Study Of The Properties Of Dyed Silk And Cotton-Silk Fabrics From Chitosan-Based Compositions

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ABSTRACT

The results of studying the possibilities of textile auxiliary substances of chitosan for intensifying the process of dyeing silk and mixed fabrics with active dyes are presented. The article proposes the chemistry of the interaction and the nature of the bonds in the fiber - chitosan - dye system, investigated the effect of the concentration of intensifiers on the degree and amount of fixation of active dyes on the fiber.

Keywords: chitosan, silk fabric, reactive dyes, dyeing, fixation degree.

Introduction. Currently, in the world in the field of the textile industry, there is a need to reduce energy costs while improving the quality of textile products to ensure its competitiveness in the world market. Therefore, scientific and practical research on the improvement of the process of coloring silk and mixed fabrics based on it with active and acid dyes using organic intensifiers are considered relevant [1].

The main directions for improving the dyeing technology are: saving energy, water, fibers, dyes and TVB without compromising product quality. Reducing the technological cycle is possible by eliminating individual operations, combining several operations, reducing processing time by intensifying processes and introducing high technologies.

We synthesized chitosan from dead bees by a chemical method. The chemical method is based on carrying out deproteinization, demineralization and depigmentation using chemical reagents - acids, alkalis, peroxides, etc. [2,3,4].

It is gratifying that chitosan is actively used even in the textile industry for dyeing, printing and finishing various natural fabrics, such as wool, cotton and silk. In turn, the use of intensifiers provides for high economic efficiency and minimum concentration in the dye bath. Despite the widespread use of chitosan for printing as a thickener, its introduction into the dyeing of silk fabrics is hindered due to the lack of technology.

Results and its discussion. The study used chitosan synthesized from dead bees Apis Mellifera in the scientific laboratory of the institute, cotton, silk and cotton-silk fabric (silk warp, weft cotton 55/45) produced at the joint venture Bukhara-China JSC "Bukhara Brilliant Silk", as well as anionic dye "active bright blue K".

The dye solution in the alkaline method consists of g / l:

- active dye - 2% of the mass of the fabric,
- electrolyte (sodium sulfate) - 10 g/l,
- in the second stage of the methods enter:
- alkaline agent sodium carbonate (Na_2CO_3) - 10 g/l.

When dyeing, we used chitosan synthesized from dead bees and the process was carried out according to a periodic method.

Active bright blue K was chosen as the dyes. Chitosan concentration varied from 0 to 1.5 g/l. A solution of chitosan in acetic acid (2%) was applied to the fabric before dyeing and dried at a temperature of 100–110°C until completely dry.

Interactions of chitosan with active dyes were determined by UV spectroscopy. The transmission spectra of solutions of chitosan, the dye, and their mixtures were recorded on a UV 1900i spectrophotometer (Shimadzu) controlled by a personal computer. The measurements were carried out in the visible and UV regions of the spectrum.

Morphological studies of the surface of the textile material were carried out using a scanning electron microscope SEM - EVO MA 10 (Zeiss, Germany). This instrument is designed for microscopic analysis of the structure and surface defects of inorganic materials, including particles, fibers, surface microstructures of metals, semiconductors and thin films.

The study of the processes occurring between water-soluble dyes and the chitosan film, as well as the possibility of interaction between the chitosan film and the tissue, is of great importance, since it allows one to judge the nature of the bonds that arise in the "tissue - chitosan - dye" system, which can largely determine the quality of coloring. when coloring textile materials.

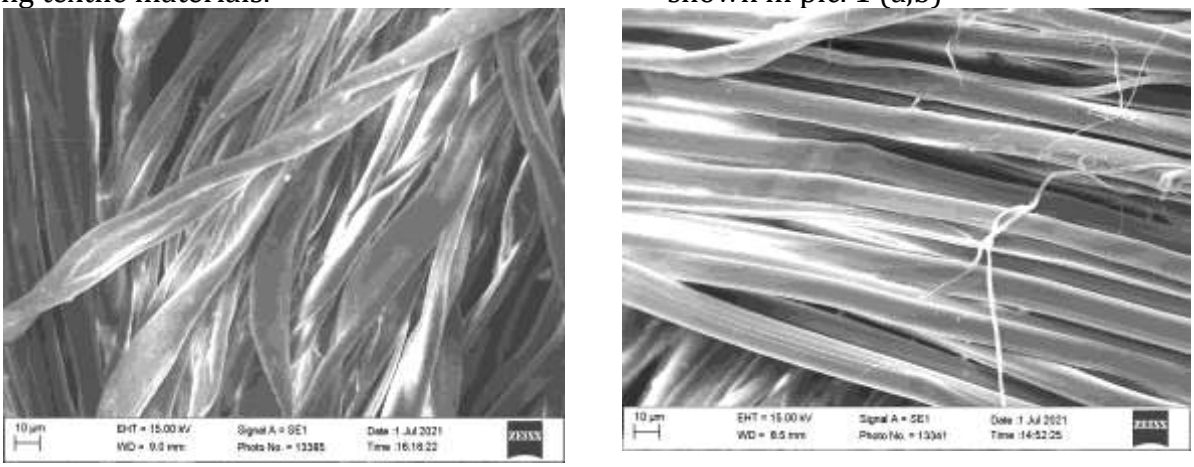
Active and acid dyes are fixed in an amorphous film of chitosan, which dyes have a greater affinity for. The chitosan film, in turn, is fixed on the fiber due to adhesive and intermolecular bonds.

To test the assumption about the interaction of chitosan with the dye, the absorption spectra of solutions of dyes, chitosan, and their mixtures were recorded at pH from 3–11 in the visible and UV regions of the spectrum using a UV-1900i spectrophotometer (Shimadzu). For the study, a solution of chitosan from dead bees was used. Prepared by dissolving the dry preparation in 2% acetic acid with a concentration of 0.1 g/l, as well as active dyes: active bright blue K with a solution concentration of 0.1 g/l.

From the spectrum drawings, there is a sharp increase in optical density at a wavelength of 290-370 nm, which corresponds to the ultraviolet region of the spectrum and a large increase in the range of 590-700 nm, i.e. in the visible part of the spectrum. This indicates that a chemical interaction occurs between the dye and chitosan in solution under these conditions.

It is known from the literature that chitosan has film-forming properties. Morphological studies of the surface of the textile material were carried out using a scanning electron microscope SEM - EVO MA 10 (Zeiss, Germany).

The resulting micrographs of silk fabrics treated and untreated with chitosan are shown in pic. 1 (a,b)



a) b)

Picture 1. Micrographs of silk fabric, untreated (a) and treated with chitosan (b)

Comparison of the original fiber (pic. 1.a) with that treated with chitosan (pic. 1.b) shows that the polymer causes noticeable changes in the fiber surface. It can be seen from Fig. 1 that the original fabric (pic. 1.a) has a loose structure of the surface layer, while the fabric treated with chitosan (pic. 1.b) has a different appearance, i.e. the surface of the fabric is smoothed, adhesions are formed, and a film is formed on the surface of the fiber.

On the whole, it can be concluded that a film is indeed formed on the fabric after impregnation with a polymer, which, in the process of dyeing, contributes to an increase in the color intensity.

Table 1

Influence of chitosan on the degree of fixation, dye penetration and color intensity when dyeing silk fabrics

The name of indicators		
Color properties	**Dye without intensifier, g/l**	**dye + Chitosan 1,0 g/l**
Degree of fixation, g/kg	26	36
The degree of use of the dye,%	65	90
Color intensity, K/S	5.0	6.8
Increases in K/S, %	-	36

The table 1 shows that the proposed composition at a concentration of 1.0 g/l leads to an increase in the degree of fixation of the active dye by 36 g/kg.

To study the capillary characteristics of tissues, samples of silk fabric were taken before and after treatment with chitosan solutions. the concentration of chitosan varied from 0.5 to 1.5 g/l.

In the case of silk and cotton-silk fabrics (pic. 3 and pic. 4), there is a significant increase in both the height of rise and the volume of absorbed liquid with an increase in the concentration of chitosan during tissue processing, which is probably caused by an increase in the critical surface energy. It can be assumed that chitosan, being fixed on the silk fiber, glues the scales, contributing to the formation of a more complete capillary, improving the rise of liquid through it.

Conclusions. Based on the results of a comprehensive study, it can be concluded that the dyeing of silk and cotton-silk fabrics with active dyes in the presence of chitosan has improved physical, mechanical and color characteristics with high color fastness, which ensures high performance properties of the finished product. Thus, the amino groups of chitosan react with the active dye to form covalent bonds, the protonated NH_3+ groups form ionic bonds with the acid dye, and the OH groups participate in the formation of covalent bonds with the active dye.

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