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Investigation of Influence of Fillers on the Properties of Composite Polymeric Materials Obtained with the Use of Solar Energy

U.A.Ziyamukhamedova, L.Y.Bakirov

Tashkent State Technical University named after Islam Karimov

ABSTRACT: The results of studies of the effect of fillers from branch kaolins of various grades on the performance properties of composite polymer materials are presented. Optimum amounts of fillers in the composite polymer material were determined.

KEYWORDS: composite polymer materials (CPM), fillers, dispersity, microhardness, impact strength, performance properties, mechanical properties

I.INTRODUCTION

Among renewable energy sources, solar energy in terms of resources, ecological purity and prevalence is the most promising.

The main climate-forming factor is a significant influx of solar radiation, reaching 800-1000 MJ/m^2 per month during the summer [1]. This creates favorable prerequisites for the development of solar energy in the Republic of Uzbekistan.

Solar energy is transferred mainly light and, to a lesser extent, infrared rays. In the interaction of light with matter, part of the incident light is absorbed with the substance and it heats up. When heated, the degree of freedom of the elements of the macromolecule of the polymer increases, and the polymer passes into a highly elastic state. Polymers are characterized by stickiness when heated.

It is also known that direct exposure to the sun improves the physico-mechanical properties of composite polymer materials (CPM) [2,3]. This is because when the polymer coating is directly processed in the sun, that is, during the chemical cross linking reaction, the polymer mass is heated up and a substrate with a curing agent. Reducing 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 authors [4] studied the effect on the technical state of the technology of the aging process of structural materials under the influence of loads and environmental factors: temperature, humidity, and solar radiation. According to the authors of [4], the experience of operating aviation equipment in different climatic conditions, the most significant impact on its technical condition is not the mechanical wear of parts, but the processes of corrosion and aging of materials under the influence of environmental factors. With reference to the CPM, these factors contribute to the development of the flow of physico-chemical processes in materials, causing a change in their operational, in particular, strength indicators.

Stabilization of the structure, increase in the resistance of polymers to degradation and aging are achieved by various technological and operational measures of a general and specific nature. A comparatively general way of inhibition of destruction under the influence of light and irradiation is the introduction of chemical reagents (compounds) capable of absorbing ultraviolet and other rays without undergoing photosynthesis or changes themselves. Such reagents include fillers, stabilizers, etc.

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

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

Secondary Angren kaolin refers to the output of raw coal output. The estimated and confirmed reserves of secondary kaolins 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.

At present, enriched kaolin of the brands AKF-78, AK-30, ACT-10 [5] is produced in enterprises.
Kaolin AKF-78, mainly intended for use as a filler in the paper industry. Among its distinctive properties are excellent viscosity and excellent ratio to the thickness of kaolin particles of 30: 1.

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

ACT-10 is used in limited quantities, and the tail product (ACO) is a waste of production, accounting for about 50% of the total volume of processed products. It is practically not used and its accumulation is fraught with an environmental problem of the area. In this regard, the definition of ways to rationally use the products of Angren kaolin, in our opinion, is promising, connected with the use of local raw materials in various sectors of the economy of the republic, in particular in machine building in the development of polyfunctional materials and coatings from them.

II.OBJECT AND METHODS OF RESEARCH

The objects of research were polymeric materials for coating on the basis of epoxy compound based on ED-16 resin and fillers - industrial kaolin of the Angren deposit. Steel (St.3) is used as model and control samples as a widely used structural material. Coatings were prepared using a plasticizer-dibutyl phthalate (DBP) and a hardener-polyethylene polyamine (PEPA) with a cold cure for 24 hours.

For the use of PPS and coatings in mechanical engineering, mechanical properties are one of the main factors ensuring the reliability of materials.
Physicomechanical properties of composite polymer coatings were investigated with the help of PMT-3 and the pendulum device ME-3.

Formation of coatings, carried out heliotechnological method ie. under the influence of solar radiation on a specially designed stand that provides a constant direction to the Sun.
Disperse analysis of mineral fillers was carried out on the device of the particle size analysis system in the laboratory of Angren Kaolin LLC on a SediGraph 5100 device from MICRO MERITICSINSTRUMENT CORPORATION.

III. RESULTS OF THE RESEARCH

The results of the investigation of the operational properties of coatings showed that the best performance properties are provided by coatings filled with ACT-10 Angren kaolin, and the worst are observed in a composite coating filled with AKF-78 (Fig. 1, 2).

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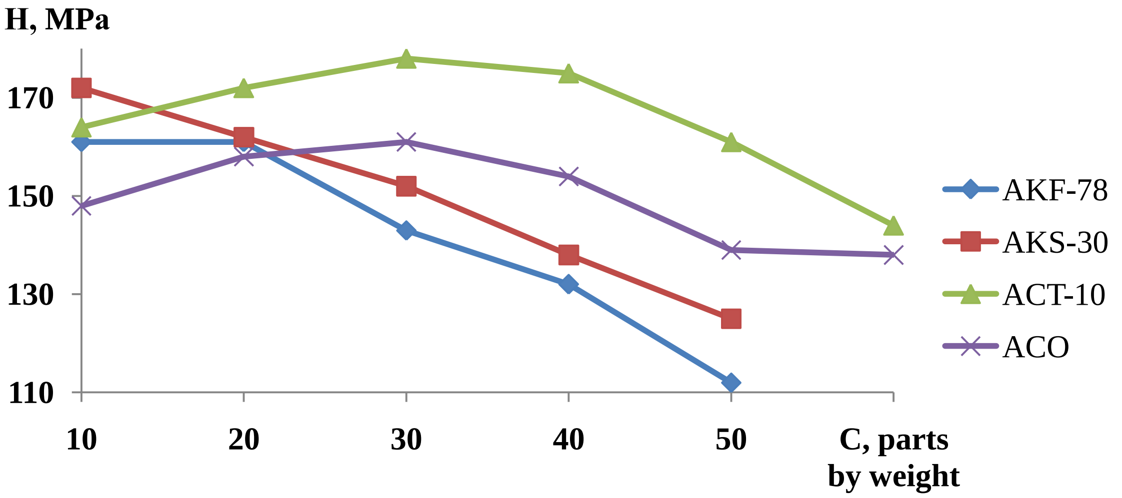

Fig.1. Influence of the type and content of excipients
(Angren kaolin - AKF-78, AKS-30, ACT-10 and ACO) for microhardness (H) of epoxy coatings

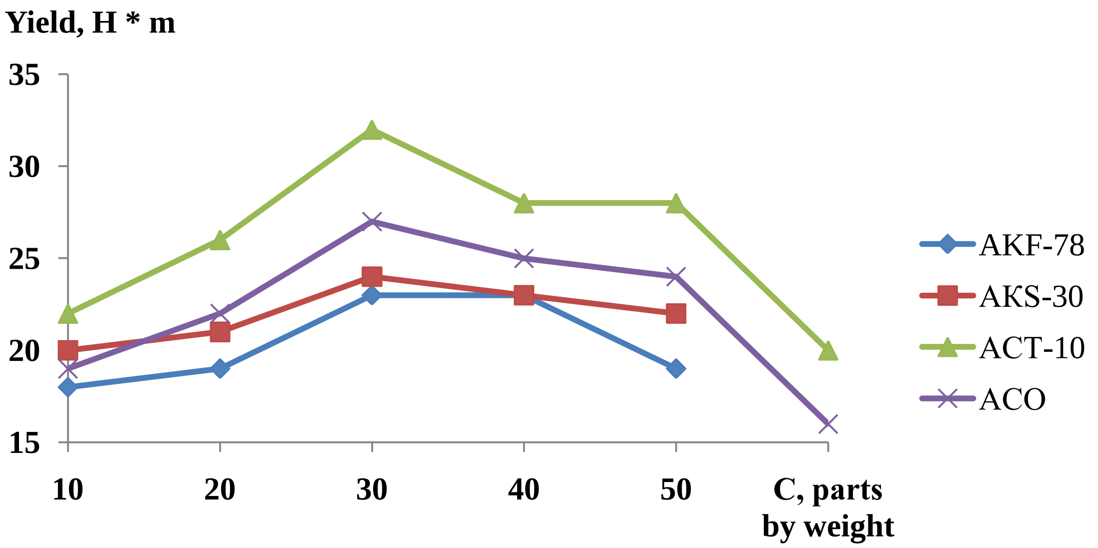

Fig.2. Influence of the type and content of excipients
(Angren kaolin - AKF-78, AKS-30, AKT-10 and ACO) for the impact strength (Y) of epoxy coatings

As can be seen from the analysis of the results obtained, the microhardness and toughness of the coatings are different depending on the brands of kaolins. It should be noted that the higher the grain size index of the filler particles (Table 1), the higher the performance properties of coatings with its low (10-20 mass parts) content, and at its high content (30- 50 parts by weight), deterioration of the performance properties of coatings is observed.

№	Industrial brands of Angren kaolin	Grain distribution, %	
		less than 1 μm	5-45 μm
1	AKF-78	71-73	25-28
2	AKC-30	49-50	47-49
3	ACT-10	25-32	65-72
4	ACO	21-25	72-75

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This can be explained on the basis of technological properties, namely, deterioration of the wet ability of the filler particles, which is observed with a sharp increase in the viscosity of the composition with filler contents of 60 parts by weight. and more.

From the analysis of the results of the study presented in Fig. 3, it can be noted that for filling materials, the filler content is 60 parts by weight. not yet the limit.

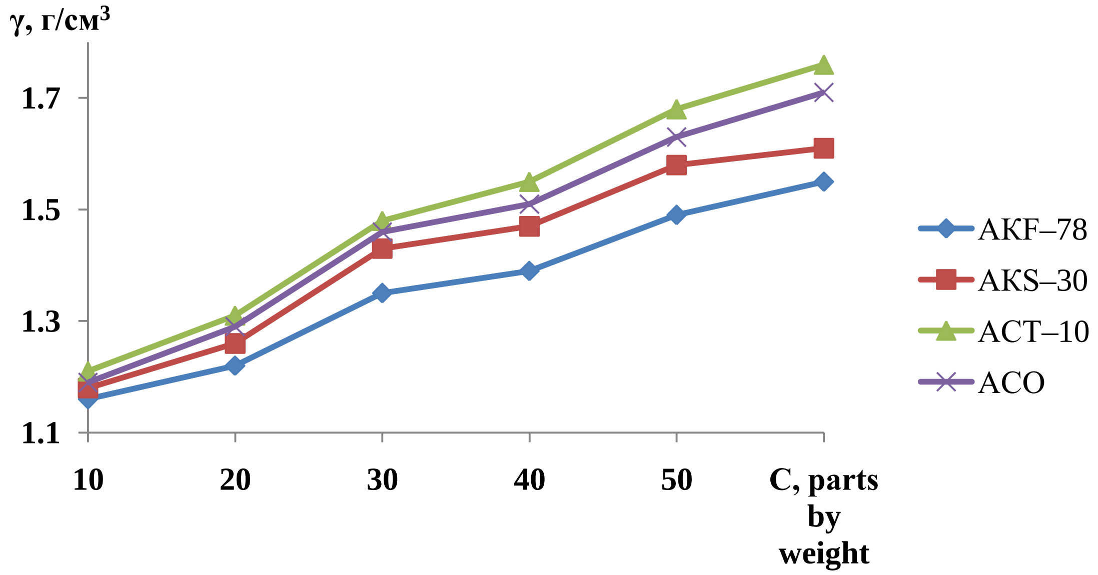

Fig.3. Influence of the type and content of fillers (Angren kaolin - AKF-78, AKS-30, ACT-10 and ACO) on the density (γ) of nanocomposite epoxy coatings

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

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

IV.CONCLUSION

The quantity of Kaolinic fillers in the composite polymer materials influences the physical and mechanical properties of the materials depending on their grades associated with their dispersion, the less the dispersion of the filler, the higher the performance properties of the coatings at low (10-20 mass parts) filler contents, and at high filler contents (30-50 mass parts) deterioration of the coating properties is observed with a particle size of 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 standpoint, kaolins with large particles are more advantageous in compositions, which is associated with the consumption of costly epoxy oligomers

REFERENCES

1. Liashkov VI, Kuzmin SN Non-traditional and renewable energy sources. Tutorial. - Tambov: Publishing House, TSTU, 2003. - 96 p.
2. White VA, Yurkevich OR, Dovialov VA Thin-layer polymer coatings. - Minsk, Science and Technology, 1976, - 416 p.

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3. Lipatov Yu.S. Physical Chemistry of Filled Polymers. - M: Chemistry, 1977. - 304 p.
4. Kirillov VI, Efimov VA, Barbotko S.L., Nikolaev E.V. Methodological features of conducting and processing the results of climatic tests of polymeric composite materials. // FSUE "All-Russian Scientific Research Institute of Aviation Materials", RF, Plastics Masses, 2013 - Moscow, №1S. 37-41 http://plastics-news.ru/pdf/1-2013.compressed.pdf.
5. Dzhumabaev, A. B. Friction and damage of the cotton. // NII.. The Agency "Uzstandard". - Tashkent, 2011. -275 C.