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Potential Bases of Physical Modification of Local Minerals-Heterocomposite Polymer Materials

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Abstract. The article explains that "Angren Kaolin" LLC produces enriched kaolin of AKF-78, AKS-30, AKT-10 brands, Kaolin AKF-78, mainly used as a filler in paper production and its unique properties include excellent adhesion and a high kaolin particle thickness ratio of 30:1 and solar curing of the polymer composition to control the strength response in the preparation of highly viscous epoxy composites using GS in a 10:10 (w/w) ratio with DBF, high-viscosity epoxy compositions using gossypol resin in a ratio of 50:50 with DBP, which is an effective way to save energy, and solar treatment of the polymer composition is important in their practical application in the industry for technological equipment and products operating under conditions of corrosion-hydroabrasive corrosion save energy in cooking, effective way to control the hardening reaction.
Key words: "Angren Kaolin" LLC, AKF-78, AKS-30, AKT-10 branded enriched kaolin, polymer, compositions, plasticizer - dibutyl phthalate, solar radiation, gossypolsmol, processing, corrosion-hydroabrasive.

The actuality of the research. Today, improving the machine-building industry on the basis of resource-saving technology and solving scientific and technical problems is considered one of the urgent issues. A number of scientific researches are being carried out in the developed countries of the world on non-traditional technology using the parabolic cylindrical solar energy concentrator. Decree of the President of the Republic of Uzbekistan dated January 28, 2022 No. PF-60 "On the Development Strategy of New Uzbekistan for 2022-2026" assigned tasks on "Through the further development of cooperation in the automobile industry, increase the volume of production by 1.4 times, double the volume of exports and increase the level of localization"

Degree of knowledge of the problem: In our republic, scientists, namely Sh. Tilavoldiyev, U.A. Ziyomukhammedova, M.A. Nurdinov, L.Y. Virgins [1-5;] and Gulyakova A., Frubing P., and Gorokhovatsky Yu.A [3;] V.A. Belyy, A.I. Sviridenok, M.I. Petrokovets[4;] used the parabolic cylindrical solar energy concentrator used in mechanical engineering, and by introducing unconventional technology, they conducted a number of researches on corrosion and abrasive wear on the working surfaces of machine and aggregate parts, as well as their use in wheeled and crawler machines.

Taking this into account, "Angren kaolin" LLC, operating in our republic, is currently producing enriched kaolin of AKF-78, AKS-30, AKT-10 brands. Kaolin AKF-78 is mainly intended for use as a filler in paper production. Its unique properties include excellent adhesion and a high kaolin particle thickness ratio of 30:1. Kaolin AKS-30 is widely used in the production of ceramics. Due to the positive effect on the formation of ceramic pieces, this brand of kaolin is recommended for use, especially in cases where the process of creating ceramics is carried out by casting method.

The aim of the research: Research objects for obtaining nanocomposite materials and coatings from them and methods for determining their properties. Based on the goals and objectives of the research, the following were selected: cold-hardening thermoset polymer: epoxy resin ED-20, polyethylene polyamine (PEPA) reinforcement, plasticizer - dibutyl phthalate (DBP), as well as a structure-forming agent - local industrial waste and products of "Angren Kaolin" LLC Chemical modifiers from AKF-78, AKS-30, AKT-10 brands (Table 1).

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As a filler for composite materials in mechanical engineering, we selected the products of Angren Kaolin LLC and well-known standard methods for studying the properties of heterocomposite materials and their coatings, using AKF-78, AKS-30, AKT-10 brand kaolins.

The methods of the research: In the conducted research, physical and mechanical properties were determined by standard methods known to everyone [6]. Structural changes on the surface of coatings by optical (MIN-8, MBI-6) and electron microscope (SEM-1002) methods, and mechanical properties (microhardness) using PMT-3 and ME-3 pendulum instruments, thermomechanical properties of coating materials – Q– 102 in the derivatograph, the adhesion force was studied on the F01 dividing machine.

Table 1

Selected materials for coating of chemical modifiers from AKF-78, AKS-30, AKT-10 brands

№	Name of materials	State Standard (GOST) or TU	Note
1	Epoxy resin	GOST10587–72	Thermo-reactive binder
2	(ED-20)	GOST 8728–76	Plasticizer
3	Dibutyl phthalate (DBF)	O′zDSt86–38:2001	Structure builder
4	Gossippolsmola	TU 6–02–594–70	Stiffener
5	AKF–78		Filler
6	AKS–30		Filler
7	AKT–10		Filler
8	AKO		Filler

The research results: The following results were obtained in the conducted researches, after processing of epoxide and furanoepoxide compositions for 5 minutes, the strength reaction is accelerated by 1.7-2.4 times depending on the strength content, and during the 5-minute processing, the strength response is accelerated to a high level at an external temperature of 42^0C and it was observed that the composition contained 12 PEPA for ED. The results of our observation depend on the following conditions, that is, it became clear that the viscosity of the composition under the influence of solar energy is significantly reduced compared to the compositions in the shade, the decrease in viscosity is due to the increase in the liquid and, as a result, to a more uniform distribution of the hardening molecules and their functional helped the orientation of the groups.

In order to establish the optimal proportions of plasticizing components and solar radiation processing modes, the effect of external temperature on the micro-hardness of polymer coatings was studied (Table 2.6). For these purposes, an epoxide composition containing 12 mass/parts of PEPA was selected.

It was found that the processing time of solar radiation was 1800-36000 seconds and due to the effective influence of solar energy, not only the rapid increase in the degree of interconnection, but also the hardening reaction of the polymer network begins, but as a result of improving the structure of PCM, especially with GS, it was observed that the durability of epoxy coatings was improved.

Table 2

Effect of different ratios of GS and DBF on micro-hardness of coatings during solar treatment

Processing time in the sun τ, c	Micro-hardness of coatings in GS:DBP ratios in Nm, MPa, mass/part.				
	20:0		20:0		20:0
1800	82	1800	82	1800	82
3600	132	3600	132	3600	132
18000	151	18000	151	18000	151
36000	192	36000	192	36000	192

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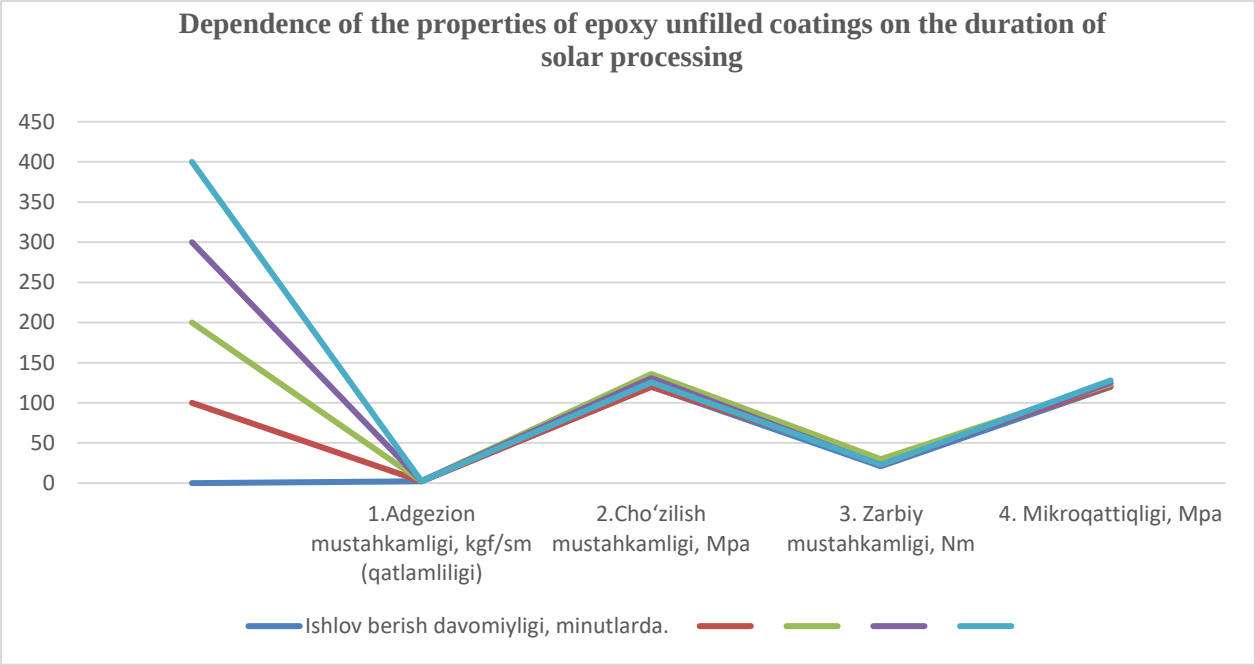
In addition, in our research, the influence of external temperature on the micro-hardness and impact strength of polymer coatings was studied in order to apply optimal modes of solar radiation processing, for its implementation, an epoxy composition containing 12 mass/parts of PEPA was chosen, the time of sunlight treatment was 5 minutes, the curing process of the coating was carried out in the shade (air temperature in the room 30 0C), and the samples were 24 hours after the coating was obtained. was then



tested and due to the effective influence of solar energy, it was observed that not only the beginning of the strengthening reaction of the polymer network, but also the intensive growth of the level of interconnection, the improvement of the mechanical properties of epoxy coatings as a result of the improvement of the structure of the polymer. In addition, it was found that the greater the flow of solar energy (or outdoor temperature, processing), the higher the micro-hardness and impact resistance of the coating with the same composition.

Figure 1. Dependence of the properties of epoxy unfilled coatings on the duration of solar processing

In the conducted experiments, the properties of epoxy coatings were studied depending on the duration of treatment in order to develop methods for the formation of polymer coatings by sunlight treatment and the composition includes 12 mass/part PEPA, 10 mass/part DBP and 10 mass/part GS, and as the curing time increased to 300 minutes, the viscosity of the epoxy coatings increased from 2.21 kgf/cm (control) to 2.50 kgf/cm cm, i.e. 13% increase compared to untreated was observed.

In addition, the tensile strength - by 12%, the impact strength - by 47%, and the micro-hardness of the coating increases slightly and an increase in processing time and improvement of physical and mechanical properties in the process of direct processing of the polymer coating in the sun, i.e., if heating of the polymer mass and the substrate in the process of crosslinking of the chemical reaction by the processing agent was observed, it was found that reducing the viscosity of the composition increases the mobility of the macromolecular chains of the polymer and improves the orientation of the functional groups of the interacting components.

Table 3

Dependence of properties of epoxy coatings produced by solar treatment on ambient temperature

Mechanical properties of coatings	**30 ^{0}C**	**35^{0}C**	**40 ^{0}C**	**45 ^{0}C**	**47 ^{0}C**	**50 ^{0}C**
1. Microhardness, Mpa	75,3 (67,2)	78,4 (70,3)	87,3 (79,2)	103,0 (95,1)	117,2 (105,8)	120,8 (109,7)
2. Impact strength, Nm	17,5 (19,2)	21,3 (24,6)	28,4 (31,5)	28,0 (32,7)	25,0 (29,5)	25,4 (30,1)
3. The degree of	93,4	94,8	94,9	97,6	98,2	97,3

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crosslinking of the polymer network, %	(95,6)	(96,5)	(96,9)	(98,8)	(99,4)	(99,4)
Note: given in parentheses for plasticized GS coatings						

According to the operational characteristics of Angren kaolins: microhardness and impact resistance to tearing, with the same composition of 50 mass/share and after sun treatment for 10 hours, it was found that the nanocomposite coatings filled with Angren kaolin brand AKT-10 had very good performance characteristics, and the worst indicators were observed in the composite coating filled with AKF-78.

According to the analysis of the obtained results, fillers with the same natural properties affect the properties of coatings in different ways depending on the dispersion. It should be noted that the higher the amount of nano-sized fillers (AKF-78), the higher the operational properties of coatings with a low filler content (10–20 mass/part) are and high cost-effective (30-50 mass/part) coatings with a high content of nano-sized substances deteriorate the properties. Also, if we explain it on the basis of technological characteristics, that is, the deterioration of the wetting of fillers, a sharp increase in the viscosity of this composition, and the deterioration of the quality of the coatings containing 60 mass/part and more, it is observed that it is completely suitable for bulk materials. 60 mass/part of the filler is not yet the limit, and with the increase in the content of the filler, the density of the material makes it possible to increase various intensities.

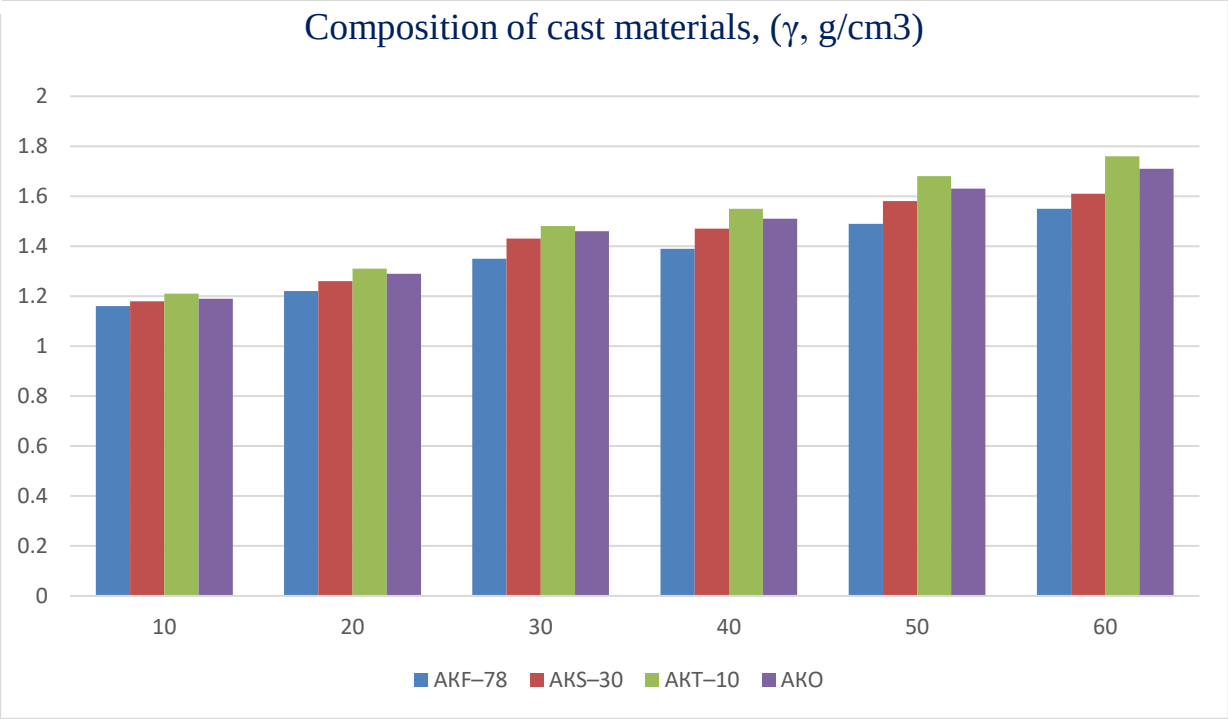

Figure 2. Effect of the type and composition of fillers (Angren kaolins) on the microhardness of nanocomposite epoxy coatings.

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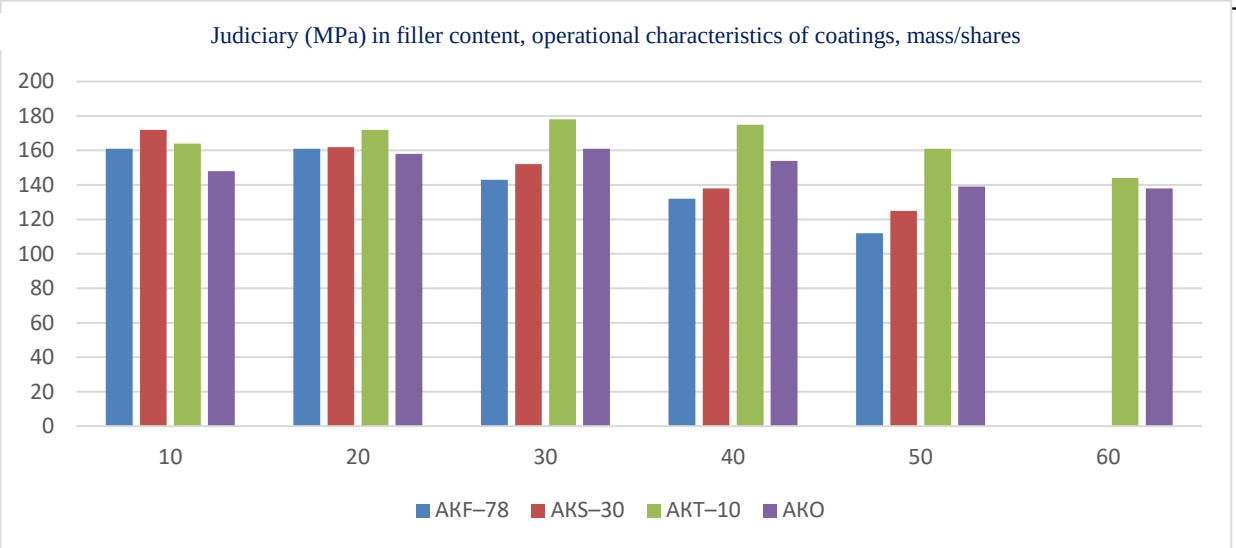

Figure 3. Influence of the type and composition of fillers from Angren kaolins on the density of nanocomposite bulk materials.

Conclusion: The above results are an effective way to control the strength reaction in the preparation of high-viscosity epoxy composites using GS with 10:10 (w/w) ratios of DBF with DBF, an effective energy-saving method, and the technology of solar processing of polymer materials and corrosion- It is explained by the conclusion that it is an effective method of controlling the hardening reaction, saving energy in the preparation of high-viscosity epoxy compositions using gossypol resin in a ratio of 50:50 with DBP, which is important in their practical application in the industry for products working under conditions of hydroabrasive corrosion.

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