Adsorption of fulvic acids by activated carbon in aqueous solutions

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The aim of this paper was to research processes and reactions that occur on anthracite activated carbon (AC) interface in fulvic acids (FA) aqueous solutions.

Structural-adsorptive characteristics of AC are listed in Table 1, where S_{BET}, S_{me} – specific total and mesopore surface area respectively, V_a, V_{mi}, V_{me}, V_{ma} – specific total, micropore, mesopore and macropore volume respectively.

S_{BET}, m^2/g	S_{me}, m^2/g	V_a, cm^3/g	V_{mi}, cm^3/g	V_{me}, cm^3/g	V_{ma}, cm^3/g
950	345	0.55	0.37	0.14	0.04

Table 1: Structural-adsorptive characteristics of AC

FA are the main part (more than 90%) of Dnieper river organic matter. Studies of the molecular weight distribution of FA extracted from the Dnieper River water have shown that it is basically the substances with relatively low molecular weight (<1000 Da). FA with molecular weight > 1000 Da are only 11%.

Isotherms of FA adsorption were measured at different pH (2, 7, 12). It was revealed that isotherms are adequately described by the Langmuir equation.

The ionization of both phenol and carboxyl FA groups was suppressed at pH 2, which made possible the densest packing of FA molecules in the adsorption layer. Limiting specific adsorption of FA was 207.7 mgC/g, the area of the "landing surface" varied from 2.92 to 4.19 nm^2 (depends on different carbon content in the molecule) corresponding to a Van der Waals volume of the molecule of 1.16 to 1.68 nm^3.

Carboxyl and phenol groups of FA molecules were ionized at pH 7 and 12 resulting in electrostatic repulsion of the anions and an increase of their hydration, which reduced anion packing density and limiting specific adsorption of FA consequently. Limiting specific adsorption at pH 7 and 12 was 136.6 and 91.1 mg C/g respectively.

Received data indicated that FA molecules formed layer associates during adsorption. Association factor of these associates was limited by the adsorbent pores radius, while the "landing site" in the dense adsorption layer was equal to the projection of the Van derWaals size of a molecule and did not depend on the value of the association factor.