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Learning the Technology of Preparation for Finishing Of Fabric with the Compound of Cotton and Polyester Fiber

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ABSTRACT: The process of preparation for the finishing of blended fabrics based on cotton and polyester fibers has been studied. Increased the capillarity of the tissue by boiling in a slightly alkaline medium. The technology of the bleaching process of the blended fabric in proposed.

KEY WORDS: Cotton fiber, polyester, boiling process, bleaching process, mercerizing process, the degree of whiteness, capillarity, the rupture resistance

I. INTRODUCTION.

The finishing process has an important role in the provision of the quality and performance properties of textile products. It is known that in the process of finishing, the cellulose, which is in the content of cotton, neutralizes from its agents, obtains necessary capillary capacity, colorlessness or color. The fabric which is produced from chemical fiber is coloured by using amylopectin for elimination of the lubricant used when getting the fiber in the process of finishing or reach variety of colors as a result of printing. It is clear, that each fabric receives treatment specific for the fiber in its content in the process of finishing. The finishing process of the fabric, produced from the mix of fibers, is more complicated. In general, the fabric's finishing process is multi-staged and contains the following steps: cleaning the surface of the raw material by mechanical and heating methods; cleaning the fabric off the amylopectin and boiling – steaming; bleaching of the fabric; coloring of the fabric or printing; illative finishing [1].

The quality of the fabric, produced by alkaline-peroxide steaming and "cold" method, colored with substantive and non-substantive coloring agents was estimated. It was found that, for improving the volume indicators, as well as for obtaining the desired quality of color, it is necessary to intensify the dyeing process with partially active coloring agents. For the fabric processed by "cold "method are more advisable to imbue with pigments. [2]. Before imbuing of the textile fabric, its characteristics are improved by low temperature plasms. As a result of treatment with plasma, the capillary of the bleached fabric increases 2 times, and of the boiled fabric 3 times. [3].

There are possibilities of application of ultrasonic shifts for the acceleration of the processes ongoing in the liquid, solid and polymeric materials. In the production of cotton polyester fabric, the technology is chosen according to the component properties, the impurity leveland purpose of usage. In this case, it is necessary to choose options of production, where it is possible to get the desired effect by retaining invaluable properties of each fiber [4].

It is indicated that, it is possible to get positive results by preparation for finishing by methods combined with hypochlorite peroxide, which forms a complex with participation of a mixture of cotton and polyester. The silicate remainder is not formed in this process of preparation for finishing, it is possible to reach high level of whiteness, dye-ability of the fabric ameliorates. Being offered a simple and economically cost-efficient method of bleaching of cotton-based products, this process can be applied to the fabric with mixture of cotton and lavsan, because it differs from the content of the classical bleaching solution for cotton-fiber fabric, which brings to the distortion of synthetic fibrous content of treatment solution by alkaline effect. [5]. The fabric bleached by an advanced technology reaches sufficient whiteness degree without loss of mechanical properties. In recent years, the attention is given to the production in continuous way of cotton and synthetic content fiber textile material in more soft conditions (low temperature, low concentration alkaline, neutral medium) [6].

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II. EXPERIMENTAL

A. MATERIALS.

The samples of fabric with the cotton and polyester content of different proportions are the object of research, and it consists of cotton (Namangan-77) and polyester (formed in JV LLC "Reprocessing Uz" from polyethylene terephthalate pieces produced in South Korea) fibers.

B. METHODS.

The textile materials with a mixture of cotton and polyester are prepared for finishing in two-step method [7]. The quality indicators of materials prepared for finishing are determined according to the: capillarity GOST 3816-81, degree of bleaching GOST 18054-72 and physical-mechanical properties [8] GOST 3813-72; GOST 3813-71.

III. RESULTS AND DISCUSSION

It is known, that preparation of materials for dyeing and printing – consists of waste elimination, and giving them permanent whiteness level. In the base of these processes lie the colloid –chemical processes which flow with the participation of surface active compounds, because water insoluble hydrophobic matters, waxy substances are drawn out of the fiber with the help of the surface active substances with the ability to emulsification. Whereas starching agents and natural dyeing agents are drawn out of the fabric with specially selected oxidizers by breaking into water soluble products, then by washing. However, in these procedures, it is required to ensure that the polymer base of the fiber does not break-down. In the development of the sustainable condition of boiling process, reaching the high capillary capacity of mixed fiber and fabric is set as a boundary value. Boiling of the mixed fiber content fabric was done during 5 minutes in a solution warmed upto 70^0C by soaking in a solution consisting of (gr/L) sodium hydroxide-25, sodium silicate (d=1,44)-3, 38%$NaHSO_3$-2, CAM-1. Then the fabric was squeezed upto 130% and steamed in 100^0C during 60minutes, washed in hot and cold water, obtained results are given in the Figure-1.

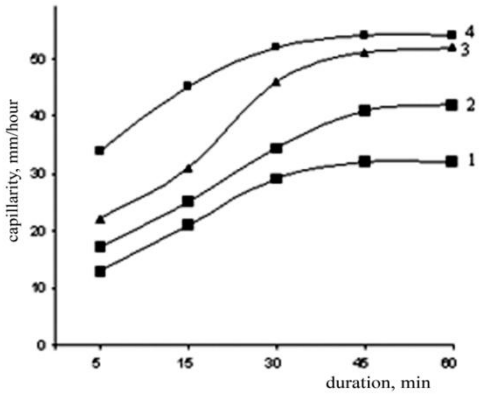

Figure 1. The connection of the capillary capacity of thread to the duration of boiling. Thread content, cotton/PE: 1-80/20; 2-60/40; 3-40/60; 4-20/80.

It can be seen that, with the increase of the proportion of a synthetic fiber in the content of a mixed fibrous yarn, their capillary capacity rises correspondingly. Although the synthetic fiber is hydrophone its capillary capcity is hydrofillic fiber – requires proving that it is higher capillary than cotton capillary capacity. The samples from cotton and polyester, which were used in obtaining mixed fiber, were separately prepared and gone through the same boiling condition and their capillary capacity was checked (Picture-2).

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Vol. 6, Issue 6 , June 2019

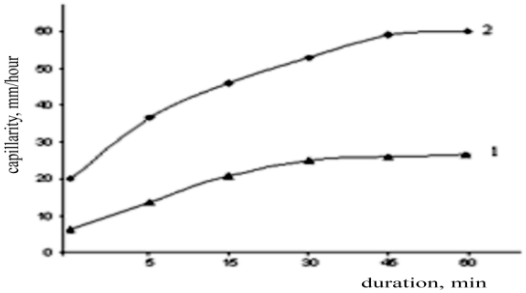

Figure 2. The effect of boiling process duration to cotton and PE fibers. 1- cotton, 2-PE.

It is seen from the Figure-2 that in separate boiled samples observed the abovementioned condition. We can explain it taking into consideration the structure of the thread. In the process of yarn spinning from cotton and polyester, fue to the fact that cotton fiber freely spins around the polyester fiber,the spaces are formed between the fibers. Besides, in the yarn spinning device synthetic polyester fibers under the influence of electrostatic power bounce off each other due to which spaces may also the spaces in the system. There are less such artificial spaces in the yarn span from the cotton fiber. It is known from the literature [9] that, more influence to the soaking process of the luqiud by the fiber, have the spaces between the fibers than ccapillaries. The nature of the fiber influences to the raising of the liquid up the yarn as well. The liquid in the hydrophillic cotton fiber raises up the yarn not mechanically, but physical-chemical interaction with with the polymer, whereas in the polyester fiber the liquid raises up the yarn without soaking mechanically through the spaces between the fibers according to the physical laws. That is why, in he mixture with the increase of the synthetic fibers' proportion in the fiber, the capillary capacity of the thread will have a great value.The next research was conducted on the boiling process of the fabric with mixed fibers (Table-1).

Table 1. Capillarity of the fabric with mixed fibers after boiling

Duration, min	**Capillarity mm/hour**			
	Samples, cotton/PE, %			
	100/0	**75/25 warp-55/ 45 weft-0/100**	**57/43 warp and weft-57/43**	**44/56 warp-55/45 weft-89/11**
5	30	89	98	98
10	95	119	127	132
15	112	139	150	156
30	135	160	180	190
60	140	162	180	191

The connection of the capillary capacity of mixed fiber content fabric to the duration of the boiling process.
From research results given in the the Table-1 we can observe the repetition of the results of the research on boiling process of the yarn. That is, the capillary capacity of the fabric produced from 100% cotton fiber has less value than the fabric produced from mixed fibers. However, the capillary capacity of the fabric consisting of wool yarn 100% from polyester fiber, rope thread from 55% cotton and 45% polyester, is lower than the capillary capacity of the fiber made from rope thread and wool yarn. Thus, it ispossible to reach high degee capillarity, when the liquid raises up thtough the space between the yarn by the fiber capillarity. Obtained results can be applied in the planning of dyeing process of mixed fiber content fabric. That is, the dyeing process has four steps, the first of them is fibrous diffusion of the coloring agent, the second is the sorption of the molecule of the coloring agent into the fiber. By the provision of flowing of these two steps, there is chance for accelerating the dyeing process of textile fabric. In the boiling step of preparation the natural colorful substances and colorfulpigment substances applied to it do not break down, as a result they give originality to the fabric. It is required to increase the whiteness degree of the fabric used in white condition or to be coloured to the light colour. Therefor, the fabric should be treated with the oxidizers breaking down these pigment materials. Hydrogen peroxide, sodium hypochlorite and sodium chlorite are widely used in the industry as oxidizing agents. There are specific advantages and disadvantages of using each oxidizer. Taking into consideration that this issue was the reason for many researches and that as a result, hydrogen peroxide is widely used in industry, we found

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its usage as purposeful. Its mechanism functioning as an oxidizer can be explained as follows [10]. In the hydrogen peroxide pH 10,5-11,0 alkaline medium dissociates and forms per hydroxonium ion.

$H_2O_2 + OH^- \Leftrightarrow HOO^- + H_2O$

This ion can shred natural and synthetic coloring agents in the content of the fiber. For the fabric which is boiled for continuous bleaching with hydrogen peroxide, in the solution with the following content of (gr/l) hydrogen peroxide, 100% -2, sodium hydroxide -8, sodium silicate (d=1,44)-14, CAM-1, with 85-90^{0}C degrees during 2 hours. Here the length of bath is 50, and after the process is over, the bleached fabric is washed in hot and cold water. The results of the experiment are given in the table 2-3.

Table 2. The degree of whiteness of mixed fiber fabric samples.

№	Samples, cotton/PE, %	The degree of whiteness, %	
		before bleaching	after bleaching
1.	100/0	72	87
2.	75/25	70	75
3.	57/43	80	97
4.	44/56	78	93

Table 3. The degree of whiteness of the yarn samples with mixed fiber.

№	Samples, cotton/PE, %	The degree of whiteness, %	
		before bleaching	after bleaching
1.	100/0	72	85
2.	80/20	77	87
3.	60/40	79	89
4.	40/60	80	89
5.	20/80	81	89
6.	0/100	82	89

The results given in the table comply to the rules of bleaching of textile materials. It is possible to reach the demanded level permanent whiteness level by processing the raw matrial or yarn thread by alkaline solutionof hydrogenperoide. If we compare the whoteness degree of raw and treated fabric we can see that the whiteness degree of the fabric produced from polyester fiber complies the requirement even in raw condition, but with the decrease of the cotton fiber proportion in the mix, the brightness degree is increasing in reverse proportion. Consecuaently, when the mixed fiber content textile materials are to be dyed in white or light colours, there is no need to conduct the bleaching process as a separate one. In order to increase the consumer appeal of the fabric with cotton and polyester content, the process of lisle finishing is conducted. It is necessary to take precautionus actions in order keep from break down of the fabric with mixed cotton-based fiber in the process of lisle finishing. The polyester fiber in the mix is considered as intolerant to caustic alkali in high temperature. However, as the lisle finishing process usually flows with heat generation, the process is conducted on 15-20^{0}C degrees. Based on the above given information, the effect of the alkali concentration to the strength of the lisle finished fabric was investigated.

Table 4. Connection of the alkali concentration to the strength of the mixed fiber content fabric

Alkali concentration, g/l	Samples, cotton/PE, %			
	100/0	75/25 warp -55/ 45 weft-0/100	57/43 warp and weft -57/43	44/56 warp -55/45 weft -89/11
	The rupture resistance, H			
200	531,23	579,81	576,78	576,53
220	551,23	580,23	572,58	570,35
260	568,78	579,91	568,27	565,27
280	570,54	577,25	565,27	560,09
300	570,96	576,68	537,80	523,70

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Vol. 6, Issue 6 , June 2019

With the increase of the alkali concentration in the mercerization solution the rupture resistance of the samples, with high proportion of polyester fiber content, decreases. With the increase of cotton fiber content, correspondingly the strength of cloth has a greater value. The reason of this is the changes happening in the morphology of the cotton fiber and supramolecular structure. The fiber swollen in the process of lisle finishing, its ribs thicken and the diameter of the filament channel gets smaller. As a result, the cotton fiber from the ribbon-like form changes to cylindrical form. It is known that in the lisle finishing process the porosity of the cotton fiber increases. When studying the effect of the alkali concentration to the porosity of the mixed fiber content fabric, it shows that decrease of concentration lower than 220 gr/l is not suitable.

Table 5. Connection of the capillary capacity of the mixed fiber content fabric to the alkali concentration.

Alkali concentration, g/l	**Samples, cotton/PE, %**			
	100/0	**75/25 warp -55/ 45 weft-0/100**	**57/43 warp and weft -57/43**	**44/56 warp -55/45 weft -89/11**
	Capillarity, mm/hour			
200	150	170	179	188
220	160	196	210	218
260	165	200	227	230
280	166	220	230	235
300	168	225	232	238

The increase of porosity of the mercerized fabric with the increase of its strength can be explained as follows. Treatment with cellulose concentrated alkali solution, then as a result of washing with water the cellulose first changes to alkaline cellulose, then to hydrated cellulose. These changes in the cellulose do not affect its chemical content, but significantly influence the supramolecular structure [11,12]. First in this process happened decrystallization in the cellulose, that is, its amorphous part increases 10-20%, instead of the cellulose I forms the new crystal cellulose II. In the transformation of cellulose I to cellulose II, the configuration of the building block of the macromolecule also changes. The pyran rings being located in one line in cellulose I, most hydroxyl groups are connected though hydrogen bindings. Yet, in cellulose II pyran rings are located at 90^0C to each other, as a result intermolecular hydrogen bindings break down, and the amorphism of the cellulose increase, which in line, brings to increase of the reaction and sorption capacity of the cotton fiber. These changes happen only to the surface area of the fiber as the lisle finishing process is conducted in low temperature and speed, so the strength of the fiber decreases.

IV.CONCLUSION

Was studied the process of preparation and finishing of fabric and thread composed of polyester and cotton fiber in different proportions. It is shown that, it is possible to give high capillary capacity degree to the mixed fiber textile materials by holding the boiling process weak alkalie conditions. It is scientifically based that the capillary capacity of the mixed fiber fabric is higher than of the cotton fiber fabric. Offered the technology for conducting the bleaching process regarding the area of synthetic content fabric. Proved that the durability and porosity increase in the process of lisle finishing.

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International Journal of AdvancedResearch in Science, Engineering and Technology

Vol. 6, Issue 6 , June 2019

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