One-bath dyeing of polyester/cotton blend with reactive dye after alkali and chitosan treatment

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REZUMAT – ABSTRACT

Vopsirea într-o singură baie a amestecurilor din poliester/bumbac cu coloranți reactivi, după tratamentul cu alcalii şi chitosan

În lucrare s-a studiat efectul tratamentului cu alcalii şi chitosan asupra caracteristicilor de vopsire reactivă a amestecurilor din poliester/bumbac. Au fost utilizate diferite metode de caracterizare a modificărilor fizice şi chimice în stratul de suprafaţă al fibrei de poliester şi utilizarea colorantului, după aplicarea unor tratamente individuale şi combinate. Vopsirea simultană a ţesăturilor din bumbac şi poliester şi a amestecurilor din poliester/bumbac au fost efectuate în urma aplicării unor tratamente individuale şi hibride. Ţesăturile vopsite au fost evaluate în funcţie de intensitatea şi rezistenţa culorii. Prin aplicarea unui tratament alcalin, suprafaţa fibrei de poliester s-a modificat din punct de vedere fizic şi chimic şi, în acelaşi timp, bumbacul mercerizat a favorizat absorbţia colorantului reactiv C.I. Reactive Red 3 şi creşterea intensităţii vopsirii cu 24%, în cazul ţesăturii din amestec de fibre. Prin depunerea biopolimerului de chitosan, intensitatea vopsirii pe toate mostrele a crescut proporţional cu concentraţia, în special în cazul poliesterului. Tratamentul hibrid, care combină tratamentele cu alcalii şi chitosan, s-a dovedit a fi cel mai eficient şi ar putea permite o nouă abordare a vopsirii şi finisării textile.

Cuvinte-cheie: amestec, vopsire, colorant reactiv, tratament cu alcalii, chitosan, strat de suprafaţă, tratament hibrid, intensitatea vopsirii

One-bath dyeing of polyester/cotton blend with reactive dye after alkali and chitosan treatment

The effect of alkali and chitosan treatment on reactive dyeing characteristics of polyester/cotton blend is studied in this work. Various methods for characterization of physical and chemical changes in the surface layer of polyester fiber and dye utilization after individual and combine treatments were used. A simultaneous dyeing of cotton and polyester fabrics and dyeing of factory blends of polyester/cotton were carried out after individual and hybrid treatment. Dyed fabrics were evaluated by dye intensity and fastness. By using alkali treatment, the surface of polyester fiber is physically and chemically modified and at the same time the cotton is mercerized, favorably affecting absorption of reactive dye C.I. Reactive Red 3, resulting to a dye intensity increase of 24% on factory blend. With deposition of chitosan biopolymer, dye intensity on all samples is increased proportionally with concentration, especially on polyester. Hybrid treatment combining alkali and chitosan treatments is the most effective and it could enable a new approach to textile dyeing and finishing.

Key-words: blend, dyeing, reactive dye, alkali treatment, chitosan, surface layer, hybrid treatment, dye intensity

Blends of polyester and cotton are the most popular blends in clothing industry due to complementary properties of these fibers [1]. Easy care polyester and cotton blend is used for making fabrics for man's and woman's clothing, shirts, sport garments, uniforms, coats, bedding and table cloths. According to literature, 90% of work clothing is made of polyester/cotton blends because these fabrics are considerably more stabile to washing, i.e. they resist three times more washing cycles compared to cotton fabrics [2]. In polyester/cotton blends, polyester is characterized by high strength, possibility of thermal stabilization, excellent care behavior, uniform quality but it also has some disadvantages in terms of low water adsorption, static electricity, high tendency for contamination with oil impurities etc. The nature component – cotton, is characterized by high ability for water adsorption and release, in that way it offers indispensable comfort to textile, but it has lower mechanical properties than synthetic fibers. In polyester and cotton blends, combination of their properties gives improved overall quality of material.

The current known dyeing methods for binary textile blends polyester/natural fiber use two classes of dyes for dyeing of components in one or two solutions, producing high quantities of polluted waste waters embarrassing the whole environment. The global initiative for rational utilization of natural resources and increasingly more stringent environmental legislation impose the need for development of new methods more superior compared to traditional dyeing in terms of technological productivity, economy and protection of watercourses. Moreover, the new dyeing methods should provide high performances of dyes on textile, and from this point of view the main challenge in dyeing of blends is matching color intensities on blend components. In order to rationalize dyeing of polyester/cotton blends, recently, dyes with new coloristic

properties have been developed or pretreatments improving dye affinity for fibers have been applied [3–8].

In this work, commercial polyester, cotton and factory blended polyester/cotton fabrics were treated with alkali and chitosan solutions of various concentrations, with the aim to improve dyeing with reactive dye. The effects of alkali on surface structure and chemical composition of polyester have been studied. The improved dyeing of components and factory blended polyester/cotton blends after combined pretreatment was evaluated by color intensity, fixation degree and dye fastness.

EXPERIMENTAL PART

Material and methods

100% polyester commercial fabric with surface mass of 149,5 g/m^2, 100% cotton fabric with surface mass of 206,67 g/m^2 and 50/50% polyester/cotton factory blend with surface mass of 172,53 g/m^2 were used in experiments.

Alkali treatment of polyester fabrics (separately and in combination with cotton fabrics) and fabrics of blended composition was performed in aqueous NaOH solution (Kemika – Croatia) in Ahiba apparatus (Type G7B) with vertical material movement in closed metal cuvettes at temperatures of 80 and 100ºC, alkali concentrations were 15, 50 and 80 g/dm^3 and treatment time 20, 40, 60, 75 and 90 minutes. Sample mass was 5 g and solution volume was 200 cm^3. After alkalization the samples were neutralized with diluted acetic acid followed by distilled water rinsing and drying in air.

Mass loss (*GM*) of alkali treated polyester fabrics was estimated using equation (1):

$$GM = \frac{m_1 - m_2}{m_1} \times 100 \quad [\%] \quad (1)$$

where:

m_1 is mass of untreated sample;

m_2 – mass of hydrolyzed sample; sample mass was weighed on analytical balance with accuracy of 0,0001 g.

Chitosan used for treatments was obtained from Primex – Norway and it has the following characteristics: degree of deacetylation 96%, viscosity 102 cP, solubility 99.9%, dry matter content 85% and ash content 0.1%. Chitosan was used without further purification. Chitosan treatment was performed in freshly prepared solutions with concentrations of 1, 5 and 10 g/dm^3. Liquor ratio in chitosan treatment was 1:20, treatment temperature 25ºC for 20 minutes with continuous stirring. After treatment the samples were sqeezed on padder at the same conditions and dried in air at ambient temperature, washed with distilled water and dried again.

Reactive dye C.I. Reactive Red 3, molecular mass 774,048 g/mol (Bayer – Germany), was used for dyeing of pretreated samples and its structure is shown in figure1. The dye was commercial quality.

To characterize surface morphological changes on polyester surface scanning electron microscope JEOL JCM 5300 (Jeol – Japan) was used. The samples were prepared by standard preparation technique of gold sputtering producing conductive surface on a cathode gold sputter for 5 minutes.

The content of end carboxyl groups is in direct correlation with static ion-exchange capacity (*SJK*), that is determined by volumetric method as follows: in an Erlenmeyer flask containing 100 cm^3 of 0.01M NaOH solution 0,1 g of fiber is added (weighed to 0,0001 g). The flask is stopped to prevent reaction between NaOH and CO$_2$ from air. Treatment is performed for 1 hour with stirring and than 20 cm^3 of the solution is taken and titrated with 0.01 M HCl solution with phenolphthalein indicator. Three measurements are made and an average of acid volume used is taken. *SJK* is calculated as follows [9]:

$$SJK = 5 \frac{V_{NaOH} \cdot c_{NaOH} - V_{HCl} \cdot c_{HCl}}{m(1 - w)} \; [\text{mmol/g}] \quad (2)$$

where:

V_{NaOH} is NaOH volume taken for titration, cm^3;

V_{HCl} – HCl volume used up for titration, cm^3;

c_{NaOH} – molar concentration of NaOH solution, mol/dm^3;

c_{HCl} – molar concentration of HCl solution, mol/dm^3;

m – fiber mass, g;

w – moisture content, %.

Based on the values obtained and the ratio of COOH group concentrations for alkalized and untreated sample, relative increase of carboxyl group content of modified polyester fabrics compared to untreated fabrics was estimated.

In the experiment, pretreated polyester and cotton fabric samples and factory blend of polyester/cotton 50/50 were simultaneously dyed. In simultaneous dyeing, mass ratio of components was 50:50. Sample mass was 4 g and liquor ratio 1:45.

Dyeing was carried in laboratory dyeing apparatus Ahiba type G7B (Ahiba, Swiss) with vertical movement of material as shown on diagram in figure 2.

After dyeing fabrics were rinsed with hot and cold distilled water. After dye values were measured, samples dyed with reactive dye were treated in soap
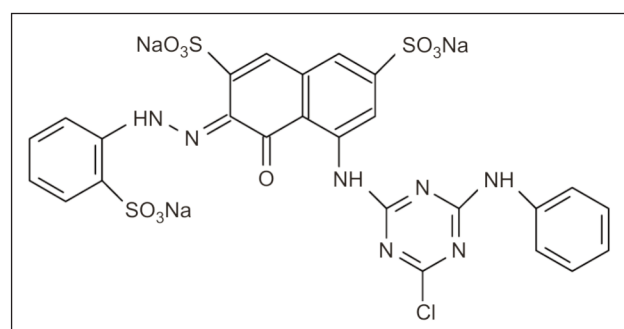

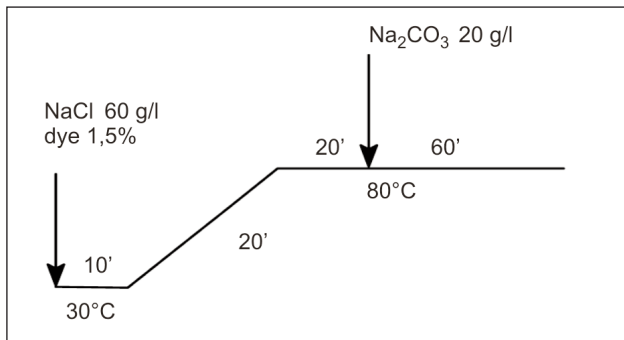Fig. 1. Dye structure of C.I. Reactive Red 3 (RR 3), C.I. 18159

Fig. 2. Dyeing diagram with C.I. Reactive Red 3

Color reflaxion values and color coordinates were determined with reflexion spektrophotometer Spectraflash SF600X (Datacolor) by typical procedure. After treatment of reactive dyed samples in soap solution (95ºC for 10 minutes) measurement was repeated to estimate dye fixation degree F.

Color intensity (K/S) was estimated at maximum absorption wavelength (λ = 550 nm) according to Kubelka-Munk equation (3):

$$\frac{K}{S} = \frac{(1-R)^2}{2R}$$ (3)

Fixation degree was calculated according to equation (4):

$$F = \frac{\left(\dfrac{K}{S}\right)_T}{\left(\dfrac{K}{S}\right)_0} \cdot 100$$ (4)

where:
subscript T refers to soap treated fabric and subscript 0 to untreated fabric.

Percentage of color intensity increase (I) on modified samples in relation to original sample was estimated from the following equation (5):

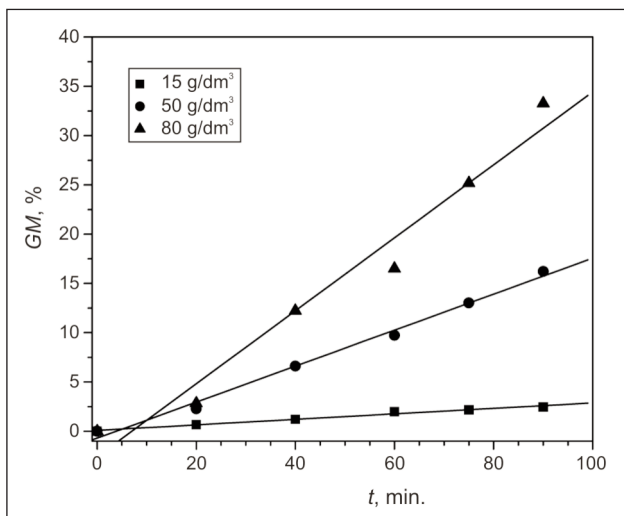$$I = \frac{(K/S)_m - (K/S)_0}{(K/S)_0} \cdot 100 \quad [\%]$$ (5)

where:
subscript m refers to modified fabric samples and subscript 0 to untreated samples.

Dye fastness to laundering and rubbing for dyed samples was estimated according to ISO 105-C06: 1994 and ISO 105-X12:2001, respectively.

RESULTS AND DISCUSSIONS

Kinetics of mass loss

Chemical constitution and fiber surface morphology play an important role in wet processing of textile material. Low content of polyester carboxyl groups give rise to obvious hydrophobic polyester fiber surface and therefore it is inert to dyes dissociating in dyeing bath. Hydrophilization of polyester, introducing polar oxygen groups into macromolecular structure, can alter polyester behavior, i.e. enable dyeing at 100ºC and possibly using dyes with low thermal stability, e.g. reactive dyes. Alkaline treatment of polyester fabrics has favorable effects on some textile characteristics of practical importance, because fabrics have better aesthetic appearance, they are less prone to pilling, have higher resistance to staining and better hydrophilic properties [10, 11]. Effects observed with alkaline treatment of polyester are highly dependent on mass loss.

Figures 3 and 4, for temperatures 80 and 100ºC, respectively, show graphic presentation of fabric mass loss versus time and NaOH concentration. Prolonged reaction time progressively increases mass loss at higher NaOH concentration and solution temperature. In all cases mass loss with time is linear and is in good agreement with straight line equations shown in table 1.

When polyester is treated in aqueous alkaline solution it loses mass due to nucleophilic substitution in such a way that hydroxyl ions attack electron deficient carbon atoms in carbonyl groups inducing ester group hydrolysis (fig. 5). Alkaline hydrolysis of polymers produces water soluble depolymerized polyester fragments that separate from fiber surface and
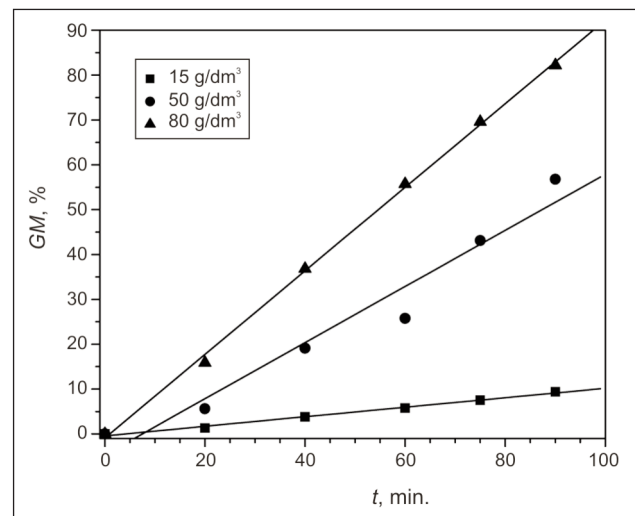

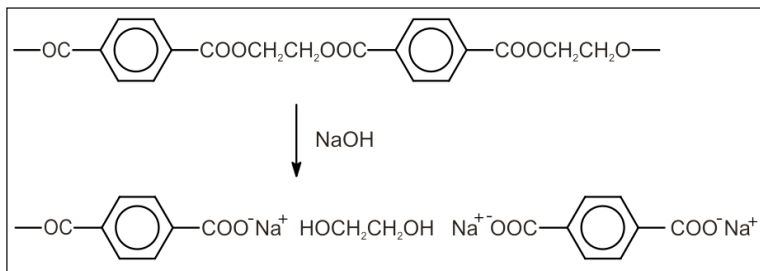Fig. 3. Mass loss of polyester fabric at 80°C depending on the NaOH concentration

Fig. 4. Mass loss of polyester fabric at 100°C depending on the NaOH concentratione

Fig. 5. Scheme of polyester alkali degradation

Tempe-rature, °C	NaOH con-centration, g/dm³	Equation	R
	15	$GM = 0.028 \cdot t + 0.087$	0.992
80	50	$GM = 0.183 \cdot t - 0.699$	0.996
	80	$GM = 0.370 \cdot t - 2.585$	0.984
	15	$GM = 0.106 \cdot t - 0.415$	0.996
100	50	$GM = 0.626 \cdot t - 4.671$	0.977
	80	$GM = 0.932 \cdot t - 0.894$	0.999

LINEAR EQUATIONS OF MASS LOSS DEPENDING ON TIME AND CORRELATION COEFFICIENTS

Note: R is correlation coefficient, t – treatment time

transfer to solution, which is observed as a mass loss. Higher mass loss at higher temperatures is explained by increased alkaline diffusion in polyester fiber and is particularly pronounced at temperatures higher than polyester glass transition temperature.

Effect of alkaline treatment on the structure of polyester fiber surface

Fiber surface photographs using SEM reveal very significant differences in surface appearance between untreated samples and samples treated in NaOH solution with various intensities. Untreated fiber has a smooth surface with a number of visible white particles (fig. 6). These particles are oligomers that migrat-

ed and crystallized on the surface during stretching and thermal processing. At moderate levels of hydrolysis, rifts and ellipsoidal pits (fig. 7) appear on fiber surface and enlarge with further mass loss (fig. 8). Based on fiber surface morphology changes it could be concluded that reaction of polyester with alkali starts on fiber surface where high negative charge [12] of fiber acts as a barrier hindering penetration of hydroxyl ions to fiber core. Shorter chains, produced as a result of hydrolysis, are removed into solution resulting in mass loss and changes of surface structure. It is, therefore, presumable that polymer degradation occurs on areas of decreased structure order where polymer density and energy of side bonds are lower facilitating access of alkali.

The content of end carboxyl groups

During the treatment of polyester in alkaline solution, modified compounds with terminating carboxyl or hydroxyl groups remain in polyester structure after removal of the products of hydrolytic degradation. Table 2 shows relative increase of terminating carboxyl groups in alkali treated samples compared to
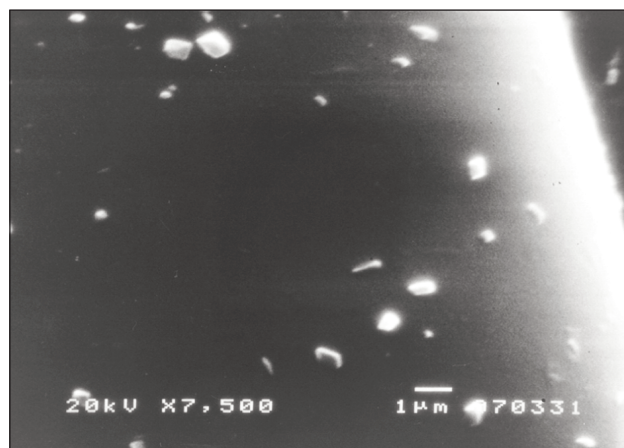
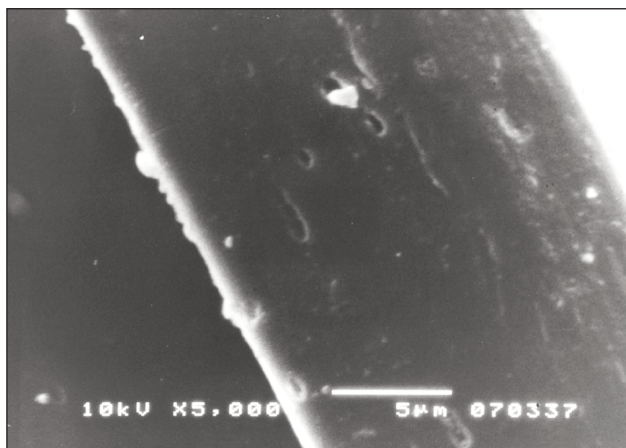

Fig. 6. Scanning micrograph of untreated polyester

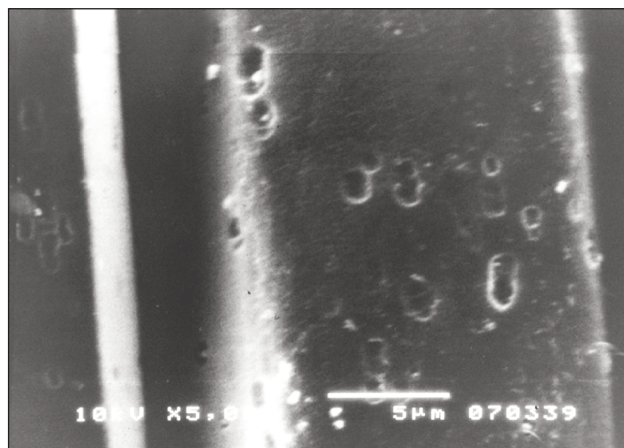Fig. 7. Scanning micrograph of alkalized polyester
GM = 6,62%

Fig. 8. Scanning micrograph of alkalized polyester
GM = 13,01%

Table 2

Index of COOH group	Mass loss, %	Sample designation	Treatment conditions
1	-	R*	utreated
1.85	0.66	A	80°C, 20 minutes, 15 g/dm³ NaOH
2.13	1.98	B	80°C, 60 minutes, 15 g/dm³ NaOH
2.03	2.45	C	80°C, 90 minutes, 15 g/dm³ NaOH
2.26	6.62	D	80°C, 40 minutes, 50 g/dm³ NaOH
2.61	9.74	E	80°C, 60 minutes, 50 g/dm³ NaOH
3.01	16.23	F	80°C, 60 minutes, 80 g/dm³ NaOH

RELATIVE INCREASE OF COOH GROUP NUMBER FOR ALKALI HYDROLYZED POLYESTER FABRICS

* R is referent (untreated) sample

Table 3

SIMULTANEOUS DYEING RESULTS OF POLYESTER, COTTON AND FACTORY BLEND SAMPLES PRETREATED WITH ALKALI SOLUTION

Sample	K/S	I, %
R polyester	0.028	-
A polyester	0.046	64.3
B polyester	0.048	71.4
C polyester	0.047	67.8
D polyester	0.050	78.6
E polyester	0.056	100
F polyester	0.068	142.8
R cotton	2.81	-
A cotton	3.61	28.5
B cotton	3.45	22.8
C cotton	3.23	14.9
D cotton	3.42	21.7
E cotton	3.56	26.7
F cotton	3.20	13.9
R bld*	0.71	-
A bld	0.88	23.9
B bld	0.88	23.9
C bld	0.86	21.1
D bld	0.87	22.5
E bld	0.84	18.3
F bld	0.85	19.7

* bld is factory blend polyester/cotton

the original sample. The relative increase is 1,85–3 times higher, because it is not possible to establish a simple relation between the number of terminal carboxyl groups and mass loss, i.e. higher mass loss does not necessarily mean higher number of terminal groups. In view of the fact that the mass loss occurs when hydrolysis takes place at the ends of molecules, and that the number of terminal groups increases when hydrolysis takes place inside the polyester macromolecule, it can be concluded that polyester hydrolysis is a statistically random process for defined reaction conditions, which is in accordance with FTIR analysis results of C. Samon et al. [13]. Polyester modified in this way can react through its new functional oxygen groups with various substances, and in that aspect it is similar to natural fibers.

One-bath dyeing of alkali treated polyester/cotton blend with reactive dye

Polyester and cotton fabrics were dyed simultaneously after alkaline treatment in C.I. Reactive Red 3 reactive dye solution. Under the same conditions, factory polyester/cotton blend was also dyed after alkaline treatment.

Dyeing was performed with a selection of samples where technologically significant mass loss of polyester fabrics was obtained in the production of light polyester fabrics with characteristics similar to silk. Reactive dyes are the most important group of dyes for cellulose fibers and their ability of chemical reaction with fibers makes them different from other dye classes. The importance of using one dye class for dyeing cotton-polyester fabrics having ability to be fixed by covalent bond refers also to the possibility of synthesis and use of reactive disperse dyes and, in recent times, disperse dyes containing a reactive group [14].

In table 3 are given intensity values of reactive dye (K/S) and percentage of dye intensity increase (I) after alkaline treatment. A trend of increased absorption of reactive dye on all modified samples was observed. For increased absorption of reactive dye from 64 to 143% on alkalized polyester samples, new incorporated OH groups on the ends of depolymerized polyester chains are responsible.

Cotton fabric samples after alkaline treatment absorb 14–28% more dye as a result of changes in supramolecular structure during hot alkaline treatment. When cotton is treated with an alkaline solution a good mercerization effect is achieved because cellulose crystal structure is modified and percentage of amorphous regions is increased [15]. By increasing non crystal regions, swelling of fiber is increased and dye penetrates more easily into fiber. Modified polyester fabrics have better concurrent dyeing with cotton and it can be asserted that intensity increase of 18–24% on factory blend is a contribution of both fibers. On modified samples, standard values for fixation degree F and dye fastness (table 4) are observed indicating the stability of dye-fiber bond.

One-bath dyeing of polyester/cotton blend with reactive dyes after chitosan treatment

One way to achieve multifunctional properties of textile, including better absorption, is deposition of biodegradable polymers with functional groups. Chitosan is a biopolymer possessing reactive amino and

FASTNESS OF C.I. REACTIVE RED 3 ON ALKALI SOLUTION PRETREATED SAMPLES				
Sample	Fastness			Fixation degree, F
	Washing	Rubbing-dry	Rubbing-wet	
R polyester	3-4	4-5	4-5	0.78
A polyester	3-4	4-5	4-5	0.77
B polyester	3-4	4-5	4-5	0.78
C polyester	4	4-5	4-5	0.77
D polyester	4	4-5	4-5	0.81
E polyester	4	4-5	4-5	0.79
F polyester	4	4-5	4-5	0.76
R cotton	4	5	4-5	0.83
A cotton	4	5	4-5	0.81
B cotton	4	5	4-5	0.80
C cotton	4	5	4-5	0.81
D cotton	4	5	4-5	0.80
E cotton	4	5	4-5	0.79
F cotton	4	5	4-5	0.78
R bld	3-4	5	4-5	0.83
A bld	3-4	5	4-5	0.81
B bld	3-4	5	4	0.80
C bld	3-4	5	4-5	0.80
D bld	4	5	4-5	0.81
E bld	4	5	4-5	0.82
F bld	3-4	5	4	0.80

SIMULTANEOUS DYEING RESULTS OF POLYESTER, COTTON AND FACTORY BLEND SAMPLES PRETREATED WITH ALKALI SOLUTION		
Sample	K/S	I, %
R polyester	0.028	-
H_1 polyester	0.117	317
H_5 polyester	0.445	1 489
H_{10} polyester	0.528	1 785
R cotton	2.81	-
H_1 cotton	3.07	9.2
H_5 cotton	3.20	13.9
H_{10} cotton	3.30	17.4
R bld	0.71	-
H_1 bld	0.83	16.9
H_5 bld	0.94	32.4
H_{10} bld	1.10	54.9

Note: H_1 is treatment with chitosan solution, 1 g/dm^3;
H_5 – treatment with chitosan solution, 5 g/dm^3;
H_{10} – treatment with chitosan solution, 10 g/dm^3

FASTNESS OF C.I. REACTIVE RED 3 ON CHITOSAN TREATED SAMPLES				
Sample	Fastness			Fixation degree, F
	Washing	Rubbing-dry	Rubbing-wet	
R polyester	3-4	4-5	4-5	0.78
H_1 polyester	3-4	4-5	4-5	0.77
H_5 polyester	3-4	4-5	4-5	0.78
H_{10} polyester	4	4-5	4-5	0.77
R cotton	4	4-5	4-5	0.76
H_1 cotton	4	5	4-5	0.81
H_5 cotton	4	5	4-5	0.82
H_{10} cotton	4	5	4-5	0.81
R bld	4	4-5	4-5	0.78
H_1 bld	3-4	5	4-5	0.81
H_5 bld	3	5	4-5	0.82
H_{10} bld	3	5	4-5	0.81

hydroxyl groups and owing to its unique characteristics it is suitable for many applications on textile. Chitosan absorbs anionic dyes and has recently attracted scientific and industrial interests as a suitable sorbent for dyes in textile dyeing and wastewater treatment.

After treatment of polyester fabrics in chitosan solution, dramatically increased absorption of reactive dye was observed and the maximal intensity was achieved with fabric treated in highest concentration of chitosan solution (table 5). On cotton fabric, too, simultaneously dyed with polyester fabric, C.I. Reactive Red 3 dye intensity increases uniformly with concentration of chitosan treatment solution. Hydroxyl groups of chitosan layer on the surface of pretreated fibers represent binding sites for additional quantities of reactive dye and this treatment multiplies polyester capacity so that color on factory blend components is better leveled giving higher K/S value which is 55% higher at maximal chitosan concentration compared to untreated fabric.

On all samples, values for fixation degree F and color fastness (table 6) were high. Higher dye yield means lower dye content in waste water and is based on reaction of chitosan hydroxyl group with reactive center of monochlor thiazine (MCT) dye. It is known that MCT reactive dye can react with cellulose hydroxyl group after adjusting alkaline pH with Na$_2$CO$_3$. Moreover, under alkaline conditions, deprotonation of chitosan hydroxyl group also occurs [16]:
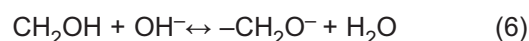
$$CH_2OH + OH^- \leftrightarrow -CH_2O^- + H_2O \qquad (6)$$

so that chitosan hydroxyl group can bind reactive dye covalently under alkaline conditions as with cellulose alkaline group in dyeing process.

One-bath dyeing of alkalized and chitosan treated polyester/cotton blend with reactive dye

Hybrid treatments of textile material combining surface modification of fibers and deposition of compound with higher dye adsorption capacity are potentially the most effective for improved dye yield from technological solution. On combined treated samples of polyester fabric (alkalization and 5 g/dm^3 chitosan solution treatment) quantity of C.I. Reactive Red 3 is dramatically increased so that dye intensity is increased

Table 7

SIMULTANEOUS DYEING RESULTS OF POLYESTER, COTTON AND FACTORY BLEND SAMPLES PRETREATED WITH ALKALI AND CHITOSAN SOLUTION (5 g/dm^3)		
Sample	**K/S**	**I, %**
R polyester	0.028	-
AH$_5$ polyester	0.52	1 757
BH$_5$ polyester	0.51	1 721
CH$_5$ polyester	0.53	1 792
CH$_5$ polyester	0.57	1 935
EH$_5$ polyester	0.50	1 685
FH$_5$ polyester	0.63	2 150
R cotton	2.81	-
AH$_5$ cotton	3.65	29.9
BH$_5$ cotton	4.16	48.0
CH$_5$ cotton	3.34	18.9
DH$_5$ cotton	4.63	64.8
EH$_5$ cotton	3.56	26.7
FH$_5$ cotton	3.22	14.6
R bld	0.71	-
AH$_5$ bld	1.46	105.6
BH$_5$ bld	1.19	67.6
CH$_5$ bld	1.47	107.0
DH$_5$ bld	1.40	97.2
EH$_5$ bld	1.33	87.3
FH$_5$ bld	1.18	66.2

Table 8

FASTNESS OF C.I. REACTIVE RED 3 ON ALKALI AND CHITOSAN SOLUTION PRETREATED SAMPLES				
Sample	**Fastness**			**Fixation degree, F**
	Washing	*Rubbing-dry*	*Rubbing-wet*	
R polyester	3-4	4-5	4-5	0.78
A polyester	3-4	4-5	4-5	0.77
B polyester	3-4	4-5	4-5	0.78
C polyester	4	4-5	4-5	0.77
D polyester	4	4-5	4-5	0.81
E polyester	4	4-5	4-5	0.78
F polyester	3-4	4-5	4-5	0.77
R cotton	4	5	4-5	0.83
A cotton	4	5	4-5	0.81
B cotton	4	5	4-5	0.80
C cotton	4	5	4-5	0.79
D cotton	4	5	4-5	0.80
E cotton	4	5	4-5	0.80
F cotton	4	4-5	4-5	0.79
R bld	3-4	5	4-5	0.83
A bld	3-4	5	4-5	0.81
B bld	3-4	5	4	0.80
C bld	3-4	5	4-5	0.80
D bld	4	5	4-5	0.81
E bld	4	5	4	0.80
F bld	3	4-5	4	0.79

16,8–21,5 times (table 7). Cotton fabric samples treated with combined methods and dyed in the same solution with polyester fabric also have higher absorption capacity and fixation degree and the yield is higher, up to 65%. Percentage of reactive dye intensity increase on blended fabric was 66–105% and it is significant in terms of economy and environmental protection, because with higher dye utilization degree from technological solution, the required dye quantity to achieve a specified color shade is reduced and dye quantity reaching waste water is also reduced. Fixation degree and fastness of reactive dye (table 8) were not reduced because cellulose and chitosan hydroxyl groups fix the dye by covalent bond.

CONCLUSIONS

One bath dyeing of cotton-polyester blends with one dye progressively attracts scientific and industrial interest because it can to a great extent facilitate color matching and lower production costs. In this respect, modification and pretreatment with suitable compounds have been studied in order to improve fiber sorption properties.

Alkaline treatment modifies physically and chemically the surface of polyester fiber and at the same time mercerizes cotton favorably affecting absorption of C.I. Reactive Red 3 dye resulting in 24% increase of color intensity on factory blend. Deposition of chitosan biopolymer on all samples increases, proportionally with concentration, reactive dye absorption, especially on polyester. Hybrid treatment combining alkaline and chitosan treatment is the most effective resulting in 100% increase of reactive dye intensity on factory blend with high color matching on components and with retained high dye fixation degree and color fastness it can enable a new approach to textile dyeing and finishing.

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INDUSTRIA TEXTILĂ ÎN LUME

GRUPUL KURABO ŞI-A EXTINS PRODUCŢIA DE CONFECŢII TEXTILE

Producătorul de materiale textile *P.T. Kurabo Manunggal Textile Industries* (Kumatex), din Jakarta/Indonezia, şi producătorul de confecţii *P.T. Akurabenitama* (AKM), din Jawa Barat/Indonezia – o filială a Grupului Kurabo din Osaka, în cooperare cu alţi parteneri, printre care şi *Agro Group*, din Jakarta/Indonezia, şi-au extins liniile de producţie, de la filare la ţesere, vopsire, finisare şi confecţii. Conform planurilor elaborate, urmează ca investiţia în confecţii să se dezvolte, pentru a putea face faţă atât cererii de ţesături şi fire de pe piaţa internă a Indoneziei, cât şi volumului de exporturi către Japonia. Pe parcursul anului fiscal în curs, compania şi-a planificat o producţie totală de 1,35 milioane de bucăţi de articole de îmbrăcăminte.

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