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THE APPLICATION OF UNTOXIC POLYMERS AT SIZING AND BLEACHING TEXTILE PROCESSES

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Abstract. *This paper has discoursed about the probability of polymers used to some finishing process of textile. Those polymers have been untoxic and water-soluble macromolecules with characteristic groups. The role of polymer at finishing textile, for example the sizing process or the bleaching process, is warp yarn impregnating to giving an enough strength or reduce a speed peroxide decompose and decrease the risk of damage the cotton fibers. After sizing process, to went the desizing process comprising only water treatment (60^0C, 15 min) and a drying. The results of investigation the sizing and bleaching process have shown good effects, particularly mechanical parameters, and whiteness grades. Scanning electron microscopy has utilized to the structural and morphological changes understanding of the cotton fibre in sizing regime.*

Key words: *polymers, sizing, desizing, bleaching, cotton, whiteness degrees, mechanical characteristics, scanning electron microscopy.*

INTRODUCTION

Cotton warp yarn sizing is the significant process of textile industry whereof dependence characteristics future fabrics, i.e. possible efficiency and the continuous production of theirs. The agent of this process is commonly starch and other additives, but they have defied problems at the desizing process. The desizing process usually used enzymes for removal of starch-based size. Another desizing agents as acids, alkali and oxidation chemicals attack the cotton fibre as well as the starch size [1]. The enzyme (amylase) only interacts with the molecules of starch, living the cotton cellulose untouched. The application of synthetic means at sizing process is today present but with poorly experiences of practical. Particularly is valuable water-solubility of these agents because then very easy the desizing process realization, i.e. it is enough a hot water processing.

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Cotton bleaching is the most important process in the finishing system. Without bleaching, it would be impossible to achieve fastness and uniformity of light shades of cotton coloring. The bleaching substances, including oxidizing or reducing chemicals, that coloring matter (natural dyes or pigments) decolorized and removed from the material. Today, H_2O_2 is the most used agent for bleaching of textile materials; particularly cotton, due to its advantages [2, 3].

In order to prevent or reduce catalytic degradation and the consequent risk of chemical damage to fibres and to increase the stability of the alkaline-activated HOO^- ion, stabilizers has used during bleaching [4]. Very important is influence of polymer stabilizers, which stabilize peroxide solution and decrease cotton damage, giving the same time high whiteness effect. Conventional stabilizers create deposits on the apparatus walls, which cannot be readily removing, as well as on textile, causing the poor handle and they are toxic and scarcely nature decomposed.

Cotton fibres have the microscopic multilayer structure [5, 6]. The noncellulosic constituents are mainly located in the outmost layers of the structure, the cuticle, except for the protein residues of the protoplasm and some mineral matter believed to be within the lumen [7]. Raw mature cotton has a smooth surface when viewed by the electron microscope, but with a characteristic system of roughly parallel ridges and grooves spiraling around the fibre at an acute angle to its axis [8, 9].

The application of polymer additives at textile finishing has been very significant, especially the special methods of finishing textile. It usually is using polymer types as the polyacrylate, polystyrene, polyurethane, polyolefine, polysiloxane, polyester, polyamide, etc. Moreover, besides these denominate polymers, it is using with different monomer units themselves, i.e. the copolymers and the graft copolymers [10, 11, 12]. Some of them are ecology acceptable but other unacceptable, because they are toxic and dangerous for working and living environmental. The polymers used in this paper are untoxic and nature decomposed [13].

EXPERIMENTAL

The 100 % pure cotton warp yarn and fabric (100% cotton) produced of hers used for all experiments, produced by "Yumco" Vranje (Yugoslavia), have basic characteristics showed in Table 1.

The formulation used in sizing process was included only water solution of the polymers S1 and S2 (5 and 10 gdm^{-3}).

Basic formulation (F) used in bleaching treatments contained: H_2O_2 (30%), 10 gdm^{-3}, NaOH, 1.7 gdm^{-3}, wetting agent, 1 gdm^{-3}, and polymers (S1 and S2), 0.5 and 1 gdm^{-3}.

These water-soluble polymers of vinyl type contained difference functional groups (carboxyl, amide, and hydroxyl) and laboratory synthesized (purity about 99%, molecular weights of polymers S1 and S2 are 60,000 and 80,000, respective). Polymers S1 or S2 at sizing process colligated fibres of cotton warp the adhesion forces strengthening structure of the yarn necessary for the later weaving process. Polymers have formed the complex with peroxide i.e. intermediary compound when the peroxide decomposition has been slow during the bleaching process. It is needs because uniform releasing an oxygen, the active agents for bleaching.

The sizing process lasted different time (3, 5 and 10 min), bath ratio 1:20 and solution temperature 20, and 60^0C. The bleaching process lasted 40 min at 80^0C, bath ratio 1:30, pH = 10 – 11.

The cotton fabric has conditioned at 65% relative humidity and 21^0C before any investigations. The whiteness (spectrophotometer, Instrumental Colour Systems, Berger criteria), the strength, and the elongation (dynamometer, Kovostav Ustin.Orl., JUS ISO 5081) have measured. We used a JEOL JSM-840 scanning electron microscope (the samples are coating a gold thickness 12 μm in a vacuum and the tension of jet primary 24 KeV) in this study. The cotton fibre surface has observed with the magnification of a few thousand times. The sizing process and bleaching process performed in laboratory (the glass reactor, with solution of reagent and sample - sizing process, and all it plus thermometer, stirrer and condenser - bleaching process).

Table 1. Basic characteristics of the fabric

Fabric Composition	Weave	Area Weight (g/m^2)	Warp Yarn Count (tex)	Weft Yarn Count (tex)	Warp Setting (cm^{-1})	Weft Setting (cm^{-1})
100% cotton	Linen	168	20	20	48	31

RESULTS AND DISCUSSION

The results of different treatments the sizing process of the cotton yarn (Table 2 and 3) has showed good values of mechanical characteristics, especially the breaking strengths, which to rise. The elongation of break is not practically change. The better results procured at higher temperature i.e. at 60^0C. The deposit of polymers on the yarn surface has been present at different amount and it has depended of polymer concentration and time processing. Something larger values of the deposit have treatments at 60^0C. The purpose of sizing process is the strength of rupture enlarged because the weaving process and production of the fabric shall be without cease.

Table 2. Some results of sizing process the warp yarn at 20^0C

Concentration of polymer solution (gdm^{-3})	Processing time (min)	Breaking strength (cN)	Elongation of break (%)	Deposit (%)
-	-	220.75	5.0	-
S1 - 5	3	222.36	4.9	2.26
	5	222.96	5.0	2.36
	10	224.48	4.9	2.85
S1 - 10	3	224.25	5.2	3.69
	5	225.36	5.1	3.58
	10	226.51	5.0	3.89
S2 - 5	3	223.45	4.9	3.01
	5	223.95	4.9	3.11
	10	224.58	5.0	3.24
S2 - 10	3	226.88	5.1	4.01
	5	228.04	5.2	4.20
	10	229.12	5.2	4.18

Table 3. Some results of sizing process the warp yarn at 60^0C

Concentration of polymer solution (gdm^{-3})	Processing time (min)	Breaking strength (cN)	Elongation of break (%)	Deposit (%)
-	-	220.75	5.0	-
S1 - 5	3	225.36	5.0	2.45
	5	225.28	5.1	2.55
	10	226.48	5.2	3.01
S1 - 10	3	225.49	5.0	3.78
	5	226.96	5.0	3.69
	10	227.58	5.1	3.94
S2 - 5	3	224.59	5.2	3.24
	5	225.92	5.3	3.33
	10	226.85	5.2	3.37
S2 - 10	3	227.46	5.2	4.41
	5	228.46	5.1	4.59
	10	229.59	5.0	4.85

The results of bleaching treatments the cotton fabric (Table 4) has showed good values of whiteness and mechanical characteristics. The whiteness degrees of treating samples of cotton fabric are over tree times larger than raw samples. The formulation of the bleaching process has been very effective enabling the coloring matter removing of surface cotton fibres. The breaking strengths of treating samples of cotton fabric have been any less than a raw. It has expected because the bleaching process represent treatments at high temperature and relative the long time of comparatively aggressive chemicals.

Table 4. Breaking strength and elongation of break of cotton fabric bleached

Kind of treatment	Whiteness degrees (%)	Breaking strength (N)		Elongation of break (%)	
		Warp	Weft	Warp	Weft
-	27.58	568.29	500.05	6.0	12.0
F (Without Polymer)	8059	561.67	489.29	6.5	13.0
F + Polymer S1 - 0.5 gdm^{-3}	83.25	564.24	493.58	6.5	12.0
F + Polymer S2 - 0.5 gdm^{-3}	83.91	563.48	495.46	6.0	12.5
F + Polymer S1 - 1 gdm^{-3}	84.12	564.71	495.12	6.5	12.5
F + Polymer S2 - 1 gdm^{-3}	84.87	565.12	494.12	6.0	12.5

The effects of treatments, specific effects on the surface of fibres, have monitored by scanning electron microscope (SEM) observations. The results of SEM can to give an answer on question how the sizing agent changes the cotton fibre surface, and how these changes affect some properties of the cotton. Fig. 1 show a typical the SEM micrograph of fibre the raw cotton yarn.

The figures 2-3 showed the surface of fibres with pieces of the polymers S1 and S2. These pieces can to wind or connect surfaces of fibres, what are specific appreciable at Figure 2. The appearances can to influence on mechanical characteristics of the cotton

yarn, heightening her structure. The dynamics processes of sizing solutions and interactions especially between the macromolecule of polymers and the substratum are decisive to get adequate effects on the cotton fibers, i.e. the yarn.

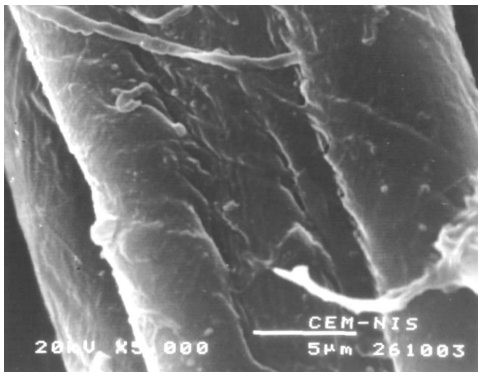

Fig. 1. Scanning electron micrograph of the surface of a raw cotton fibre

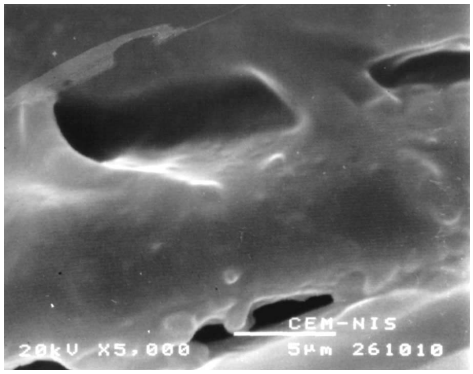

Fig. 2. Scanning electron micrograph of the fiber surface after sizing treatments (Polymer S1 - 10 gdm-3, 600C, 5min)

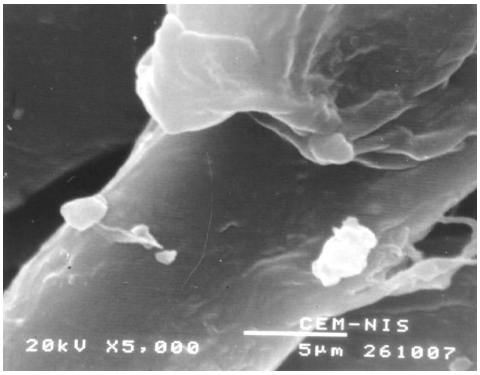

Fig. 3. Scanning electron micrograph of the fiber surface after sizing treatments (Polymer S2 - 10 gdm^{-3}, 60^0C, 5min)

CONCLUSION

The results of this paper show that sizing and bleaching process with polymers bring beneficial effects, especially when mechanical parameters and whiteness degree are concerned. It has found out that the polymers can to use as alternative of conventional agents showed weakly effects and they did not fully nature decomposed.

The traditional treatments of bleaching process, although having good whiteness degrees, cause precipitation on the material and consequently problems in subsequent dyeing and problem related to handle property of textile goods, or problem with working and living environmental protection. The application of polymer stabilizers is solving these problems.

Microscopy observations have showed presence of polymers on fiber surface, i.e. their presence on yarn surface. The surface of cotton fibres was wrap round of the water-soluble polymer film easily removed the desizing process.

The industrial development must to accompany major requirements environmental protection. The sources of textile industry pollution are present and they need eliminate any more. The best way of protecting the environment is removing toxic and not readily biodegradable components or limits amounts of theirs. The polymers used can to decide only problems part of environmental protection but they can be reason further investigations and thereby working and living environmental protection helped.

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PRIMENA NETOKSIČNIH POLIMERA U PROCESIMA SKROBLJENJA I BELJENJA TEKSTILA

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Rad govori o upotrebi nekih polimera u nekim procesima dorade tekstila. To su netoksični, vodorastvorljivi polimeri čije makromolekule imaju karakteristične funkcionlane grupe. Uloga polimera u doradi tekstila npr. u procesu skrobljenja ili u procesu beljenja je u impregniranju osnovine pređe i davanju dovoljne jačine ili u redukovanju brzine razlaganja peroksida i smanjenju rizika od oštećenja pamučnih vlakana. Posle procesa skrobljenja ide odskrobljavanje koje obuhvata samo obradu vodom (60^0C, 15 min) i sušenje. Rezultati istraživanja procesa skrobljenja i beljenja pokazuju dobar efekat, posebno mehanički parametri i stepen beline. Skaning elektronska mikroskopija je iskorišćena za razumevanje morfologije pamučnih vlakana u režimu skrobljenja.