Volume 1, Issue 9, December, 2023 **ISSN (E):** 2938-3811

DEVELOPMENT OF THE COMPOSITION OF THICKENING COMPOSITIONS FOR PADDING FABRICS BASED ON MIXED FIBERS

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Abstract
The viscosity of the developed composition was studied depending on the concentration of the components and it was found that an increase in the concentration of PVA and AE promotes an increase in the viscosity of the system. Because of this, the developed polymer composition becomes stable during long-term storage, which is an important factor from a technological point of view. The change in thermodynamic parameters during the formation of thickening compositions was studied.

Keywords: composition, viscosity, thickener, crumbling, blended fiber, concentration, thermodynamic parameters, fibers.

Introduction

In the industry for dyeing silk and acetate blended fabrics, the problem of creating an effective binding thickener is very urgent. The role of the binding thickener is to increase the degree of dye fixation to the fiber and increase the intensity of the color. The thickener should have a wide range of properties. These properties include: good thickening effect at low polymer concentrations, storage stability, good washability, brightness, hiding power, water retention capacity, lack of foaming, etc. [1-4].

LITERATURE AND METHODOLOGY

In this aspect, the peculiarities of the rheological behavior of solutions of polymer composite binding thickeners based on polyvinyl acetate (PVA), acrylic emulsion (AE) and surfactant OP-10 are of great importance. At the same time, the speed of restoration of the internal structure of the system after mechanical action in the dyeing process is very important, which to a certain extent can be judged by hysteresis loops on flow curves (Fig. 1 and 2).

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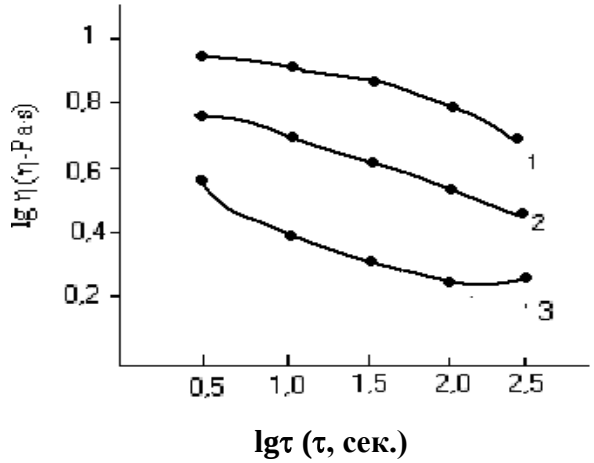
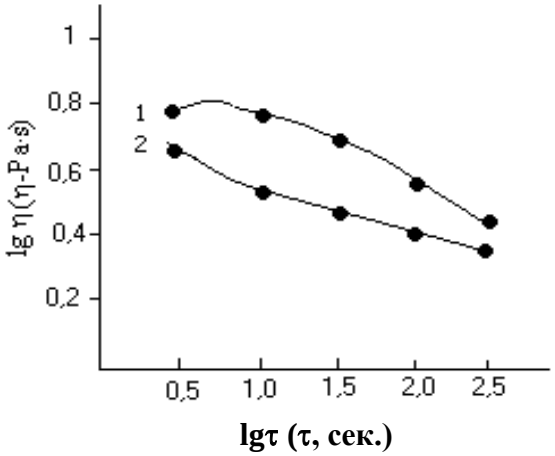


Rice. 1. Dependence of the viscosity of the compositions on the shear stress. Composition containing PVA, AE and OP-10
1 – freshly prepared composition
2 – after 3 days of storage of the composition



Rice. 2. Viscosity Dependence Compositions from Shear Stress
1 – PVA-AE
2 – PVA-OP-10;
3 – ПВА-АЭ-ОП-10

Table 1 Dependence of viscosity of compositions on the concentration of components (at 298K)

Component Concentration in solution (%, wt)			Viscosity, η Па·с	Concentration of components in solution (%, wt)			Viscosity the Па·с
PVA	AE	OP-10		PVA	AE	OP-10	
1,0	0,5	-	1,36	1,0	-	0,4	1,22
	1,0	-	1,47		-	0,5	1,17
	1,5	-	1,55		-	0,6	1,10
1,5	0,5	-	1,43	1,5	-	0,4	1,34
	1,0	-	1,57		-	0,5	1,27
	1,5	-	1,75		-	0,6	1,23
2,0	0,5	-	1,61	2,0	-	0,4	1,48
	1,0	-	1,78		-	0,5	1,40
	1,5	-	1,84		-	0,6	1,34
1,5	0,5	0,4	1,31	2,0	0,5	0,4	1,48
	1,0	0,8	1,27		1,0	0,8	1,63
	1,5	1,2	1,15		1,5	1,2	1,77

OUTCOMES

From the data obtained in Figures 1 and 2, it can be seen that the proposed water-soluble polymer composition is stable during long-term storage and does not show a tendency to syneresis. This phenomenon can be explained on the basis of data on the compatibility of the miscible ingredients that are part of the thickeners in solution. As is known, in the case of poor compatibility, macromolecules, due to the repulsion of the latter, tend to curl up into balls and reduce their effective size, as a result of which the number of bonds between them decreases, and due to this, the viscosity of the mixture decreases. As a result, the system becomes unstable

and such thickeners become unsuitable for the preparation of mixed thickeners [3].

At the concentration ratio of PVA:AE:OP-10 = 1.5:1.0:0.5 (%, wt.), even some additional unfolding of the macromolecules of the miscible thickeners and the intensification of the interaction between them leads to an increase in the viscosity of the mixture and its stability. Such a phenomenon in the solutions of the developed formulations is also confirmed by the results of the experiment, which are presented in Table 1. 1.

The obtained data (Table 1) show that the viscosity of the solution of the polymer composition is significantly influenced by the concentrations of the components. For example, the viscosity of the composition at a concentration of PVAc 1.5%, AE – 1.0%, OP – 10 0.5% was 1.27 Pa·s at T=298 K, and PVAc at a concentration of 2.0% viscosity increased to 1.78 Pa·s.

It should be noted that there is practically no information on the cohesive properties of thickening compositions currently used in dyeing, which is explained by the complexity of the compositions and the poor knowledge of the chemical structure and structure of such thickeners. In view of the above, the study of changes in thermodynamic parameters in the process of formation of thickening compositions is not only of practical importance, but also theoretically plays an important role in the study of such polymer composite materials.

Therefore, when studying the reaction of structure formation in compositions and the stability of the formed composites, great importance is attached to the study of thermodynamic characteristics: activation energy, enthalpy and entropy [6]. When studying the effect of changes in the concentration of PVAc polymer on the thermodynamic parameters of the compositions, an anomaly was revealed. The introduction of PVAc into the composition of the composition containing AE and OP-10 prevents the mutual ordering of the formed enlarged supramolecular formations, which is indirectly confirmed by the increase in the entropy of the viscous flow of these systems in contrast to similar ones polymer systems (Table 1.2).

Table 2 Influence of PVAc content on thermodynamic parameters thickening mortar

Concentration, %, wt.		ΔG	ΔH	ΔS
Composite No.	PVA	kJ/mol (at T=298 K)		
1	0,5	11,6	10,1	-2,7
2	1,0	14,7	12,3	-1,6
3	1,5	16,2	14,4	-0,3
4	2,0	20,7	17,6	2,8
5	2,5	23,4	21,2	4,6
6	3,0	24,8	23,4	5,7

From the data in Table 2 it can be seen that the administration of water-soluble PVA leads to an increase in the Gibbs energy and enthalpy of the system. Obviously, its macromolecules are incorporated into the supramolecular structure of the water-soluble polymer due to the adsorption interaction of polymer chains with the AE surface. This leads to a decrease in molecular mobility in the boundary layer and an increase in supramolecular structures, the formation of a more developed spatial network in the polymer system. As a result, its viscosity increases. However, when OP-10 is introduced into the composition, the viscosity decreases

slightly. This appears to be due to a partial decrease in the interaction between them.

DISCUSSION

The viscosity depends on the concentration and size of the macromolecules injected with PVA and AE. The observed thickening effect persists in a wide temperature range (293-353 K). Increasing the viscosity of the aqueous solutions of the composition when PVAc is introduced opens up the possibility of developing new thickening preparations with a reduced content of thickening material. Changes in the thermodynamic parameters of the viscous flow of PVAc with different AE content are given in Table 3.

Table 3 Thermodynamic characteristics of the composition at different concentrations (%) of AE. The content of PVAc and OP-10 is 1.5 and 0.5 %, respectively

AE content in solution, %	Viscous Flow Activation Energy, Ea, kJ/mol					Heat of activation of viscous currentΔ, N, J/mol	Entropy, (ΔS<0) J/mol				
	298	313	333	343	353		298	313	333	343	353
	14,25	13,86	13,64	13,24	13,06	375,16	54,70	52,56	48,30	41,15	39,26
0,5	16,64	16,07	15,72	15,26	14,92	396,80	60,36	56,75	51,84	46,25	41,17
1,0	17,82	17,41	17,20	16,86	16,64	404,25	63,15	60,27	57,15	54,47	52,25
1,5	19,16	18,83	18,36	17,93	17,71	409,16	66,26	64,18	61,72	58,15	55,47
2,0	21,08	20,76	20,27	19,82	19,56	412,23	70,18	67,84	65,14	63,07	60,72

From the data in Table 3. As can be seen from Table 3, the activation energy of the viscous flow increases with an increase in the AE content in polymer solutions. The activation energy of the viscous flow characterizes the potential barrier that must be overcome in order for the macromolecule to transition from the state of a dense ball to an unfolded conformation. The higher the activation energy value, the higher the cohesive interactions between the macromolecules. This means that the polymer system (PVA-AE-OP-10), formed by the addition of AE, it is characterized by a more complex and durable structure in terms of both the dye and the binder. The more AE there is in the system, the more complex and strong the resulting structure.

CONCLUSION

From the data obtained, as expected, the introduction of AE into the solution of the composition is accompanied by an increase in entropy. According to the second law of thermodynamics, spontaneous processes occur in the direction of increasing entropy. This means that the formation of complexes in PVAc, AE and OP-10 solutions is a spontaneous process, and the more PVAc, AE and OP-10 in the system, the more stable it is.

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