
Development of a New Composition for Sizing Cotton Yarn

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Abstract: In the article, the influence of the concentration of dressing components on the physical, mechanical and operational properties of sized yarn is studied. The specificity of the influence of sericin on the physical and mechanical properties of sizing compositions and the main indicators of sizing has been established. The expediency of the development of scientific research and practical developments in the chosen direction is substantiated. The effectiveness of the sizing polymer composition was compared with the base composition, and the practical and economic aspects of the developed technology were determined.

Keywords: Efficiency, polymer composition, practical aspects, physical and mechanical properties, concentration.

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 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 [1-3]. In this regard, it becomes extremely urgent to find ways to reduce the starch content in adhesive compositions without reducing the quality of sizing.

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].

Given the foregoing, it seems quite reasonable to try to use a synthetic polymer of polyvinyl alcohol (PVA) in starch sizing compositions in order to reduce the concentration of starch and increase the efficiency of sizing.

In this regard, this article presents the results of the use of water-soluble polymer compositions based on prondronopolymer of starch and synthetic PVA polymer for sizing cotton yarn.

It was planned to evaluate the effect of the concentration of PVA on the relative viscosity of starch gels and the main indicators of the efficiency of sizing of yarn with different contents of starch and PVA in the sizing compositions.

The work was structured in such a way that the concentrations of starch and PVA were simultaneously varied, which was assigned by random selection. This approach to bringing

the search experiment is most appropriate, because it allows you to characterize a wide field of the studied parameters by a small number of experimental points.

The starch content in the dressing composition was varied in the range from 4 to 6%, PVA from 1.0-3.0% (in terms of the weight of starch).

As one would expect, the introduction of PVA into the polymer composition leads to a decrease in the mobility of the starch macromolecule, i.e., limitation 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 PVA 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 increase and PVA acts as a plasticizer. As one would expect, the plasticization process of dressing polymers significantly affects the physic mechanical properties of cotton yarn [5].

Solutions of polymers, including starch, are not structure less. The substructure of solutions includes 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. From the table. 1. Shows that starch paste containing PVA are characterized by higher values of the degree of thixotropic recovery.

Table 1. Yield strength and degree of thixotropic reduction of starch solutions with different PVA contents

Composition and content of components		Limit yield strength, Pa	The degree of thixotropic recovery, %
Starch, %	PVA by weight of starch, %		
4	-	3,76	76,4
	1,0	4,23	88,3
	1,5	7,19	91,2
	2,0	11,65	93,4
	2,5	17,28	97,7
	3,0	31,45	98,4
5	-	4,81	78,2
	1,0	6,73	90,6
	1,5	10,82	93,5
	2,0	14,73	95,2
	2,5	22,19	97,3
	3,0	37,60	99,1

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 when the system flows 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, some restoration of the structure occurs and, accordingly, the effective viscosity and strength of the structure increase, and the higher the PVA content in the system, this effect is more pronounced [6-12].

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

It was of interest to evaluate the effect of the concentration of PVA on the technological properties of the sacked yarn. Laboratory test data are presented in table 2. Data analysis table. 3 showed that only after achieving complete cleavage of the starch paste is a certain constant value of breaking load and elongation established. With this increase in the concentration of PVA, the yarn breakage in the loom was significantly affected. 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 [13-19].

Table 2. Changing the properties of dressing and sizing yarn at different concentrations of PVA. The starch concentration is 4%.

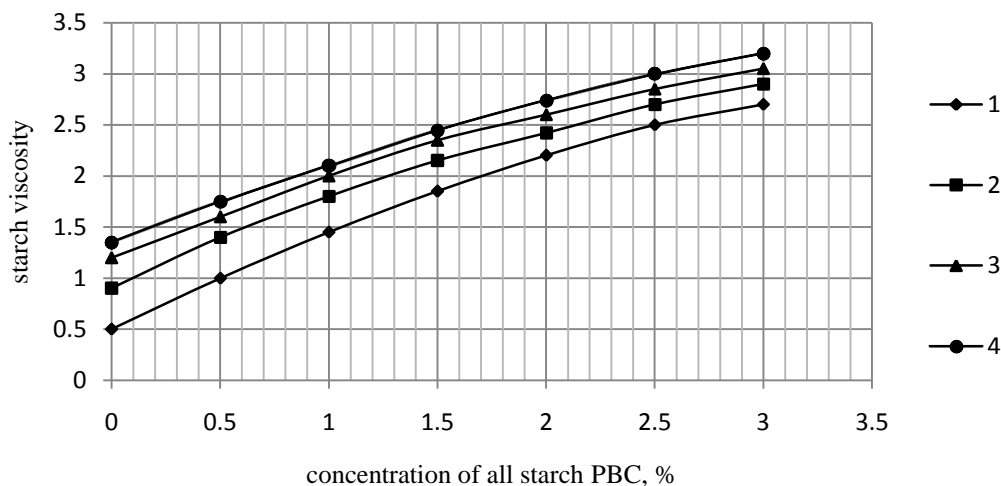
The concentration of PVA,% by weight of dry starch	Degree of cleavage, %	Glue,%	Breaking load, g, cN	Tensile elongation E%	Openness, arr / meter
1,0	69,8	4,6	264	9,1	0,39
1,5	72,6	4,8	286	7,4	0,34
2,0	7,4	5,1	314	6,4	0,29
2,5	8,6	6,3	317	5,7	0,28
3,0	93,8	6,8	321	5,2	0,26
soft yarn	-	-	223	15,4	-

Adhesive properties are the main indicator of sizing compositions, as they help to increase 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 are necessary so that the dressing penetrates deep into the ion fiber and must be viscous enough to remain on the surface of the yarn in the form of a film.

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 the bonding of a large number of fibers, the thread receives a certain increase in strength, while the elongation is significantly reduced. High viscosity dressing, by contrast, remains in most cases on the surface of the thread and easily crumbles during processing [20-24].

A study of the viscosity of dressing compositions based on starch and PVAI showed that the adhesive properties of the dressing will depend on the composition of the dressing. In all experiments, the PVA content in the composition was 3.0%. An increase in the above concentration leads to a sharp increase in viscosity and this in turn contributes to film formation in the drum, which negatively affects the sizing process, i.e. due to film formation, the thread complex breaks during passage through the combs of the sizing machine.

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



**The dependence of the viscosity of starch solution on the concentration of PVA.
Concentrations of starch: 1 - 3, 2 - 4,3 - 5, 4 - 6%.**

Assessing the result 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 [25-35].

Thus, the developed dressing polymer composition based on starch and PVA 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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