Nanocomposites and nanomaterials

Nanotechnology: Environmentally friendly method of utilization of petroleum-refining wastes.

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Use of petroleum-refining wastes as an anthropogenic resource for other sectors of industry can be limited by their heterogenety as well as their chemical composition, structure and reactivity because they are the mixtures of different hydrocarbons. The separation of mixture into its pure constituents is a complex technological process. Therefore, the utilization of petroleum wastes in their native form is a promising, cost effective and environmentally friendly solution.

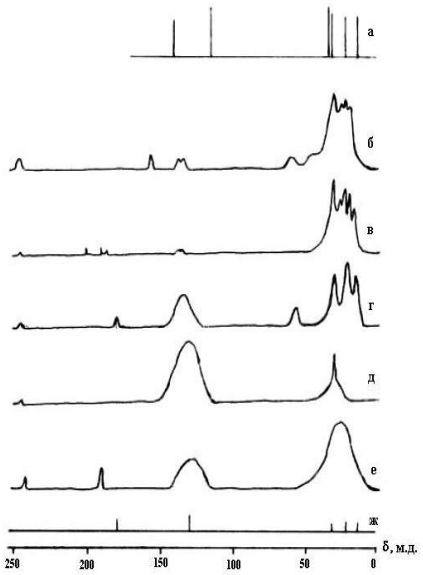
In terms of organizational and technological processes, power inputs and consumer value of end product, an effective method of utilization of industrial wastes generated during the recycling of hydrocarbon raw materials (acid tar, technical sulfuric acid and wastes of synthetic fatty acids manufacturing) is proposed. Cationites, formed as a result of structural transformation of hydrocarbons, display a set of promising properties that allow to use them in the field of water treatment, hydro- and electrolytic metallurgy, metal processing, soil science (investigation of metal ion migration) and catalysis.

Analytical methods such as potentiometry, thermogravimetry and spectrometry (NMR and EPR) were used to describe the properties of resulting solids and carry out a comparative analysis.

Systematic investigations of physical and chemical evolution of reaction mixtures have shown that different types of organic compounds from the blend, containing acid tar and sulfuric acid, are consumed during the reactions of sulfuric polymerization and condensation with the following formation of bifunctional sulfocarboxyl cationites. The scope of scientific investigation indicates that these cationites contains the carboxyl, hydroxyl and sulfuric groups that define the increase their static ion exchange capacity, selective ion sorbtion and other functional characteristics.

Investigation of evolution of anthropogenic and modelling systems allowed to formulate an algorithm of successive transformations of raw materials and develop a technology of production of functional carbon matrix with specified mechanical and physicochemical characteristics (strength, dispersion ability, specific surface area, ion-exchange capacity, reactivity of immobilized functional groups).

^{13}C NMR spectra of "acid tar+syntetic fatty acids" system and modeling compounds are shown below (Fig). Hexane has signals of carbon atoms (δ 11, 12, 22, 28, 124 and 130 ppm) in its NMR spectrum. As it was shown the addition of sulfuric acid to hexane results in broadening of spectral line in aliphatic area due to the reaction of sulphurization.



An analysis of structural and functional evolution of the studied systems allows to state a set of important guidelines for the processing and transformation of petroleum wastes into marketable products:

1. The environmentally friendly, effective functional method of utilization of acid tar and wastes containing salts of fatty acids resulting in bifunctional cationites production was suggested.
2. Described bifunctionality of carbon sulfocarboxylate can be explained by its adsorption activity (relates to the petroleum products and anionic surface active agents), ion exchange and complexing capacity (relate to the ions of heavy metals).
3. All technological characteristics of synthesized carbon-containing material mentioned below indicate that developed cationites can be used in the industrial oil refinery waste water treatment as well as organic catalysis.

Fig. ^{13}C NMR spectra of: a-hexene-1; b-hexene-1+H_2SO_4;
c-acid tar; d-acid tar (t=300°C); e-pitch;
f-acid tar+salts of fatty acids; g- synthetic fatty acids.