

INVESTIGATION OF COAL AS A FILLER IN POLYMER COMPOSITES

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In modern times, phenol-formaldehyde resin (PFR) and composite compositions based on it occupy a special place among polymers with a wide range of industrial applications. This is primarily due to the fact that PFR has an economically viable wide raw material base, a technologically simple processing method, and a complex of useful operational properties such as high thermal, chemical and mechanical resistance, thermoplastic and thermosetting and so on.

In addition, in recent years, taking into account the requirements placed on the operational properties of polymer materials, including PFR-based compositions, due to the rapid development of science and technology, scientific and practical research has been conducted to improve the physicochemical properties of these resins, such as thermal, electrical, mechanical, adhesion, tribological, etc.

As is known, complex and waste-free processing of oil is one of the global problems that requires the solution of the oil refining industry. In this regard, the involvement of aromatic hydrocarbons contained in the light gas oil fraction obtained in the catalytic cracking process as raw materials in the synthesis process of petroleum polymer resins allows increasing the range of products with a wide range of applications. Taking into account the above, studies have been conducted to study the synthesis process of modified PFR (MPFR) with improved complex operational properties, primarily thermal stability and electrical conductivity, which obtained by modification of PFR with aromatic hydrocarbons contained in the light gas oil fraction obtained in the catalytic cracking process of oil.

The article also presents the results of studies conducted to study the changes in the properties of the final product by incorporating nanoscale coal powder as a filler into the PFR.

It should be noted that the use of Printex® XE 2B brand coal as a filler in research provides the production of composite compositions with high corrosion resistance and desirable physicochemical properties. Thus, modification products prepared using carbon or graphite have applications such as the production of columns, plates used in a number of processes, including distillation and rectification, a number of chemical equipment in contact with chloride, fluoride and other corrosive acids, electrode materials, including graphite electrodes used in the smelting of steel materials [1,2].

Composite samples based on MPFR were obtained by adding coal to the composition during synthesis (N1) and later (N2), and the structure of these samples was studied on SeZn crystals in the range of 600–4000 cm^{-1} on an ALPHA IR Fourier spectrometer of the German company BRUKER. It was found that the spectra of the composite composition obtained by both methods were similar in terms of functional groups and were characterized by absorption bands reflecting deformation and valence vibrations characteristic of CH_2 , CH_3 , C-H , C-C , C-O and H-O bonds, confirming the presence of phenol and methylol fragments, and absorption bands detected at wavelengths of 170–1203 cm^{-1} and 3262–3270 cm^{-1} .

In the conducted studies, it was determined that the composite compositions obtained by adding coal powder had a relatively high electrical conductivity compared to MPFR. Thus, if the electrical conductivity of MPFR was $1.4 \cdot 10^{-7}$ S/m, the electrical conductivity of the obtained composite samples was $1.0 \cdot 10^{-3}$ S/m (N1) and $1.5 \cdot 10^{-5}$ S/m (N 2), respectively. Despite the addition of the same amount of filler to the composition of the composite samples (N1 and N 2) by different approaches, a relatively high conductivity was observed with the addition of coal during synthesis (N1), which, in turn, was associated with the effective dispersion of coal particles with the resin and the formation of a strong network. As a result, the addition of coal to MPFR during synthesis was evaluated as a more effective approach in terms of increasing the electrical conductivity.

References

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