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МАТЕМАТИЧЕСКОЕ ОПИСАНИЕ РЕОЛОГИЧЕСКИХ СВОЙСТВ СОСТАВОВ С ИСПОЛЬЗОВАНИЕМ МЕСТНОГО СЫРЬЯ ДЛЯ РАБОЧИХ ПОВЕРХНОСТЕЙ КОНСТРУКЦИОННЫХ МАТЕРИАЛОВ ТЕХНОЛОГИЧЕСКИХ ОБОРУДОВАНИИ

Аннотация. В статье приведены методы и средства для изучения физико-механических, реологичесих и эксплуатационных свойств защитных покрытий. Теоретические основы реологических свойств наполненных полимеров.

Ключевые слова: гетерокомпозитные материалы, реология, интерполяция, наполненные полимеры, математическое моделирование.

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MATHEMATICAL DESCRIPTION OF RHEOLOGICAL PROPERTIES OF COMPOSITIONS USING LOCAL RAW MATERIALS FOR WORKING SURFACES OF STRUCTURAL MATERIALS OF TECHNOLOGICAL EQUIPMENT

Annotation. The article presents methods and means for studying the physical-mechanical, rheological and operational properties of protective coatings. Theoretical foundations of the rheological properties of filled polymers.
Key words: heterocomposite materials, rheology, interpolation, filled polymers, mathematical modeling.

Based on the study of the rheological properties of heterocomposite materials, it is necessary to study the effect of the type of mineral filler and the composition of the chemical structurant on the properties and operational reliability of large-sized and complexly configured equipment operating in aggressive and abrasive media [1]. The aim of the study is to identify the effect of the type of structural modifier and filler on the structure, formation and technological properties of pouring HCFM and protective coatings obtained by the activation-heliotechnological method for sheet and complex-configuration technological equipment, taking into account their rheological properties, using Newton's interpolation formula when studying the effect of structure-forming modifiers on the properties of heterocomposite mixtures.

Modeling the process of structure formation of heterocomposite mixtures depending on the type and content of the filler and the number of structures of the former. ... Mathematical model of the influence of rheological parameters on the operational properties of heterocomposite materials. Development of technology for obtaining protective coatings from heterocomposite materials on the surface of sheet materials [2]

We are considering a complex of research tasks:
study of the current state of the problem of obtaining coatings on the working surfaces of large-sized complex-configuration technological equipment using the activation-heliotechnological method, development of methods and means for studying the rheology of heterocomposite mixtures to ensure uniformity of thickness and properties of coatings on the surface of large-scale and complex configuration technological equipment, substantiation of technological and theoretical aspects of rheological parameters control to ensure the required properties and operational reliability of coatings made of GKPM for sheet structural materials and complex configuration parts, selection and justification of the object of study, finding patterns of structure formation depending on the type and content of the structural modifier, based on the study of the mechanism of gelation, characterizing the viability of the heterocomposite mixture, study the effect of the type of mineral filler Angren kaolin of industrial grades on the operational reliability of protective coatings based on the GCFM and

development of scientific and technical recommendations for the implementation of research results.

Scientific experiments conducted to reveal a particular phenomenon in science are formed by entering the results obtained in the form of tables, diagrams, graphs characterizing the object under study by a number or a set of numbers and cannot be physical laws. Only a mathematical model of an object in the form of a formula can be a law. Interpolation, the theory of dimensions and the theory of similarity are the scientific foundations of modeling and combine experience and knowledge, experiment and discovery [3].

They are built according to the specified coordinates of the points. For example yi is the ordinate of the desired point y_{i+1} - is the difference of the ordinate. The difference of this function in mathematics is called the finite difference.

The finite difference of the first order has the form:

$$\Delta y_i = y_{i+1} - y_i \text{, (1)}$$

Where $y_{i+1} = f(x_i + h)$ and $y_i = f(x_i)$.

For a function specified in a table in $(n+1)$) nodes, $i = 0,1,2...n,$ finite differences of the first order can be calculated at the points $0,1,2...n-1$

$$\Delta y_0 = y_1 - y_0$$

$$\Delta y_1 = y_2 - y_1 \qquad (2)$$

$$\Delta y_{n-1} = y_n - y_{n-1}$$

$$p = p + r$$

Using finite differences of the first order, one can obtain finite differences of the second order:

$$\Delta^2 y_0 = \Delta y_1 - \Delta y_0$$

$$\Delta^2 y_1 = \Delta y_2 - \Delta y_1 \qquad (3)$$

$$\Delta^2 y_{n-1} = \Delta y_n - \Delta y_{n-1}$$

Note that any finite differences can be calculated through the values of the function at the interpolation nodes, for example:

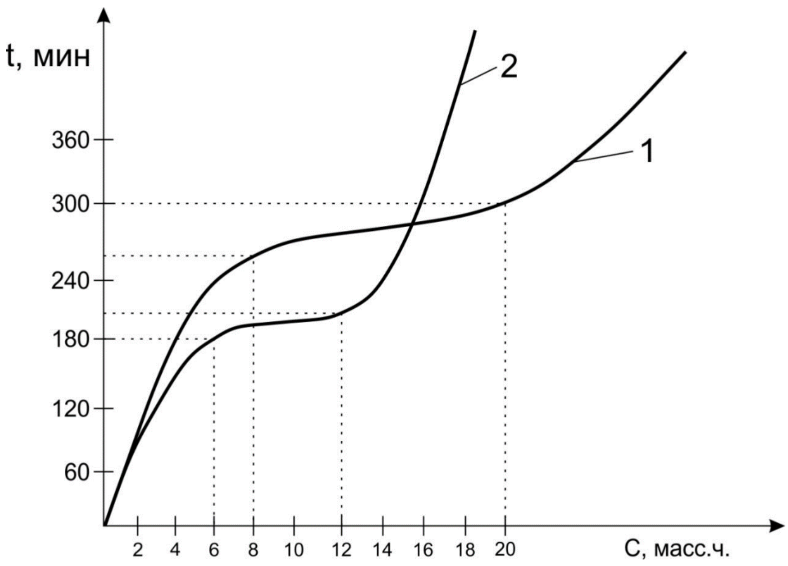
$$\Delta^2 y_0 = \Delta y_1 \cdot \Delta y_0 = (y_2 - y_1)(y_1 - y_0) \qquad (4)$$

Based on our research and the experimental data obtained, we came to the conclusion that the points of heterocomposite mixtures are in equally distant coordinates. 1 Newton's interpolation formula can be applied on the dependence of steps and nodes for the process under consideration. Which look like this.

$$P_n(x) = y_0 + \frac{\Delta y_0}{1!h}(x - x_0) + \frac{\Delta^2 y_0}{2!h^2}(x - x_0)(x - x_1) + \ldots + \frac{\Delta^n y}{n!h^n}(x - x_0)(x - x_1)\cdots(x - x_{n-1}) \quad (5)$$

Let us investigate the influence of the type and amount of structure-forming modifiers on the properties of heterocomposite mixtures.

Figure 1 shows the dependence of the gelation time (t, min) on the content of DBP and HS (wt.h). The experiments were carried out in the conditions of the city of Tashkent at an ambient temperature in the shade of 30 ± 2 and in an open area of 42 ± 2 ° C. The intensity of natural solar radiation is 710-750 W / m2.



1-DBF, 2-GS

Fig.1. Dependence of gelation time (t, min) on the content of structure-forming components of polymer mixtures.

As can be seen from the figure, the most stable values of the gelation time are observed in compounds containing DBP in the range of 10–20 wt.h. with a gelation time of 270 minutes and in compounds with a GS content in the range of 6 ÷ 12 wt.h. with a gel time of 180 minutes. A further increase in the content of DBP and GS leads to a decrease in the gelation time of different intensities and a deterioration in the technological properties of the heterocomposite material [4].

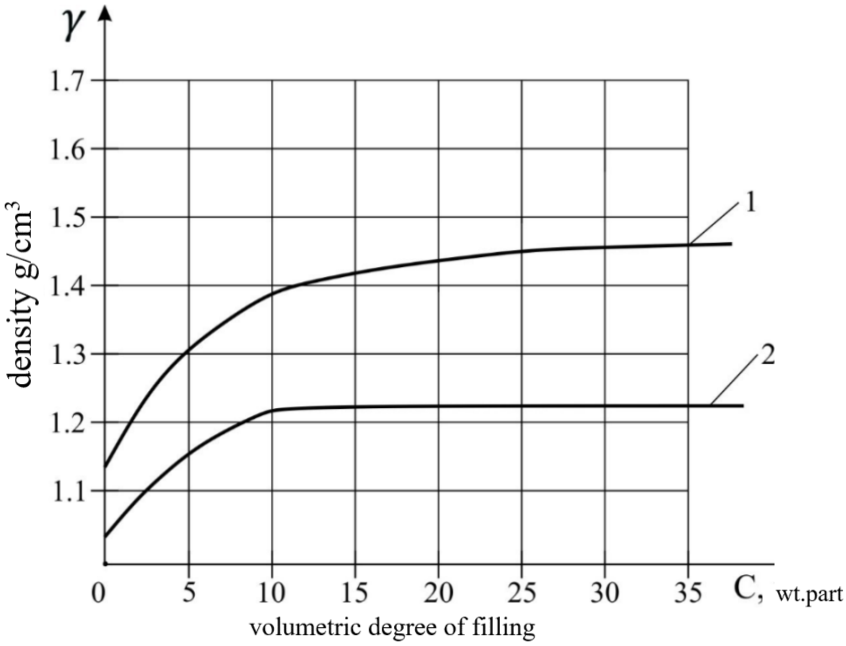
Similar results were obtained with the filler AKC-30, where, with a filler content of 30 wt h and a modifier in an amount of 12 wt. h. HS mixture also did not pass through the nozzle of the viscometer. Change in the fluidity of a heterocomposite mixture containing AKC-30 in an amount of 20 and 30 wt.h.

modified HS in the amount of 6-12 wt.h. showed high viscosity values exceeding the limit of 700 mm 2 / t according to GOST 9070-75.

Thus, on the basis of experimental studies, it can be concluded that from the technological point of view of structure formation of heterocomposite mixtures, compositions with AKT-10 fillers in an amount of 10.20.30 parts by weight are suitable. and AKS-30 in the amount of 10 wt.h of modified HS [5]. The results of our studies have shown that during the formation of the structure of a heterocomposite material, chemical changes in the structure occur, which affect the physical and mechanical properties.

Corrosion (in aggressive environments) and wear - (in abrasive environments) resistance of heterocomposite materials depends on the density of the material structure.

Experiments have shown the possibility of achieving the best results by adjusting the ratios between the components of the heterocomposite potting material (binder, hardener and filler). [5]. In this regard, the influence of the degree of filling on the density of the filling material was studied (Fig. 2).



1-AKT-10 + ED-20 + PEPA + GS, 2. AKC + ED-20 + PEPA + GS

Fig. 2. Dependence of the density of the gas condensate mixture on the content of the filler

As can be seen from Figure 2, in heterocomposites with AKT-10 filler, the most stable values are observed at a maximum filling of 25 pbw, similarly, but with relatively lower values, are characteristic of AKS-30 coatings in an amount of 10 pbw. a further increase in fillers deteriorates the technological and physical and mechanical properties of heterocomposite materials and coatings.

It was revealed that the structure formation of heterogeneous mixtures depends on the chemical composition of the mineral fillers of LLC "Angren-Kaolin" AKT-10 and AKS-30 and functionally active groups of the structure-forming chemical modifier GS and the polymer binder ED-20 and the method of modification of heterocomposites at the stage of their formation under the influence of solar radiation. It has been shown that the content of fillers, both AKT-10 and AKS-30, and the structural modifier GS leads to an increase in the coating thickness, which is explained by a decrease in the gelation time and a more active effect of the filler on the structure formation of the coating.

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