TECHNOLOGY OF MATERIALS AND PRODUCTS OF THE TEXTILE AND LIGHT INDUSTRY

FEATURES OF APPLICATION IN THE TEXTILE INDUSTRY OF SYNTHETIC POLYMER COMPOSITIONS SOLUBLE IN NATURAL WATER

Sitora Sultonova
Assistant,
Bukhara State Medical Institute,
Republic of Uzbekistan, Bukhara

Sherzod Ortikov
Assistant,
Bukhara State University
Republic of Uzbekistan, Bukhara

Ilgor Norov
Assistant,
Bukhara State University
Republic of Uzbekistan, Bukhara
E-mail: i.i.norov@buxdu.uz

ОСОБЕННОСТИ ПРИМЕНЕНИЯ В ТЕКСТИЛЬНОЙ ПРОМЫШЛЕННОСТИ СИНТЕТИЧЕСКИХ ПОЛИМЕРНЫХ КОМПОЗИЦИЙ РАСТВОРИМЫХ В ПРИРОДНОЙ ВОДЕ

Султонова Ситора Фахриддиновна
ассистент,
Бухарский государственный медицинский институт,
Республика Узбекистан, г. Бухара

Ортиков Шерзод Шарофович
ассистент,
Бухарский государственный университет
Республика Узбекистан, г. Бухара

Норов Ильгор Ильхомович
ассистент,
Бухарский государственный университет
Республика Узбекистан, г. Бухара

ABSTRACT

In looms, due to the forces of friction, the thread sometimes leads to its rupture. At textile enterprises, yarn is sizing to increase its strength. Therefore, the creation of new technologies for the production of sizing agents and the study of their properties, as well as their use in textile enterprises, is relevant.

АННОТАЦИЯ

В ткацких станках за счет сил трения нити иногда приводит к ее разрыву. На текстильных предприятиях пряжу шлихтуют для повышения ее прочности. Поэтому создание новых технологий производства шлихтующих веществ и изучение их свойств, а также использование их на текстильных предприятиях является актуальным.

Keywords: size, polyacrylamide, polymethyl methacrylate, starch, polyvinyl acetate, viscosity, strength, paste.

Ключевые слова: клей, полиакриламид, полиметилметакрилат, крахмал, поливинилацетат, вязкость, прочность, клейстер.

Библиографическое описание: Sultonova S.F., Ortikov Sh.Sh., Norov I.I. FEATURES OF APPLICATION IN THE TEXTILE INDUSTRY OF SYNTHETIC POLYMER COMPOSITIONS SOLUBLE IN NATURAL WATER // Universum: технические науки : электрон. научн. журн. 2023. 6(111). URL: https://7universum.com/ru/tech/archive/item/15665

The addition of synthetic polymers such as PAA (polyacrylamide), HPMA (hydrolyzed polymethyl acrylate) and PVA (polyvinyl acetate) to the composition of the dressing sizing on starch leads to significant changes in the structural and mechanical properties. High adhesive properties of polyacrylate compositions as sizing agents testify to its advantages [1]. When studying the rheological properties of pastes based on 6% rice starch with a small amount of PAA (1.0-3.0% by weight of starch) and HPMA (6-10% by weight of starch), a sharp change in the properties of starch was noted with the introduction of PAA and HPMA (table 1). As can be seen from the table, the addition of HPMA leads to an increase in the viscosity of the system. This indicates that HPMA reacts with starch to form bonds due to hydrogen forces and Van der Waltz forces, since the hydroxyl groups in the polymer chain of starch (more precisely, its components - amylose and amylopectin) are conveniently located at a distance of 2.42 Å and at an angle of 190°.

Table 1.

Viscosity change of 6% starch paste at different temperatures depending on the amount of HPMA

Temperature, ºK	Composition viscosity, Pa·s (At different concentrations of HPMA)				
	4,0	6,0	8,0	10,0	12,0
298	0,42	0,76	1,22	1,34	1,76
313	0,34	0,68	1,13	1,28	1,63
323	0,26	0,61	0,98	1,22	1,55
333	0,21	0,57	0,84	1,16	1,43
343	0,14	0,50	0,72	0,94	1,44
353	0,10	0,42	0,76	0,89	1,23

The ability of the composition to form a film is one of the important properties of the sizing process. When processing and drying the threads with a sizing composition, a smooth film is formed on the surface of the fiber and inside the fiber [2].

Therefore, the physico-mechanical properties of films based on natural and synthetic polymers were studied, the results of which are presented in table 2.

From Table. 2 shows that the strength of the film based on starch-HPMA-PAA-PVA is 1.5-2.5 times higher than the strength of starch-PVA or other three-component systems. This feature of the film is very important for the formation of a strong and elastic film with a reduced coefficient of friction on the surface of the thread, as well as for increasing the resistance of the thread to abrasion, bending, twisting, elongation and similar mechanical stress.

Table 2.

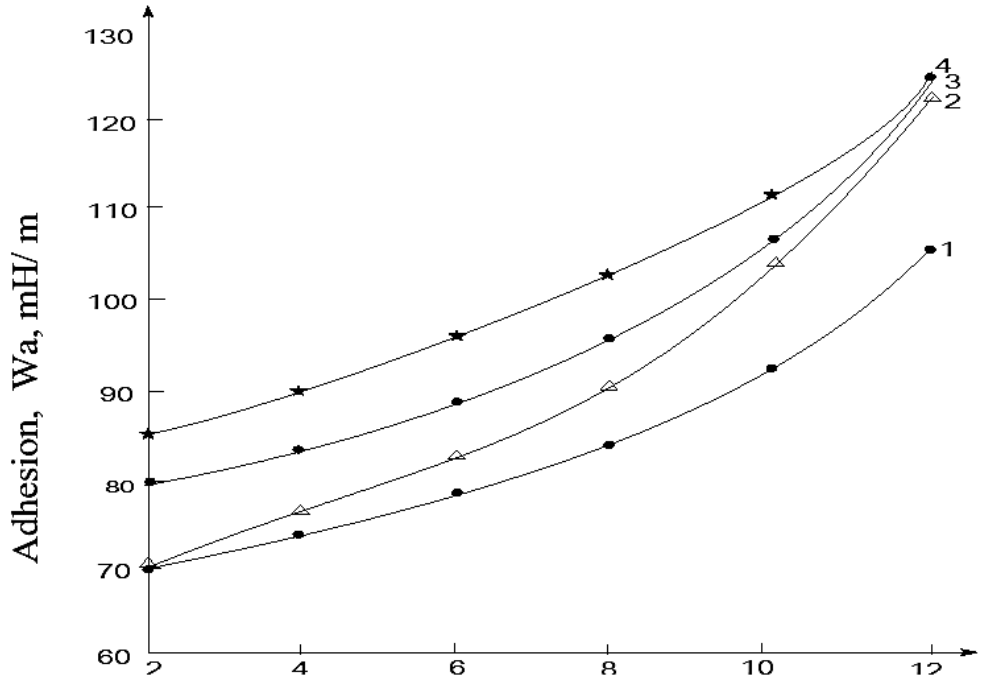
Physical and mechanical properties of sizing mix from different systems

Film type	Film compression length at break, mm	Film width, mm	Film thickness mm	Resis-tance to interrupts g/c	Film strength, kg/mm^2	Stretching, %
Starch	50	50	0,314	11,6	1,6	27
Starch-PAA	50	50	0,276	19,3	2,3	21
Starch-PVA	50	50	0,234	19,7	2,6	18
Starch-HPMA	50	50	0,184	21,4	3,1	16
Starch-PVA-HPMA	50	50	0,196	24,6	3,8	15
Starch-HPMA-PAA	50	25	0,163	26,1	4,2	14
Starch-HPMA-PAA-PVA	50	25	0,157	28,4	4,5	13

Adhesive properties are one of the main properties of sizing components, since they are designed to increase the strength of the yarn by forming an adhesive film on the yarn. To form a strong film with sufficient viscosity, it must be absorbed into the fiber, but the viscosity and surface tension should not be too low, as this will worsen the physical and mechanical properties of the yarn [3].

On fig. 1 shows the dependence of the adhesion of starch dressings at various concentrations on the amount of HPMA. As can be seen from the figure, the introduction of HPMA leads to an increase in the adhesive properties of the system.

With the introduction of HPMA, the surface tension of starch solutions increases. The resulting complexes facilitate the transition of a large amount of substrate from the composite solution to the surface, since the internal molecular interaction in the solution is small.



HPMA concentration, %

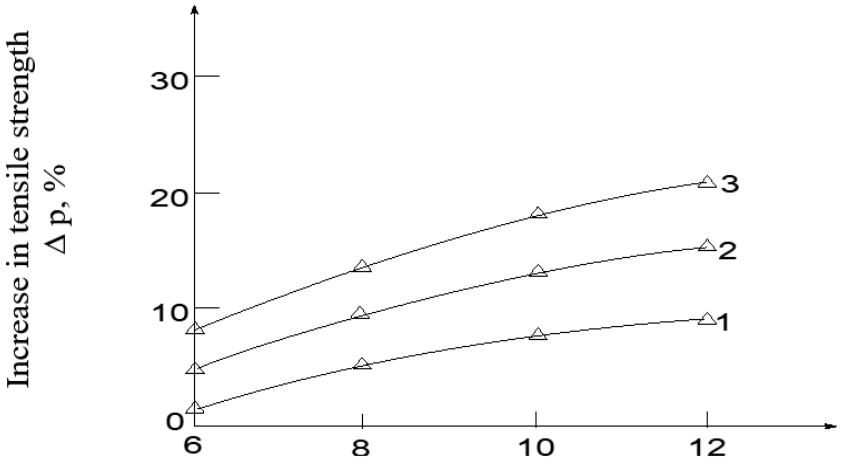
starch concentration: 1 – 4, 2 – 5, 3 – 6, 4 – 7.

Figure 1. Effect of HPMA Concentration on Adhesion Change

Thus, the composition based on water-soluble natural and synthetic polymers (starch 6%, PAA up to 5%, HPMA 12% and PVA 2% by weight of starch) improves the systemic adhesive properties of the yarn.

The discontinuous characteristics of the weaving process are mainly determined by the penetration of the dressing into the yarn, as a result of which a part of the fibers that make up the basis of the yarn merges [4].

When studying the effect of the composition composition on the strength, rupture and stretching of yarn (fig. 2 and 3), it was found that an increase in the amount of PAA, HPMA and PVA in starch compositions increases the strength of yarn due to the formation of films on the fiber surface.

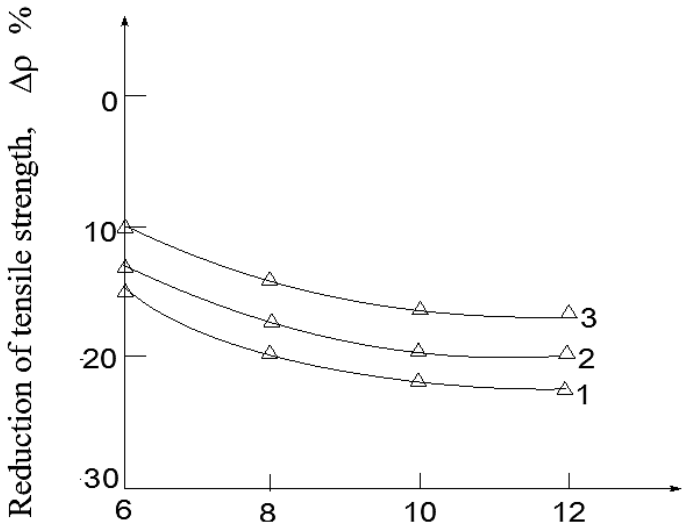


HPMA concentration, %

Concentrations of PAA and PVA respectively 5 and 2%

Amount of starch: 1 – 5, 2 – 6, 3 – 7%.

Figure 2. The effect of the concentration of HPMA on the strength of yarn impregnated with a polymer composition



HPMA concentration, %

Concentrations of PAA and PVA respectively 5 and 2%

Amount of starch: 1 – 5, 2 – 6, 3 – 7%.

Figure 3. The effect of the concentration of HPMA on the relative decrease in elongation under the influence of the polymer composition

Excessive strength reduces elongation, which, in turn, reduces the efficiency of dressing. As a rule, the sizing solution yarn has higher strength and lower elongation [5].

Thus, according to the data obtained, starch, PAA and HPMA, which are part of the dressing composition, have a significant effect on the physico-mechanical properties of the coated yarn. The addition of 5% PO, 12% GPMA and 2% PVA to 6% starch paste increases the strength of the yarn and reduces its tear during elongation.

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