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STRUCTURAL AND MASS TRANSFER CHARACTERISTICS OF CARBON-FIBER MATERIALS

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Among separation/adsorption processes used for controlling environmental pollution, adsorption on microporous solids offers an effective solution. Commercially, active carbons are generally used mainly because they possess a largespecific area and high adsorption capacity. However, theirthermal and chemical instabilities complicate regeneration and limit their reuse. In recent years, graphene fibers have arisen as new carbonaceous fibers (CF) with high expectations in terms of mechanical and functional performance. CFs are fabricated by the pyrolysis of organic precursors, which inevitably generates polycrystalline composition and structure (e.g. weave density). Carbon-fiber materials obtained by carbonization of hydrate-cellulose (CHC) exhibit a higher adsorption capacity and have faster adsorption kinetics than activated carbons [1]. Microspores, which dominate in CHCs, are primarily responsible for the adsorption of polar contaminants due to the overlap of attractive forces of opposite pore walls. Thus, quantitative characteristics of the pore structure is necessary to gain knowledge about total porosity, pore diameter and volume as well as macro and micropores surface area of the CHCs [2].

The aim of the present work was an investigation of macro- and micro-pore structure of carbon fiber materials by adsorptionof water and benzene. The followingcarbon fiber materials were used: AUVM Dnipro, Busofit T-1, OUT-M (substrate for production of Enterosorbent), and Karbopon (ventilation filter).Their structures were analyzed by usingtwo differentin strumental techniques: the thermal print head calorimetric and the classic adsorption-desorption isotherm. Detail description of the analyses and calculations can be found in related literature [3, 4].

The adsorption-desorption isotherms obtained for the carbon-fiber materials, dry and wetted with water or benzene,are depicted in Figure 1. For desorption isotherms (dash lines),the integral and differential curves of pore size distribution were calculated[3]and presented in Figure 2. In thethemograms of materials dry and wetted with water, two straight segments and five critical points corresponding to different forms and types of communications moisture from the material could be distinguished. In case of materials dry and wetted with benzene, there is only one straight segment corresponding to multimolecular adsorption. This indicates a lack of micropores whichdimensions correspond to 2-4 diameters of benzene molecule.

Mass transfer properties and pore structure characteristics of carbon fiber materials wetted with benzene and water were investigated. The material AUV-M

Dnipro has the most complete weight capacity and volume of macro- and micropores. The developed ultramicropore structure has large number of micropores in size of (5 ... 30) · 10-10m, which results in a large specific surface area (1884m^2/g), calculated as a sum of poly- (S4), and monomolecular (S5) adsorption. The value of steady moisture of AUV-M Dniproat φ→1is equal 59,9 ТГКindicating higher hygroscopicitythancotton [3]. The developed ultramicropore structure increases adsorption capacity towards low-, medium- and high-molecular contaminates such as toxins, microbial bodies, gases, alkaloids etc.
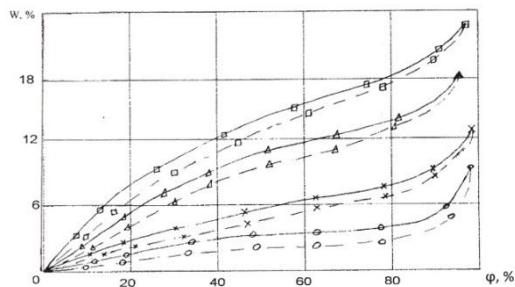

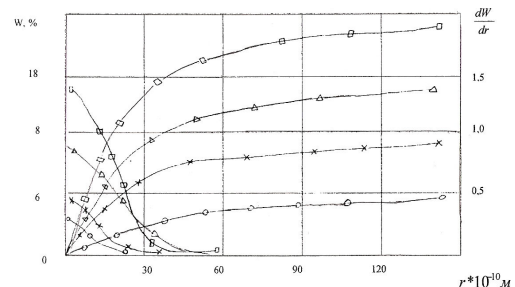Fig. 1 Adsorption-desorption (solid-dash) isotherms

Fig. 2. Integral and differential curves of pore size distribution

The pore structure of Busofit T-1 material depends on the fluid moistens. When wetted with water,both total pores and macropores volumesare similar to AUV-M, while the microporesvolume is 3 times lower. When wetted with benzene,the total pore volume of Busofitis almost 3 times lower than for AUV-M Dnipro, while, the microporesvolume is 10 times lower. Thie identified the presence ofmesoporeswhich dimensionis in-between the size of benzene and watermolecules. Hygroscopicity and specific surface of Busofit T arelower than AUV-M (10-12 timesif wetted with benzene, 1,2-1,4 times if wetted with water)suggesting the development of micro- and macro-pore structures. This makes the Busofit T useful as a adsorbent oforganic solvents (toluene, benzene, acetoneetc.).

Regardless of used fluide,the macro- and micropores volume ofAUT-M material is similar to AUV-M and Busofit. Instead, its ultramicropore volume is 2 times smaller than AUV-M. The data obtained by measurements of pore structuresby adsorption-desorption isotherms indicate that AUT-M can be utilized as a filter for medium and high-technology materials in mild, food and pharmaceutical industries.

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