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Development of a new composition for sizing the warp thread

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ABSTRACT: The article presents the results of a study of the specific structural and mechanical properties of the newly developed dressing compositions based on corn starch and water-soluble polymer preparations, such as «GAE» and «Uzkhitan». It has been established that the introduction of acrylates and the natural polymer uzkhitan into starch pastes leads to an increase in the thixotropic reduction coefficient, i.e., an increase in the rate of relaxation processes.

KEY WORDS: polymer, glue, starch, uzkhitan, composition, qualities, thixotropy, efficiency, adhesion, viscosity, fibers, glue, solution.

I.INTRODUCTION

Currently, 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 huge consumption of valuable food product for sizing purposes not only causes significant damage to food resources, but also is a source of severe pollution of water bodies, since all starch goes into drains during desizing [1-3]. In this regard, the task of finding ways to reduce the starch content in adhesive compositions without reducing the quality of sizing becomes extremely urgent.

Low and high molecular weight amines and amides, nitrile compounds, salts of acrylic acids, urea derivatives and other substances are used as chemical starch modifiers. The grafting of functional groups to starch, the carriers of which are the listed compounds, improves its adhesive ability, increases the elasticity of the films formed and, accordingly, reduces the consumption of dressing [4].

In this; connection timely and extremely significant for the textile industry is the search for ways to reduce the consumption of starch in sizing by adding local raw materials produced in our republic.

II. RELEVANCE OF THE SYSTEM

Structural - mechanical or rheological properties of fluid systems are understood to mean the behavior of polymer systems during deformation. They determine the dependences that bind stresses at various temperatures and deformation modes of polymer systems, provide valuable information about their properties, structure, and structural transformations. They are of great importance not only from the point of view of studying the systems themselves and studying the changes occurring in them, but also from the point of view of problems associated with the use of such systems in technological processes [1,2].

In the sizing processes of textile materials, the sizing compositions used undergo various mechanical influences, in which the rheological properties of the sizing systems based on starch and water-soluble acrylates change [3]. It can be expected that due to the complexation reaction of starch and acrylic polymers, the rheological properties of the systems undergo significant changes.

Based on these studies, we have developed a new dressing composition based on corn starch obtained from secondary raw materials, as well as a synthetic water-soluble polymer of acrylic emulsion, produced in Navoiazot OJSC. Since the acrylic emulsion is an insoluble polymer, we hydrolyzed the acrylic emulsion and obtained a hydrolyzed acrylic emulsion (GAE) [4].

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The introduction of water-soluble acrylic polymers into the composition of the sizing agents leads to a change in the structural and mechanical properties [5].
Solutions of polymers, including starches, are not structureless. The structure of solutions is understood as the mutual arrangement of solvent and polymer molecules, the conformation of macromolecules, and the interaction between polymer macromolecules.

The stability of the structure can be judged by the values of the degree of thixotropic recovery given in Table 1. Thixotropy - the ability of structures after their destruction as a result of some mechanical action spontaneously recovers over time, that is, thixotropy is the ability to reversibly isothermal transformation of sol into gel .

III. METHODOLOGY

As one would expect, the introduction of GAE and Uzhitan into the composition of the polymer composition leads to a decrease in the mobility of starch macromolecules, i.e., to a restriction of their thermal motion, an increase in the structure of the system and the formation of a more rigid chain, and, as a result, the viscosity of the system increases.
In addition, the addition of GAE and uzkhitan to starch pastes leads to the transition of an elastic-brittle system into an elastic-plastic system, i.e., the plastic properties of the films of the sizing polymer composition and GAE increase and uzkhitan acts as a plasticizer. As one would expect, the process of plasticization of dressing polymers significantly affects the physicomechanical properties of cotton yarn [6].

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Yield strength and degree of thixotropic reduction of starch solutions with different polymer contents

Table 1.

The composition and content of components in solution			Yield strength (Pa)	Thixotropic degree recovery%
Starch,%	GAE %	Uzhitan,%		
6	-	-	4,21	87,15
6	0,1	0,1	6,43	89,32
6	0,2	0,2	11,24	90,16
6	0,3	0,3	16,35	91,55
6	0,4	0,4	24,25	93,33
6	0,5	0,5	37,63	94,35
6	0,5	0,6	38,45	95,11
6	0,6	0,5	39,17	95,86
6	0,5	0,4	39,84	96,16

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The stability of the structure can be judged by the values of the degree of thixotropic recovery (table. 1). From table 1 it is seen that starch paste containing uzkhitan, are characterized by higher values of the degree of thixotropic recovery.

Such a gradual restoration of the structure and, consequently, an increase in its strength occurs not only when the system is at rest, but also during the flow of the system at a speed lower than that which caused this degree of destruction of the initial structure. However, upon the reverse transition from the steady-state flow regime with a high velocity to a flow with a lower velocity, a certain restoration of the structure occurs, and, accordingly, the effective viscosity and strength of the structure increase, and the higher the content of uzkhitans in the system, the more pronounced this effect.

Thus, the introduction of Uzhitan into starch paste leads to an increase in the thixotropic reduction coefficient, i.e., an increase in the rate of relaxation processes.

It was of interest to evaluate the effect of the concentration of uzkhitan on the technological properties of sagonated yarn. Laboratory test data are presented in table 2. Analysis of the data in table 2 showed that only after achieving complete cleavage of the starch paste, some constant value of breaking load and elongation is established [7]. At the same time, an increase in the concentration of uzkhitan significantly influenced the breakage of the yarn in the loom. So, for example, at a sericin concentration of 1.0% in the composition, the breakage is 0.39, and an increase in its concentration to 3.0% leads to a decrease in breakage to 0.26.

IV. RESULTS OF THE EXPERIMENT

Adhesive properties are the main indicator of sizing compositions, since they contribute to increasing the strength of the yarn by forming an adhesive film on it. To achieve a strong adhesive film, a low viscosity and surface tension of the system is required so that the dressing penetrates deep into the fiber and it must be sufficiently viscous to remain on the surface of the yarn in the form of a film.

Changing the properties of dressing and sizing yarn at different concentrations of uzkhitan.
Starch Concentration 6%
Table 2.

The concentration of uzkhitan, % by weight of dry starch	The degree of splitting, %	Glue,%	Breaking load, G, cN	*Burst elongation, E%*	Openness, arr / meter
1,0	69,1	4,6	337	21,4	0,39
2,0	72,4	4,8	362	21,2	0,33
3,0	7,5	5,1	380	21,1	0,30
4,0	8,4	5,5	401	21,1	0,25
5,0	93,3	6,0	416	21,2	0,22
soft yarn	-	-	335	25,4	-

A dressing with a low viscosity quickly penetrates deep into the thread, but, as a rule, has little adhesive ability and, therefore, does not provide sufficient protection for the surface of the thread, although due to bonding a large number

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of fibers, the thread receives a certain increase in strength, while the elongation is significantly reduced. High viscosity dressing, in contrast, remains in most cases on the surface of the thread and easily crumbles during processing.

A study of the viscosity of dressing compositions based on starch and ukhitan showed (Fig.) That the adhesive properties of the dressing will depend on the composition of the dressing. In all experiments, the content of uzkhitan in the composition of the composition was 5.0%. An increase in the above concentration leads to a sharp increase in viscosity, and this, in turn, promotes film formation in the drum, which negatively affects the sizing process, that is, due to film formation, the thread complex breaks during passage through the combs of the sizing machine [8].

In addition, due to the high adhesion and structure-forming ability of Uzhitans to cotton fiber, the consumption of adhesive materials when used in sizing is reduced by 1.3-1.5 times compared with purely starch dressing, while the rate of breakage in weaving is reduced by 20-25% , and strength indicators increase in the range from 21 to 24%.

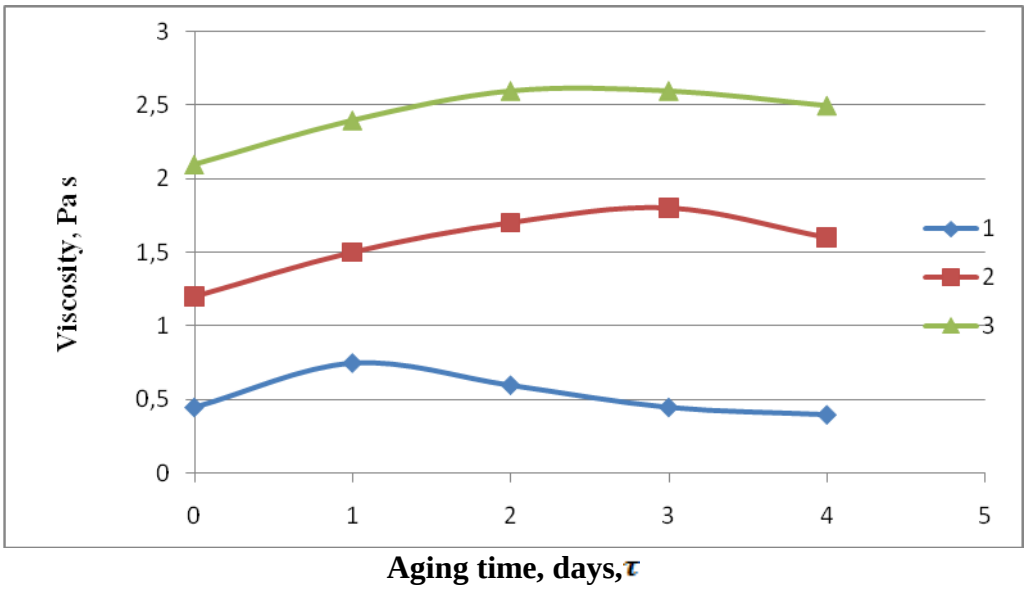

Fig.1. Kinetics of the "Aging" process of a 6% starch paste with GAE and uzkhitan (1), GAE (2), without them (3).

From the figure it follows that for a starch paste not containing 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. In contrast to 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.

V.CONCLUSION

Evaluating the results of the study from a technological point of view, it can be emphasized that the use of a polymer composition can simultaneously reduce the starch content in the sizing compositions and improve the most important physical and mechanical characteristics of the sizing base.

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Thus, the developed dressing polymer composition based on starch and GAE and uzkhitan provides highly dispersed, homogeneous dressing with a high degree of starch degradation. The increased degree of useful use of the sizing polymer composition allows to reduce the specific consumption of starch while improving the quality of sizing.

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