CARBON BLACK SURFACE MODIFICATION BY ORGANIC ACIDS

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The recovery of metals from aqueous solutions using different waste materials in adsorption processes is of great interest /1/. It is well known that carbonaceous materials can be used as efficient adsorbents. An activated carbon is the most often used adsorbent. However, because of its high cost the less expensive non-conventional adsorbents are being studied including their surface modification. This can be performed by adsorbing foreign organic compounds on the surface of carbons /2/.

In this work, the influence of citric acid and acetic acid on the surface modification of commercial carbon black was examined. Carbon black consists essentially of fine carbon particles semi-graphitic in structure with varying amounts of volatile matter and ash. Its main application is as a reinforcing agent in rubber; other uses are in printing inks, paints, plastics and dry electric cells. The important relevant characteristics of carbon black is specific surface wich is governed by particle structure.

Examined samples of carbon black (CB) were produced by oil furnace process of the Petrokemija Kutina plant in Croatia. The basic characteristics of examined CB are: jodine adsorption number 121 mgg⁻¹; CTAB 108 m²g⁻¹; 98.7% C; 2.35% moisture; 1.0% S; 0.28% ash.

In batch experiments performed, 1 g of CB with particle size ≤ 0.1 mm was equilibrated with a citric acid (CA) and acetic acid (HAc) solutions for 24 hours. Acid concentrations before and after adsorption process were determined by NaOH-titration. The surface morphology of the CB samples was visualized by scanning electron microscopy (JEOL, JXA 50 A). SEM enables the direct observation of any surface morphology changes in the CB that would have occurred due to the acid modification.

Figs. 1-4 show the SEM images of carbon black samples before (CB) and after acetic acid (CB+HAc) and citric acid (CB+CA) surface modification. The shape of the CB particles is spherical or near-spherical but they have not the equal diameters (Fig. 1). Generally, they exist as aggregates of coalesced, fused elementary particles. Morphological observations revealed that there are small cavities, cracks and attached fine particles over the CB surface forming a system of pore networks (Fig. 2). Comparison of micrographs exhibits that the modification does not significantly change the morphology of the surface matrix of the carbon sample. However, the both HAc and CA reduced the number of cracks and cavities on the surface which are clogged by the adsorbed acid molecules (Figs. 3 i 4). This was confirmed by the data obtained on the concentration of acids before and after adsorption. Before adsorption the concentration of CA was c₀=0.047 módm⁻³ while the equilibrium concentration has been decreased to c=0.024 módm⁻³. For the CA, less reduction of concentration (c₀=0.05 módm⁻³; c=0.04moldm⁻³) was obtained. It follows that 1 mmolg⁻¹ of the CA and 2.3 mmolg⁻¹ of the HAc was adsorbed on CB. The difference could be due to the size of acid molecules adsorbed on the available CB specific surface.

The carboxyl groups of adsorbed HAc and CA have successfully modificated CB surface so that by the procedure here performed, more active carbon black is achieved.
References


Fig 1. SEM image of the surface of carbon black sample (CB) before modification

Fig. 2. SEM image of the surface of carbon black sample (CB) before modification

Fig. 3. SEM image of the surface of modified sample (CB + HAc)

Fig. 4. SEM image of the surface of modified sample (CB + CA)