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RESEARCH OF PROPERTIES OF HETEROCOMPOSITE POLYMER MATERIALS FILLED FROM LOCAL MINERAL AND COATINGS FROM THEM FORMED BY HELIOMETHOD

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Abstract
The article presents the results of studies of the effect of fillers from industrial kaolins of various grades on the performance properties of composite polymer materials processed by curing with direct exposure to natural solar radiation. The optimal amounts of fillers from the local natural mineral in the composition of the composite polymer material are determined. It is shown that in the future it is advisable to use concentrating solar radiation (CSR) with various parameters.
Key words: composite polymer materials (CPM), fillers, dispersion, microhardness, impact strength, operational properties, mechanical properties.

1. Introduction.

Among renewable energy sources, solar energy is the most promising in terms of resources, environmental cleanliness and prevalence. The main climate-forming factor is a significant influx of solar radiation, reaching 800 - 1000 MJ / m2 per month during the summer [1]. This creates favorable conditions for the development of solar energy in the Republic of Uzbekistan.
Solar energy is carried mainly by light and, to a lesser extent, infrared rays. When light interacts with a substance, part of the incident light is absorbed by the substance and it heats up. When heated, the degree of freedom of the elements of the polymer macromolecule increases, and the polymer goes into a highly elastic state. Polymers tend to be sticky when heated.

2. Literature Survey

It is also known that direct exposure to the sun improves the physicomechanical properties of heterocomposite polymer materials (HCPM) [2,3]. This is explained by the fact that during direct processing of the polymer coating in the sun, that is, during the course of the chemical crosslinking reaction, the polymer mass is heated and substrates with a curing agent. A decrease in the viscosity of the composition leads to an increase in the mobility of the macromolecular chains of the polymer and improves the orientation of the functional groups of the interacting components.

The terminology “heterocomposite” is understood [3]: a variety of composite materials consisting of heterogeneous organic, like polymer, and inorganic, like mineral, metal, etc., components that practically do not have chemical interaction between themselves at the macrostructural level. Moreover, each component has its own purpose. The traditional three-component technology (pressure, temperature, time) of obtaining a composite material with the required properties today needs further development in combination methods of colloidal chemistry and physics, in particular, ultradispersion of nanoparticle particles. This new scientific field, which is intensively developing today throughout the world, is called "nanotechnology", which results in "nanocomposites" that meet modern materials science requirements.
The authors of [4] studied the effect on the technical state of technology of the aging processes of structural materials under the influence of loads and environmental factors: temperature, humidity, solar radiation. It is noted that the experience of operating aircraft in various climate conditions, the most significant impact on its technical

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condition is not caused by mechanical wear of parts, but by the processes of corrosion and aging of materials under the influence of environmental factors. In relation to CPM, these factors contribute to the development of the course of physical and chemical processes in materials, causing a change in their operational, in particular, strength indicators.

3. Methodology

The objects of research were polymer materials for coatings based on epoxy compounds based on ED-16 resin and fillers - industrial kaolins of the Angren deposit. As model and control samples used steel (Art. 3) as a widely applicable structural material. The coatings were prepared using a plasticizer — dibutyl phthalate (DBP) and a hardener — polyethylene polyamine (PEPA) with cold curing for 24 hours.

For the use of CPM and coatings from them in mechanical engineering, one of the main factors ensuring the reliability of materials is mechanical properties.

Stabilization of the structure, increasing the resistance of polymers to degradation and aging are achieved by various technological and operational measures of a general and specific nature. A relatively common method of inhibiting degradation when exposed to light and irradiation is the introduction of chemicals (compounds) that can absorb ultraviolet and other rays without being subjected to photosynthesis or changes. Such reagents include fillers, stabilizers, etc.

One such filler is kaolin, mined in Angren. At the Angren deposit, kaolins of two genetic types are mined - primary and secondary. Kaolin clays are composed, mainly kaolinite is found in quartz and less commonly calcite, tourmaline, zircon, rutile, chlorite, and iron hydroxides.

Primary kaolins are the products of a change in parent aluminosilicate rocks. They lie below the Angren mine, a powerful coal deposit being developed. Their reserves are estimated at 45.6 million tons.

Secondary Angrenkaolins belong to the coal mined along the way. The estimated and confirmed reserves of the secondary kaolin of the Angren deposit are 1.4 billion tons. Kaolin is one of the most important types of mineral raw materials, the main consumer of which is currently large and growing industries - paper, rubber and plastics.

Currently, enriched kaolin of the AKF – 78, AK – 30, and AKT – 10 grades is produced at the enterprises [5].

Kaolin AKF-78 is mainly intended for use as a filler in the paper industry. Among its special distinguishing properties are its excellent viscosity and an excellent ratio of the ratio to the thickness of kaolin particles 30: 1.

Kaolin AKS-30 has a wide range of applications in the manufacture of ceramics. Due to the positive effect on the formation of shards, this brand of kaolin is recommended for use, especially in cases where the process of ceramic formation is carried out by molding.

The AKT-10 production brand is used in limited quantities, and the tail product (AKO) is a production waste, which makes up about 50% of the total volume of processed products and is practically not used and its accumulation is fraught with the environmental problem of the area. In this regard, the definition of ways of rational use of Angren kaolin products, in our opinion, is promising, associated with the use of local raw materials in various sectors of the economy of the republic, in particular in engineering when developing multifunctional materials and coatings from them.

The physicomechanical properties of composite polymer coatings were investigated using SMH-3 and the pendulum device ME-3.

The formation of coatings was carried out by the heliomethod, i.e. under the influence of solar radiation on a specially designed stand, providing a constant direction to the Sun.

The main components and parts of screw conveyors of cotton seeds coated with heterocomposite coatings subjected to solar processing are presented in Fig. 1.

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FIGURE 1. Helical conveyors of cotton seeds coated with heterocomposite coatings subjected to solar treatment. Dispersion analysis of mineral fillers was performed on a device of a particle size analysis system in the laboratory of Angren Kaolin LLC on a SediGraph 5100 instrument from MICRO MERITICSINSTRUMENTCORPORATION.

4. Findings

The results of the study of the operational properties of coatings showed that the coatings filled with AKT-10 grade Angren kaolin have the best performance properties, and the worst are observed with composite coatings filled with AKF-78 (Figure. 2, 3).

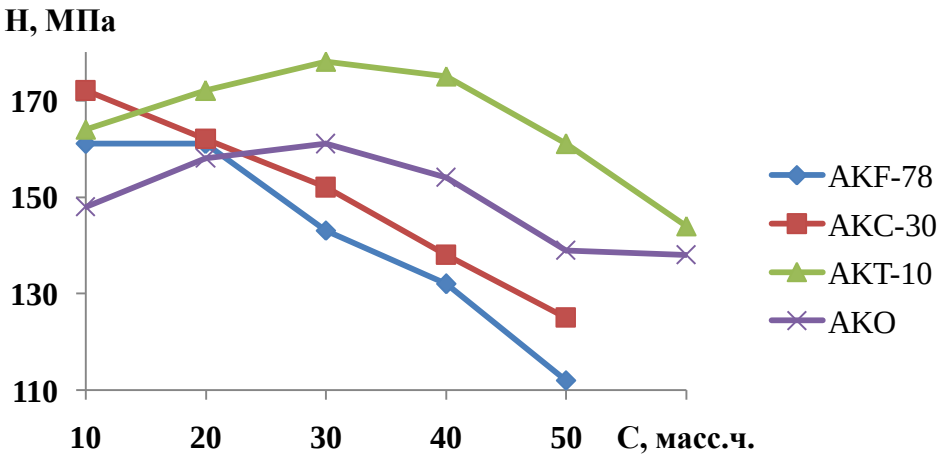

FIGURE 2. The effect of the type and content of fillers (Angrenkaolins - AKF-78, AKS-30, AKT-10 and AKO) on the microhardness (H) of epoxy coatings

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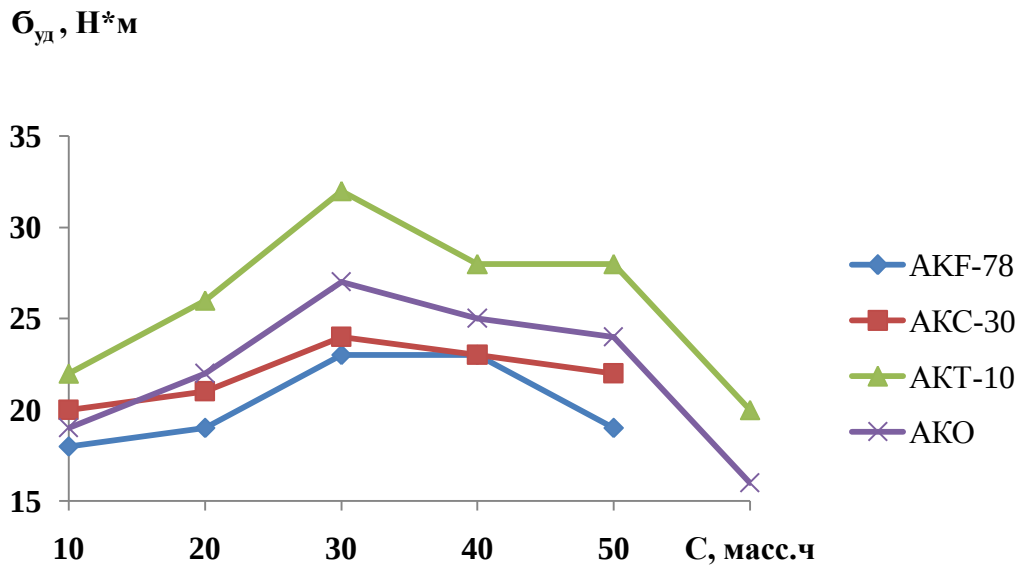

FIGURE 3. Influence of the type and content of fillers

(Angrenkaolins - AKF-78, AKS-30, AKT-10 and AKO) for impact strength (Бsp) of epoxy coatings.
As can be seen from the analysis of the results obtained, the microhardness and impact strength of the coatings are different depending on the brands of kaolin. It should be noted that the larger the distribution index of the granularity of the filler particles (AKF-78) (Table 1), the higher the operational properties of the coatings at its low (10–20 mass parts) contents, and at its high contents (30 –50 parts by weight) a deterioration in the performance of coatings is observed.

№	Industrial brands of Angren kaolin	Graindistribution,%	
		lessthan 1 micron	5-45 micron
1	AKF-78	71-73	25-28
2	AKC-30	49-50	47-49
3	AKT-10	25-32	65-72
4	AKO	21-25	72-75

This can be explained on the basis of technological properties, namely, the deterioration in the wettability of the filler particles, which is observed with a sharp increase in the viscosity of the composition at a filler content of 60 parts by weight and more.
From an analysis of the research results presented in Fig.5, it can be noted that for filling materials, the filler content is 60 parts by weight not the limit yet.

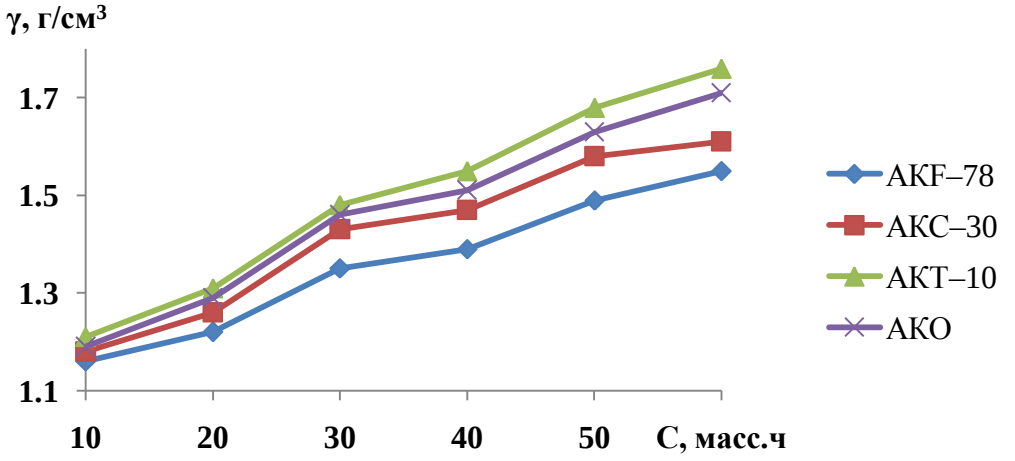

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Figure 4. Influence of the type and content of fillers (Angren kaolin -AKF-78, AKS-30, AKT-10 and AKO) on the density (γ) of nanocompositeepoxy coatings.
Since with increasing filler content, the density of the material increases, however, with different intensities.

The composition is a dispersed system consisting of a polymer matrix in which the solid particles of the filler are distributed. The properties of such a system are determined not only by the properties of the polymers and filler, but also by the nature of the distribution of particles in the matrix volume and the processes of interaction at the interface.

For example, the smaller the amount of fillers (AKF-78, AKS-30), the less rapidly the density of the material increases. This indicates the formation of micropores in the composition due to the deterioration of structure formation, due to the large specific surface of the filler.

It should be noted that there are the following main types of renewable energy sources:
- solar energy;
- wind energy;
- biomass energy;
- energy of small rivers;
- sea wave energy;
- geothermal energy;
- energy of water inflows;
- low potential thermal energy;
- sources of other energy.

Recently, concentrated solar radiation (CSI) energy has been widely used.

These include the following main devices:
1. Parabolaoid concentrating surface of devices with various parameters.
2. Large-sized devices with a cylindrical concentrating surface.
3. Devices having covered concentrating surfaces with various functional patterns.

The study showed that in the future it is advisable to use concentrating solar radiation (CSI) with various parameters. The report will provide detailed information.

5.Conclusion

The amount of Kaolin fillers in the composition of composite polymer materials affects the physicomechanical properties of materials depending on their grades associated with their dispersion, the lower the dispersion of the filler, the higher the performance of coatings at low (10–20 parts by weight) filler contents and at high filler contents (30–50 parts by weight), the properties of the coatings are deteriorated when the particle size content is less than 1 μm in an amount of 50–73% (AKF – 78, AKS – 30).

The optimal amount of Angren kaolin content in casting materials and coatings is 20–30 parts by weight. Moreover, from an economic point of view, kaolins with large particles are more advantageous in the compositions, which is associated with the consumption of expensive epoxy oligomers

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