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Current State of the Problem of Using Thickeners Based on Natural Polysaccharides for Fabric Stuffing

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Abstract: *The demand for printed fabrics is growing every year and now they occupy a large share of the market for manufactured fabrics. In the foreign textile industry, the first place in the production of printed fabrics is occupied by materials made from cellulose fibers, in particular cotton fabrics. In this case, one of the main finishing processes is printing. The use of natural polymers in printing processes improves the quality and naturalness of the fabric.*

Keywords: *natural polymers, chitosan, thickener, cotton-silk, composition.*

The republic is implementing comprehensive measures aimed at creating the production of a wide range of high-quality textile, clothing and knitwear products, deepening the localization of its production, as well as increasing the export potential of local producers[1].

The textile industry occupies one of the leading places in the economy of Uzbekistan. This industry is a central link in the process of stabilizing industrial production. Every year the republic produces more than 1 million tons of cotton fiber. In accordance with the investment progress in the development of the textile industry of Uzbekistan, cotton exports will decline in the coming years. The main reason for this will be the creation of new textile enterprises and an increase in capacity for internal processing of cotton fiber [2].

Printing is the patterned coloring of fabrics, obtaining a design on it with one or more dyes. For printing fabrics, dyes are used that give the most durable and bright colors: pigments, active, vat, dispersed, acidic, etc. To preserve the shape of the design, the dye is applied together with thickeners. Thickener is a composition that is used when applying a pattern to fabric to prevent paint from spreading due to the capillarity of the fibers [3-4].

Pigment printing on textiles has become widespread throughout the world due to its many advantages. The main components of pigment paste for printing are a binder, a thickener and the pigment used. Binders used: polymers based on styrene-butadiene, styrene-acrylate or vinyl acetate-acrylate copolymers. A binder must be used to physically bind the pigment to the fabric by forming an adhesive film, since pigments have virtually no chemical affinity for the fibers. Both the mechanical properties and the durability (washing and perspiration) of the print pigment depend on the film formed. The development of new polymers using natural materials has become an area of great interest, mainly due to the production of environmentally friendly materials that can completely or partially replace those currently used [5].

Chitosan (a biopolymer) is extracted from a by-product (crab shell) and is widely used in the textile industry. Recently there was an attempt to use chitosan as a binder. And a thickener for pigment printing on both polyester mixtures and polyester-cotton mixtures. The results showed that pigment printing using chitosan printing paste produced prints with satisfactory color fastness, but noticeably the problem was poor color gamut and stiffness of the printed fabrics. Many studies on the formulation and identification of starch-chitosan films as a green composite have been published in food preservation and packaging technology journals, but are less commonly used in textiles[6].

In recent years, there has been a noticeable increase in interest in polysaccharides with a number of valuable properties, such as biodegradability, environmental friendliness, film-forming and thickening abilities. In this regard, an urgent task is to create complex thickeners based on local resources in the process of dyeing and printing mixed fabrics, such as cotton-lavsan, cotton-nitron, etc. The development of thickeners with specific rheological properties: viscosity characteristics, fluidity, thixotropy, plasticity is important in the development of chemistry and technology of textile materials [7]. Natural dyes are used for food coloring, paints and textile dyeing. They have shown more interest in dyeing textile tiles because they are more environmentally friendly than synthetic dyes. Curcumin (1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadione-3,5-dione) is a yellow pigment present in the rhizome of Curcuma longa, which is widely used in the food industry. Treating fabrics with chitosan, which is considered a multifunctional varnish, not only contributes to its antimicrobial properties, but also improves color fastness, which has generated great interest in chitosan. Also used as an aid in textile printing. It is reported that the printed samples have comparable color fastness to commercially printed samples, but chitosan on the fabric surface is undesirable as it causes fabric stiffness problems (poor processing) [7].

In the textile industry, three areas for the use of chitin and chitosan are being actively developed - the direct production of fibers based on them; — processing of textile materials; — production of auxiliary materials for textile production. Due to its film-forming properties, chitosan is used as a sizing and anti-shrink agent.

It seemed interesting to study the physicomechanical and physicochemical properties of cotton fabrics printed with chitosan. The physical and mechanical properties of fabric treated with chitosan, compared to samples printed with a traditional composition, are much higher. In particular, the tensile strength of the fabric is three times greater, the abrasion resistance is two times greater, which ensures good performance properties of the fabric. It can also be noted that the strength properties of cotton fabric treated with chitosan are preserved compared to the original fabric.

Fabrics dressed with chitosan salts acquire smoothness, shine, fullness, and when washed, the chitosan dressing, unlike starch, is removed by only 20%. Chitin derivatives are widely used in the production of viscose fibers, threads and films, which retain their properties for a long time. Due to the high adhesion of chitosan to cellulose, its addition to cellulose-based fabric products increases their strength, colorability, and bactericidal properties. Impregnation of fabrics with chitosan helps to give them a deodorizing effect and antimicrobial properties, improving the resistance of the fiber to physical and mechanical influences. The work examines the antimicrobial properties of cotton fabrics treated with a mixture of chitosan and fluoropolymers. It has been shown that treatment with a 1% chitosan solution slows down the growth of microorganisms by 90%; however, treatment with fluoropolymers reduces the effectiveness of chitosan. Antimicrobial finishing of cotton fabrics using chitosan and citric acid has also been developed. Chitosan is also widely used in dyeing textile materials. The use of chitosan solves the difficulties associated with coloring fiberglass. It has been established that when chitosan is applied to glass fiber, a film is formed on the surface of the fabric that improves the sorption of dyes[8].

The work proposes a technology for using chitosan to improve the dyeability of cotton, with a simultaneous low-crease finish. The fabric was treated with a mixture of chitosan, 4,5-dioxy-1,3-dimethyl-2-imidazolidone and a catalyst in a one-step process. The work used samples of chitosan with molecular weights of 185300, 73200, 59000, 21000, 14000, 3800. Chitosan significantly improved the absorption of direct and acid dyes, and the absorption improved with increasing molecular weight of chitosan. The absorption of active dyes in a weakly alkaline medium improved slightly with a decrease in the molecular weight of chitosan. The dyeability of cotton improved more in an acidic environment than in an alkaline one. Treatment with chitosan did not significantly change the wash fastness of the dyes, but did worsen the color fastness to abrasion when wet. The authors of the work studied the effect of UV irradiation on the fixation of chitosan on cotton and polyester fabrics. It is proposed that electrostatic interaction occurs between the fabric and chitosan, and aldehyde and carboxyl groups are also formed. Similar effects of chitosan fixation on fabric are also observed in the case of tissue treatment with low-temperature plasma.

The current state of the problem of using various thickening agents for printing fabrics in the textile industry is determined by the development of the production of new types of dyes, as well as certain types of fibers.

In the textile industry, the leading place in terms of the volume of use of thickeners for fabric printing continues to be occupied by expensive natural polymers, in particular gum, tragacanth, chemical derivatives of starch - prisulon, lamiprint, monagum, imprint, solvitose and polyacrylates of various structures. All of the thickeners listed are expensive drugs, and they are not without certain disadvantages. Although alginates have good strength and softness of the printed pattern, they do not provide high color yield. Starch derivatives do not always provide sufficiently high strength of the printed pattern. The use of polyacrylates is associated with wastewater pollution and they are very sensitive to electrolytes.

The most widely used thickeners in printing with active dyes are natural polysaccharides—alginates. When using sodium alginate in printing with active dyes, the degree of fixation of the dye on the fabric increases and the rigidity of the fabric in the areas of the printed pattern decreases.

Thirty different thickeners were studied in the work: several brands of guarana, carrageenan, manutex, starch acetate, carboxymethylcellulose (CMC), polyacrylamide, sodium silicate and other thickeners. It has been established that when using thickeners based on carboxymethyl starch, carboxymethylcellulose, starch acetate and oxidized guarana when printing with active dyes, the degree of fixation of the active dye is higher than when using thickeners based on alginate. Particularly bright colors are obtained when using carboxymethyl starch and starch acetate. The lowest degree of fixation of active dyes is obtained with dextrin. Production tests of carboxymethylcellulose, guarana and manutex have shown that the use of thickeners based on carboxymethylcellulose and guarana when printing with active dyes allows one to obtain a higher degree of fixation of active dyes on fabric than with manutex. However, guarana and carboxymethylcellulose are more difficult to wash off from printed fabric. The use of carboxymethylcellulose as a thickener allows one to obtain a brighter color than with guarana.

Of particular interest among thickening agents for printing with active dyes for alkaline fabrics are new types of thickeners based on mineral substances. An example is bentonites, [9] which have a high content of Na montmorillonite (a mineral that determines the swelling of bentonites and thickening ability). It was found that paints based on Ca-containing bentonites, although characterized by a high content of thickening agent, do not affect the physical and mechanical properties of the fabric, have a low degree of penetration of printing ink into the fabric, high clarity of the pattern, but are accompanied by a noticeable deterioration in color yield values. compared with paints prepared on the basis of Na-alginate or Na-CMC [9].

Fabric samples printed using bentonites are characterized by satisfactory print evenness and a reduced degree of penetration of printing ink into the fabric. In addition, when using such thickeners, the sharpness of the contours of the printed pattern increases and the color yield increases compared to Na-CMC. The use of bentonite clays does not lead to a change in the shade of the dyes. This thickener is characterized by easy washability, and the fabrics they print have a soft feel.

Research by the authors [9] has established that a chitosan-based thickener has good thickening and film-forming properties and mixes well in any ratio with the dye. It has been revealed that treatment with a chitosan solution before printing leads to an increase in the color intensity of cotton fabric and an increase in the resistance of colors to friction (wet and dry) and washing, an increase in breaking load and air permeability, and an increase in abrasion resistance. The influence of chitosan concentration on the indicators of the above parameters was noted. The optimal concentration of chitosan in a solution for padding cotton fabrics has been established [10].

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