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Studying the Influence of Various Factors on the Properties of Thickers and Printing Compositions

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Annotation. The article analyzes thickening ability of the developed composition in order to identify an integrated approach for stuffing fabric. The kinetic parameters of the influence of various factors on the physicochemical and rheological properties of the composition have been established. Particular attention is paid to the determination of the structural-mechanical, rheological properties of thickening polymer systems. The regularity of the interaction of the components in the aqueous medium, which are part of the polymer composition, is determined.

Keywords. Fabric, dye properties, textile material, starch thickeners , structural and mechanical research, fiber, physical and mechanical properties.

The task of washing printed fabrics is to remove thickeners from the fabric - substances that help fix the dye and the surface applied dye during processing, in the machines of the previous transitions. Washing of printed fabrics has a certain specificity compared to dyed fabrics, as there is a thickening film on the fabric, which has a significant effect on the quality of washing. In addition to such factors as the properties of the dye (affinity, diffusion and reactivity), the properties and quality of the preparation of the fibrous material for printing, the conditions for applying the dye and the nature of the thickener also play a certain role.

The removal of unfixed active dyes from a textile material is a special case of washing water-soluble contaminants with an affinity for fiber from the fabric. The papers discuss the theoretical foundations for the removal of unfixed active dyes from fabric after printing and printing with active dyes. The same works dealt with the influence of the nature of thickeners on the kinetics and completeness of desorption of monochlorotriazine dyes [1].

Starch thickeners form rigid films on the fabric, which are difficult to remove during washing and worsen the physical and mechanical properties of fabrics. When starch is modified with a water-soluble CMC polymer and sericin , functional groups accumulate in it, which, on the one hand, should reduce the interaction of the dye with starch, and, on the other hand, increase the hydrophilicity and, consequently, the solubility of the thickener itself .

In this subsection of the dissertation, the physical and mechanical properties of printed fabrics, the washability of the actual thickener from starch, polymer composition and manutex were studied. RS, thickener with dye, as well as washability of both full and dye-free printing inks [2-5].

When conducting complex structural-mechanical studies, the results were obtained. It should be noted that there is a uniform decrease in the yield strength depending on the composition of the composition. This, in turn, indicates a good compatibility of the components, regardless of their ratio in the mixture, as well as additives of printing ink components; the presence of good compatibility is also evidenced by the high stability of the resulting mixtures.

Next, we studied the dependence of the amount of dye transferred by the printing ink to the fabric (g), the degree of penetration of the dye particles and fixation into the fabric, depending on the concentration of sericin in the printing ink of various compositions of the polymer composition.

microstructure of both the thread and the polymer composition has a strong influence on the printing results . In this regard, in all experiments, we assumed that the degree of transfer of printing ink from the engraving of the printing roller to the fabric will depend both on the ratio of the adhesion forces of adhesion of the printing ink to the roller, and the cohesive forces determined by the internal structure of the system components [6].

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The degree of fixation of the dye particles will be determined both by the total amount of printing ink passing onto the fabric and by the depth of its penetration into the fabric. The more the printing ink passes to the fabric and penetrates deeper into it, the higher the degree of its fixation. An increase in the concentration of sericin in the printing ink leads to an increase in color saturation, which is especially noticeable when rice starch, Na -CMC and sericin are present in the composition . It was found that an increase in the concentration of sericin contributes to an increase in color saturation. However, in the case of the polymeric composition of the thickener starch- Na -CMC, with an increase in the concentration of sericin , the color saturation decreases. Apparently, this is due to the fact that the hydrophobic part of the Na -CMC molecules serves as an obstacle to the transfer of the composition from the tissue [7-10].

As a result of the studies carried out , the concentrations of printing ink components were established, which determine the minimum color unevenness and shading . For example , we note that the minimum color unevenness is observed when the content of rice starch is 6%, sericin is 0.25% by weight of dry starch, Na -CMC is 0.15%. At the same concentrations, the minimum color variation is also found .

An analysis of all experimental data allows us to state that the most durable color can be achieved using a printing composition containing 0.25% sericin . Obviously, at these amounts of sericin , the greatest binding of film-forming components to the polymer base of the fabric occurs, which ensures a sufficiently high color fastness. In addition, we note that when the composition contains 0.25% sericin , the rigidity of the printed fabric is sharply reduced.

It was also observed that a subsequent increase in the concentration of sericin does not lead to further abrupt changes in hardness. The decrease in stiffness with the introduction of sericin is obviously associated with its plasticizing effect. The data obtained show that with an increase in the fixation temperature, the color strength increases. Already at 393K, quite satisfactory results of the color fastness of the fabric to washing, to dry friction and to sweat are obtained. Low results of color fastness of fabrics are observed in relation to wet friction. Apparently, an insufficiently high degree of crosslinking of the polymers is observed at this temperature. Hence the conclusion: it is advisable to carry out thermal fixation at a temperature of 413-423K for 3 minutes [11].

The reactive dyes chosen for printing fabric samples were orange 2R , turquoise 23T and bright red 5CX. The choice of these dyes is due to the fact that such active dyes are widely used for printing cellulose, wool, silk and other fibers. They give a durable, high-quality color that is resistant to physical and chemical treatments.

Molecules of active dyes contain groupings of atoms that form covalent bonds during printing connection with the reactive groups of fibers. The covalent bond is the strongest in comparison with other types of bonds formed between the fiber and the dye. Its rupture energy is 215-300 kJ / mol, which is much higher than the binding energy of a hydrogen bond (20-30 kJ / mol) and the energy of intermolecular interaction [12-14] .

It is this connection that provides color stability to physical and chemical treatments. As a result of printing, the active dye becomes part of the fiber macromolecule, so the resulting colors are highly resistant to wet treatments, friction, dry cleaning and other external influences.

The dyes we have chosen belong to different classes of active dyes: bright red 5CX, orange 2 R belong to dichlorotriazine , turquoise 23T to vinylsulfone. In this regard, the study of the printing process will also allow us to study the influence of the composition and structure of dyes on the printing process and color fastness.

The structure of the selected dyes was presented as follows:

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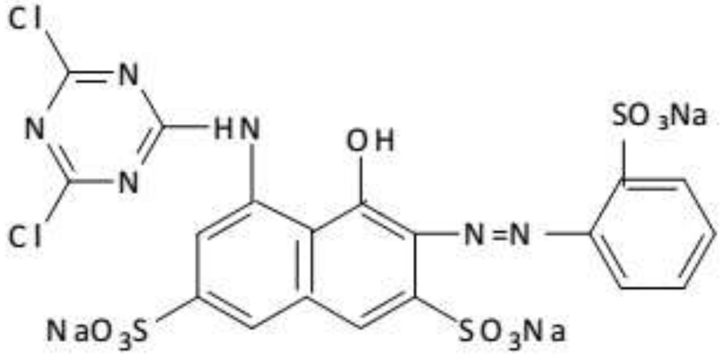
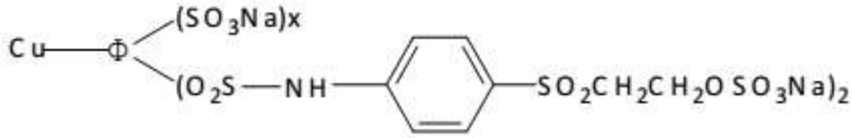
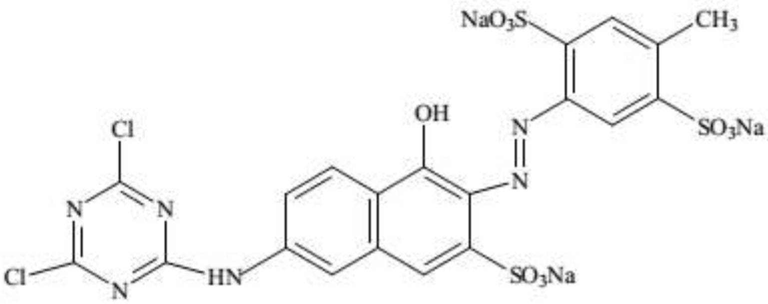


The structure of the dye active bright red 5CX



The structure of the dye turquoise 2ZT



Structure of dye orange 2R

We evaluated print quality parameters to determine how sericin affects quality and color fastness . In this case, the generally accepted methods described in Chapter 2 were used, such as the degree of dye fixation , color saturation, stability to processing both to wet, and tomechanical , resistance to washing and kpot .

The results obtained show that all criteria for the quality of dyeing for fabrics are higher than similar ones .

For the studied samples and the control, the saturation of the color with a bright red 5CX dye is 65.8 and 56.9%, respectively; for orange 2R dye - 57.4% (sizing sample) and 45.7% (control) ; for turquoise 2ZT dye - 40.2% and 34.2% (control).

When comparing the degree of fixation of dyes, the results show that the indicators of the studied samples are higher relative to the control sample .

For the bright red dye 5CX, the degree of fixation is 94% and 81.28% (control sample), for the orange dye 2 R , the indicators are 87.76 and 69.87%, respectively; turquoise 2ZT dye - 90.33% and 76.85 (control sample) [15].

When carrying out spectrophotometric analysis, the degree of fixation of the dye by the fiber was determined by the colorimetric method, which is confirmed by analyzes of the absorption spectra of the re-extracted printed fabrics . The absorption spectra of the bright red 5CX dye are given . In contrast to the dye spectrum from fabric samples printed with factory and developed compositions, the 540 nm absorption band characteristic of the dye has a higher intensity for a fabric sample with a developed composition.

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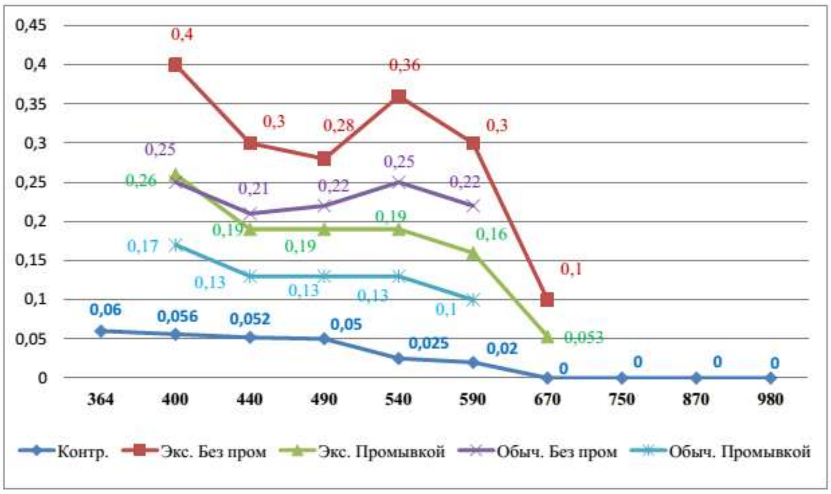


Absorption spectra of bright red 5CX dye solutions after fabric printing

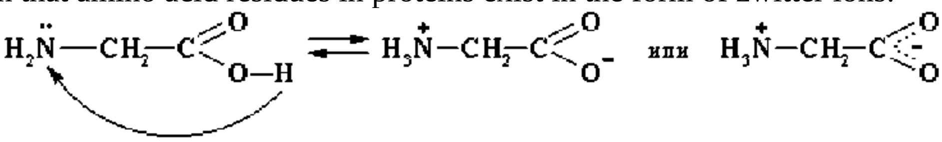
The obtained data of organoleptic analysis are confirmed by the analysis of the IR spectra of the samples. The IR spectra of fabric samples printed with orange 2 R before and after wet treatments are shown in Figures 3.21-3.23.

The IR spectra of printed fabric samples after wet treatments do not differ in any way from the IR spectrum of a dyed sample, which is confirmed by data on color fastness to wet treatments [16].

Increasing the value of color quality indicators for fabric , about sized sericin , compared with control samples , are explained, in our opinion, by the influence of sericin .

The chemical composition and structure of the sericin molecule determine the formation of stable bonds between sericin and the fiber molecule. The same reasons, that is, a large number of functional groups present in the side chains of the sericin macromolecule , contribute to the formation of a chemical bond between sericin and the dye molecule during printing. Sericin , attached to the fiber during printing , can also form chemical bonds with the dye molecule due to free functional groups that did not take part in binding to the fiber and, thus, the dye molecules seem to be sewn onto the fabric and ensure color stability. The functional groups of sericin make possible the formation of covalent, ionic, hydrogen bonds. The emergence of van der Waals forces of intermolecular interaction is also possible [17-18].

It is known that amino acid residues in proteins exist in the form of zwitter ions:



It is believed that the affinity of the dye for the fiber should increase if the polarization caused by sulfo groups is directed perpendicular to the length of the molecule and is as evenly distributed as possible over the entire molecule. A comparison of the chemical composition and structure of the bright red 5CX and turquoise 23T dyes chosen for the experiment shows that, based on this theory, the bright red 5CX dye should have a greater affinity for cellulose, and therefore give a greater color intensity [19-21].

We have carried out a comparative economic assessment, in comparison with the cost of compositions, currently used thickening compositions and printing inks based on them at domestic enterprises.

Conclusions: 1. The study of the surface tension of a system based on starch with the introduction of Na -CMC and sericin into it showed that the introduction of up to 0.3% Na -CMC helps to reduce the surface tension of the system. With a subsequent increase in the concentration of Na -CMC, the surface tension increases.

2. The rheological properties of polymer compositions were studied depending on the concentration and nature of the components that make up the composition. It was found that, compared with native starch, the degree of binding of the dye of the composition based on starch, Na - CMC and sericin decreases by almost 1.6 times . It was determined that the stability of the modified starch is up to 4 days to her , against starch, up to 1.5 days.

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3. It was found that the introduction of starch and polymers such as Na-CMC and sericin into the thickener composition of printing inks leads to the formation of a film with increased elasticity and fluidity. It was determined that in terms of color fastness to wet treatments, their intensity, friction strength and stiffness of the printed fabric, the results obtained with the recommended composition are almost close to alginate thickening .

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