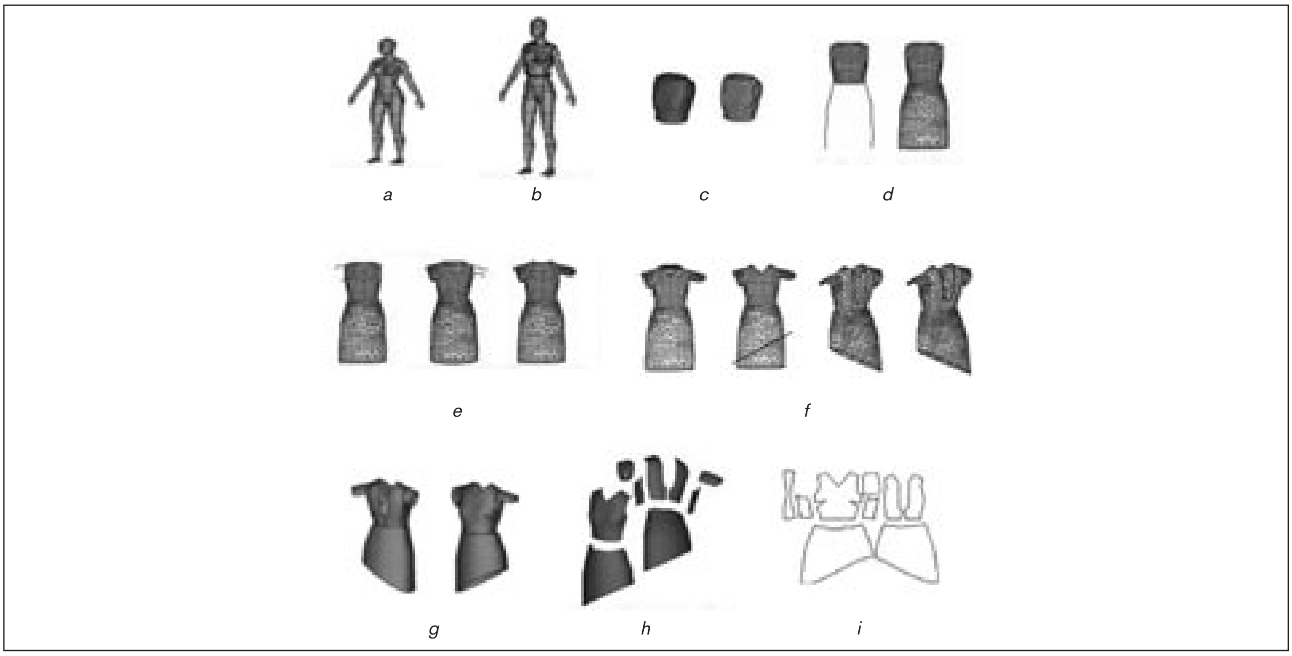


Fig. 3. The 3D modeling using virtual models: ***a*** – feature human model; ***b*** – input strokes to specify profile; ***c*** – results of surface construction; ***d*** – input and result of extruding; ***e*** – progressive extruding; ***f*** – cutting strokes and results; ***g*** – painting seam line; ***h*** – results of separation; ***i*** – related 2D patterns

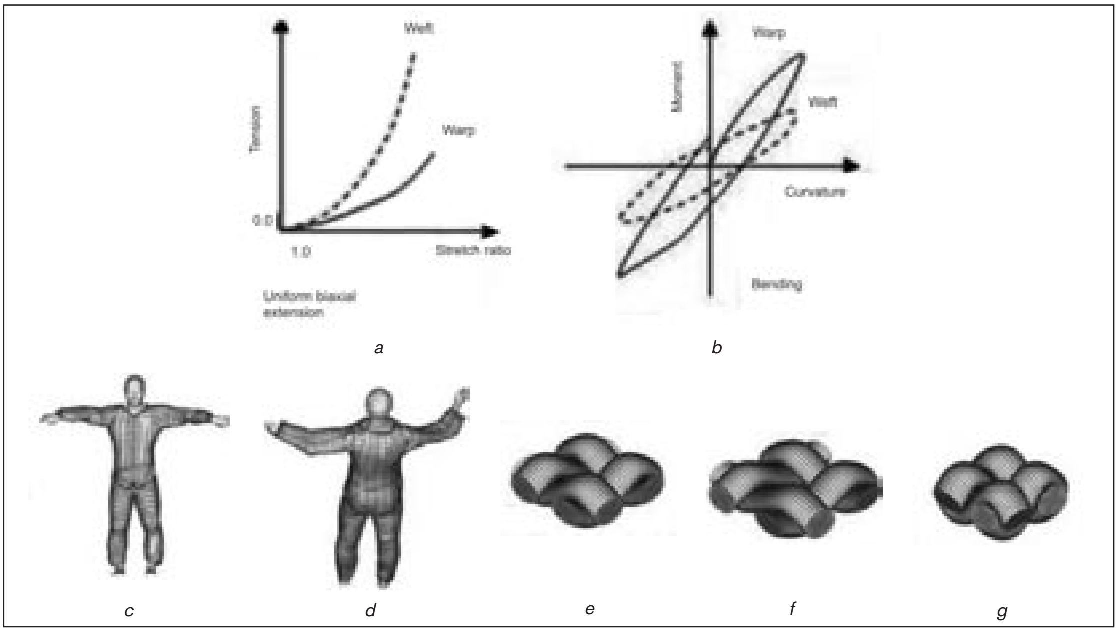
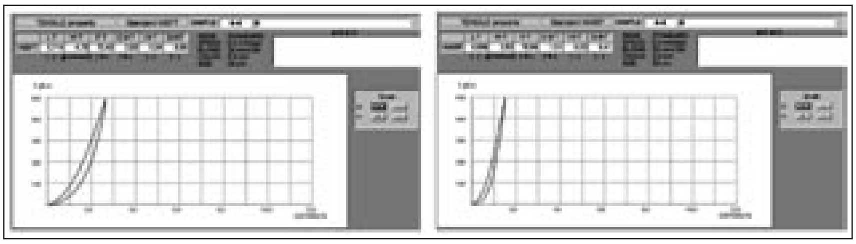
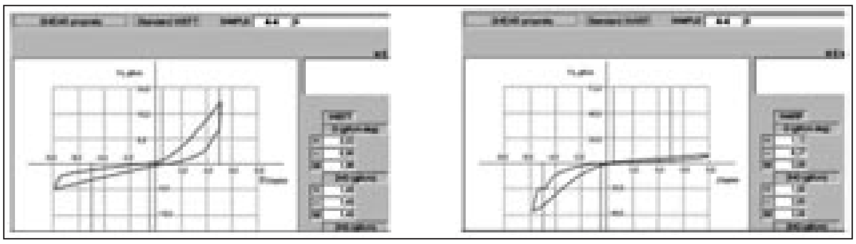


Fig. 4. Behavior of the textile structure of clothing to bending and stretching: ***a*** – schematic of tension versus stretch behavior of fabric shoving both nonlinearity and hysteresis; ***b*** – schematic of hysteresis in moment – curvature response of fabric; ***c*** – human-scale fabric model; ***d*** – undeformed unit cell model of plain-weave fabric; ***e*** – biaxially stretched unit cell; ***f*** – biaxially compresed unit cell; ***g*** – virtual mannequin clothed with a mathematical clothing model



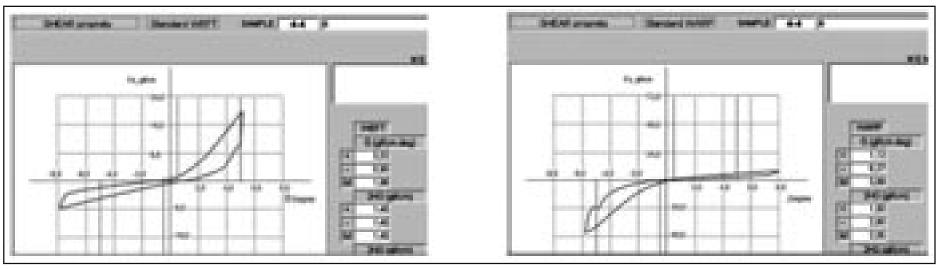
a ***b***

Fig. 5: ***a*** – tensile property on weft direction; ***b*** – warp direction



a ***b***

Fig. 6: ***a*** – shearing property on weft direction; ***b*** – warp direction



a ***b***

Fig. 7: ***a*** – bending property on warp direction; ***b*** – weft direction

determined different mechanical behaviors for each of them.

In 2006, at the Department of Civil and Environmental Engineering, University of Iowa in the USA, there were a number of concerns in the highlight of the impact of clothing that protects the body in the context of difficult environmental situations. The research focuses on the description of the various virtual clothing products from different textile materials.

It has been recourse to computer animation (fig. 4), considering the circumstances in which the carrier

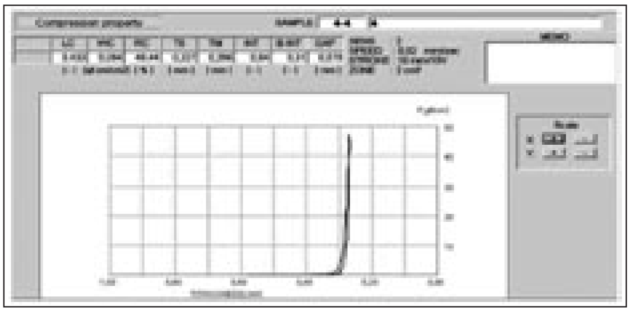


Fig. 8. Compression property

Fig. 9. Parametric mannequin

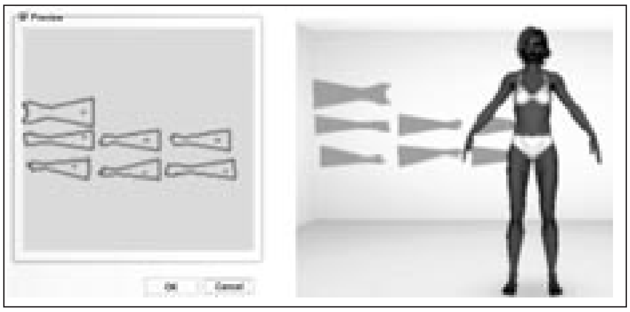


Fig. 10. Pattern product import – Modaris 3D fit

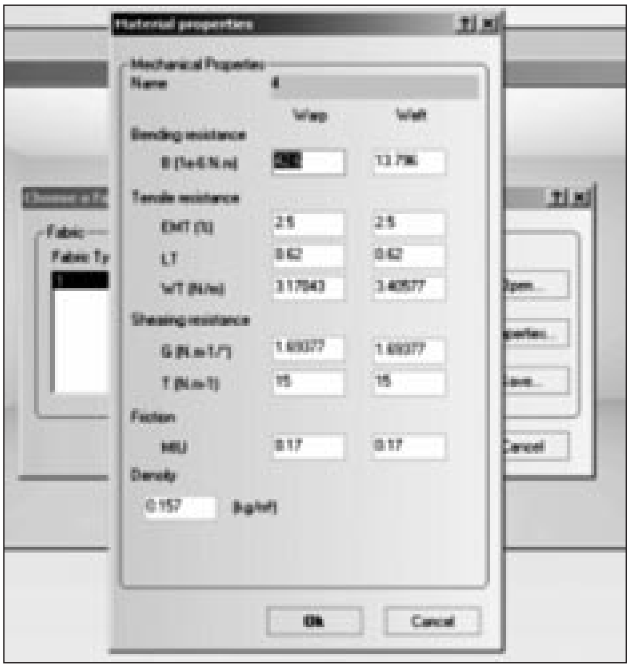


Fig. 11. Defining the material properties by using the parameters obtained from Kawabata testers

runs, climbs or walks, to assess the impact of clothing on human performance [from *www.engineering.uiowa.edu*].

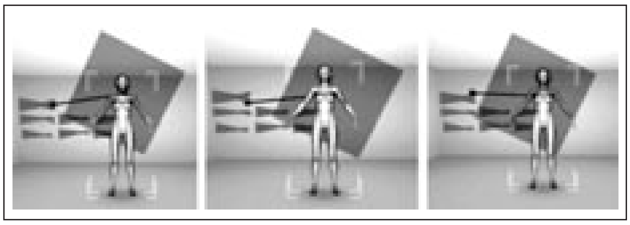


Fig. 12. Defining the slip on points

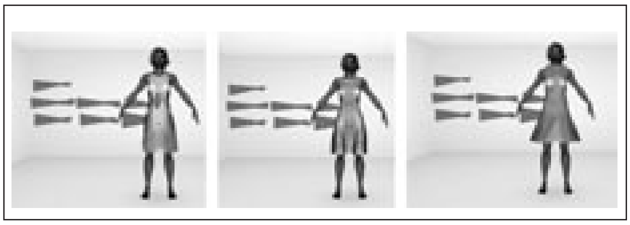


Fig. 13. Textile garment draped on the mannequin

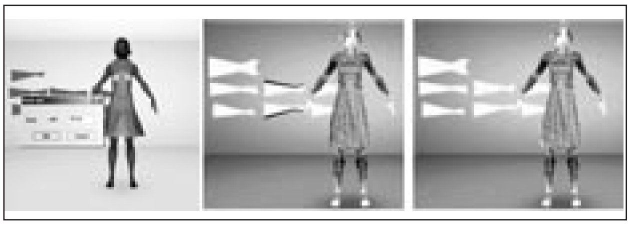


Fig. 14. Re-mesh process

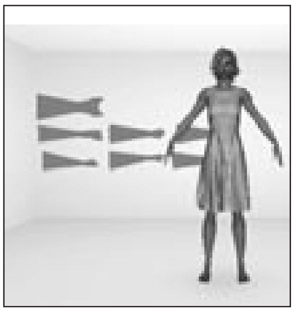


Fig. 15. The final simulated image of the product

EXPERIMENTAL RESULTS AND DISCUSSIONS

For the textile surface modeling, a simple fabric type was used in the paper. The fabric properties were determined using the Kawabata Evaluation System (KES). By using the testers, KESFB1, KESFB2 and KESFB3, there were obtained the tensile, bending and compression behavior requests [3] of the textile surfaces analyzed.

The tensile test on warp (fig. 5 *b*) or weft direction (fig. 5 *a*) involves the extension of a rectangle cloth material (20 · 20 cm), having two opposite ends fixed at a constant velocity stretch. In this test the rest of elongation, maximum elongation, elongation ratio (*EMT*), the traction energy (*WT*), the resilience (*RT*) and the linearity (*LT*) can be computed.

The shearing test uses a rectangle textile surface that is moving on the transversal direction (fig. 6 *a, b*). The shearing stiffness (*G*) and the 2 hysteresis (*HG*) can be computed.

From the bending test a warp or weft direction (fig. 7 *a, b*), the flexion stiffness (*B*) and the hysteresis (2 *HB*) for the same curvature can be computed.

The compression test compresses a fabric sample between a flat surface and a cylinder (fig. 8). The rest thickness for 0.05 Kpa pressure, the compressed thickness (T*M*), the compression energy (*WC*), the compressibility ratio (*EMC*), the resilience (*RC*) and the linearity (*LC*) can be computed.

By using the Lectra Modaris 3D Fit, the 3D simulation of the textiles surface is made. This simulation involves importing a valid model or a parameterized model (fig. 9) from Modaris 3D Fit program mannequin library and product patterns (fig. 10) made in Lectra Modaris program.

By using the parameters obtained from Kawabata testers it is possible to set the new type of textile material (fig. 11) in the program database library.

For the start, there will be selected the pins points – "slip on point" garment – mannequin (fig. 12). For a dress simulation on the mannequin it is important to set on the garment openings – point for passage of the head and for the arms crossings.

On the product simulation to the mannequin, some interruptions may occur in the form of discontinuities in the textile surface, due to the interlocking of the body surface with the textile area (fig. 13). The increase of the simulation accuracy is directly proportional to the density of the triangulation [6]. As the density of triangulation is greater the more they will get a simulated textile surface more uniform this will be, but this will increase the processing time. Exceeding value of a certain level of triangulation density leads to the hardening of the simulated surface, which has a negative influence on the ability to drape. Consequently, it remains the responsibility of the designer, depending on the material, to establish an optimal level of triangulation density.

The next step, to obtain a realistic simulation, is to re-mesh the pattern surface, for cleaning the holes or the surplus points (fig. 14).

Following this sequence of steps there is obtained an accurate picture of the product, which has simulated surface continuity (fig. 15).

CONCLUSIONS

The 3D visualization and simulation for clothing products is to define the geometric parts of the product and objects that will interact with the product (ex. the product parts of the human body). It is necessary to simulate the constraints and the impact of body – product, product – parts of the product. The study of the constraints consists in finding the limits of the product movement, such as those caused by the seamless of coat parts or product placement in a rack (mounting in a fixed point).

Image quality and animation in 3D modeling involve costly hardware resources and advanced software tools.

The advantages of clothing modeling and simulation are:

- fast reaction to market requirements;
- developing and verifying prototypes in virtual environment cause a rapid product development;
- virtual prototype selection based on aesthetic and quality criteria;
- possibility of product testing using various types of apparel fabrics;
- time economy in execution;
- save raw materials and equipment;
- high productivity for staff charged with achieving physical prototypes.

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The matematisation of parameters for a cam mechanism needed in the textile industry machinery

MARIANA DRIŞCU

REZUMAT – ABSTRACT – INHALTSANGABE

Matematizarea parametrilor unui mecanism cu came, necesară maşinilor din industria textilă

Elaborarea unei metodologii asistate de calculator pentru analiza cinematică a unui mecanism cu came este necesară pentru efectuarea unor investigaţii în cadrul unor cercetări ce urmăresc evidenţierea posibilităţilor de optimizare a operaţiei, ce se efectuează pe maşina respectivă, în scopul reproiectării mecanismului şi încorporării acestuia în maşini numerice automate. În cadrul lucrării s-a elaborat o metodologie de aproximare cu funcţii G(x), aparţinând unei serii Fourier, a unui set de date experimentale, ale căror valori numerice $\{x_i, y_i\}$ se repetă la un interval $T = 2*\pi$.

Cuvinte-cheie: mecanism, maşini numerice automate, funcţii Fourier

The mathematisation of parameters for a cam mechanism needed in the textile industry machinery

The elaboration of a computer-assisted procedure for the cinematic analysis of a cam mechanism is necessary in making a certain type of research operations that mainly refer to the optimization of operations running on specific machinery, or to the re-designing of the mechanism and its incorporation into automatic digital machines. This analysis seems even more important when we consider the fact that most of the machines used in the textile industry nowadays use a cam mechanism. In this article, there was developed an approximation method with G(x) functions, belonging to a Fourier series, a set of experimental data whose numerical values $\{x_i, y_i\}$ repeat with a $T = 2*\pi$ interval.

Key-words: mechanism, automatic digital machines, Fourier functions

Die Parametermathematisierung eines Exzentermechanismus für Textilindustriemaschinen

Die Untersuchungen im Rahmen der Forschungen für Maschinenoperationsoptimierung im Sinne des Wiederentwurfs des Mechanismus und seiner Eingliederung in automatischen numerischen Maschinen setzen voraus die Erarbeitung einer Computerunterstützten Methodologie für die kynematische Analyse des Exzentermechamnismus. In der Arbeit wurde eine Annäherungsmethodologie mit G(x) Fourrier-Funktionen eines experimentellen Datensets erarbeitet, dessen numerische Werte $\{x_i, y_i\}$ sich mit einer Periode $T = 2*\pi$ wiederholen.

Stichwörter: Mechanismus, automatische numerische Maschinen, Fourrierfunktionen

Cam mechanisms are part of numerous machines used in the textile industry. At present, the analysis of a cam mechanism means determining these parameters of the position of the push rod, and also determining its movement law.

Taking into account the fact that the push rod always makes an alternative-periodic move, we will mathematically model the position parameters of the push rod (its movement S and the rotation angle Ψ), by using Fourier series (fig. 1).

To this aim, the paper presents the theoretical analysis of Fourier series and the numerical calculating methods, for a definite integral necessary for the determination of the Fourier coefficients, establishing some optimization criteria, in order to obtain the function that best approximates the position parameters of the push rod. Thus, each item will be analyzed in MathCAD sessions. In this sense, the paper uses a set of experimental data that resulted after measuring a cam mechanism of a machine used in the textile industry.

Finding the function that most accurately approximates the data set, for the position parameters of the push rod $S(\omega) - \Psi(\varphi)$ – will lead to a complete kinematical and dynamic analysis of the cam (fig. 1).

In this context, the paper presents a methodology based on Fourier series that can be used to approximate a set of experimental data whose values repeat with a period of $T = 2*\pi$.

FOURIER SERIES AND FUNCTIONS: GENERAL CONSIDERATIONS

It is already known from the specialty literature that a periodical function *f(x)*: $[0, T]$ with values in R can be approximated with Fourier [2], [3] series, according to the relation:

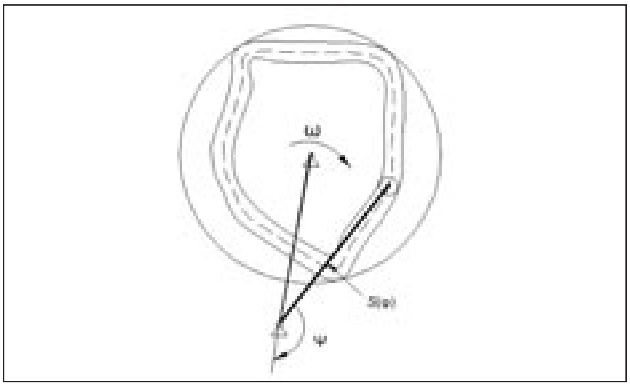


Fig. 1. The position parameters of the push rod

$$F(x) := \frac{a_0}{2} + \sum_n \left[a_n \cdot \cos\left[\frac{(2n\cdot\pi\cdot x)}{T}\right] + b_n \cdot \sin\left[\frac{(2n\cdot\pi\cdot x)}{T}\right]\right] \quad (1)$$

From this relation, one can notice that the Fourier series are an infinite sum of trigonometric functions sin, cosine, with arguments increasing in arithmetical progression and multiplied by a_n and b_n. To these, it adds the a_0 term divided by 2. The forms of the Fourier coefficients for [2], [3], [4], [6] are:

$$a_0 := \left(\frac{1}{T}\right)\cdot\int_0^T f(x)dx \quad (2)$$

$$a_n := \left(\frac{2}{T}\right)\cdot\int_0^T f(x)\cdot\cos\left[\frac{(2\cdot n\cdot\pi\cdot x)}{T}\right]dx \qquad (3)$$

$$b_n := \left(\frac{2}{T}\right)\cdot\int_0^T f(x)\cdot\sin\left[\frac{(2\cdot n\cdot\pi\cdot x)}{T}\right]dx \qquad (4)$$

where:
n is a number taking values from 0 and ∞.
For the period is $T = 2^*\pi$, the a_0, a_n and b_n are the Fourier series coefficients and, according to the specialty literature, they take the form:

$$a_n := \left(\frac{1}{\pi}\right)\cdot\int_0^{2\pi} f(x)\cdot\cos(n\cdot x)dx \qquad (6)$$

$$b_n := \left(\frac{1}{\pi}\right)\cdot\int_0^{2\pi} f(x)\cdot\sin(n\cdot x)dx \qquad (7)$$

and Fourier series will be:

$$F(x) := \left(\frac{a_0}{2}\right) + \sum_n a_n\cdot\cos(n\cdot x) + b_n\cdot\sin(n\cdot x) \qquad (8)$$

This is an infinite sum of trigonometric functions sin, cosine, multiplied by coefficients a_n and b_n, calculated for different values of the argument x. For a finite terms number of the series given by relation (8), Fourier functions will be obtained. Hence, a Fourier function will have the following form:

$$G(x) := \left(\frac{a_0}{2}\right) + \sum_{n=1}^{nf} a_n\cdot\cos(n\cdot x) + b_n\cdot\sin(n\cdot x) \qquad (9)$$

where:
- nf* represents the number of terms of the series;
- n is a variable taking values from 1 to nf;
- a_0, a_n and b_n are the Fourier series coefficients calculated with the relations (5), (6), (7), for n in the range [0, nf].

METHOD OF APPROXIMATION FOR A PERIODICAL EXPERIMENTAL DATA SET

In most of the situations, a data set $\{y_i, x_i\}$ cannot be approximated with an elementary analytical function *f(x)*. For this reason, in computer-assisted design, there can be approached modern mathematical methods providing means of finding functions able to drive to the approximation of the data set.

In this paper, a method is presented used in finding the function *G(x)*, belonging to a Fourier series, which approximates the numerical values $\{x_i, y_i\}$ with the highest accuracy. These values repeat with $T = 2\pi$ period.

***The work routines of the present methodology are*:**

- *Calculation of the Fourier series coefficients.* From the relation (2), (3), (4) or (5), (6), (7), we can notice that, for the coefficients a_0, a_n and b_n obtaining, an integral calculation is used from an analytical function *f(x)* or *f(x) cosin (nx)* and *f(x) sin (nx)*. As long as the

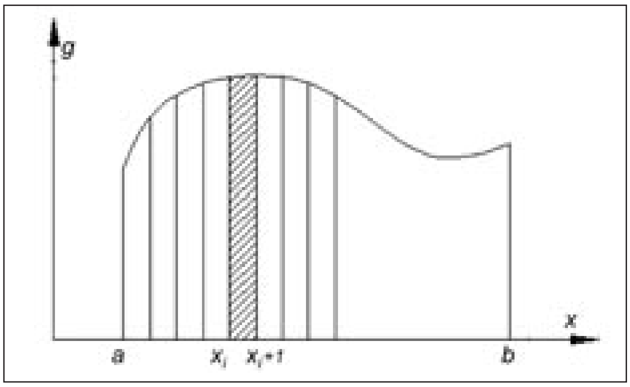


Fig. 2. The area of the field limited by axis *Ox*, function *g(x)* and the segments of bee line: *x = a* and *x = b*

values of these functions are unknown, the integral calculus will apply to numerical methods of determination of a finite integral. According to these, the numerical value of the finite integral represents the area of the field limited by axis *Ox,* function *g(x)* and the segments of bee line: *x = a* and *x = b,* having the following relation:

$$\int_a^b g(x)dx := \sum_i g(x_i)\cdot h_i \qquad (10)$$

where:
- x_i are values of the independent variable for the range [*a, b*];
- $g(x_i)$ – values of the function *g(x)* in the points x_i;
- h_i – the distance between two consecutive values x_i, x_{i+1} like:

$$h_i = x_{i+1} - x_i$$

- *Execution of the integral calculus using the trapezes method.* In the case of the periodical data set with period 2π, whose values are obtained from 10^o to 10^o for example, the numerical data for the integral calculation will be:

$$a = 0 \quad b = 2\pi \quad h_i = 2\pi/360 \quad g(x_i) = Y_i$$

The professionals consider that the trapezes formula is the most accurate one for the integral calculation that can be found in the specialty literature. Based on this methodology, for a data set Y_i determined in the points $x_i = 0, 10^o, 20^o, 30^o \ldots 360^o$, the relation (7), can be rewritten as:

$$S := \left(\frac{h}{2}\right)\cdot\left(Y_0 + Y_{36} + \sum_{i=1}^{35} Y_i\right) \qquad (11)$$

From the above presentation, the relations used for the coefficients a_0, *an* and b_n determination are:

$$a_0 := \left(\frac{1}{36}\right)\cdot\left(Y_0 + Y_{36} + \sum_{i=1}^{35} 2\cdot Y_i\right) \qquad (12)$$

$$a_n := \left(\frac{1}{72}\right)\cdot\left(\sum_{i=1}^{35} 2\cdot Y_i\cdot\cos(\phi r_i) + Y_0 + Y_{36}\right) \qquad (13)$$

* Note:
The number *nf*, defining the Fourier function form, is choosing as function of convergence the criterion of the series, so that the function *G(x)* approximates the function *F(x)* with the best accuracy.

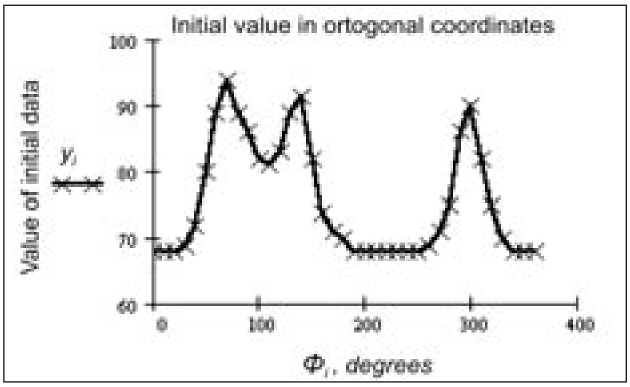


Fig. 3. The graph of the initial value in ortogonal coordinates

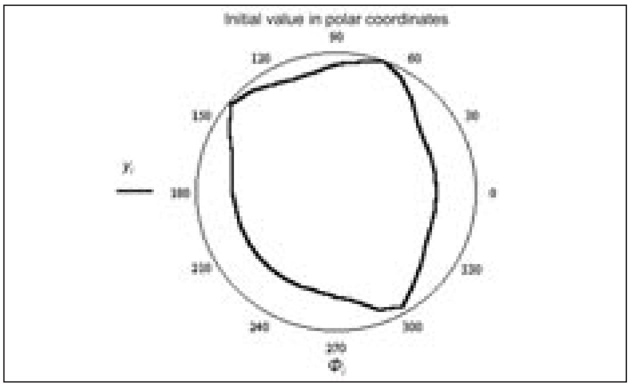


Fig. 4. The graph of the initial value in polar coordinates

$$b_n := \left(\frac{1}{72}\right) \cdot \sum_{i=1}^{36} 2Y_i \cdot \sin(\phi r_i \cdot n) \qquad (14)$$

where:

Y_i are experimental numerical values;

Φr_i – angle belonging to the range [0,2 π], rad.

- *Determining the Fourier function.* In this routine, the number can be determined for the terms of the series, which will approximate with the highest accuracy the routine of points $\{x_i, y_i\}$ obtained in the sessions of data gathering/acquisition, which will determine the Fourier function. To this aim, we can calculate with the relation:

$$F_i := \frac{a_0}{2} + \left[\sum_{n=1}^{nf} \left(a_n \cdot \cos(n \cdot \phi r_i) + b_n \cdot \sin(n \cdot \phi r_i)\right)\right] \qquad (15)$$

the values of the Fourier function for a finite variable number *nf* of terms and we can also select that *nf* for which the difference between the initial values Y_i and F_i is minimum. It results that the selection criterion of the number of terms of the series and, therefore, of the Fourier function is:

$$|Y_i - F_i| < \varepsilon \qquad (16)$$

where:

ε is value dependent of the application nature.

EXPERIMENTAL APPRECIATION OF THE METHODOLOGY DRAFT

For the experimental appreciation of the elaborated methodology, MathCAD system was used, which allows a numerical and graphical analysis of the mathematical relations involved. For example, we can consider a series of experimental data (Φ_i, S_i), which are processing with the following routines [7], [8], [9], [11]:

- the vectors of the initial data are created: In this example, the initial data are the angles Φ_i for the range [0,2 π] and length of a peg marked as S_i, mm;
- for the appreciation of the elaborated methodology and the correctness of the data, the graph of the initial values is plotted in orthogonal coordinates, as can be seen in the figures 3, and in polar coordinates, figure 4 [8–10];
- using *MathCAD,* we can calculate with the relations the coefficients of the Fourier series a_0, a_i, b_i for those 37 values (Φ_i, S_i), and Fourier functions:

$$F_i := \frac{a_0}{2} + \left[\sum_{n=1}^{nf} \left(a_n \cdot \cos(n \cdot \phi r_i) + b_n \cdot \sin(n \cdot \phi r_i)\right)\right] \qquad (17)$$

where:

i is the index of those 37 experimental data;

Φ_{ri} – angle for the range [0, 2π], rad.;

N – degree of the Fourier coefficients;

a_0, a_n, b_n – the Fourier coefficients [1];

nf – the terms number of the Fourier series corresponding to function F_i.

Choosing the number of *an* and *bn* coefficients

In determining that function approximating the initial data set with the best accuracy, one can proceed as follows:

- Creates a matrix $G_{k,i}$ of Fourier functions having 37 columns and *nf* lines like this one:

$$G_{k,i} := \frac{a_0}{2} + \left[\sum_{n=1}^{k} \left(a_n \cdot \cos(n \cdot \phi r_i) + b_n \cdot \sin(n \cdot \phi r_i)\right)\right] \qquad (18)$$

- Makes an analytical and graphical analysis for the obtained functions: In this paper, for exemplification, the graph of the Fourier functions is presented for all points Φ_i = 0°, 10°, 20°, 30° ... 360° and k = 0, 5, 10 ... 35, 36 (fig. 5). Analyzing the graphical form, it results that the numerical data are approximated with a good accuracy with the Fourier functions defined for k = 5, 10 ... 35.

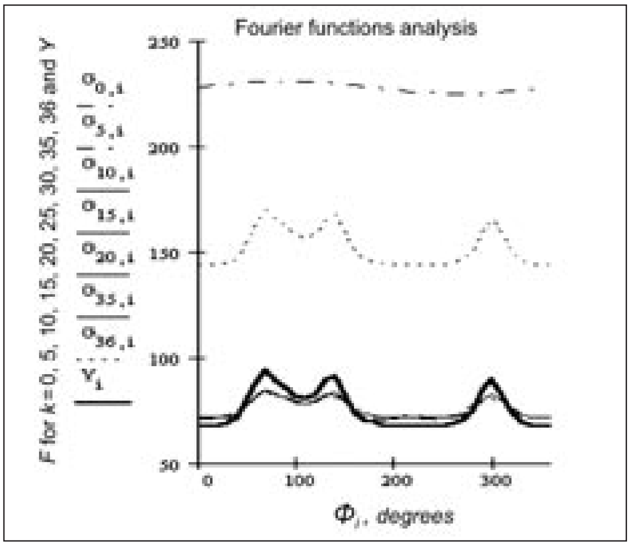


Fig. 5. The graph of the Fourier function for all points

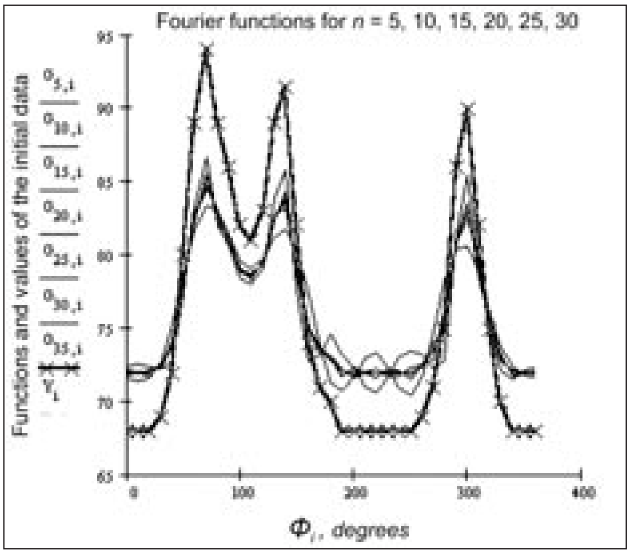
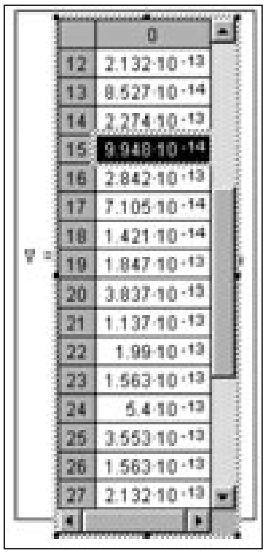


Fig. 6. The graph of the Fourier functions for n = 10, 15, 20, 25, 30 terms



V =

	0
12	$2.132\cdot10^{-13}$
13	$8.527\cdot10^{-14}$
14	$2.274\cdot10^{-13}$
15	$9.948\cdot10^{-14}$
16	$2.842\cdot10^{-13}$
17	$7.105\cdot10^{-14}$
18	$1.421\cdot10^{-14}$
19	$1.847\cdot10^{-13}$
20	$3.837\cdot10^{-13}$
21	$1.137\cdot10^{-13}$
22	$1.99\cdot10^{-13}$
23	$1.563\cdot10^{-13}$
24	$5.4\cdot10^{-13}$
25	$3.553\cdot10^{-13}$
26	$1.563\cdot10^{-13}$
27	$2.132\cdot10^{-13}$

Fig. 7. Partial values of V vector

- Limits the field of the Fourier functions for k = 5, 10 ... 35 and the graphical form of the Fourier functions is re-analyzed by comparison with the initial graph (fig. 6). For the numerical determination of that function which approximates with best accuracy the initial data, a matrix of the errors will be created having the form:

$$ER_{k,i} = \left|G_{k,i} - Y_i\right|$$

in which the differences will be inscribed between initial data and those obtained by approximation, i = 0 ... 36, for those 36 Fourier functions. Then, the V vector is created:

$$V_i = \min\left\{ER_{k,i}\right\}$$

For the data set studied, we can inscribe the values of the Fourier function defined by 35 terms in the vector V. Analyzing the numerical values inscribed in the vector V (fig. 7), we can notice that they are very small, about 10^{-13} or 10^{-14}. Thus, one can certainly assert that the Fourier function defined for 35 terms approximates with the best accuracy the initial data set. The determined Fourier function will be:

$$F(x) := \frac{a_0}{2} + \left[\sum_{n=1}^{35}\left(a_n \cdot \cos(n \cdot x) + b_n \cdot \sin(n \cdot x)\right)\right] \quad (19)$$

defined for 36 values of the coefficients a_n and b_n for n = 0, 1,2 ... 35.

The graph of the Fourier function calculated for 36 terms a, b and initial point Y_i is presented in figure 8.

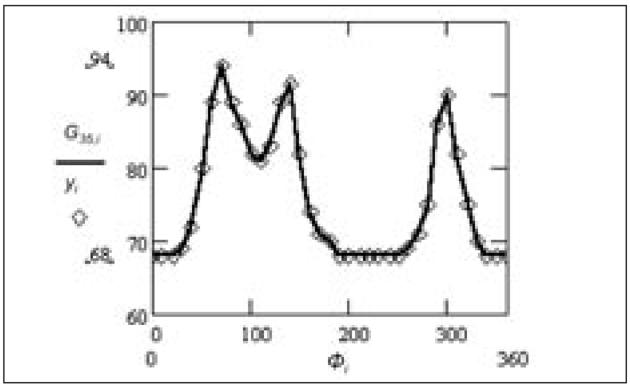


Fig. 8. The graph for yhe best Fourier functions

The analysis of this graph shows the mode of the positioning that the initial values Y_i take on the Fourier graph. The values were obtained in the session of data acquisition.

CONCLUSIONS

From the above presented, there can be undoubtedly asserted that the Fourier function belonging to a Fourier series, having 35 terms approximates with the best accuracy a periodical experimental data set. Once found the function of the position parameters for the S peg and the other sets, which best approximate the set of data, a complete cinematic analysis of the cam can be made. This analysis seems even more important, when we consider the fact that most of the machines used in textile industry nowadays use a cam mechanism. Taking into consideration the fact that the peg always executes an alternative and periodical movement, one has to use Fourier series to mathematically model the position parameters following the shift of the S peg in the second part.

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DOCUMENTARE

Tehnologie chimică

UN NOU SISTEM DE MARE VITEZĂ PENTRU USCAREA VĂLULUI

Noul sistem de uscare cu unde radio *Macrowave,* elaborat de ***Radio Frequency Co. Inc.****/*S.U.A. permite uscarea rapidă și la viteze mari a adezivului pe bază de apă și a peliculizărilor și oferă o eficiență mai mare comparativ cu uscătoarele convenționale, care ofereau asemenea performanțe doar pentru peliculizările pe bază de solvent.

În aplicațiile de peliculizare, sistemul de uscare *Macrowave RF* (fig. 1) încălzește selectiv doar porțiunile de văl acoperite, lăsând intactă umiditatea de cristalizare din substrat și prevenind astfel uscarea excesivă, decolorarea, distorsionarea și contracția.

Având capacitatea să opereze la viteze ale vălului de până la 1 500 FPM, acest sistem are nevoie doar de 1/5 până la 1/3 din spațiul ocupat de către uscătoarele cu aer fierbinte și IR.

Totodată, noul sistem permite temperaturi ale vălului mai mici și economii de energie electrică de până la 50%.

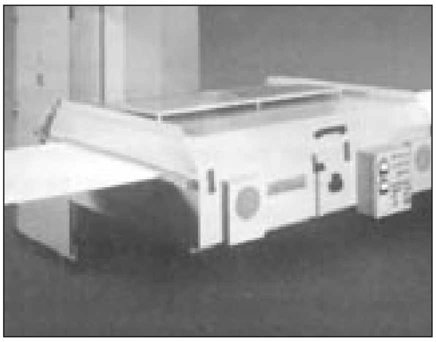

Fig. 1

Eliminând timpii mari de depozitare necesari în cazul folosirii metodelor convenționale de uscare, sistemul de uscare Macrowave RF reduce timpul de pregătire, deoarece energia undelor radio operează instantaneu, pe modelul pornit/oprit, iar energia consumată este proporțională cu încărcarea sistemului.

Sistemul Macrowave poate fi configurat pentru a manevra văluri cu o lățime de până la 120 inch și îndeplinește cerințele OSHA privind reglementările de siguranță și standardele FCC pentru siguranța comunicării.

Melliand International, mai 2011, nr. 2, p. 102

Study regarding the ink-jet printing with reactive dyes of natural silk. The influence of pretreatment conditions on the intensity of the prints

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CĂTĂLIN GHERASIMESCU
ROMEN BUTNARU

REZUMAT – ABSTRACT – INHALTSANGABE

Studiu privind imprimarea cu jet de cerneală a mătăsii naturale, folosind coloranţi reactivi. Influenţa condiţiilor de pretratare asupra intensităţii imprimeurilor

Lucrarea prezintă particularizarea pretratamentului aplicat mătăsii naturale, ce urmează a fi imprimată cu jet de cerneală, cu coloranţi reactivi. Pentru crearea reţetelor de pretratare, s-a utilizat metoda regresiilor multiple. Mostrele de mătase naturală pretratate au fost imprimate cu jet de cerneală, cu coloranţi reactivi, iar intensitatea culorilor a fost măsurată cu ajutorul unui colorimetru. Pe baza valorilor obţinute, s-a urmărit evoluţia intensităţii culorii, atât în funcţie de concentraţia de uree, cât şi de agent anionic, din flotele de pretratare.

Cuvinte-cheie: imprimare, jet de cerneală, coloranţi reactivi, colorimetru, uree, agent anionic, mătase, intensitatea culorii

Study regarding the ink-jet printing with reactive dyes of natural silk. The influence of pretreatment conditions on the intensity of the prints

This paper presents the tailoring of the pre-treatment applied to natural silk to be further ink-jet printed with reactive dyes. To create the pre-treatment recipes, the multiple regressions method was used. The pretreated natural silk samples were ink-jet printed with reactive dyes and the intensity/yield of colors achieved was measured with a colorimeter. By values achieved, the evolution of colors intensities was monitored, both in terms of urea concentration and for the anionic agent in the pretreatment baths.

Key-words: printing, ink-jet, reactive dyes, colorimeter, urea, anionic agent, silk, color intensity/yield

Untersuchung des Reaktivfarbstoff-Tintenstrahldrucks für natürliche Seide. Einwirkung der Vorbehandlungsbedingungen auf die Druckintensität

Die Arbeit präsentiert die Absonderung der Vorbehandlung für natürliche Seide, welche weiterhin mit Reaktivfarbstoff-Tintenstrahl bedruckt werden wird. Für die Vorbehandlugsrezepte wurde die mehrfache Regressionsmethode angewendet. Die vorbehandelten natürlichen Seidemuster wurden mit Reaktivfarbstoff-Tintenstrahl bedruckt und die erhaltene Farbintensität wurde mit Hilfe eines Farbmessinstrumentes gemessen. Aufgrund der erhaltenen Daten wurde die Entwicklung der Farbintensität aus den Vorbehandlungsflotten analysiert, sowohl in Abhängigkeit der Harnstoffkonzentration, als auch in Abhängigkeit des Anionmittels.

Stichwörter: Druck, Tintenstrahl, Reaktivfarbstoffe, Farbmessinstrument, Harnstoff, Anionmittel, Seide, Farbintensität

The ink-jet printing of natural silk with reactive dyes represents an important achievement in the field of textile finishing, since it no longer requires templates, which adds flexibility and speed (from the design to the elaboration of the finished product).

Thus, this technology can be used especially in:

- samples preparation;
- cylinder engraving;
- small and medium production series;
- advertisement production [1].

Digital Printing is the shortest, cheapest and most effective way to get from one idea to the finished product. The printed silk fabrics will always have some vivid, intense and uniform colors, in comparison with other natural fiber fabrics, due to the rounded and smooth appearance of the silk fibers [2].

To obtain a uniform printing and intensity of color, a preparation is necessary for the material, which consists in the natural silk boiling and scouring at 95°C [3].

The dyes used in printing are water-soluble reactive dyes. These azo dyes have a high reactivity, forming covalent bounds with the fiber. Dye setting takes place in the presence of sodium carbonate. The dye settles on the fiber at 101–103°C in the presence of saturated steam. The degree of attachment is high, which leads to obtaining maximum resistance to: light, washing, industrial gas, perspiration (table 1) [4].

Ink-jet printing involves a pretreatment phase with agents that facilitate the fixation of the dye onto the fiber. In this respect, a bath containing an alkaline substance is used for the pretreatment, usually Na_2CO_3, anionic agents, antistatic agents, as well as urea.

Table 1

REACTIVE DYES RESISTANCE

Tests	Marks
Xenon lamp 240 hours	3–6
Light AATCC 16 E	4–6
Water ISO 105 – E01	4–5
Washing 4, 95°C ISO 105 – C 04	4–5
Chlorinated water ISO 105 – E 03 20 mg/l	3–5
Acid perspiration ISO 105 – E 04	4–5
Alkaline perspiration ISO 105 – E 04	4–5

After this treatment, the textile material is dried and then subjected to the actual printing.

Due to silk sensitivity in an alkaline environment, the dosage of the Na_2CO_3 amount is very important for maintaining the fiber strength. At the same time, the setting temperature as well must be maintained between 101–103°C, in order to avoiding the fiber's degradation.

Table 2

EXPERIMENTS PLANNING						
Sample no.	x_1 (code)	Thermacol g/L (real)	x_2 (code)	Urea, g/L (real)	x_3 (code)	Fixation steam flow, kg/h (real)
1	–1	170	–1	70	–1	2.88
2	1	230	–1	70	–1	2.88
3	–1	170	1	130	–1	2.88
4	1	230	1	130	–1	2.88
5	–1	170	–1	70	1	7.56
6	1	230	–1	70	1	7.56
7	–1	170	1	130	1	7.56
8	1	230	1	130	1	7.56
9	–1.682	150	0	100	0	5.4
10	1.682	250	0	100	0	5.4
11	0	200	–1.682	50	0	5.4
12	0	200	1.682	150	0	5.4
13	0	200	0	100	–1.682	1.8
14	0	200	0	100	1.682	9
15	0	200	0	100	0	5.4
16	0	200	0	100	0	5.4
17	0	200	0	100	0	5.4
18	0	200	0	100	0	5.4
19	0	200	0	100	0	5.4
20	0	200	0	100	0	5.4

The intensity of color in the ink-jet printing is directly proportional to:
– the amount of ink retained on the fiber;
– the depth to which the ink penetrates.

The amount of ink retained on the fiber is directly proportional to the anionic agent able to mediate the formation of covalent bonds between the reactive dye and the silk fiber [5].

The same amount of dye retained on the fabric also depends on the temperature provided by the flow of steam during fixation, as well as on the amount of urea used.

The depth to which the ink penetrates depends on:
– the speed of the fabric fed for printing;
– the angle formed between the ink flow and the fabric's plane [6].

Considering the abovementioned, the purpose of this paper is to determine the optimal fixation and pretreatment conditions for achieving a more efficient printing, whether the colors are obtained from ink mixtures or from primary ink.

EXPERIMENTAL PART

For this experiment, a scoured silk fabric has been used, weighing 75 g/m^2. The size of the analyzed samples was of 45 cm in length and 45 cm in width, the warp density being 500 ± 20 yarns/10 cm and weft density 800 ± 20 yarns/10 cm.

The fabric samples were treated in a bath containing:
- urea x_1, g/l;
- thermacol MP – anionic agent x_2, g/l. This anionic agent is an aqueous solution of a polyacrylic acid derivative;
- Na_2CO_3 20, g/l;
- Lyoprint RG – 20 g/l – reduction inhibitor produced by Huntsman, being the sodium salt of sulphonic nitrobenzene acid – 20 g/l;
- Lyoprint AP – 10 g/l – de-aeration agent, being a nonionic compound.

For a better and more accurate ordering in both data processing, and their precision, the multiple regressions method has been used, considering as independent variables: x_1 – concentration of anionic agent, g/l; x_2 – urea concentration, g/l; x_3 – amount of saturated steam, kg/10 minute, and as dependent variable Y_1; ΔE was traced, representing the total color difference between the value in $L^*a^*b^*$ of white reference and the value in $L^*a^*b^*$ of the analyzed color. Codification of the 3 independent variables and experiments planning are presented in table 2.

Impregnation was performed on the equipment Wash-X produced by the Australian company Rimslow, at SC Novartex Digital S.R.L. in Bucharest. The padded impregnation speed was 25 ml/h at a cylinders pressure of 3 atm, achieving an 80% degree of squeezing. The same equipment has been used for drying. Drying speed was 25 ml/h at a temperature of 65°C. The dryer irradiation surface is 7.6 m^2; the drying system is based on Infrared Radiation, having the following advantages:
- low overall installation size: an irradiation surface of 1.5 m^2 is the equivalent of a surface of 42 m^2;
- protects the fibers by uniform heating and by preventing over drying;
- increases the drying speed, control and automated adjustment of the process [7].

Further, the fabric samples were subjected to printing, using an ink-jet printer model FP-740 Roland, at a resolution of 720dpi and 100% color saturation. The program that the RIP has been performed with was Wasatch TX version 6.1.

In choosing RIP software, the following aspects were taken into consideration:
- ➢ Color Gamut;
- ➢ the number of primary colors that it can work with;
- ➢ the number of printers;
- ➢ type of printers that it can work with;
- ➢ manner of interpretation and printing;
- ➢ the instrumentation that it is capable to undertake [8].

Both the primary type of inks, such as Cyan, Magenta, Yellow, and usual inks from a mixture of Magenta + Yellow have been used for printing.

After performing the print, the samples were fixed on the Steam-X 1850 machine, manufactured by the Australian company Rimslow. All samples were set for 15 minute at a temperature of 102°C with saturated steam heated to 138°C. This is the temperature of saturated steam at 2 atm at sea level [3]. The removal of the curing substances and the unfixed ink was achieved through washing on the Wash-X 1850 machine, manufactured by the Australian company Rimslow.

The washing process is performed in three stages and on a wide sheet:
- 3–4 minute washing in cold water;
- squeezing with cylinders up to a squeezing degree of 80%;
- 3–4 minute washing in water heated to 98°C, in the presence of a soap substance (Eriopon R) with a concentration of 2 g/l;

Table 3

No. crt.	Color difference, ΔE (Y_1), for:			
	100% Cyan	100% Magenta	100% Yellow	100%Y + +100% M
1	68.50	87.60	93.60	88.1
2	69.30	88.30	96.20	88.3
3	72.00	88.40	95.20	88.9
4	71.90	88.50	95.10	89.7
5	68.90	87.40	93.20	87.8
6	70.30	88.20	94.90	88.0
7	72.90	88.60	96.00	90.0
8	72.30	88.50	95.80	89.5
9	70.40	87.80	94.60	88.2
10	70.90	88.30	95.00	88.9
11	66.80	86.80	93.50	87.4
12	72.70	88.20	94.90	89.5
13	68.30	87.70	94.70	89.2
14	71.60	88.50	94.60	88.6
15	71.00	88.30	94.40	89.3
16	71.00	88.40	94.00	88.4
17	71.90	88.00	95.10	89.2
18	71.8	87.9	95.1	89.7
19	72	88.1	95	89.6
20	71.9	88.2	95.1	88.4

COLOR DIFFERENCES BETWEEN THE SAMPLES PRINTED WITH PRIMARY INK AND THOSE PRINTED WITH INK BLENDS

- squeezing with cylinders up to a squeezing degree of 80%;
- rinsing in cold water for 1 minute and de-alkalization with acetic acid in a concentration of 0.5 g/l;
- squeezing with cylinders up to a squeezing degree of 80%.

Drying takes place in a dryer based on IR radiation, at a temperature of 80°C for 3 minutes. Results reading (color difference ΔE) was performed by a Gretag Macbeth colorimeter (fig. 1) model I-One iO in the Maker Pro 5.0 program, Color Piker 5 section.

The reading of the results was performed at SC Mons Medius SA, Bucharest, and the results were listed in table 3.

RESULTS AND DISCUSSIONS

The results obtained were processed in the Math Cad program. Thus, the multiple regression equation was obtained, showing dependence of the variable Y_1, as compared to variables x_1, x_2 and x_3, in the case of primary colors (100% Y; 100% M; 100% C), as well as for those achieved from blends (100% M + 100% Y).

100% Yellow

$$Y_1 = 94.7822 + 0.3422\,x_1 + 0.473\,x_2 - 0.02\,x_3 - 0.575\,x_1^2 - 0.0125\,x_2^2 + 0.4x_3^2 + 0.0952\,x_1x_2 - 0.1169\,x_1x_3 + 0.042\,lx_2x_3$$

100% Cyan

$$Y_1 = 71.6031 + 0.1714\,x_1 + 1.6073\,x_2 + 0.6091\,x_3 - 0.3625\,x_1^2 - 0.0125\,x_2^2 - 0.0125x_3^2 - 0.1927\,x_1x_2 - 0.51092\,x_1x_3 + 0.4402\,lx_2x_3$$

100% Magenta

$$Y_1 = 88.1525 + 0.1714\,x_1 + 0.3490\,x_2 + 0.0976\,x_3 - 0.1875\,x_1^2 - 0.0125\,x_2^2 + 0.0625x_3^2 + 0.242\,x_1x_2 - 0.1702\,x_1x_3 + 0.0419\,lx_2x_3$$

Fig. 1. Gretag Macbeth colorimeter

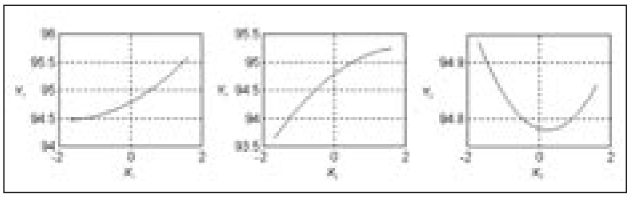

Fig. 2. Graphic representation of variable Y_1 dependency, according to the independent variables X_1, X_2, X_3, for printing achieved with 100% Yellow Ink

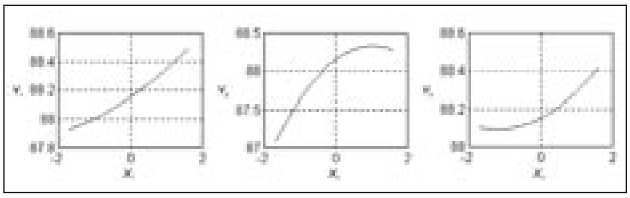

Fig. 3. Graphic representation of variable Y_1 dependency, according to the independent variables X_1, X_2, X_3, for printing achieved with 100% Magenta Ink

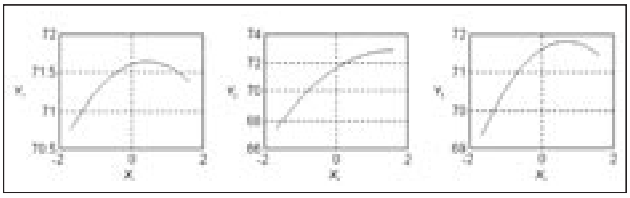

Fig. 4. Graphic representation of variable Y_1 dependency, according to the independent variables X_1, X_2, X_3, for printing achieved with 100% Cyan Ink

The graphic representation of this equation for primary colors is presented in figures 2–4. Analyzing the graphics from the above figures, there is a similarity regarding the ΔE dependency according to the three variables studied, similarity particularly evident for the Yellow and Magenta colors.

For the Cyan dye, there is a clear difference regarding the ΔE dependency, compared with the two colors mentioned above. This aspect can be explained by the very large size of the Cyan molecule, which contains Cu (copper).

For this reason, further printings have been performed with dye blends, which have a dependency similar to that of the dependent variable Y_1 according to the independent variables (x_1, x_2, x_3), meaning an Ink blend 100% Magenta and 100% Yellow.

Measurements made with an ink blend of Yellow and Magenta Inks, presented in table 3 and then processed, have led to the following regression equation:

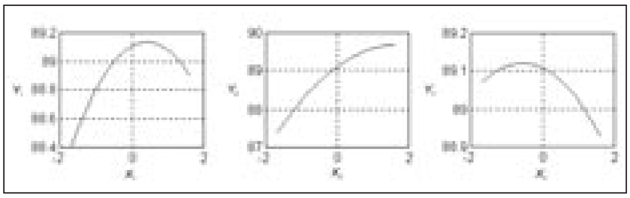

Fig. 5. Graphic representation of variable Y_1 dependency, according to the independent variables X_1, X_2, X_3, for printing achieved with 100% Magenta + 100% Yellow Ink blend

100% Magenta + 100% Yellow

$$Y_1 = 89.1071 + 0.1375\,x_1 + 0.6841\,x_2 - 0.0454\,x_3 - 0.0125\,x_1^2 - 0.1625\,x_2^2 + 0.1875x_3^2 - 0.1640\,x_1x_2 - 0.1994\,x_1x_3 + 0.0403\,x_2x_3$$

Through the graphic representation of the equation, the following figures were obtained variable Y_1 dependency, according to the independent variables X_1, X_2, X_3, for printing achieved with 100% Magenta + 100% Yellow Ink blend (fig. 5).

The dependency of color intensity according to Thermacol MP concentration

If tracing the intensity dependence of variable Y_1 for the two colors, compared with the Thermacol MP concentration (x_1, in g/l) from the treatment liquor, a maximum intensity of the 100% Magenta and 100% Yellow blend can be noticed, around the encoded value of 0.4, which corresponds to a real concentration of Thermacol MP 210 g/l.

Instead, for 100% Magenta, the color intensity increases with the increase of Thermacol MP concentration. This difference can be explained by the limited number of links that can bind the substrate, but also by the anti-migration component of the Thermacol. Thus, by increasing the concentration of Thermacol MP, the anti-migration property of the substrate increases as well.

The influence of urea concentration on the color intensity

Unlike Thermacol, the concentration of urea (X_2, g/l) has a reverse action. In the case of the colors achieved of a single primary ink, the concentration of urea is in the range of 125–130 g/l. Due to the appearance of the curve and the harmful effect on the environment, the concentration of urea may be set at 110 g/l in the case of printing performed with colors composed of a single dye; in this particular case 100% Magenta.

The concentrations of urea necessary to increase the intensity of color achieved from a blend like 100% Magenta and 100% Yellow are different, being at least of 150 g/l. This disparity is explained by the function that urea has in the process of fixation, being the reaction medium. Thus, a higher concentration of urea enhances the formation of more bonds, which is favorable when using a larger amount of ink; in this particular case, the 100% Magenta and 100% Yellow blend.

The influence of steam quantity

By increasing the steam quantity (X_3, kg/h), the temperature in the reaction chamber increases (steamer in this case), which leads to the deterioration of the silk fiber; in the case of the ink blends, it translates to a reduction in the number of covalent bonds that can be formed. The optimal value between enhancement and derogation in the forming of bonds, in the case of 100% Magenta and 100% Yellow, is 0.5 (encoded), the real equivalent of the steam flow value being 3.6 kg/h.

The color intensity given by 100% Magenta increases, as the amount of steam increases; but, a large amount of steam deteriorates the fiber; so, the steam flow value can be set to 1.25 (encoded), which translates to 9 kg/h. Surpassing this amount leads to energy waste and irreversible degradation of the fiber.

CONCLUSIONS

- The level of customization that can be achieved if knowing the amount of ink that is to be fixed on the fiber has been determined.
- The optimal pretreatment conditions regarding the concentration of the substance used for the pretreatment have been established, Thermacol and urea have as effect lower costs of production and implicitly a lower pollution degree.
- Also, the optimal steam consumption has been established, which leads to a reduction of the manufacturing costs.

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Shape categories for the Romanian female population and specific clothing recommendations

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REZUMAT – ABSTRACT – INHALTSANGABE

Grupe conformaționale pentru populația feminină din România și recomandări vestimentare specifice

Produsele de îmbrăcăminte se caracterizează prin forme și dimensiuni foarte variate, dependente de conformația și dimensiunile corpului, de tipul produsului și de proprietățile materialelor din care se execută. Utilizând baza de date antropometrice, au fost realizate prelucrări statistice privind diferențele dintre principalele circumferințe ale corpului, pentru a sublinia încadrarea subiecților de sex feminin în diferite grupe conformaționale, în acest caz în formele geometrice. Pentru fiecare grupă conformațională, se prezintă propuneri grafice de produse vestimentare, în concordanță cu tendințele vestimentare ale sezonului de toamnă-iarnă 2011/2012.

Cuvinte-cheie: grupe conformaționale, design, populație feminină, îmbrăcăminte

Shape categories for the Romanian female population and specific clothing recommendations

The clothing products are characterized by a wide variety of shapes and sizes, depending on the conformation and body sizes, on the garment type and the properties of the materials they are made of. Using the anthropometric database, statistical processing were developed regarding the differences between the main body circumference to highlight the classification of female subjects in different conformational categories, in this case geometric shapes. For each shape category are presented graphics proposals of outfits according to the fashion trends for the season autumn-winter 2011/2012.

Key-words: shape category, design, female population, clothing

Konformationsgruppen für die rumänische weibliche Bevölkerung und spezifische Bekleidungsempfehlungen

Die Bekleidungsprodukte werden durch eine breite Unterschiedlichkeit von Formen und Dimensionen charakterisiert, in Abhängigkeit der Körperkonformation und Körpergrössen, des Bekleidungstyps und der entsprechenden Materialeigenschaften. Durch Anwendung einer anthropometrischen Datenbasis wurden statistische Berechnungen betreff der wichtigsten Körperumfangsdifferenzen durchgeführt, für die Eingliederung der weiblichen Subjekte in unterschiedlichen Konformationsgruppen, in diesem spezifischen Fall geometrische Formen. Für jedwelche Konformationsgruppe werden graphische Empfehlungen für Bekleidungsprodukte vorgestellt, in Übereinstimmung mit den Bekleidungstendenzen für den Herbst-Winter Saison 2011/2012.

Stichwörter: Konformationsgruppe, Design, weibliche Bevölkerung, Bekleidung

The constructive designing of any clothing article requires information regarding: body shape and dimensions of the potential end-user, destination of the product, features of the product type and the characteristics of the materials that are used to manufacture the garment. From this information, the most important are the body shape dimensions of the potential end-user [1].

To develop a custom-made garment, the initial information about the body are obtained directly by measuring the customer, using a number of anthropometric indicators established by the pattern designer according to the type and the model of product. An advantage of our days is the advanced technology in the field of body measurements through three-dimensional scanner. Three-dimensional body scanning allows garment manufacturers in the industry to change their vision of the clothing production from large series to unique garments that have aesthetic aspects specified by the client and individual sizes. A multitude of advanced technologies, including 3D scanning, have developed an explosive phenomenon of “mass customization”, introducing clients in the process of creation and designing the model, resulting “made-to-measure” articles with a high degree of fitting, at competitive prices and with a reduced time of manufacture.

SHAPE GROUP IDENTIFICATION

The clothing products are characterized by a wide variety of shapes and sizes, dependent on the body shape sizes, on the product type (destination and decorative features of the product) and the properties of the materials they are made of.

The shape of the product represents the spatial configuration of the product dressing the body of the end-user. Basically, the three-dimensional shape of the garment must be related the human body shape, because the shape of the product is not an exact copy of the human body shape. The degree of similarity between the shape of the garment and the body shape depends on the position of the product towards the body – the order of the outfit layers and the support area on the body – model features, age and conformation of the end-user [2].

The shape of clothing is related to human body and can be analyzed only with its appearance, proportions and movement. The unity between garment form and content express itself through the connection between shape and destination of the product (for whom and for what was created that garment). To reproduce a garment form is necessary to determinate a shape which tends to the shape of the garment, correlated with the body shape.

Using the database resulted from the anthropometric survey done by National Research and Development Institute for Textiles and Leather in 2008, statistical processing was made regarding the differences between the main body girths, whatever the height and weight of the person, to highlight the classification of

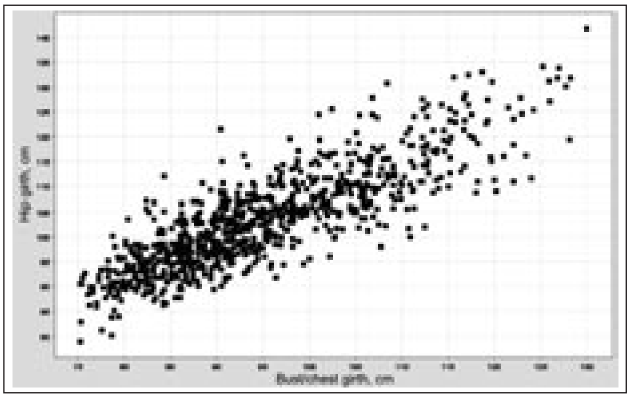

Fig. 1. Correlation between bust girth and hip girth

Fig. 2. Standard body placed between the two extremities of bust/hip girth

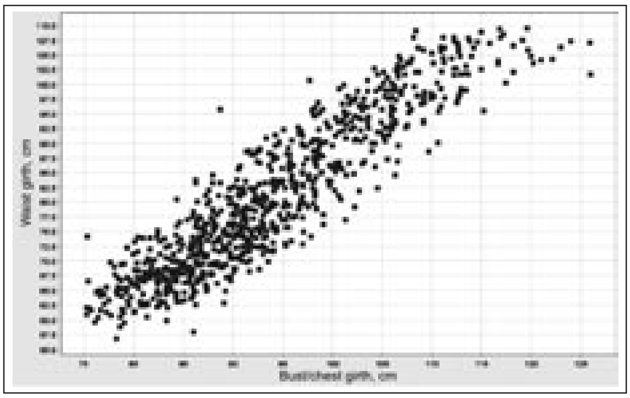

Fig. 3. Correlation between bust girth and waist girth

Fig. 4. Standard body placed between the two extremities of bust/waist girth

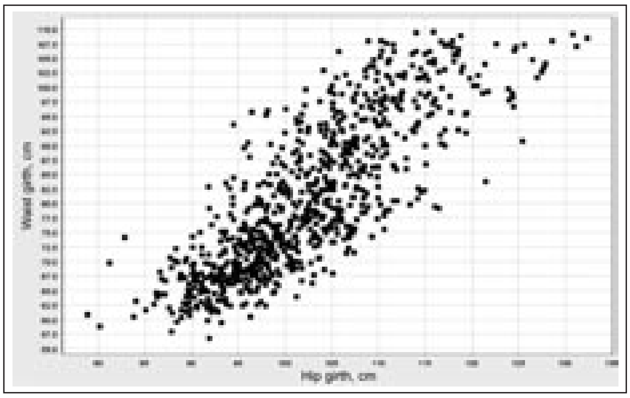

Fig. 5. Correlation between waist girth and hip girth

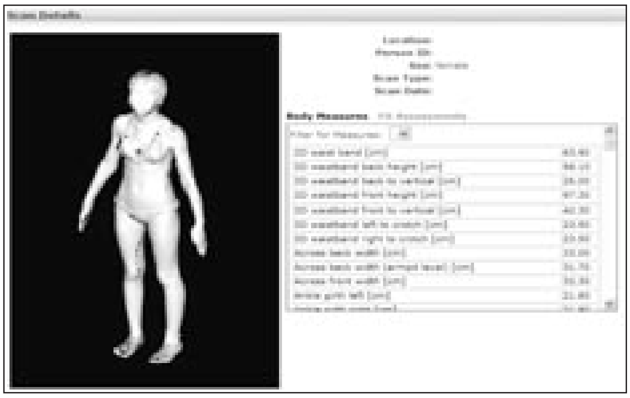

Fig. 6. Standard body placed between the two extremities of waist/hip girth

female subjects in different conformational groups, in this case geometric shapes [3].

The female body became an example, the woman being usually the main exponent of fashion. As selection criteria were used the differences between:

– bust girth and hip girth;
– bust girth and waist girth;
– waist girth and hip girth.

Figure 1 highlights the relationship between bust girth and hip girth in the form of a point cloud. This representation is specific for the correlation and allows to select a standard body which is placed between the two extremes: highs and lows of the bust and hip girths (fig. 2).

The relationship between bust girth and waist girth is shown in figure 3 as the cloud of points. After analyzing the representation, a standard body is selected which is placed between the two extremes: highs and lows of the bust and waist girths (fig. 4).

Figure 5 presents the correlation between the waist girth and hips girth as a point cloud. Through this representation a standard body is selected which is placed between the two extremes: highs and lows of the waist and hips girths (fig. 6).

For a more complex analysis of the shape categories was created the representation of the bust circumference frequencies distribution in female population (fig. 7). The data obtained reveals the number of

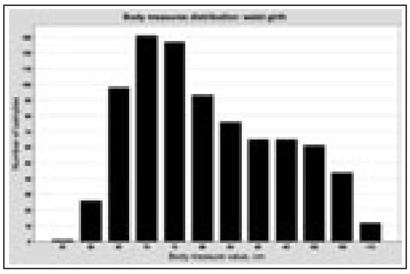

Fig. 7. Frequency distribution of bust girth in the female population

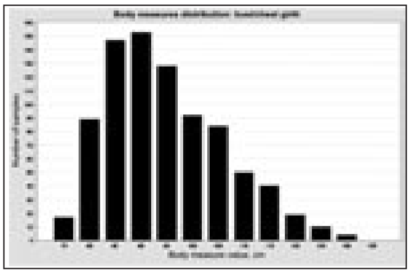

Fig. 8. Frequency distribution of waist girth in the female population

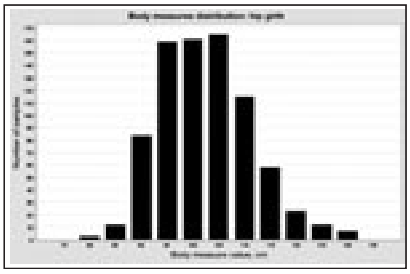

Fig. 9. Frequency distribution of hip girth in the female population

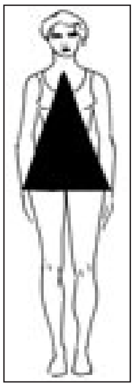

Fig. 10. Triangle shape category

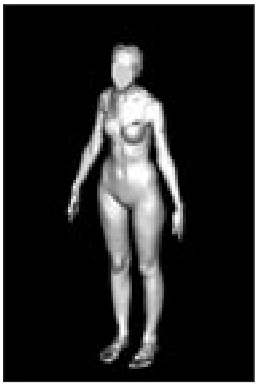

Fig. 11. Subject from triangle shape category

Fig. 12. Outfit proposals for females within the triangle shape category

women that have a bust girth in the range of 75–130 cm.

Likewise, it was realized the representation of the waist girth frequencies distribution in female population (fig. 8) that shows the number of women that have a waist girth between 55–130 cm. Also, from the analysis of hip girth frequencies distribution representation within the female population (fig. 9) was shown the number of women that have a hip girth in the range of 90–130 cm.

Table 1

COMMON SHAPE GROUPING		
Figure type	**Traits**	**Illustration**
Triangle *"A"* frame pear spoon	– Shoulders narrower than hip; – Heavy bottom with weight distributed mainly in buttocks, low hips and thighs; – Bust is small to medium; – Upper body smaller than lower body.	
Inverted triangle cone *"V"* frame	– Heaviest part of body is on top; – Shoulders wider than hips; – Weight gain in upper body and abdomen; – Usually large chest; – Very narrow hips.	
Hourglass figure *"8" "X"* frame	– Equally broad on top and hips; – Thin waist, usually 25 or more centimeters smaller than chest and hips.	
Rectangle ruler *"H"* frame	– No definition at the waistline; – Shoulders and hip about the same width; – Equal body proportions.	
Oval circle/ round apple diamond *"O"* frame	– Top and bottom are narrow; – Weight distributed at chest and abdomen; – Skinny legs.	

INDIVIDUAL SHAPE CATEGORY INFORMATION AND CLOTHING RECOMMENDATIONS

When descriptions of different body or shape category are discussed, the terms "endomorph, mesomorph and ectomorph" are not usually the most common but terms like "apple, pear, triangle, oval" are used most often. So figure types are categorized by name of shapes, letters/ numbers and fruits/vegetable like:

- apple and pear are identifiers in the fruits/vegetable category;
- oval, circle, round, hourglass, rectangle, straight, ruler, triangle, inverted triangle, cone belong to shape category;
- *O, X, H, A, 8* belong to letters/numbers category.

Table 1 characterizes these figure types. This paper describes the geometric forms of the human body and clothing according to shape categories using scanned image with the females that exemplify each geometric shape. For each shape category are presented graphical proposals for clothes according to the fashion trends for autumn–winter 2011/2012 season. Clothing recommendations in the form of graphics highlight in terms of style, each body form.

The shape category of Triangle uses the underlying criteria that the hip circumference is larger than the bust circumference and the ratio hip circumference/waist circumference is small. The person with a Triangle shape has the appearance of being larger in the hips than the bust without having a defined waistline (fig. 10 and fig. 11). This shape is the most common one, but feminine because women are defined by having the shoulders wider than the hips.

Women within the Triangle shape category are advised to wear simple trousers, slightly flared skirts or bell form

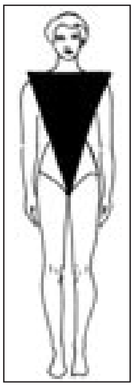

Fig. 13. Inverted triangle

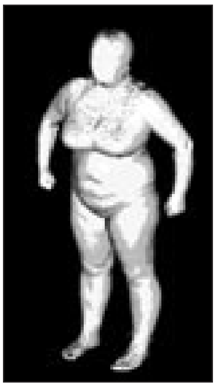

Fig. 14. Subject from inverted triangle shape category

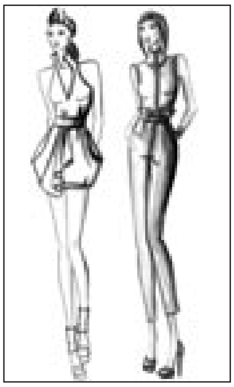

Fig. 15. Outfit proposals for females within the inverted triangle shape category

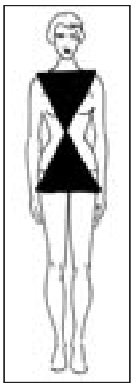

Fig. 16. Hourglass shape category

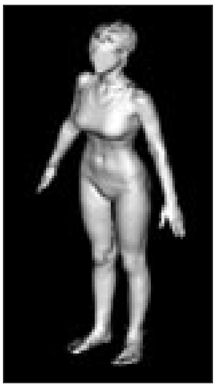

Fig. 17. Subject from hourglass shape category

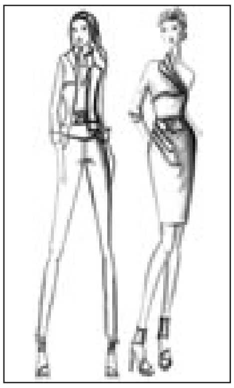

Fig. 18. Outfit proposals for females within the hourglass shape category

hiding the more rounded sides, jackets with big lapels, blouses with ruffles, strapless dresses – "Empire", drawstring waist coats, marking the waist belts (fig. 12). In addition, the vertical stripes or seams on the lower body camouflages the area, and light colors, design accents or decorative applications on the upper body distract attention from the hips.

The shape category of Inverted Triangle utilizes the underlying criteria that the bust girth is larger than the hip girth and the ratio bust girth/waist girth is small. The person with a Inverted Triangle shape has the appearance of being heavy in the bust as compared to the hips but not having a defined waistline (fig. 13 and fig. 14).

Women with the Inverted triangle body shape are advised to wear clothes from fluid materials but not molded, deep décolletages, flared skirts or with tulip form, normal sleeves (not raglan), dresses and blouses that slip to the waist, flaring pants, jackets arched with a row of buttons to highlight the waist (fig. 15).

The Hourglass shape is defined by the underlying criteria that if a subject has a very small difference in the comparison of the girth of the bust and hips and if the ratios bust girth/waist girth and hip girth/waist girth are about equal and significant, then the shape will be in the Hourglass category. The person with an hourglass shape has the appearance of being proportional in the bust and hips with a defined waistline. Figure 16 and figure 17 present examples of bodies with this ideal shape.

Women with the Hourglass body shape are advised to wear outfits that fall gently flowing the body, semi-molded and molded clothes, shirts with deep V-or U décolletages, dresses that accentuate the waist, straight trousers, tapered, flared or slightly flared skirts, sweaters with high collar (fig. 18).

The Rectangle category has the underlying premise that bust and hip measure are fairly equal and the ratios bust girth/waist girth and hip girth/waist girth are low. The person with a Rectangle shape is characterized by not having a clearly discernible waistline. Therefore, the bust, waist and hips are more inline with each other (fig. 19 and fig. 20).

Women who are in the Rectangle shape category should wear semi-molded clothes with short sleeve or sleeveless if arms are thin, with normal or small décolletages, overlapped knitted dresses that veil the body and creates an ideal hourglass form, with furbelows on the top, A – form blouses, wide at the bottom, straight trousers and slightly flared, pleated (fig. 21).

The Oval shape category is defined by utilizing the body measurements of the bust, waist, hips and abdomen. The person with an Oval shape is characterized by having several rolls of flesh in the midsection of the body and appears to have a large midsection in comparison to the rest of their body. The shape from the front view can be different for each subject but the

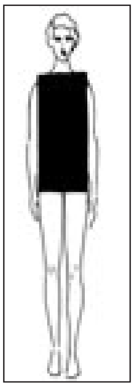

Fig. 19. Rectangle shape category

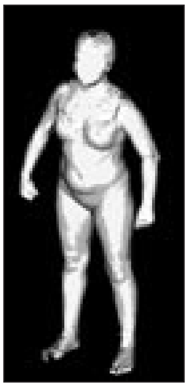

Fig. 20. Subject from rectangle shape category

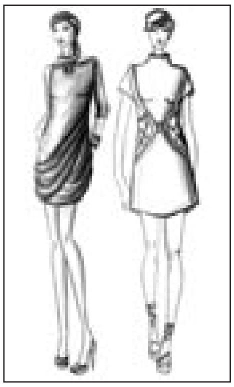

Fig. 21. Outfit proposals for females within the rectangle shape category

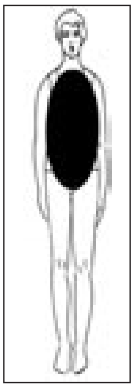

Fig. 22. Oval shape category

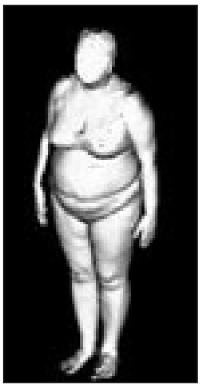

Fig. 23. Subject from oval shape category

Fig. 24. Outfit proposals for females within the oval shape category

side view is where the true characteristics of the Oval shape are seen (fig. 22 and fig. 23). The oval shape category utilizes the underlying criteria that the average of the subject's stomach, waist and abdomen measures is less than the bust measure.

Women within the Oval shape category are advised to generally wear easily loose clothes, shirt and pants in the same color, deep décolletages, straight or slightly flared skirts, pants too, earrings, chains, to attract attention in the upper part of the body (fig. 24).

CONCLUSIONS

In order to ensure the equilibrium between the clothing and the body and the aesthetic requirements a high dimensional body – clothing correspondence must be achieved. This is one of the fundamental problems of clothing design. Therefore pattern designers need information about end-users and clothing, information that is obtained through a constant research on morphological indicators characterizing the exterior shape of the body.

Depending on the body shape category of each end-user, outfit graphics proposals can be developed in accordance with fashion trends in terms of style that highlight each body form.

Acknowledgemens

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RECENZII

GHID PENTRU FIBRE TEXTILE

Autori: ***Emilia Visileanu, Iuliana Dumitrescu, Marilena Niculescu***
Editura *CERTEX*, Bucureşti, 2011
ISBN 978-973-1716-73-2

Ghidul a fost editat de Institutul Naţional de Cercetare-Dezvoltare pentru Textile şi Pielărie şi finanţat de proiectul Eureka E! 3272, cu participarea unor parteneri din România, Grecia, Polonia, Turcia şi Slovenia.

Cartea are ca obiectiv promovarea dezvoltării fibrelor cu noi performanţe şi funcţionalităţi, în conformitate cu cererea crescută de produse high-tech complexe.

Lucrarea prezintă cele mai importante metode de identificare şi caracteristicile principale ale fibrelor textile, ca instrument practic.

Pentru sectorul textil, legislaţia europeană include Directiva 96/74/EC privind denumirea textilelor, cu amendamentul 97/37/CE, prin care producătorii sau reprezentanţii lor trebuie să introducă pe etichetele produselor textile şi compozitia fibroasă a acestora.
În acest sens, în lucrare sunt prezentate numele generice ale fibrelor textile şi reprizele comerciale admise, conform directivelor amintite.

Acest ghid intenţionează să fie o legătură între instituţiile de cercetare textilă şi firmele cu profil textil. El vine în sprijinul IMM-urilor din sectorul textil, pentru a satisface cerinţele legislaţiei europene şi a celei similare din România, în ceea ce priveşte introducerea produselor textile pe piaţă şi protecţia consumatorului.

Redacţia

TECHTEXTIL NORTH AMERICA 2011

Cea de-a opta ediție a ***Techtextil North America*** s-a desfășurat în perioada 15–17 martie 2011, la Centrul de Conferințe Mandala Bay, din Las Vegas/Nevada.

Potrivit afirmațiilor Președintelui Messe Frankfurt din S.U.A., David Audrain, *Techtextil North America* a fost primit, în acest an, cu același entuziasm și emoție, atât de către expozanții care au participat și în anul 2009 – inclusiv American Polyfilm, Brookwood, Apex Mills, King Tech Industry și Stein Fibers, cât și de către companii care au venit pentru prima dată la această expoziție, precum TenCate, Lenzing și MoistTech.

Printre cei mai importanți producători, ale căror realizări au fost promovate, în acest an, la Las Vegas, pot fi menționați:

- ***BASF*** – care a promovat gama de rășini acrilice *Acrodur*, pentru lianți copolimerici, dezvoltată pentru aplicații durabile, de înaltă performanță, din domeniul netesutelor. Acest sistem pe bază de rășină vulcanizată la cald, cu o singură componentă, asigură o flexibilitate ridicată a prelucrării și o performanță excelentă a netesutelor obținute din fibre naturale, fibre de sticlă și fibre sintetice. Ținând cont de actualele cerințe ale pieței privind materialele sustenabile, ecologice, noul sistem a fost conceput pentru a elimina emisiile de produse chimice nocive.
- **PyroTex** – o nouă companie cu sediul în Hamburg/ Germania, care a dezvoltat o fibră ignifugă (FR), destinată textilelor de protecție și de siguranță. Comercializată sub denumirea *PyroTex*, într-o mare varietate de lungimi și densități lineare, aceasta nu este comparabilă cu nicio altă fibră FR, datorită proprietăților sale net superioare: indicele limită de oxigen (LOI) de 43%, rezistență bună împotriva acizilor și a substanțelor alcaline, nu se topește, nu picură, nu scoate abur sau fum și nu este solubilă în niciun solvent cunoscut. Posibilele aplicații includ îmbrăcămintea de protecție, barierele de incendiu în transportul public, izolarea termică a construcțiilor, țesăturile de interior (draperiile și tapițeriile), filtrarea casnică și cea industrială. PyroTex poate fi folosită în amestec cu alte fibre naturale sau sintetice, poate fi prelucrată pe toate sistemele de filare cunoscute sau tranformată în văl netesut și poate fi vopsită cu coloranți reactivi și metalici complecși.
- **Stein Fibres** – cu sediul în South Carolina/S.U.A. – care a promovat fibra *Infinity*, reciclată din poliester, disponibilă în două forme: *Gold* – din fulgi de PET 100% și *Silver* – din cel puțin 30% fulgi de PET, restul fiind material postindustrial.
- **Zeus** – care a expus o gamă diversă de fibre monofilamentare performante, cu greutate redusă și durabilitate ridicată, realizate din polimeri rezistenți la agenți chimic și la temperaturi înalte, precum: polieter eter cetonă, perfluoroalchilvinil eter, copolimer fluorurat de etilenă-propilenă, etilen-clorotrifluoroetilenă, copolimer de etilenă-tetrafluoroetilenă și fluorură de poliviniliden.

  Aplicațiile obișnuite includ acoperitori împletite pentru furtunuri, materiale țesute pentru pasta de hârtie, filtrare, producerea de compozite și sistemele de transmisie etc. Caracteristicile fizice ale fibrelor pot fi modificate în funcție de anumite utilizări finale.
- **Heatcoat fabrics**/Marea Britanie, care a prezentat un bogat sortiment de țesături și tricoturi, din diverse tipuri de fibre – în special fibre meta-aramidice și poliesterice, destinate consolidării compozitelor. Acestea pot fi supuse la diferite tratamente, pentru a spori adeziunea ulterioară la cauciuc și poliuretani termoplastici (TPU). Piețele reprezentative pentru astfel de materiale sunt piața auto și cea aerospațială. Compania a expus țesături din fire de polipropilenă (PP) și sulfură de polifenilenă (PPS), rezistente la temperaturi ridicate și la agenții chimici; țesături realizate din fire para-aramidice, cu peliculizări speciale, pentru aplicații balistice; o țesătură cu contracție redusă și stabilitate ridicată, concepută pentru garnituri cu diametre mari, precum cele utilizate la turbinele eoliene; țesături cu greutate redusă, peliculizate și calandrate, create pentru aplicații militare și civile; construcții plane și rip-stop, din fire para-aramidice și poliamidice (PA66), cu o înaltă tenacitate, pentru aplicații aerospațiale și o țesătură 3D, *Spacetec*, disponibilă în diverse game și greutăți, care poate asigura confort și amortizare.
- **KingTech** – care a promovat țesăturile tehnice *HYGY* – de înaltă performanță, îmbrăcămintea *LumiTech* – de înaltă vizibilitate, materialele strălucitoare, reflexive *KTTEX* – cu aplicații în îmbrăcămintea de protecție, o țesătură retroreflexivă, cu perle de sticlă colorată, respirabilă și impermeabilă.
- **RKW US** – care a expus produse din noul polietilentereftalat monolitic copolimerizat, pelicula metalizată cu reflexie ridicată și emisivitate scăzută și peliculele microporoase *Aptra* – ce oferă o barieră împotriva lichidelor, în timp ce rămân foarte permeabile la vaporii de umiditate, având aplicații atât în domeniul articolelor medicale de protecție, recuperabile, cât și în domeniul industrial, al construcțiilor (acoperișuri și izolații), al instrumentelor analitice și al ambalării. Pentru sere, RKW a creat un strat cu bule de aer *Polydress LP-Keder*, care înlocuiește eficient sticla și alte materiale plastice rigide, ajutând la reținerea a 60–95% din energia captată. Acesta are o greutate redusă, este flexibil și foarte rezistent la radiațiile UV, prezintă etanșeitate la aer și la apă, poate fi tăiat cu cuțitul sau foarfeca - pentru ajustarea elementelor structurale, și poate fi reciclat sau ars în siguranță, după utilizare.
- **Dilo Group**, producător de marcă de utilaje destinate sectorului de netesute, a prezentat mașini pentru destrămare, amestecare, cardare și interțesere. Împreună cu partenerii săi, Dilo asigură linii complete, inclusiv tehnologii de consolidare termică și chimică și de consolidare prin filare chimică. Produsele netesute create de Dilo includ acoperitoare de pardoseli, materiale pentru saltele și tapițerie, produse medicale și cosmetice, produse de igienă, șervețele, pâsle tehnice pentru automobile, materiale filtrante, materiale de acoperire, materiale de izolare fonică și termică, pâsle pentru mașini de producere a hârtiei și a pielii sintetice.

Informații de presă.
Messe Frankfurt, aprilie 2011

HIDROGEL BIODEGRADABIL PENTRU PIAŢA MEDICALĂ

DSM, compania care se ocupă de știința vieții și a materialelor, lansează un joint-venture cu compania ***DuPont,*** pentru fabricarea materialelor chirurgicale biomedicale avansate. ***Actamax Surgical Materials*** va dezvolta produse pentru piețele de adezivi chirurgicali, bariere de aderență și adezivi pentru țesuturi.

Având în vedere faptul că, la nivel mondial, în acest sector au loc, anual, peste 100 de milioane de proceduri chirurgicale, gama de produse biomedicale se va diversifica continuu. Compania ***DuPont*** a proiectat deja asemenea produse, folosind tehnologii biodegradabile, pe bază de hidrogel. Dezvoltarea comercială a materialelor se va baza pe prelucrarea polimerilor medicali și pe lărgirea capacităților de producție a ***DSM. DuPont*** și ***DSM*** vor deține fiecare o cotă de 50% în *Actamax.*

„Platforma noastră tehnologică va oferi medicilor și pacienților rezultate îmbunătățite în intervențiile chirurgicale, prevenind, pe de o parte, complicațiile postoperatorii și, pe de altă parte, reducând costurile de îngrijire a sănătății... Actamax va oferi o serie de produse, care vor putea fi optimizate și adaptate pentru diferite situații chirurgicale și necesități clinice" – a declarat John Ranieri – vicepreședinte al ***DuPont Applied BioScience.***

„Cooperarea cu DuPont este o modalitate foarte bună de a ne consolida în continuare activitățile desfășurate în domeniul biomedical... În conformitate cu strategia noastră, deschisă de inovare, acest lucru ne va permite să combinăm punctele forte ale celor două companii, importante pentru dezvoltarea de soluții care să răspundă mai bine nevoilor pacienților, prin elaborarea de materiale avansate" – a declarat Christophe Dardel – președinte al ***DSM Biomedical.***

Sursa: www.dsm.co

ACŢIUNI EURATEX PENTRU ACCESUL LA MATERIILE PRIME TEXTILE

Industria textilă și de îmbrăcăminte din Europa este puternic preocupată de situația actuală de pe piața materiilor prime. Problema nu se limitează doar la fibrele din bumbac, ci afectează, în egală măsură, fibrele textile naturale și cele artificiale. Creșterea pe ansamblu a prețurilor, în intervalul decembrie 2009–decembrie 2010, a fost cuprinsă între 35% și peste 100%, iar situația s-a deteriorat și mai mult în 2011.

Organizația Europeană a Industriei Textile – EURATEX, cu sediul la Bruxelles, solicită întreprinderea unor acțiuni concrete, atât în cadrul U.E., cât și la nivel internațional. Este vizată posibilitatea elaborării unor politici cuprinzătoare, pe termen scurt și mediu, care să reglementeze măsuri în diverse domenii, precum: comerț, dezvoltare, competențe, cercetare, inovare și piață internă.

În perioada 31 martie–1 aprilie, EURATEX a organizat, la Bruxelles, cea de-a șasea *Conferință Anuală a Platformei Tehnologice Europene pentru Textile și Confecții*, la care au participat 140 de reprezentanți din industrie, cercetare și Comisia Europeană.

Tema principală, de larg interes pentru participanți, a fost prezentarea poziției sectorului de textile și îmbrăcăminte față de politicile pe cale de a fi elaborate de U.E. în domeniul cercetării și inovării. Au fost prezentate conceptele-cheie ale *Uniunii inovării,* care stau la baza politicii U.E. privind strategia de cercetare-inovare, în perioada 2013–2020. Va fi concepută o declarație comună, care va fi prezentată, cu diferite ocazii, factorilor de decizie din U.E. implicați în pregătirile pentru programele viitoare.

Pe parcursul conferinței au fost subliniate, de asemenea, diversele colaborări de succes între Platforma Tehnologică Europeană pentru Textile și Confecții și Platformele Tehnologice din sectoare conexe.

Melliand International, mai 2011, nr. 2, p. 62

CREŞTEREA PONDERII BIOFIBRELOR ÎN INDUSTRIA MATERIALELOR COMPOZITE

Conform previziunilor recente ale ***Institutului Nova***, din Germania, ponderea biofibrelor în industria europeană producătoare de materiale compozite ar putea crește de la nivelul actual de 13% la aproximativ 28%, până în 2020. Acest lucru ar reprezenta o creștere a producției de la aproximativ 315 kt – în 2010, la 830 kt – în 2020.

Potrivit Institutului, în jur de 40 de mii de tone de fibre naturale – in, cânepă, iută, chenaf, sisal și nucă de cocos – sunt utilizate, în prezent, în compozitele obținute prin turnare cu presare. 95% din aceste aplicații sunt în industria de automobile, iar restul în domeniul bagajelor. În 2020, se preconizează ca producția să se ajungă la 120 kt.

Pentru alte 100 kt de materiale compozite se folosesc fibre de bumbac, acestea fiind destinate, în principal, producerii pieselor pentru vehiculele de mare tonaj, însă această creștere se preconizează a fi destul de mică.

Producția de compozite care folosesc fibre lemnoase, destinate industriei de automobile, se preconizează a se tripla, astfel că, de la 50 kt – în 2010, se va ajunge la 150 kt – până în 2020. În procesele de extrudare și de turnare prin injecție, utilizarea materialelor compozite din plastic și lemn (WPCS), de asemenea, se va tripla: de la 120 de mii de tone – cât este în prezent – se va ajunge la 360 de mii de tone, în 2020. Aplicațiile acestor compozite includ industria materialelor de construcție, industria mobilei și a bunurilor de larg consum, precum și industria auto.

În următorii zece ani, cea mai mare creștere va fi reprezentată de piesele extrudate sau turnate prin injecție, obținute din fibre naturale de in, cânepă, iută, chenaf, sisal și plută, cu aplicații în industria materialelor de construcție, industria auto, industria mobilei și a bunurilor de larg consum. Cu toate că, în prezent, sunt utilizate doar 5 mii de tone, numărul acestora ar trebui să crească la 100 de mii de tone până în anul 2020.

Producția europeană de compozite, inclusiv a celor din sticlă, carbon și diverse tipuri de fibre naturale, a fost de 2,4 Mt, în 2010, și va crește la 3 Mt, în 2020.

Sursa: www.nova-institut.de

Materii prime

MATERIALE DIN POLIESTER PENTRU CONTROLUL *p*H-ULUI

Compania ***Teijin*** a elaborat un nou material din poliester, care conferă confort și moliciune în contact cu pielea, prin menținerea stabilă a unui nivel al *p*H-ului ușor acid, similar celui al pielii sănătoase. Acest material va fi disponibil pentru colecțiile sport, destinate sezonului de primăvară–vară 2012.
Aciditatea ușoară a țesăturii a fost obținută, mai degrabă, prin modificarea polimerului poliesteric, decât prin adăugarea în fibre a unor agenți de tratare, care să permită menținerea unui nivel constant al *p*H-ului, chiar și după spălări repetate și uzură, dar și a unor caracteristici superioare specifice poliesterului, cum ar fi proprietățile de absorbție a apei și de uscare rapidă.
Noua țesătură a fost elaborată pentru a satisface cerințele crescânde ale consumatorilor în domeniul îmbrăcămintei, atât în ceea ce privește proprietățile de moliciune la atingere și de prevenire a mirosurilor neplăcute, cât și proprietățile antibacteriene și antimurdărire.
Până în prezent, pentru ca țesăturile să confere purtătorului astfel de proprietăți, acestea trebuiau să fie supuse unor metode de tratare ulterioară cu diferiți agenți chimici. Aceste metode, însă, pot afecta țesătura, ducând la o funcționalitate redusă, o durabilitate limitată și o pierdere a texturii inițiale, pe parcursul purtării.
De asemenea, gama țesăturilor care ofereau un control al *p*H-ului era limitată la cele din fibre hidrofile din bumbac sau din mătase artificială. Însă, niciunul dintre aceste materiale nu promova suficient uscarea rapidă a unei cantități mari de transpirații, caracteristică ce reprezintă o cerință de bază în cazul îmbrăcămintei sport, de înaltă performanță.
Pielea unei persoane sănătoase este, în general, ușor acidă, dar poate deveni mai alcalină din cauza transpirației din timpul verii sau a uscării din timpul iernii. Acest lucru poate favoriza apariția unor mirosuri neplăcute sau a unor pete, din cauza bacteriilor distructive, care, la rândul lor, pot duce la o sensibilitate crescută a pielii supuse radiațiilor ultraviolete.
Teijin a modificat polimerul poliesteric, pentru a crea proprietăți localizate de hidrofile și aciditate ușoară pe suprafața fibrei. Ca urmare, noul material își menține un nivel al *p*H-ului ușor acid, chiar și atunci când purtătorul este transpirat.
Dezvoltarea bacteriilor, cum ar fi *Staphylococcus aureus* și *Corynebacterium*, care produc mirosuri urâte și fac ca pielea să fie uscată și aspră, poate fi controlată prin conferirea unui *p*H ușor acid țesăturii. Acesta promovează dezvoltarea unor bacterii benefice, cum ar fi *Staphylococcus epidermidis*, care ajută la protejarea și menținerea sănătății pielii.
Componentele alcaline din transpirație, cum ar fi amoniacul, sunt rapid absorbite și neutralizate de aciditatea ușoară a țesăturii, prevenind astfel dezvoltarea de mirosuri neplăcute în articolele de îmbrăcăminte.
Suprafața hidrofilă a țesăturii reduce răspândirea de bacterii, îmbrăcămintea menținându-se curată. În plus, aciditatea ușoară a țesăturii ajută la protejarea pielii împotriva radiațiilor UV, prin promovarea prezenței unor bacterii benefice.

Sursa: www.teijin.co.jp

FIBRE *DRYARN* CU PERFORMANȚE RIDICATE

Producătorul ***Aquafil SpA***, din Arco/Italia, a elaborat microfibra polipropilenică *Dryarn*, cu proprietăți de uscare îmbunătățite, comparativ cu cele ale fibrelor din bumbac, poliamidă sau poliester.
Testele efectuate au demonstrat că fibrele Dryarn oferă performanțe ridicate în ceea ce privește greutatea, viteza de uscare și respirabilitatea. De asemenea, în urma testelor efectuate pe diferite tipuri de fibre, la Dryarn s-a înregistrat cel mai bun indice de confort.
Pe parcursul experimentelor ulterioare, un tricou confecționat din material Dryarn a fost purtat în condiții constante de temperatură (25^{o}C) și umiditate relativă (50%). Au fost efectuate testări comparative ale materialului din fibre Dryarn cu materiale din fibre de bumbac și poliester, pentru tricouri. Parametrii monitorizați pe parcursul testelor de purtare, realizate pe voluntari, au evidențiat avantajele fibrelor Dryarn, comparativ cu cele ale fibrelor de bumbac, în producția articolelor de îmbrăcăminte sport. Atleții care poartă tricouri din fibre Dryarn au înregistrat un ritm cardiac mai scăzut și, prin urmare, un stres cardiocirculator redus.

Melliand International, mai 2011, nr. 2, p. 60

FIBRE ECOLOGICE *THERMOCOOL ECO$_2$*

Cool ECO$_2$, de la ***Advansa****,* oferă o opțiune mai responsabilă din punct de vedere ecologic, privind tehnologiile de realizare a fibrelor cu emisii reduse de CO_2. Pentru a satisface cererea consumatorilor pentru confecții din materiale textile avansate din punct de vedere tehnologic, care, în același timp, să fie prietenoase mediului, Advansa oferă fibre și fire cu o amprentă redusă de CO_2. Folosind o cantitate mai mică de petrol, *ThermoCool ECO$_2$* ajută la reducerea impactului asupra mediului. Datorită amprentei reduse de CO_2, ECO$_2$ ne aduce cu un pas mai aproape de construirea unei economii durabile, fără a compromite performanțele termoreglării.
În acest scop, au fost folosite diferite tehnologii prietenoase mediului, în funcție de tipul de produs. Pentru producerea firelor filamentare, Advansa continuă să utilizeze, cu mult succes, polimerul PTT, obținut din materii prime regenerabile, cum ar fi zaharoza din porumb. Fibrele scurte se obțin prin tehnologii de reciclare sofisticate, în care polimerii din PET sunt transformați, pe parcursul unui proces tehnologic de fabricație foarte avansat, în fibre de poliester de aceeași calitate.
În acest sens, Gerard Illeras – Global ASW Market Manager – a afirmat: *„Deoarece suntem o companie responsabilă din punct de vedere ecologic, ne-am*

angajat să concepem produse care respectă mediul. Ca reacție la cererea tot mai mare de produse prietenoase mediului, inovația tehnologică obținută de Advansa în realizarea fibrelor ThermoCool ECO_2 oferă clienților noștri nu numai o calitate superioară a materialelor, dar și caracteristici extraordinare de performanță în domeniul termoreglării".

Pentru a conștientiza consumatorii cu privire la beneficiile ecologice ale produsulelor realizate, Advansa va furniza producătorilor de confecții un logo și o etichetă suplimentară exclusivă, care vor fi adăugate etichetelor standard.

Sursa: www.advansa.com

TENCEL – O NOUĂ FIBRĂ ANTIBACTERIANĂ

Producătorul de fibre celulozice ***Lenzing AG***/Austria, a lansat pe piață o nouă fibră Lyocell cu proprietăți cosmetice, *Tencel C*., impregnată cu chitosan. Acest biopolimer este extras din cochilii de crustacee și, apoi, este aplicat pe fibră. Chitosanul este utilizat în cosmetică și în industria farmaceutică, datorită proprietăților lui de a diminua pruritul, de a proteja pielea și de a conferi un efect antibacterian.

Noua fibră are caracteristici de barieră îmbunătățite cu până la 50%, acționând ca un rezervor de umiditate și prevenind pierderea umidității din piele. În plus, reînnoirea celulară este stimulată de fibra impregnată cu chitosan. Astfel, pielea se poate regenera mai ușor. Chitosanul este solubil în apă, de aceea în urma proceselor de prelucrare se poate împrăștia în afara fibrei. Lenzing a dezvoltat o tehnologie specială, pentru a preveni acest lucru. Tencel C poate suporta cu ușurință 50 de cicluri de spălare automată, fără a pierde proprietățile cosmetice ale substanței oceanice.

Melliand International, martie 2011, nr. 1, p. 5

FIBRE DIN BIOPOLIMERI INGEO PLA

Producătorul de fibre din poliester ***Trevira GmbH***, cu sediul în Bobingen/Germania, a finalizat primele realizări în domeniul fibrelor din biopolimeri Ingeo PLA. Obținute din compuși din plante regenerabile, fibrele sunt biodegradabile și reprezintă o parte a conceptului Trevira de creștere a sustenabilității.

În prezent, se află în fază de testare două variante de fibre, una consolidată prin filare chimică și alta filată în stare umedă. Noile fibre sunt testate, în prezent, de către clienți, prin teste de producție privind proprietățile și prelucrabilitatea acestora.

Compania preconizează viitoare aplicații ale acestor fibre în sectorul nețesutelor tehnice, în special lavete și produse de igienă.

Odată cu producerea de fire într-o gamă de finețe mai mică, sortimentul acestor produse se va extinde.

Melliand International, martie 2011, nr. 1, p. 6

FIBRĂ DIN POLIESTER CU MIEZ PCM

După o intensă activitate de cercetare-dezvoltare, compania ***Outlast Technologies***/S.U.A. – important producător de materiale cu schimbare de fază (PCM), a reușit, pentru prima dată, să încorporeze tehnologia Outlast, de reglare a temperaturii, în fibra de poliester. Noua fibră bicomponentă este alcătuită dintr-un înveliș din poliester și un miez din materiale cu schimbare de fază (PCM). În prima etapă, au fost lansate pe piață fibrele scurte, urmând ca, în scurt timp, să fie produse și fire filamentare.

Fibra din poliester cu miez PCM păstrează proprietățile specifice fibrei din poliester. Avantajul suplimentar este reprezentat de echilibrul dinamic al fluctuațiilor de temperatură, ceea ce duce la creșterea indicelui de confort.

Melliand International, martie 2011, nr. 1, p. 6

Tehnologie chimică

OPTIMIZAREA IMPLANTURILOR DE ȚESUTURI

În ultimii ani, utilizarea materialelor textile de înaltă tehnologie în sectorul medical este în continuă dezvoltare, cu o viabilitate economică de necontestat.

Proiectul *Panagenesi* are ca scop optimizarea implanturilor de țesuturi. Acest proiect este finanțat de către Regiunea Lombardia și este dezvoltat de cinci entități diferite, reunind know-how-ul propriu cu expertiza multisectorială.

Printre partenerii de cercetare se află trei mari producători italieni, care operează în sectorul textil, și anume: ***Torcitura Di Menaggio*** – o companie specializată în firele de mătase, ***Gaetano Rossini Holding*** – o companie specializată în producția de țesături 3D și ***Comez*** – cu sediul în Cilavegna (PV), lider mondial în fabricarea mașinilor de țesut pentru țesături înguste.

Acești producatori își unesc eforturile cu ***Sperimentale Stazione Per La Seta***, unul din cele mai renumite centre de cercetare din Italia, specializat în sectorul textil, și cu ***Spitalul Niguarda Ca Granda*** din Milano, cel mai important centru de cercetare medicală din Italia în domeniul histoterapiei, concentrându-se asupra regenerării in vitro a țesuturilor umane.

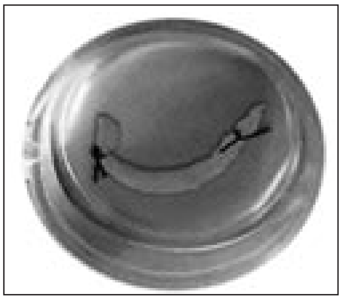

Fig. 1

Scopul proiectului *Panagenesi* este de a optimiza implantarea de țesuturi insulare – prin utilizarea de structuri variabile ale secțiunii circulare a fibrinelor, reducând numărul de insule pancreatice necesare pentru succesul deplin al unui transplant și pentru prelungirea funcției acestora de-a lungul timpului.

Scheletul este, în esență, un articol textil tubular (fig. 1), cu un diametru mic, care cuprinde o secvență de structuri cu lobi – având o secțiune transversală variabilă, și o structură internă de tip tridimensional, folosind fire subțiri de fibrină.

Sursa: www.comez.com

ARMURĂ DE PROTECȚIE LICHIDĂ

Compania ***BAE Systems*** a dezvoltat o nouă armură lichidă, concepută pentru a satisface nevoia unor materiale inovatoare, cu greutate redusă, cu un grad mare de acoperire și o manevrabilitate ușoară, care să ofere purtătorilor o protecție optimă (fig. 1).

Plăcile pe bază de ceramică ale armurii – utilizate la sistemele actuale de protecție, pentru a acoperi zone mari ale trunchiului – sunt grele și voluminoase, restricționând mișcarea și sporind oboseala în timpul purtării, în special de către soldați.

Tehnologia de realizare poate fi integrată în armura standard din kevlar, pentru a oferi o mai bună libertate de mișcare și o reducere a grosimii totale cu până la 45%. *„Tehnologia poate fi explicată prin exemplul amestecării apei cu o lingură... În apă, se simte, la început, o rezistență mică asupra lingurii, dar cu cât se amestecă mai repede, cu atât rezistența este mai mare. La armura lichidă, se simte cum rezistența crește, pe măsură ce elementele din fluid se fixează, astfel încât atunci când un proiectil se lovește în viteză de un material, acesta se întărește foarte repede și absoarbe energia de impact“* – a afirmat Stewart Penney, de la BAE Systems.

Atunci când este integrat în kevlar, fluxul redus de lichide din armura lichidă limitează mișcarea firelor din țesătură, creând o zonă mai mare, în care energia de impact este dispersată. Ca urmare, este puțin probabil ca materialul să se deformeze, în comparație cu armura standard, care, în general, se curbează în interior, atunci când este lovită de un glonț, prevenind decesul, dar provocând dureri considerabile.

Studiile efectuate la Centrul de Tehnologie Avansată al BAE, din Filton/Marea Britanie, au arătat că armura lichidă, chiar mai subțire decât cea standard, conferă o rezistență sporită, la niveluri echivalente de forțe.

Un prototip al acestei tehnologii a fost prezentat la Ministerul Apărării din Marea Britanie. BAE speră să dezvolte în continuare armura lichidă, pentru a crea o versiune mai ușoară, care să poată avea și alte aplicații în afara celor militare, de exemplu pentru forțele de poliție și echipajele de pe ambulanță.

BAE a încheiat un contract de 35 de milioane de dolari cu armata S.U.A., pentru livrarea a 60 000 de veste balistice. În plus, acesta a introdus sistemul Ultra Lightweight Warrior (ULW) în Australia – care oferă avantaje semnificative, datorită greutății reduse, protecției adaptabile pentru soldați și dotării cu o sursă de alimentare integrată. Sistemul a fost prezentat oficial, pentru prima dată, la Conferința Land Warfare 2010, de la Brisbane/Australia. *„Sistemul ULW se axează pe cinci domenii-cheie de produs, respectiv cască, vestă, plăci de armură, echipament de transport și sursă de alimentare integrată... Fiecare echipament oferă caracteristici distincte și beneficii, cum ar fi: sursă de energie reîncărcabilă, integrată în vesta balistică, și mecanism de eliberare cu acționare mai rapidă și asamblare mai ușoară. Dar, valoarea reală constă în modul în care piesele individuale acționează ca un tot unitar pentru soldați... Acest echipament militar flexibil, modular oferă opțiuni multiple, specifice misiunilor. Designul ergonomic și materialele avansate noi, mult mai ușoare, conferă un confort sporit, o mai mare mobilitate și o protecție sporită“.*

Fig. 1

Operațiunile de luptă din Afganistan și Irak au ajutat la crearea ingineriei sistemului, pentru a expune modul de luptă al trupelor moderne. *„Prin scăderea greutății cu până la 35%, comparativ cu echipamentul clasic, noua soluție oferă soldaților australieni un avantaj real și semnificativ... Este cel mai avansat sistem de echipamente pentru soldați, disponibil în prezent, care oferă forțelor armate opțiunea de a atinge un nivel superior de protecție, adaptat fiecărei misiunei speciale“* – a declarat Kim Scott, de la BAE.

Experiența producerii a peste 2,5 milioane de articole pentru transport și protecție individuală, care întrunesc toate cerințele de calitate și balistice, destinate armatei S.U.A., a oferit companiei BAE Systems o perspectivă de neegalat asupra nevoilor soldaților din Irak și Afganistan.

Noua vesta tactică exterioară (IOTV), utilizată ca armură standard a armatei S.U.A., oferă o acoperire mai mare împotriva amenințărilor balistice, este mai ușoară și mai confortabilă, conferă soldaților o mai mare mobilitate pe câmpul de luptă, are un sistem de eliberare rapid – în caz de urgență, precum și caracteristici multiple de ajustare pe corp, fiind compatibilă cu toate componentele auxiliare, cum ar fi elementele de protecție a gâtului și a zonei inghinale, precum și cu o varietate mare de plăci ale armurii corpului, inclusiv inserții mici de protecție a brațelor (SAPI), de protecție sporită a brațelor (ESAPI) sau de protecție de ultimă generație a brațelor (XSAPI).

BAE Systems este o companie internațională de apărare, securitate și aerospatială, cu aproximativ 107 000 de angajați în întreaga lume. Compania oferă o gamă completă de produse și servicii pentru forțele aeriene, terestre și navale, precum și electronice avansate, de securitate, soluții de tehnologia informației, precum și servicii de asistență pentru clienți.

Sursa: www.baesystems.com

COSTUM DE ÎNOT CU CARACTERISTICI SPECIALE

Cercetătorii de la ***Institutul Hohenstein*** – Bönnigheim au elaborat un costum inovator pentru înot, care utilizează efectul de microbarbotare, ajutând înotătorii să alunece prin apă ca pe o pernă de aer, asemenea unui pinguin.

Costumul posedă o peliculă specială de suprafață, care face ca materialul textil să fie ultrafin și ultraușor, dar, în același timp, superhidrofob. Aerul izolat între fibre nu este forțat să iasă în exterior și, astfel, formează o pernă de aer ultrafină, argintie, care reduce semnificativ rezistența la frecare în timpul înotului. Acest sistem este întâlnit și în natură, de multe păsări de apă, cum ar fi pinguinul.

Recent, costumul a fost supus primei testări practice, la piscina acoperită Soleo – din Heilbronn, de către oamenii de știință de la Institutul Hohenstein, în colaborare cu cei de la Universitatea din Reutlingen. După primele câteva lungimi de încercare, Sarah Ziem, o înotătoare de performanță și studentă la Universitatea din Reutlingen, a afirmat foarte entuziasmată: *„Chiar a depășit așteptările. Comparativ cu un costum de înot standard, acesta prezintă beneficii evidente în ceea ce privește comportamentul la înotul contra curentului, reflectate într-o viteză îmbunătățită. Chiar și după lungi sesiuni de antrenament, costumul de înot rămâne complet uscat“.*

Important este și faptul că această nouă dezvoltare satisface deja, în mare măsură, cele mai recente reglementări ale Federației internaționale de înot – FINA. În conformitate cu noile recorduri, mondiale și europene, obținute de înotători în anul 2009, FINA a stabilit reglementări mai stricte privind costumele de înot high-tech. În consecință, nu se mai permite ca gâtul, umerii și gleznele să fie acoperite. Materialul din care sunt realizate costumele de înot nu trebuie să fie mai gros de un milimetru, iar flotabilitatea materialului nu trebuie să depășească 1 N/100 g (fig. 1).

Fig. 1

Dr. Beringer afirma că, în următoarele câteva luni, vor fi îmbunătățite efectele pozitive ale peliculei textile, costumul fiind pregătit pentru a fi lansat pe piață: *„Până la Jocurile Olimpice din 2012, de la Londra, probabil că primii înotători vor purta deja costume de înot realizate de Institutul Hohenstein“.*

Comunicat de presă. Hohenstein Textile Testing Institute, Bönnigheim

Aparate de măsură și control

APARAT DIGITAL PENTRU CONTROLUL TENSIUNII

Corporația ***Montalvo*** este specializată în analiza, modernizarea și mentenanța echipamentelor de control al tensiunii din vălul fibros. Timp de peste 60 de ani, Montalvo a produs, a integrat și a oferit service pentru o gamă largă de produse și sisteme de control destinate industriei nețesutelor și peliculelor din plastic, industriei de prelucrare a hârtiei și foliei, precum și domeniului ambalajelor, medical și al tehnologiilor avansate.

Fig. 1

Noul controlor digital de tensiune *S4* (fig. 1), produs de ***Montalvo Corporation***, din Gorham/S.U.A., este foarte ușor de instalat și de operat, iar tehnologia avansată *S4* asigură un control uniform al tensiunii, indiferent de diametrul rolei, prin folosirea unor algoritmi avansați și a unor tehnologii deja experimentate. Acesta oferă un control precis, de mare acuratețe, într-o unitate modulară compactă. Performanța și simplitatea se îmbină armonios cu performanța și profitabilitatea.

Principalele caracteristici ale noului aparat de control sunt: dotarea cu tehnologie de tip „setează și uită“, posibilitatea controlului proceselor de înfășurare/desfășurare de pe bobină, interacțiunea minimă cu operatorul, lipsa variațiilor în productivitate – de la un schimb la altul, posibilitatea efectuării a peste 15 setări – în funcție de tipul de material; resetarea rapidă și ușoară, pornirea ușoară, capacitatea menținerii unei tensiuni constante, posibilitatea detectării ruperilor stratului fibros, posibilitatea reglării de la distanță a valorilor de referință ale tensiunii, posibilitatea comutării de la distanță în poziția pornit/oprit, posibilitatea montării pe un panou sau pe o suprafață plană, accesul instantaneu al cititorului de etichete la manualul de instrucțiuni, cu ajutorul unui telefon inteligent.

Melliand International, mai 2011, nr. 2, p. 83

Textile nețesute

UTILIZAREA DETECTOARELOR DE METAL ÎN PRODUCȚIA MATERIALELOR NEȚESUTE

În prezent, producerea de fibre moderne este de neconceput fără utilizarea detectoarelor de metale. Acestea protejează materialul și instalațiile din fluxul de

Fig. 1

producție, de la fibra de bumbac până la materialul nețesut.

Singurul detector de metale care poate fi integrat în banda transportoare pneumatică fără un tub-sondă este *Metron 05 PowerLine* (fig. 1), de la ***Mesutronic GmbH,*** din Kirchberg/Germania.

Compania ***Erko Trutzchler GmbH*** folosește acest dispozitiv pentru examinarea fibrelor din instalațiile pentru materiale nețesute, în vederea detectării particulelor metalice (de exemplu, ace, fragmente de lame de la mecanismul de tăiere a sforii de la desfăcătoarele de baloturi, șuruburi etc.) și a prevenirii pătrunderii acestora în materialul nețesut.

Un mare avantaj al sistemelor PowerLine îl constituie ușurința cu care acestea pot fi integrate în liniile de producție existente. Pentru instalare este îndepărtată o porțiune a conductei din banda transportoare de fibre și în locul acesteia este montată o bobină-detector în sistem „plug & play".

Sistemul de detecție pentru o conductă cu diametru de 300 mm cântărește aproximativ 40 kg și este integrat direct în conductă.

Detectorii PowerLine sunt astfel reglați, încât să detecteze cu acuratețe particule de metal, începând cu dimensiunea de 1% din diametrul nominal al detectorului. Astfel, în cazul unei conducte cu diametrul de 300 mm, senzorul de metal detectează impurități începând cu dimensiunea de 3 mm din fluxul de fibre. Reglajul de 1% asigură nu numai o bună acuratețe a detecției, dar și reducerea la minimum a pierderilor de material.

Bobina-detector este perfect încapsulată și, astfel, oferă o protecție deosebită împotriva interferențelor de frecvențe.

Mecanismul Texeject, acționat pneumatic la mare viteză și instalat în fața bobinei-detector, la aproximativ 1,5 m, separă impuritățile metalice din banda de fibre din conductă. Un profil de ghidaj, special conceput, separă particulele de metal mari de restul fibrelor, chiar înainte ca acestea să ajungă la detector. Detectarea particulelor de metal nu afectează fluxul normal al producției, deoarece acesta nu este înterupt în timpul procesului de ejectare.

O altă funcție specializată a detectorului de metale este aceea de control automat al vitezei fibrelor cu impurități metalice și de acționare a mecanismului de ejectare la momentul potrivit, prin intermediul unui impuls de comutare.

Diferite aplicații ale materialelor nețesute necesită un grad ridicat de puritate a fibrelor. Absența impurităților metalice este o componentă obligatorie a managementului calității materialelor de igienă din domeniul medical, al cosmeticelor și celor destinate îngrijirii locuinței, care trebuie să aibă o bună capacitate de absorbție și un grad ridicat de netezime.

Melliand International, mai 2011, nr. 2, p. 78

Diverse

O NOUĂ GENERAȚIE DE SENZORI HEADS

Pentru identificarea deziunilor traumatice ale creierului, provocate în timpul luptelor, ***BAE Systems*** dezvoltă noi tehnologii menite să monitorizeze mai bine soldații și să asiste la diagnosticarea acestora.

Una dintre aceste tehnologii este reprezentată de *senzorul HEADS* (Headborne energy analysis and diagnostic system), folosit pentru prima dată în domeniul militar, de către BAE Systems, în 2008.

De atunci, pentru armata S.U.A., au fost fabricate aproape 7 000 de unități HEADS. A fost încheiat un contract de 17 milioane de dolari S.U.A. pentru producerea de senzori HEADS generația a II-a, pentru caschete.

Următoarea generație de senzori, montați în interiorul căștilor de protecție și invizibili pentru utilizator, vor oferi un afișaj vizual, care poate fi folosit pentru a indica dacă un soldat a suferit un traumatism cranian în timpul luptei.

Diagnosticarea facilă a acestor leziuni este de mare importanță pentru viața soldaților. De exemplu, în urma unei explozii produse de bombă, soldații își pot continua misiunea, fără să știe că rana provocată de acea explozie poate avea efecte persistente.

Însă, folosind senzorii HEADS din generația a II-a, care sunt echipați cu o diodă emițătoare de lumină (LED), ce poate fi configurată astfel încât să se activeze în timpul exploziei, sunt transmise informații imediate personalului medical despre un posibil traumatism, chiar dacă rana provocată nu este evidentă.

Noul senzor furnizează personalului medical o analiză detaliată a impactului, prin înregistrarea accelerațiilor și a presiunii atmosferice asociate cu un eveniment semnificativ, cum ar fi explozia provocată de un dispozitiv improvizat.

Pachetul HEADS este extrem de sensibil și se activează automat, atunci când se declanșează un eveniment, de tipul unei explozii. Senzorul înregistrează date foarte importante privind severitatea impactului și stochează aceste date, până când acestea sunt descărcate utilizând o conexiune USB sau wireless.

Datele furnizate sunt importante pentru evaluarea gravității unei leziuni și, prin urmare, este asigurată o protecție mai bună a trupelor aflate în misiune.

Smart*textiles and nanotechnology,*
februarie 2011, p. 5

DEFICIT DE 22 DE MILIOANE DE TONE DE BUMBAC ÎN 2030

Estimările făcute de ***Gherzi Textile Organisation AG,*** din Zürich/Elveția, arată că, în următorii ani, producția de fibre sintetice artificiale (MMSF) și celulozice (MMCF) și cea de fibre naturale nu va putea satisface cererea de fibre la nivel mondial.

În plus, în prezent producția de bumbac a scăzut din cauza mai multor factori, precum creșterea populației globale și a PIB-ului mondial, cererea tot mai mare de fibre textile pe cap de locuitor, reducerea suprafeței de terenuri arabile, deficitul de apă etc.

Se estimează că, în următorii 20 de ani, producția de alimente va fi cu 40% mai mare decât în prezent, deoarece va avea loc o schimbare semnificativă în utilizarea terenurilor, iar cultura plantelor alimentare va ocupa tot mai multe suprafețe agricole, în detrimentul culturii bumbacului.

Comitetul Consultativ Internațional al Bumbacului (ICAC) – o asociație importantă a reprezentanților guvernamentali din țările producătoare, consumatoare și din cele care comercializează bumbacul, cu sediul în Washington, a atras deja atenția asupra problemei deficitului de bumbac, în viitor. În plus, în următoarele două decenii se prevede o creștere de 3% a cererii globale de fibre textile.

Primele estimări ale analizei arată că, în prezent, există deja un deficit de MMCF de 500 000 de tone, care ar putea ajunge, în 2030, la cca 11 milioane de tone, reprezentând 8% din cererea totală de fibre, estimată la aproximativ 140 de milioane de tone. Potrivit estimărilor actuale, MMCF va acoperi doar o parte a deficitului de bumbac, care se prevede a ajunge la 22 de milioane de tone, până în 2030. MMCF va putea substitui doar parțial aplicațiile bumbacului, aceasta neputând oferi, în totalitate, performanța dată de unele proprietăți specifice bumbacului.

Pe scurt, cel mai probabil scenariu prevede că, până în 2030, deficitul de celuloză ar putea fi de aproximativ 11 milioane de tone, ceea ce ar putea crea oportunități mari pentru producătorii MMCF și MMSF.

Melliand International, martie 2011, nr. 1, p. 4

CONSUMUL MONDIAL DE FIBRE

Departamentul de Economie a Fibrelor, o divizie a Asociației Producătorilor de Fibre din America, cu sediul în Arlington – S.U.A., a publicat un centralizator cuprinzând date privind consumul mondial de fibre din bumbac, lână și fibre chimice, la sfârșitul anului 2010. Între 2004 și 2009, ponderea Asiei în prelucrarea globală a fibrelor a crescut de la 65% la 75,6%. În ultimii 5 ani, în Europa de Vest ponderea a scăzut de la 8% la 5,6%, iar în America de Nord și America de Sud de la 15,6% la 10,2%.

Consumul total de fibre din bumbac, lână și fibre chimice prelucrate a fost, în 2004, de aproximativ 64,6 milioane de tone, iar în 2009 de circa 71,7 milioane de tone.

Previziunile Comitetului Consultativ Internațional al Bumbacului (ICAC) sugerează faptul că, până în 2015, consumul mondial de fibre textile ar putea ajunge la 83 de milioane de tone, iar până în 2020, la 99 de milioane de tone. Consumul mondial de bumbac este estimat să ajungă, până în 2015, la 27 de milioane de tone, iar până în 2020, la 30 de milioane de tone. Se estimează că ponderea bumbacului pe piața globală de textile va avea un declin de 33% – până în 2015, și de 30% – până în 2020.

Melliand International, martie 2011, nr. 1, p. 5

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