International Journal of Advanced Research in Engineering and Technology (IJARET)
Volume 11, Issue 12, December 2020, pp.2114-2121, Article ID: IJARET_11_12_201
Available online at http://www.iaeme.com/IJARET/issues.asp?JType=IJARET&VType=11&IType=12
ISSN Print: 0976-6480 and ISSN Online: 0976-6499
DOI: 10.34218/IJARET.11.12.2020.201

PHYSICAL AND MECHANICAL PROPERTIES OF YARN COATED WITH POLYMER COMPOSITIONS

Ibragimova Feruza Bakhodirxonovna
Ph. D., Associate Professor of the Department of chemistry,Bukhara State University, M. Ikbol street., Bukhara, Republic of Uzbekistan

Ismatova RanoAkhadovna
Postgraduate student of the Department of chemistry, Bukhara State University, M. Ikbol street, Bukhara, Republic of Uzbekistan

Amonov Mukhtar Rakhmatovich
Doctor of Technical Sciences, Professor of the Department of chemistry, Bukhara State University, M. Ikbol street., Bukhara, Republic of Uzbekistan

Ravshanov Kazokmurod Asadovich
Ph. D., Associate Professor of the Department of chemistry, Bukhara State University, M. Ikbol street., Bukhara, Republic of Uzbekistan

ABSTRACT

This article deals with the development of a new composition of a polymer composition for dressing cotton yarn. The optimal concentration of the dressing polymer composition, which is 50 g/kg, against the starch-based dressing is 70 g/kg, i.e. the consumption of starch is reduced by 25-30%. It is experimentally established that the concentration of the dressing, which has a significant impact on the cost of the dressing, varies within 45-50 g/kg of the composition, while the true glue remained at the same level.

Theoretically, the interaction between the polymer groups and the reactive groups PVA and HIPAN is justified. The products resulting from this interaction contain, in particular, amide -CONH, carbamide - NHCONH, carbamate - $OCONH_2$, ester - OCO and other groups. Their presence in the macromolecules of the polymer composition makes it possible to improve the elastic, structural and mechanical properties, and to reduce the electronegativity of the adhesive film formed on the yarn during sizing.

The optimal technological parameters of preparation of dressings based on the polymer dressing material for composition. At the same time, it was found that the use of these preparations makes it possible to give the coated cotton yarn good quality and technological properties, to produce fabric on high-performance weaving equipment with a reduction in breakage by 35-40%, and an increase in productivity by 5.0-10.0%.

It is revealed that in the case of dressing cotton yarn with the developed dressing compositions, a significant reduction in starch is achieved, which indicates the feasibility of using the developed composition in economic and environmental terms.

Key words: adsorption, alcohol, breakage, composition, cotton fabric, dressing, glue, humidity, polymer, polyvinyl,preparation, starch, yarn.

Cite this Article: Ibragimova Feruza Bakhodirxonovna, Ismatova RanoAkhadovna, Amonov Mukhtar Rakhmatovich and Ravshanov Kazokmurod Asadovich, Physical and Mechanical Properties of Yarn Coated with Polymer Compositions, *International Journal of Advanced Research in Engineering and Technology*, 11(12), 2020, pp. 2114-2121.
http://www.iaeme.com/IJARET/issues.asp?JType=IJARET&VType=11&IType=12

ABBREVIATIONS

PVA: polyvinylalcohol;

HIPAN: hydrolyzedpolyacrylonitrile;

TAS: textileauxiliarysubstances;

1. INTRODUCTION

The development of chemistry and chemical technology in the textile industry is accompanied by the replacement of food starch, which is used as a dressing preparation. The proportion of starch and its derivatives used in various stages of the textile industry reaches up to 70-75% and only 25-30% is made up of synthetic water-soluble polymers [1-5].

Currently, synthetic materials have been obtained, for example, preparations made from synthetic Homo - and copolymers, which allow for dressing without the use of food products. But these drugs have a high price, are difficult to access and do not have multi-functionality. In relation to the fibres of various chemical structures, which are difficult to wash out from the surface of the fabric, the consumption of preparations for loosening increases sharply. Accordingly, the time of fabric dressing increases, in addition, it is important to note that when dressing only with synthetic polymers in the process of drying yarn after dressing, the yarn is glued together, which is the main negative phenomenon of the process, which makes it difficult to carry out effective processing of yarn on high-performance weaving equipment [6-8].

The development of chemistry and chemical technology in the textile industry is accompanied by the replacement of food starch, which is used as a sizing agent.The proportion of starch and its derivatives used in various stages of the textile industry reaches 70-75% and only 25-30% is synthetic water-soluble polymers [1-5].

Today, synthetic materials have been obtained, for example, preparations from synthetic homo-and copolymers that allow sizing without the use of food products.But these drugs have a high price, are difficult to access and do not have multifunctionality.With respect to the fibres of various chemical structures, it is difficult to wash out from the surface of the tissue, and the flow rate of loosening preparations increases sharply.Accordingly, the time of fabric splicing is increased, and it is important to note that when splitting only with synthetic polymers in the process of drying yarn after splicing, the yarn is glued to each other, which is the main negative phenomenon of the process, which makes it difficult to carry out efficient processing of yarn on high-throughput weaving equipment [6-8].

Therefore, in order to reduce the consumption of food starch, the search and development of technologies and methods for treating yarn with preparations of water-soluble polymers based on starch, polyvinyl alcohol (PVA) and hydrolyzedpolyacrylonitrile (HIPAN) are very

relevant, especially since there is practically no scientific research on this problem and is little studied.

The issue of creating sizing preparations for cotton yarn using starch, their combination with some water-soluble synthetic polymers, their introduction of textile-auxiliary substances (TAS) of special purpose are reflected only in minor works [9-13].

In this regard, the purpose of this work is to develop and physicochemical substantiation of the technology of sizing cotton yarn using PVA and HIPAN as sizing preparations in order to reduce the consumption of valuable food starch [14-15].

2. EXPERIMENTAL PART

2.1 Reagents and Materials

The work used rice starch (Uzbekistan), polyvinyl alcohol, hydrolyzedpolyacrylonitrile (Russia), the physicochemical properties of which are described in [16-17].

2.2 Devices

The breaking load was determined by the single thread method.The elongation at break was determined simultaneously with the determination at breaking load.The strength of a single yarn was tested with a tensile testing machine of the PM-30 brand for a single thread.The relative strength or relative breaking load of single filaments, which is characterized by breaking load, passing per unit of linear density, was calculated by the formula:

$$P_0 = \frac{P_p}{T},$$

Where, P_p- tensile breaking load (cN)

The *T*-linear density of the yarn (tex.).

2.3 Conditions of The Experiment

It should be noted that when dressing yarn, complex physical and chemical processes occur between the dressing and the yarn fibres, which are predetermined by the chemical nature and supramolecular structure of the dressing preparation and the state of the thread surface.

The influence of these factors can be partially described by studying the adsorption of the dressing by yarn fibres, the results of which are shown in Fig.1.

figure 1 (curve 1) shows that this is the adsorption isotherm on a hydrophobic surface, which is characteristic of monomolecular Langmuir adsorption.

The isotherm for the hydrophobic surface (curve 2) resembles the S-shaped poly-molecular adsorption curve of Polyani and BET.

The adsorbent binding does not stop after the formation of a monomolecular layer but continues further [18-20].

Nevertheless, the adsorption on the hydrophobic surface turned out to be greater than on the hydrophilic one. The main role in the process of adsorption of the composition by the fibre is played not by the functional groups, but by the main carbon chain, which causes higher adsorption on the activated carbon than on the bentonite. As can be seen from Fig. 1, the rate of the adsorption process of the composition on cotton yarn depends on the physicochemical properties of the sizing agent, fibre, and process parameters.

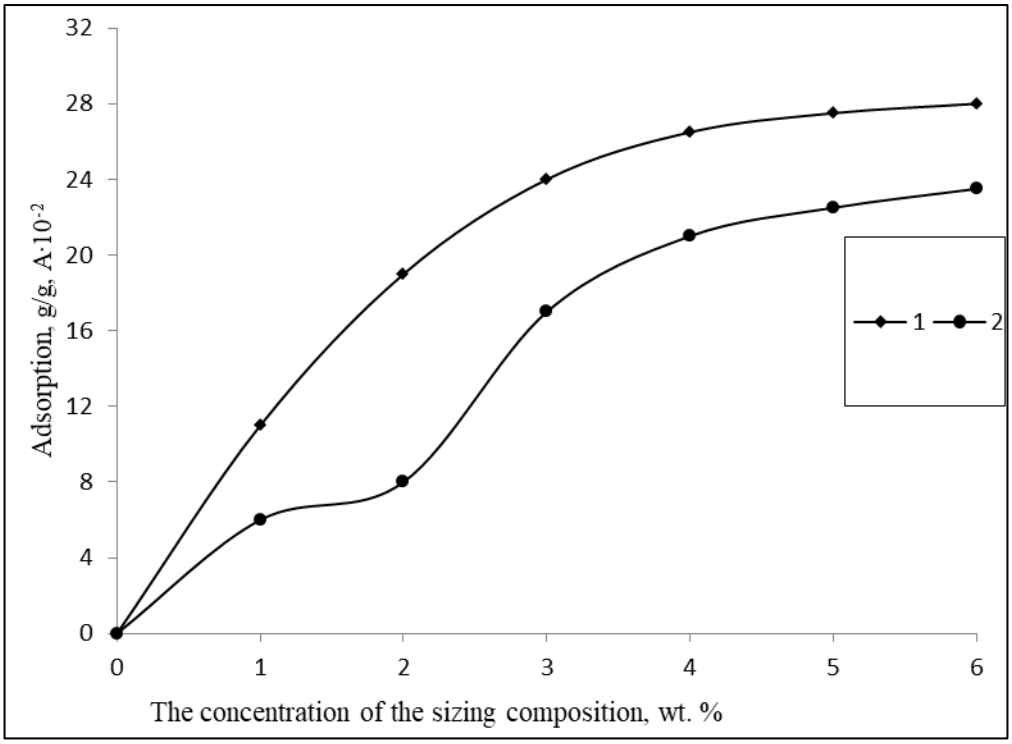

Figure 1 Isotherms of adsorption of the composition from aqueous solution sat 25 °C;1- activated carbon; 2- bentonite.

It has been experimentally established that PVA and HIPAN, as well as starch, have rather good film-forming properties; therefore, their combination with starch as a sizing preparation is quite justified.

Adhesive compositions based on starch, PVA and GIPAN do not lose their adhesive ability for a long time, i.e. are kinetically stable systems.Can be used in water of any hardness in a wide range of pH 7-8 environment.

2.4 Metrological processing

The calculation of the metrological characteristics of the presented methods was carried out in accordance with [21].

3. RESULTS AND DISCUSSION

It should be noted that at the physicochemical parameters of the sizing process, it is possible to interact between groups of polymers and reactive groups of PVA and PIPAN.The products formed as a result of this reaction contain, in particular, amide -CONH, carbamide - NHCONH, carbamate - $OCONH_2$, ester - OSO - and other groups.Their presence in macromolecules of polymer composition makes it possible to improve elastic, structural-mechanical properties, to reduce electronegativity of the adhesive film formed on yarn at splicing [22-28].

An important factor for sizing cotton yarn is drying yarn after sizing.Therefore, to establish the temperature and time parameters of drying the polished yarn, as well as to determine the speed of movement of the base during the polishing, the kinetics of drying the yarn treated with the compositions have been studied (Table 1).

Based on the study of the kinetic parameters of the sizing process, the developed compositions determined the concentrations of the components included in the sizing composition, which is presented in Table 2.As can be seen from the table, the amount of the sizing polymer composition is 50 g/kg, against starch-based sizing - 70 g/kg, i.e., starch consumption is reduced by 25-30%.

Table 1 Kinetic parameters of the process of drying the yarn, a polished composition based on starch, PVA and HIPAN at a ratio of 1: 0.05: 0.01, respectively

	Developedcoatingcomposition			Factorystarch-basedcoatings
	Dryingtemperature, oC			
	85	90	95	90
Basemoisture,%	58	54	59	43
Trueglue,%	7	6	6	7
Time of the second drying period, min.	12	10	9	14
Dryingspeed, m / s	0,5	0,8	0,8	0,5
Cumulativedryingtime	22	10	10	24

It was revealed that the drying rate is predetermined by the chemical nature of the preparation, the fibrous composition of the yarn, the time and temperature modes of drying.The ability to lose moisture of the yarn treated with various coating agents depends mainly on the type of composition.The relatively small ability to retain water molecules is due to the presence of hydrophobic cycles in PVA and HIPAN macromolecules.

Table 2 Optimal process parameters of coating preparation based on the developed composition

Coating components	Content of adhesive components, g/l				Starchcoatings
	Typeofyarn				
	Cottonyarnnumber				
	34	40/1	40/2	54	
Polyvinylalcohol, g / kg	3,0	2,0	3,5	3,5	-
Hydrolyzedpolyacrylonitrile, g/kg	2,0	2,0	2,5	2,5	-
Starch, g/kg	45	50	50	50	70
Gelatinizationtemperature, ºC	85-90	85-90	85-90	85-90	90-100
Gelatinizationtime, min	20-25	20-25	15-20	15-20	30-35

From the data obtained, it should be noted that the specific breaking load is one of the main physical and mechanical indicators of cotton yarn.For yarn coating with the proposed composition, the breaking load is 13-15% higher than in the traditional case, with the same coefficient of variation.

Table 3 Physical and mechanical properties of yarn treated with dressing, obtained at optimal preparation parameters

Indicators	Unitrev.	Developedcoatingcomposition		Factorystarch-basedcoatings
		Cottonyarnnumber		
		34	40/1	34
Viscosity, solutionflowtime	sec	6	7	7
Trueglue	%	23-25	19-21	10-12
Relativestrengthgain	%	18-20	17-19	13-15
Elongation at break of yarn	%	7-8	6-7	9-11
Yarnmoisture	%	10-12	10-11	10-15
Coefficient of variation: breaking load	%	90-100	90-100	90-100
Yarnadhesion	kg/cm	0,8-1,2	1,0-1,4	0,7-1,2
Wearresistancecoefficient	%	06,-1,2	0,5-0,9	0,8-1,4
Breakage	bre/m	0,31	0,37	0,61

Below are the comparative results of sizing cotton yarn with a composition based on the developed composition with data on coating yarn with starch under the conditions of the company "NakshOydin" LLC (Table 3).As can be seen from Table 3, the concentration of the dressing, which has a significant effect on the cost of the dressing, ranges from 45-50 g/kg of the composition, against 70 g/kg of the starch dressing, although the true glue remained at the same level.

According to the results of the experiment, it was found that in the case of coating cotton yarn with the developed sizing compositions, a significant reduction in starch is achieved, i.e. by 25-30%, which is in economic and environmental terms about the feasibility of using the developed composition.It has been established (Table 4) that the yarn breakage depends on several factors: the method of spinning, the chemical nature of the fibrous composition of the yarn, the nature of PVA and HIPAN and their amount in the composition of the coating preparation.The processing of yarn with this size in the process of weaving allows you to reduce the breakage of the warp by 35-40%, increase the productivity by 5-10% and reduce the crumbling by 20-25% in comparison with starch coating preparations.

Table 4 Average statistics of breakage and productivity in weaving

Fabric, art.	Machinebrand	Breakage, bre/m	Productivity, m/hour
47/44	АТ-120-6М	0,29	10,15
150	АТП-120-У	0,41	5,78
544	АТ100-ЛБ	0,27	11,05
12209	АТ100-ЛБ	0,24	8,66
15182	СТБ-2-220	0,36	7,74
Theaverage		0,32	9,23

The results of the analysis of the technological parameters of the process of yarn coating with the developed polymer compositions (Table 4) show that as a result of coating, a strong base is obtained with minimal sizing and TAS costs.

4. CONCLUSION

Thus, it is shown that the viscosity of aqueous solutions depending on the concentration, temperature and pH of the solution medium of the coating composition is described by a first-order equation.

It is approximately 2-3 times lower than coating preparations from starch coatings.The use of preparations from the developed components of the coating composition makes it possible to increase the speed and degree of yarn impregnation during coating, which increases the mechanical fixation of the adhesive film on the fibre and has a positive effect on weaving.

It was found that cotton yarn processed with polymer compositions can be processed on weaving machines of various types while reducing breakage by 35-40% and increasing machine productivity by 5-10% compared to yarn sizing with starch coating.

REFERENCES

[1] AmonovaKh. I., Ravshanov K. A., Amonov M. R. Evaluation of the possibility of using sericin to improve the efficiency of dressing cotton yarn. Compositematerial. Tashkent, 2008 (4.): 66-68.

[2] AmonovaKh. I. Rheological properties of aqueous solutions of polymer composition and their influence on the dressing effect. Composite material. Tashkent, 2008 (2): 32-36.

[3] Amonov M. R., Ravshanov K. A., Hayrullaev CH. K., AmonovaKh. I. Investigation of the process of loosening cotton yarn straightened with starch composition. Reports of the Academy of Sciences of the Republic of Uzbekistan. Tashkent, 2008 (4): 68-69.

[4] Amonov MR, Razzokov HC, Ravshanov KA, Mazhidov AA, Nazarov II, AmonovaKhI. Investigation of the relaxation properties of cotton yarn sized with polymer compositions. Uzbek chemical journal. 2007 (2): 27-30.

[5] Omanov BS, Fayzullaev NI, Musulmonov NK, Xatamova MS, Asrorov DA. Optimization of Vinyl Acetate Synthesis Process. International Journal of Control and Automation. 2020 Feb 27;13(1):231-8.

[6] Yariev O. M., Amonov M. R., AmonovaKh. I., Mazhidov A. A. Evaluation of rheological properties of a polymer composition based on natural and synthetic polymers. Composite material. Tashkent, 2007 (1): 6-10.

[7] Mazhidov AA, Amonov Mr, Razzokov, HC, Nazarov II. Study of thermodynamic characteristics and surface-active properties of a polymer composition based on starch and polyacrylamide. Composite material. Tashkent, 2007 (2): 24-27.

[8] Ismatova RA, Ibragimova FB, Amonov MR, Sharafutdinova RI. Development of a new composition for dressing cotton yarn. Universum: technical sciences. 2019 (11-3 (68)):82-85.

[9] Ishmatov AB, Yaminova ZA, Rudovsky PN. Substantiation of the modes of obtaining sericin in the form of a powder for the preparation of dressings. Proceedingsofhighereducationalinstitutions. Textileindustrytechnology. 2015 (6): 79-83.

[10] Ishmatov AB, Rudovsky PN, Yaminova ZA. Application of sericin for sizing of bases. Proceedingsofhighereducationalinstitutions. Textileindustrytechnology. 2012 (6): 98-102.

[11] Yaminova Z.A. development of a size recipe from silk waste for sizing cotton bases. Bulletin of the Tajik Technical University named after acad. MC Osimi. 2013 (2): 64.

[12] Vashurina IU, Kochkina NE, Kalinnikov UA. The effect of peat humic acids on the structure of the dressing material for starch gels. Journalofappliedchemistry. 2006;79(2):322-5.

[13] Vashurina IU, Kochkina NE, Kalinnikov UA. Influence of microadditives of humic acids on the properties of starch hydrogels and films formed from them. Chemical fibre. 2004(5):26-9.

[14] Ibodullayevich FN, Yunusovna BS, Anvarovna XD. Physico-chemical and texture characteristics of Zn-Zr/VKTS catalyst. JournalofCriticalReviews. 2020;7(7):917-20.

[15] Vashurina IU, Kochkina NE, Kalinnikov UA. The effect of peat humic acids on the structure of the dressing material for starch gels. Journal of applied chemistry. 2006;79(2):322-5.

[16] Zakharchenko as, Alyoshina AA, Kozlova OV. Properties of film-forming polymers used in the finishing of textile materials. Newsofhighereducationalinstitutions. Chemistryandchemicaltechnology. 2012;55(3).

[17] Akramovna YZ. Physical and chemical aspects of obtaining of sericin from silk waste to size cotton yarn. Austrian Journal of Technical and Natural Sciences. 2015(1-2):121-123.

[18] Shagina ON. New technologies in the textile industry. Bulletin of the Dagestan state technical University. Technicalscience. 2007(13): 100 – 101.

[19] Kozlova OV, Melenchuk EV. The use of domestic polymers in the creation of retroreflective textile materials. News of higher educational institutions. Chemistry and chemical technology. 2013;56(2): 121-123.

[20] Bondareva TA Neva VV. The technology of production of fabrics.2011.335.

[21] Mamadoliev II, Fayzullaev NI, Khalikov KM. Synthesis of High Silicon of Zeolites and Their Sorption Properties. InternationalJournalofControlandAutomation. 2020;13(2):703-9.

[22] ISO 5725.1-6 Accuracy (accuracy and precision) of measurement methods and results. Part 2. The main method for determining the repeatability and reproducibility of a standard measurement method

[23] GOST 10078-85. Yarn from bast fibres and their mixtures with chemical fibres. General specifications.

[24] Stepanova TYU, Sakharova SG. Modification of the friction properties of complex polyester yarns by emulsifying them. News of higher educational institutions. The technology of the textile industry. 2010(8):12-4.

[25] Sakharova SG, Stepanova TY, Talanova VA. A statistical model of the influence of physical properties of surfactant solutions on the wear resistance of polyester fibres. Izvestiyavuzov. Chemistry and chemical technology. 2010;53(6):76–78.

[26] Stepanova TY, Sakharova SG, Romanychev NK. Influence of high-molecular alcohols on the mechanical and tribological properties of polyester yarn. Plantlaboratory. Diagnosticsofmaterials. 2008;74(4):62-3.

[27] Mamadoliev, I. I., N. I. Fayzullaev, and K. M. Khalikov. "Synthesis of High Silicon of Zeolites and Their Sorption Properties." *International Journal of Control and Automation*, 13.2 (2020): 703-709.

[28] Fayzullaev NI, Bobomurodova SY. Laws of Catalytic Aromatization Reaction of C1-C4-Carbohydrates and Texture Characteristics of Catalysts. InternationalJournalofPsychosocialRehabilitation. 2020;24(04).