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Anticorrosive Composite Polymer Coatings for Corrosion Protection of Equipment of Gold Recovery Factories

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ABSRACT: This article examines the influence of fillers and aggressive media on the adhesive strength of the coating based on ED-20 epoxy resin. It is shown that filling compositions can significantly reduce the curing time of compositions, the polymer matrix is strengthened, providing high homogeneity of the system and improving physical, mechanical and operational properties.

KEYWORDS: anticorrosive composition, adhesive strength, coatings, filler.

I.INTRODUCTION

The unique properties of composite polymer materials allowed them to be used in various industries, in particular, to protect metals from corrosion.
Composite polymer coatings are more expensive than paint and other materials, so they should be used when it is impossible to achieve the desired result by painting, galvanizing, etc.
Thermosetting polymers are widely used to protect metals and alloys from corrosion [1-3]. Composite polymer materials based on epoxy resin are widely used in industry due to their high physical, chemical and mechanical properties. Depending on the filling, these mixtures can be used as anticorrosive coatings for metal substrates. It is important to determine how it is affected by the structure of the material.

II. SIGNIFICANCE OF THE SYSTEM

In this regard, the purpose of this work is to study the process of chemical destruction of composite polymer materials in aggressive environments.
Stabilizers, hardeners, fillers, initiators and activators are introduced into the coating material to transform a number of film-forming agents into a solid irreversible state and create the required structure of the polymer film. The use of these components is determined by the chemical nature of the film-forming agent and the conditions of coating formation.
It is possible to improve the performance properties of coatings by directional control of the structure: at the same time, optimal heterogeneity is achieved by introducing a dispersed filler and plasticizer into the composition.

III. LITERATURE SURVEY

The introduction of dispersed mineral fillers into polymers leads to significant changes in the physicochemical and mechanical properties of the resulting composite materials, which is due to changes in the mobility of macromolecules in the boundary layers, orienting the influence of the filler surface, various types of polymer interaction with it, as well as the influence of fillers on the chemical structure and structure of polymers formed in their presence during the curing and polymerization of monomers or oligomers. It should be noted that the surface chemistry of fillers plays an important role in determining the nature of the interaction of polymers with the filler
The introduction of mineral fillers into polymers with certain chemical properties of their surface can lead to acceleration or inhibition of various stages of the destruction process and change the chemistry of these reactions. It is

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becoming increasingly obvious that dispersed mineral fillers act as heterogeneous components of high-temperature chemical processes of polymer degradation occurring at the polymer-filler interface.
We selected the epoxy oligomer ED-20 (GOST 10587-84) and polyethylene polyamine (PEPA) as the object of research.
Phosphogypsum (FG), phosphoshlak (FSH), waste from the Marjanbulak gold extraction site of the Navoi mining and metallurgical combine (MZIUNGMK), (OZIF) and dibuty phthalate (DBF) were used as fillers.
The chemical composition of fillers is shown in the table.
Solutions and vapors of sulfuric (H_2SO_4), hydrochloric (HCl), nitric (HNO_3), and acetic (CH_3COOH) acids were used to test samples for aggressive resistance as an aggressive medium in accordance with GOST 4104-77.

Table
The chemical composition of the fillers

Fillers	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	$CaPO_4$	P_2O_5	Na_2O	K_2O	PPP	Сумма
FG	10,17	0,63	trace	32,00	0,80	46,64	2,07	0,07	0,12	7,50	100
FSh	42,73	2,38	0,16	45,72	3,20	0,25	1,57	0,65	0,30	1,47	99,25
OZIF	67,72	12,52	0,16	13,48	0,94	traces	-	1,78	0,72	2,03	99,35

IV. METHODOLOGY

The method of studying chemical resistance is based on determining changes in the mass, linear dimensions, and physical and mechanical properties of standard samples after they are kept in aggressive solutions for a certain time [4-5].
The degree of coating hardening was determined by the method of oxygen absorption [6].
Discussion of results
Fillers have a great influence on the permeability of coatings, and their nature, volume content, particle size and shape, and the degree of interaction with the film-forming agent are important. The inhibition of the transfer of substances through the films during filling is primarily the result of increasing the rigidity of molecular chains and reducing the rate of relaxation processes. Fillers differ from pigments in significantly lower coverage and dilution capacity. They are added to paint materials, mainly to reduce the cost of the latter, as well as to give them texotropy, anti-corrosion properties, increase chemical resistance and fullness of the paint film, i.e. to give them any special properties. Because of this, fillers are often referred to as functional pigments.
It should be noted that the grinding of solids, accompanied by the formation of a new surface during grinding, is accompanied by the friction of solid particles from each other. In this case, the active centers on the surface of the particles of the crushed material can occur both as a result of incandescent particles, and in the processes of tribotechnical reactions. This increases the contact of the matrix with the filler (particle size from 5 to 20 microns).
When studying the chemical resistance of composite materials used as coatings, one of the important criteria for evaluating their resistance is the change in adhesive strength under the influence of aggressive media. This criterion is particularly effective when evaluating protective properties of coatings such as diffusion permeability and internal stresses.

V. EXPERIMENTAL RESULTS

The study of the dependence of the adhesion strength of unfilled epoxy composites based on resin ED-20 from the corrosive environment showed that the adhesion strength of these coatings in all cases reduced, and in sulphuric acid 40, water – 60, in hydrochloric acid – 70% relative value of adhesion strength when exposed to these environments for more than 10 days in the air. Coatings completely lose their adhesive strength in nitric and acetic acids within 10 and 6 days, respectively, due to polymer degradation at the polymer-substrate interface (Figure).
Therefore, by analyzing changes in the adhesive strength, it is possible to judge the permeability of coatings, the nature of the chemical interaction between the substrate and the aggressive environment.
The presence of pores and microdefects in unfilled coatings (they were controlled by an electron microscope) contributes to the accelerated penetration of aggressive media into the material, increasing the contact area of the film-forming layer with the medium, speeding up the following processes: chemical destruction, sorption of components by an aggressive medium, dissolution of the zol - fraction of the film-forming layer, desorption of various additives from the polymer material, changes in the physical structure of the material.

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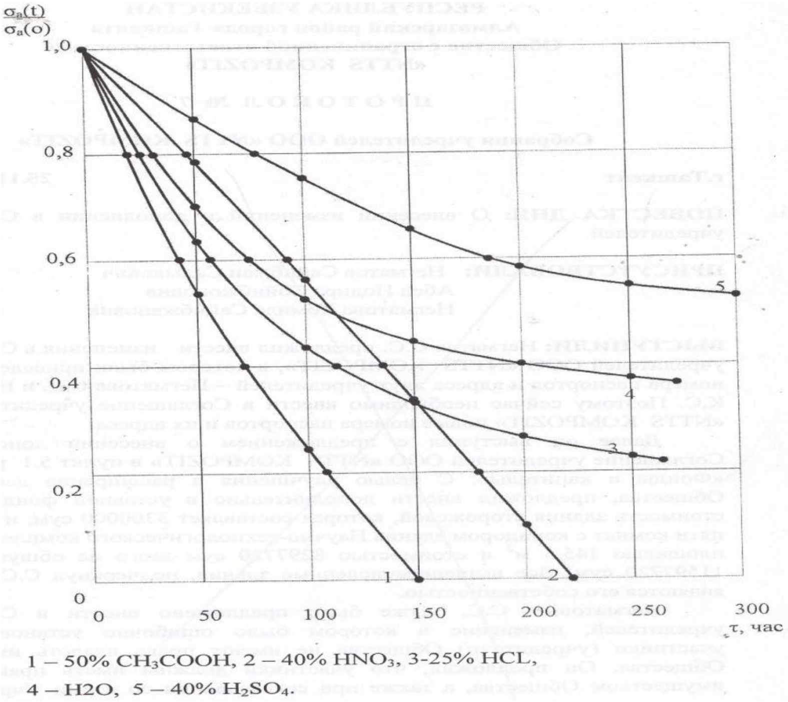

Drawing. Changes in the adhesive strength of ED-20 based coatings to steel substrates in various aggressive environments

The structure activity of a filler is understood as its ability to influence the polymer structure, which leads to changes in the characteristics of supramolecular structure formation at one or more levels of supramolecular organization or only in the packing density (a change in the ratio between disordered and ordered parts of the polymer). It is possible to influence the filler on all these structural characteristics at the same time. The structural activity of the filler can have a certain direction (form of manifestation): influence mainly the supramolecular structure or the relative density of the polymer packaging.

Fillers slow down the oxidation reaction and the rate of oxygen absorption in the deep stages after the end of the induction period is practically unchanged. When forming coatings filled with 25% kaolin, bentonite and OZIF to which the resin exhibits high adhesion, oriented structural elements of the fibrillar type are observed in the coating layers bordering both the substrate and the air near the filler particles.

The nature of changes in the adhesive strength of epoxy compositions based on ED-20 from the interaction of aggressive media shows that the adhesive strength of these coatings in all cases decreases: in sulphate acid by 40, in water by 60, in hydrochloric acid by 70% relative to the value in air when kept in these media for more than 10 days. These coatings completely lose their adhesive strength in nitric and acetic acids within 10 and 6 days, respectively, due to the destruction of polymers at the polymer-substrate interface.

When the composite is filled with industrial waste, the stabilization effect is improved.

VI.CONCLUSION AND FUTURE WORK

Thus, it can be concluded that coatings filled with secondary products can significantly reduce the curing time of compositions, strengthen the polymer matrix, providing high homogeneity of the system and improve physical, mechanical and operational properties. The use of local raw materials and industrial waste to produce anti-corrosion polymer coatings makes it possible to effectively reduce the cost of equipment, anti-corrosion protection costs and operating costs with a high degree of reliability and the necessary durability of equipment operating in aggressive environments.

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