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The use of local preparations for sizing yarn

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ABSTRACT: The article will substantiate dressing materials, which is used to increase the strength of warp threads in the manufacture of fabric and on the preparation of dressing penetrating into the threads, forming a smooth film in the surface of the threads, in the further process, i.e. during weaving, reducing the breakage of threads.

In the textile industry of our Republic at present, most of the polymers mainly used for sizing cotton warp threads are natural starch. Specifically, it is described about reducing the consumption of starch, which is a food product about corn starch, which displaces chitosins and is used to reduce the cost of dressing materials used for sizing warp threads.

Consequently, in the process, a new dressing composition which consists of chitazine characterized by a smaller amount of polysaccharides and starch is of particular importance.

KEY WORDS: Polymer, thread, dressing composition, dressing, starch, uhchitan, hydrolyzed acrylic emulsion, strength, adhesion, composition, thixotropy, breakage, rheology, machine tool, yarn, yield strength, base, paste, retrograde, structured viscosity, raw material.

I.INTRODUCTION

The current economic and environmental situation in Uzbekistan in recent years has led manufacturers of textile materials to use the cheapest substances based on local raw materials in the process of creating their products. Currently, at the domestic textile enterprises of Uzbekistan, of all the polymers used for sizing cotton yarn, the largest share is accounted for by native starch.

Especially valuable from the point of view of greening production and products, as well as resource saving in textile processes, is the use of non-recyclable waste.

For industries specializing in the creation of material-intensive fabrics from natural silk, improving processes in the direction of returning production waste to the production cycle is relevant and significant both for cheaper products, increasing their competitiveness, expanding the product range, and greening production by minimizing waste.

II. SYSTEM RELEVANCE

Corn starch is a product that has an increased ability to swell in cold water and does not detect chemical changes compared to the original starch. Corn starch also contains 83.5% grams of carbohydrates. It contains calcium, phosphorus, sodium, potassium and small amounts of willowmagnesium.

Starch $(C_6H_{10}O_5)n$ a mixture of amylose and amylopectin polysaccharides, the monomer of which is alpha-glucose. Starch synthesized by different plants in chloroplasts (under the influence of light during photosynthesis) differs somewhat in the structure of grains, the degree of polymerisation of molecules, the structure of polymer chains and the physicochemical properties.

In industry, the conversion of starch into glucose occurs by boiling it for several hours in dilute sulfuric acid (the catalytic effect of sulfuric acid on starch saccharification was discovered in 1811 by K. S. Kirchhoff). In order to remove sulfuric acid from the resulting solution, chalk is added to it, obtaining insoluble calcium sulfate from sulfuric acid. The latter is filtered off and the substance is evaporated. It turns out a thick sweet mass - starch syrup, which contains, in addition to glucose, a significant amount of the remaining starch hydrolysis products.

If you need to get pure glucose, then the starch is boiled for longer than a more complete conversion of it into glucose is achieved. The solution obtained after neutralization and filtration is concentrated until glucose crystals begin to precipitate. The hydrolysis of starch is also carried out enzymatically using alpha-amylase to produce dextrins of various lengths and glucoamylase to further hydrolyze them to produce glucose. dry starch to 200-250 ° C, its partial decomposition occurs and a mixture of polysaccharides (dextrin and others) less complex than starch is obtained.

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Physical change allows you to get starch with a high ability to retain moisture, which, in turn, gives the final product the desired consistency.

The basis of starch granules are polysaccharides - amylose and amylopectin, the total content of which reaches 80-90%. In the polysaccharide component, the ratio of the proportions of amylopectin and? Amylose for different types of starches varies from 0.72 / 0.28 to 0.82 / 0.18 [1]. In addition to polysaccharides, water is mainly present in starch granules (10-20%), but also small amounts (0.5-2%) of lipids, phosphates, fatty acids, cellulose, residues of protein compounds: [2].

Amylose is a linear polymer formed by E-glucopyranose units linked together by a-1,4-glucosidic bonds; it has now been reliably established that some of the molecules are slightly branched [3]. On average, from two to eight branch points per molecule, and side chains contain from 4 to 100 or even more glucoside units. Mentioned 5 branching of amylose ,. nevertheless, it does not significantly affect its behavior: in solution. The molecular weight of amylose, according to the results of modern studies (mainly highly sensitive by chromatographic methods or laser scanning methods [4]), varies over a fairly wide range - from $3\text{-}10^5$ to $9\text{-}10^6$ g / mol.

In the work [5] are given; approximate calculated data on the average number of amylose chains in one starch grain. With a 25% amylose content in starch, an average molecular weight of 500,000 and a granule density of 1.5 g / sm^3 for granules with a diameter of 20 mkm, the number of amylose molecules is about $1.8\text{-}10^9$.

Plant starch is synthesized in nature in the form of pseudo-crystalline granules with different polymorphic types of crystals and a degree of crystallinity. The type and degree of crystallinity are determined by the botanical origin of starch and are different: for cereals and tuber starches. [5]. Despite; for lengthy and intensive research in this? areas, it is not yet clear what the contribution of amylose and amylopectin is; in the crystallinity of starch, as are located, in the grain zones of relatively high and low ordering, what size are crystallites of various types.

Throughout the history of the development of textile production, starch has played a leading role as the basis of dressing compositions due to its relative cheapness, accessibility and smooth production. Recently, despite the presence of a number of synthetic products for sizing, the situation has not fundamentally changed: the proportion of starch sizing compositions reaches about 75%. The latter, in comparison with synthetic polymers for sizing, is characterized by low cost, good biodegradability and, therefore, less environmental hazard.

In this regard, the urgency of creating new dressing compositions based on chitosan with starch, characterized by a reduced polysaccharide content and at the same time providing high efficiency in sizing.

The choice of means to achieve this goal was based on the intuition of the authors and on the study of a large amount of literary material in the fields of science that are not related to textile chemistry. As such a means, it was decided to use chitosan as a fundamentally new additive in starch dressing compositions.

Chitosan is a special class of bioorganic polymer compounds formed in the environment as a result of the transformation of organic residues. Due to the exceptional variety of constituent fragments and functional groups, they have a wide range of properties, which allows them to be used in various technological fields, in particular, to create and improve adhesive polymer compositions — with the aim of enhancing the adhesion ability of polymer adhesives of various compositions and increasing their sustainability over time. Information on the use of uzkhitan adhesive compositions based on natural polysaccharides is not available in the literature.

In this regard, it seems: it is quite justified and advisable to study the influence of the uzkhitann properties of dressing compositions based on starch and to evaluate the possibility of reducing the polysaccharide consumption in the dressing and improving its technological characteristics.

III. METHODOLOGY

The purpose of the work was the theoretical justification of the application. Knitted in the composition of starch and the creation of dressing compositions to increase the efficiency of sizing of cotton yarn, as well as the development on this basis of a new economical local dressing composition.

In the course of the work, the following tasks were performed:

- the influence of uzkhitan on the technological parameters of the starch dressing and the cotton yarn lined with it is characterized and a new highly effective sizing composition has been developed on this basis;
- the effect of ukhitan on chemical transformations in starch during the preparation of the dressing is analyzed;
- the effect of uhchitan on the adhesive ability of starch dressing compositions to cellulosic material and on the quality of polymer films formed in this process was studied scientific novelty.

For the first time, the possibility of increasing the efficiency of sizing of cotton yarn by introducing uhchitana into the composition of starch dressing compositions, new to textile and chemical technologies, was established and

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theoretically justified.

The most significant results obtained in the work:

- The influence of the content of uzkhitan in starch gelatinized dressing compositions on their relative viscosity and the main indicators of lined cotton yarn was studied. On the concentration dependences, the presence of a deep minimum viscosity, corresponding to 0.08-0.12 masses.% Additives, was established. It is these compounds, when used in sizing, that make it possible to obtain cotton yarn that is superior to that lined with traditional compounds over the entire range of targets;

- Developed a composition for sizing cotton yarn, characterized by high efficiency and reduced starch content in comparison with the known starch sizing compositions;

- The intensification by humic acids of the chemical reactions of starch oxidation and its hydrolytic cleavage, which underlie the preparation of the finished dressing, has been proved. In the presence of uzkhitan, the rate constants of these processes increase, increases; the content of oxidized groups in starch, its degree of polymerization decreases. The catalytic activity of Uzhitans is associated with the presence in their molecules of functional groups capable of reversible oxidation-reduction.

- The rheological method revealed the destruction of the supramolecular structure of starch gels with the addition of small amounts of humic acids, which increases the stability of starch dressing compositions to delamination and increases the period of their technological suitability;

- Factors that play a decisive role in ensuring the high quality of yarn when using the developed starch-humic composition in sizing were revealed. They are an increase in the adhesion of starch dressing to a thread when humic acids are introduced into it, as well as improved deformation properties; and increased smoothness of the starch-humic film compared to starch.

Practical significance. A new dressing composition has been developed: based on starch, including the addition of chitosan isolated from mullet alkaline moth pupae, and providing a lined cotton yarn: with improved properties.

The proposed composition is tested; in the conditions of weaving "". Introduction to Uzhitan in a starch dressing composition allows you to:

- reduce the consumption of starch, which is valuable, by 40-50%; food product, without compromising the quality of the lined base and without deteriorating their ability to process in weaving;

- to exclude synthetic hard biologically degradable substances used as wetting agents from the sizing composition;

- to increase the resistance of the finished dressing to delamination and extend the period of its technological suitability to several days, which eliminates the discharge of the remains of unused dressing into the effluents of the enterprise.

- established patterns of change in the technological parameters of the dressing and lined cotton yarn under the action of humic acids;

- developed composition of starch dressing compositions;

- the detected increase in the content of carboxyl groups in the macromolecules of the polysaccharide and a decrease in the degree of its polymerization as a result of the introduction of uzkhitan into a starch dressing composition;

- the identified increase in the stability of starch-humic dressing in time as: a consequence of the weakening under the influence of uzkhitans of the supramolecular structure of starch;

- determined on the basis of experimental data, the increase in the adhesive ability of starch dressing when uzkhitan is included in its composition due to a change in the surface properties of starch gels.

To this day, in Uzbekistan, uzkhitan is obtained from a mixture of chitosan and carboxymethyl cellulose from a mulberry silkworm puple Bomrix mori, under the direction of academician S.Sh. Rashidov at the Institute of Physicochemical Polymers

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1.1. Silkworm doll

IV. EXPERIMENTAL RESULTS

Table 1 shows the change in the viscosity of 6% starch paste (at γ= 27cm^{-1}) from the content of the introduced GAE at different temperatures.

Change in viscosity of 6% starch paste from the content of GAE in it at different temperatures.

Table 1

Temperature, K	Dressing viscosity (Pa.s) at various concentrations of GAE,%				
	0,2	0,3	0,4	0,5	0,6
298	0,35	0,67	1,15	1,48	1,93
313	0,26	0,58	1,03	1,22	1,60
323	0,20	0,50	0,91	1,13	1,45
333	0,15	0,41	0,83	1,05	1,32
343	0,12	0,35	0,77	0,93	1,24
353	0,07	0,30	0,74	0,84	1,18

From table 1 it follows that the addition of GAE in the starch system causes an increase in the viscosity of the system. This fact indicates the reaction of complexation of GAE with starch, since the polymer chain of starch (more precisely, its components - amylose and amylopectin) probably contains hydroxyl groups in a position convenient for complexation (at a distance of 2.42 A at an angle of 1090).

The formation of complexes is possible both inside one polymer chain and between two chains [7]. The formation of such nodes can lead to a decrease in the mobility of the chains, i.e. limiting their thermal motion, increasing the structure of the system and the formation of a more rigid chain, and as a result of all this, increasing the viscosity of the system.

From table 2 it also follows that for all systems with increasing topics temperature, viscosity decreases. This can be explained by the fact that, with increasing temperature, the energy of thermal motion of polymer units sharply increases and, at certain values, this energy increases the energy of intra - intermolecular interaction.

Starch solutions that have stood for a long time are capable of aging due to the effects of retrograde and biological degradation. The ability to retrograde is extremely pronounced in solutions of pure amylose, which over time aggregates and finally forms an insoluble microcrystalline precipitate.

The figure shows the research data on the aging process of a 6% starch paste with GAE (0.5%) and uhchitane (0.5%), with and without GAE at a temperature of 293 K by changing the viscosity of the system (at γ= 27 s^{-1})

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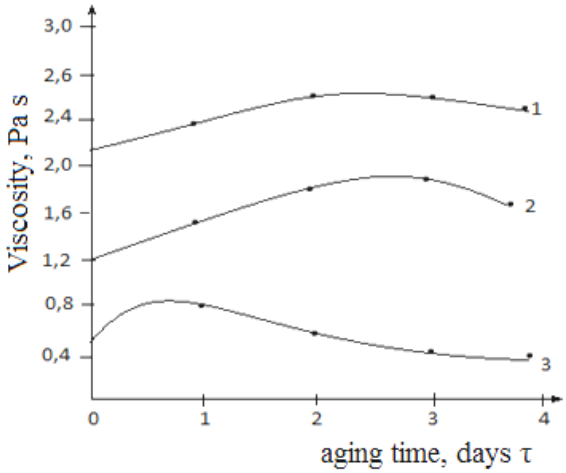

Fig. 4.1. Kinetics of the Aging process of a 6% starch paste with GAE and Uzhitan (1), GAE (2), without them (3).

It follows from the figure that for a starch paste that does not contain GAE and cheat (curve 3), the dependence of the viscosity of the paste on the storage time passes through a maximum. The presence of a maximum in this dependence can be explained by the occurrence of two processes: an increase in the viscosity of the paste during the first day is a consequence of the process of retrograde of the paste, i.e., aggregation of amylose macromolecules. Unlike curve 3, curve 1 and 2, which characterizes the dependence of the viscosity of a 6% starch paste, does not have a maximum with GAE and uzkhitan.

The viscosity of this paste monotonically increases within 5 days. The absence of a decrease in the viscosity of the paste on the second day of storage is explained by the blocking of the process of microbiological degradation of starch due to the antiseptic action of GAE and Uzhitan. This can be judged by the angle of inclination to the abscissa of the curves of the dependence of viscosity on the duration of storage. In this case, we investigated the periods during the first day, when the process of microbiological destruction does not leave its mark.

It follows from the figure that the angle of inclination of curve 1 is much larger than the angle of inclination on curve 2, which indicates a slowdown in the process of retro gradation of starch paste in the presence of GAE and uhchitan, i.e., polyacrylates have a stabilizing effect on starch paste, slowing down the process of retrograde grading pastes and microbiological degradation of starch.

The quality of the main yarn used for weaving production largely depends on the quality of sizing. In addition, the width of the fabrics is now increasing, which will lead to an increase in the number of threads in weaving.

It is important to analyze the effect of the number of threads in the weaving on the weaving process.

The experiments were carried out at the factory “Deluxe Fabrik” located in the city of Bukhara. 29.4 and 18.5 texts were sown.

Strength analysis of yarn samples. First of all, we analyzed the properties of the primary non-sifted yarn of version 1. The strength and tensile elongation of the yarn were determined on a Statimat instrument. Since dressed yarns are samples made from short sections, a diagonal tensile diagram is obtained by breaking them on an AGS-H tensile testing machine.

The following is not sizing and sizing yarn with a new composition under the microscope.

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Fig. 4.2. Raw yarn

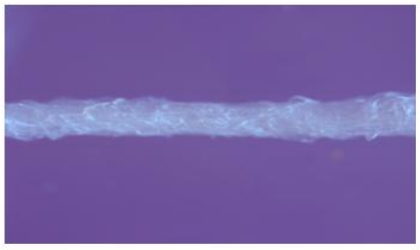

Fig. 4.3: Processed yarn with new compositions

Changes in the physico-mechanical parameters of the main threads and the composition of the new dressing composition.

Table 2

The composition,%			Amount of starch and components in dressing,%	Bursting load Yarn - R sN		Bursting elongation of yarn, %		Glue K, %	The amount of breakage of the main threads per 1 m of fabric	
Starch	GET	Excited		T=29,4 Tex	T= 18,5 Tex	T = 29,4 Tex	T= 18,5 Tex		without art.4744 T = 29,4 Tex	Satin art. 538 T = 18,5 Tex
7	0	0	100:0	306	278	21,7	17,8	5,5	0,35	0,36
6,8	0,1	0,1	97,7:2,9	337	292	21,4	17,3	5,5	0,30	0,30
6,6	0,2	0,2	95,9:6,1	362	316	21,2	17,1	5,7	0,25	0,26
6,4	0,3	0,3	90,6,1:9,4	380	327	21,1	16,9	5,8	0,21	0,22
6,2	0,4	0,4	87,1:12,9	401	335	21,1	16,8	5,9	0,17	0,18
6,0	0,5	0,5	83,3:16,6	416	346	21,2	17,0	6,0	0,12	0,14
6,0	0,5	0,5	83,3:16,6	416	346	21,1	17,1	6,0	0,12	0,14
5,8	0,6	0,6	79,3:20,7	394	339	21,3	17,3	6,2	0,15	0,16
5,8	0,6	0,6	79,3:20,7	400	340	21,1	17,2	6,1	0,15	0,16

As can be seen from Table 2, the tensile load of the yarn, the tensile elongation and the amount of bonding largely depend on the composition of the dressing. The use of uzkhitan and corn starch when sizing the main threads helps to increase strength. and reduce breakage of the main threads [7]. In the case of degradation of starch, it is possible to obtain products with low viscosity and good stability. The disadvantage of this is the decrease in adhesive properties and the formation of a film upon rupture of amylose chains. These disadvantages are eliminated by the use of starch derivatives. In addition, the properties of additive films can be improved. Adding starch with uzkhitan and hydrolyzed acrylic emulsion allows the formation of films and the regulation of bonding properties [6].

VI. CONCLUSION AND FUTURE WORK

1. Scientifically substantiated the possibility of using polymers of uzkhitan and hydrolyzed acrylic emulsion in the composition as an effective dressing preparation for a number of textile materials. As a result, it was possible to significantly reduce the food raw materials used - starch, while simultaneously increasing labor productivity by improving a number of technological characteristics, in particular, reducing the breakage of the thread.

2. It was established that the presence in the composition of the dressing composition based on corn starch, uchitane and hydrolyzed acrylic emulsion positively affects the starch gelatinization process and contributes to an increase in the viscosity of the system.

3. It has been established that the introduction of low starch concentrations into starch solutions of up to 6%, uzkhitan - up to 0.5% and hydrolyzed acrylic emulsion (0.5% solution) - up to 0.20% of the dry weight of starch helps to improve the adhesion of the system to cotton fibers.

4. It has been shown that dressing polymer compositions based on corn starch, ukhitan and hydrolyzed acrylic emulsion significantly increase the efficiency of a number of technological processes, in particular, dressing. Moreover,

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it was revealed that the rupture elongation of lined yarn is inversely proportional to the number of uzkhitans and hydrolyzed acrylic emulsion. The optimal ratio of uzkhitan and hydrolyzed acrylic emulsion was found, which provides tensile strength and tensile elongation corresponding to production requirements.

5. On the basis of comprehensive research and technological indicators, optimal compositions of dressing polymer compositions based on corn starch, uzkhitan and hydrolyzed acrylic emulsion have been developed. The proposed polymer compositions based on starch and hydrolyzed acrylic emulsion have been successfully applied as a dressing under industrial conditions.

6. The use of this development in the process of sizing cotton-cotton yarn allowed to significantly reduce starch consumption (by 35-40%), as well as significantly simplify the process of preparing the dressing and increase the stability of the dressing during storage, to give the fibers a sufficiently high mechanical strength. The addition of sericin to the polymer composition improves its adhesive ability, increases the elasticity of the films formed, which allows to reduce the percentage of thread breakage during processing.

7. Testing of the developed technology at Delyux Fabric OOO testifies to the high scientific and practical significance of the data obtained. A pilot batch of cotton yarn lined with developed polymer compositions has been released, which fully meets the requirements of regulatory technical documentation.

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