INVESTIGATION OF PHYSICO-CHEMICAL PROPERTIES OF HEAT-PROTECTIVE POLYMER MATERIALS

[1]Rufat Ruziev, [2]Fayzulla Nurkulov, [3]Alikul Rakhmankulov, [4]Abdulahat Djalilov.
[1]PhD student, Tashkent research institute of chemical technology Tashkent, Uzbekistan,
[2]D.Sc., prof. Tashkent research institute of chemical technology,
[3]Candidate of Physical and Mathematical Sciences, Assoc. Prof. Karshi IEI,
[4]D.Sc., Academician, Tashkent Scientific Research Institute of Chemical Technology.
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Abstract. *In the course of practical experiments of this research work, a composite coating based on heat-resistant acrylic styrene, liquid glass, polyvinyl acetate and vermiculite was synthesize. To study the chemical composition and functional groups of composites in these samples obtained in the course of research, an analysis of physicochemical properties was carry out. The results of the analysis show that the polymer containing acrylic-styrene, liquid glass and polyvinyl acetate were form by chemical bonds using alkaline composites.*

Keywords: *acrylic-styrene, liquid glass, polyvinyl acetate, IR spectroscopy, heat-resistant coating.*

Introduction. In recent years, there has been an increase in the production of heat-resistant coatings containing acrylic monomers [1]. In particular, 7.65 million tons of products based on acrylic monomers were produced in 2021, while 7.8 million tons were produced in 2022 [1-2]. About 18% of the acrylic content in these products corresponds to the contribution of ceramic coatings, such as acrylic - styrene, acrylic – urethane. Obtaining heat-resistant coatings based on acrylic-styrene copolymers is consider one of the urgent tasks, and today scientific research is being conduct in this area.

In this research paper, the inclusion of appropriate functional groups, additives and fillers in the composition of a heat-resistant acrylic-styrene copolymer coating leads to an increase in its heat resistance.

Methods and materials. Polymer composite coatings based on acrylic styrene, liquid glass, polyvinyl acetate and vermiculite obtained under laboratory conditions. The initial products for obtaining this polymer composition taken in a ratio of 4:4:1:1. The experimental process mixed at a temperature of 25-30°C at a speed of 1300-1500 turnover/minutes a dissolver installation (JSF-550A). During the research, the parameters of IR spectroscopy and scanning electron microscope of the obtained polymer composite sample analyzed.

Results and discussion. In the course of experiments by IR spectroscopy (IRAffinity-1S (SHIMADZU)), chemical changes, functional groups and chemical bonds of a synthesized polymer composite [3] based on acrylic styrene and liquid glass, polyvinyl acetate and vermiculite studied. (Fig. 1).

Based on the results of the analysis of polymer composites, it characterized by IR spectroscopy. Accordingly, we see that the valence oscillations in the regions of 975, 871, 790 and 742 cm^{-1} belong to metals in convex vermiculite. In the region of 1056 cm^{-1}, the valence oscillations associated with -Si-O are not visible. Absorption bands corresponding to valence vibrations of the carbonyl group C=O in the composite are observed in the region of 1734 cm^{-1} of the spectrum. Valence vibrations of the CO-NH2 group in urea occur in the 3402 cm^{-1} region.

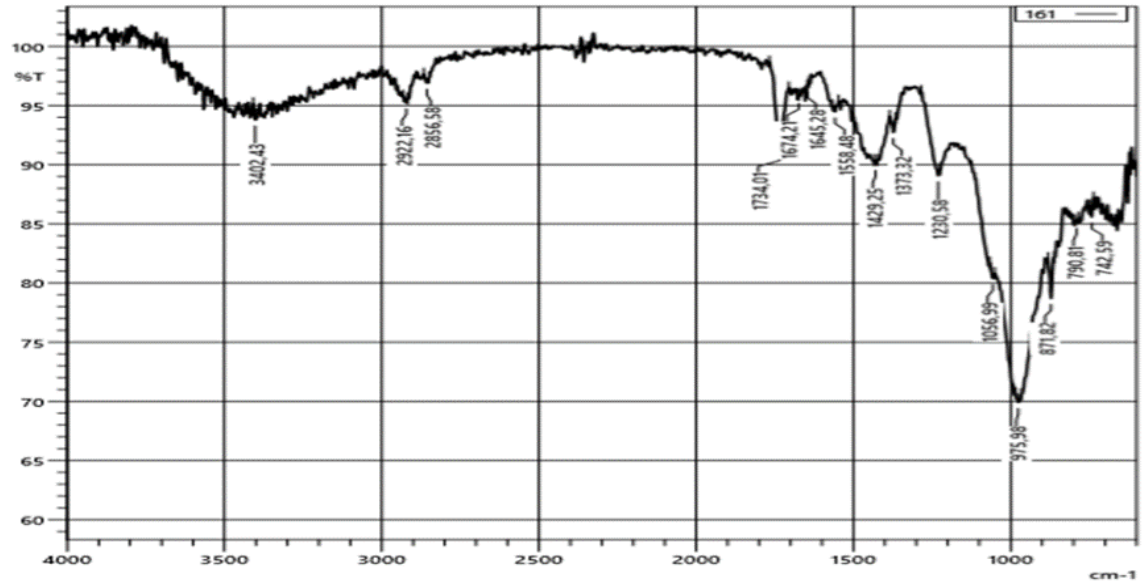

Figure 1. Indicators of IR spectra of heat-protective polymer composites.

The physicochemical properties of heat-shielding polymer composites based on acrylic-styrene, liquid glass, polyvinyl acetate and vermiculite were studied (Table 1).

Table 1.

Physic-chemical properties of polymer composites based on acrylic-styrene, liquid glass, polyvinyl acetate and vermiculite

Specifications	Indicators
Color	Light grey
Density 25ºC	1,39 *103 kg/m^3
Solubility	Does not dissolve in water
Application temperature	+1… +800°C
Время отверждения покрытия	27 hours at a temperature of 25ºC
Adhesion	2 points

In order to study the homogeneous distribution of composite particles of polymer composites based on acrylic styrene, liquid glass, polyvinyl acetate and vermiculite synthesized during the research, the indicators of an electron scanning microscope (Jeol Interactive Corporation, Japan JSM-6460LA) with an increase of 250 times and a size of 100 μm (100x10-6m) were analyzed.

A scanning electron microscope [4] of a polymer composite sample [5] taken from 3 sites of the composition showed that functional groups and particles are evenly distributed in the copolymer (Fig. 2).

When studying the elemental analysis of composite particles of this polymer composite according to the indicators of an electron scanning microscope, the percentage of elements in all 3 samples did not change, which indicates a uniform distribution of elements in the composite (Fig. 3).

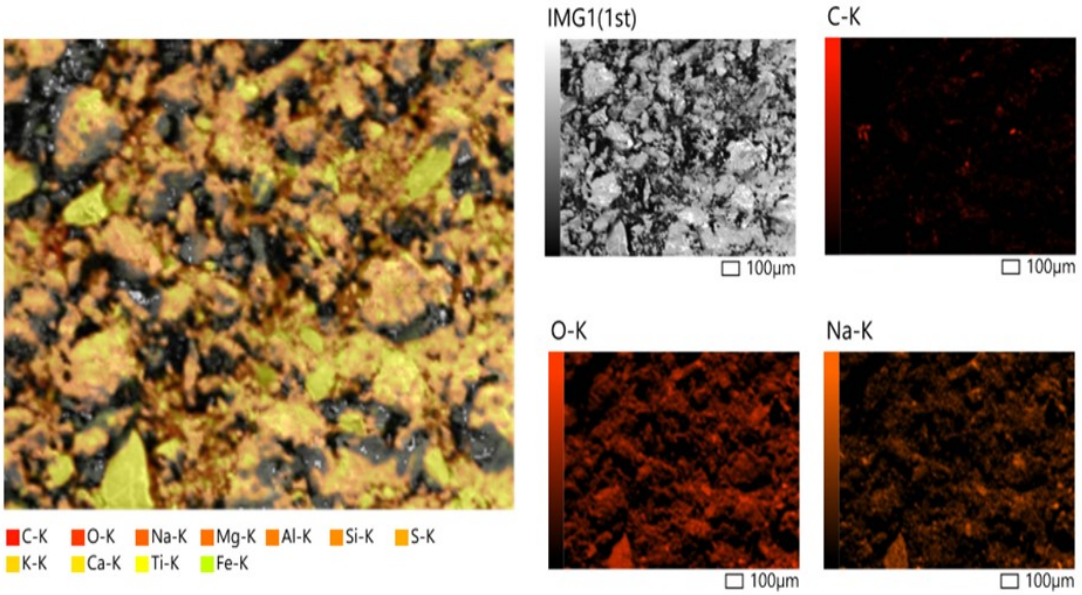

Figure 2. Indicators of a scanning electron microscope of a polymer composite

The heat-resistant polymer composite coating based on styrene acrylic copolymers makes it possible to study the mechanisms of uniform dispersion of the polymer composite contents, as well as to carry out exposure using scanning electron microscopy and elemental analysis.

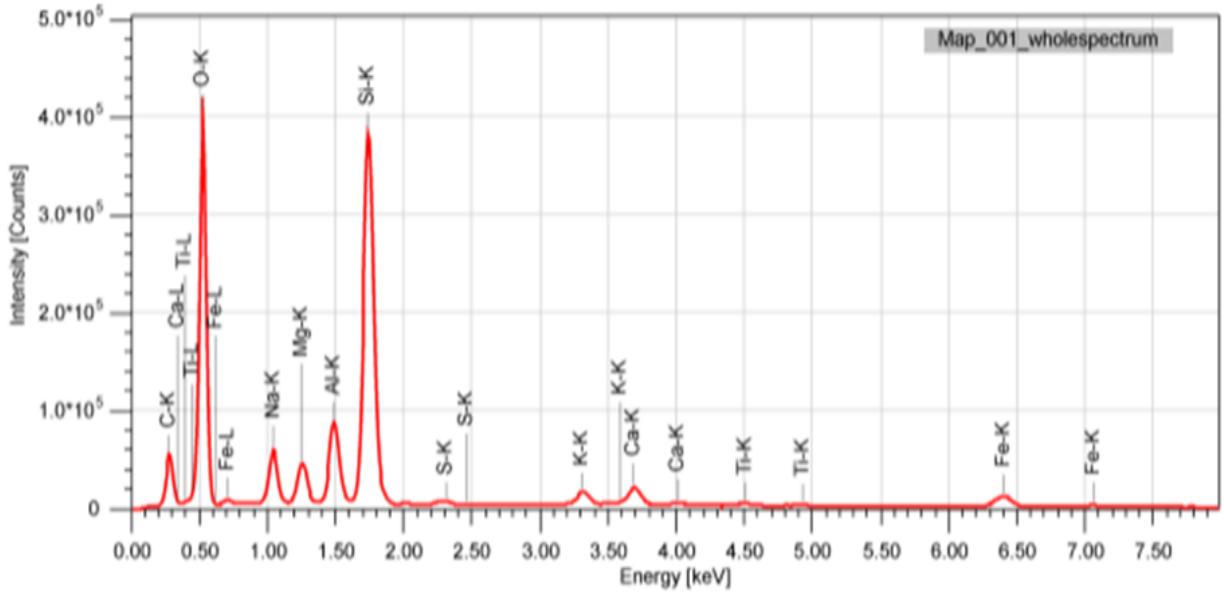

Figure 3. Elemental analysis of polymer composite

The indicators of the scanning electron microscope show that the elements are evenly distribute in the polymer composite. In particular, it was found that the polymer composite contains elements C -19.57%, O - 48.85%, Na - 3.90%, Mg - 2.08%, Al - 3.67%, Si - 16.79%, S - 0.15%, K-1.04%, Ca - 1.50%, Ti - 0.23%, Fe - 2.21%.

Conclusion. During the study, it found that the molecular structure of the heat-resistant polymer composite under study contains functional groups such as organometallic, aromatic and

unsaturated hydrocarbon bonds, and the percentage of elements in the composition of these functional groups has not changed and it is distribute equally. At the same time, it is important to synthesize these polymer composites based on local raw materials.

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