



Complexation of Hg (II) ions with humic acids of tundra soils

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Humic acids (HA) play an important role in processes of heavy metals migration, controlling their geochemical streams in environment. Accumulative and detoxification abilities of HA to heavy metals are realized by means of formation of steady complexes salicylate and pyrocatechin types. Modern researches show that HA of the Arctic and Subarctic areas are poorly enriched by aromatic frames, so and metalbinding centres. The work purpose is to study interaction mechanisms of Hg (II) ions with HA and to define tread possibilities of a tundra soils humic acids. It is established that binding ability of Hg (II) ions depends on concentration of an element, on quantity of functional groups in peripheral and nuclear parts of HA molecule as well as on a solution pH. Complexation proceeds at pH 2.5-3.5 efficiently. On the basis of kinetic models it is shown that HA interaction with Hg (II) ions, at microconcentration of a pollutant (0.025-5.0 $\mu\text{mol}/\text{dm}^3$), has a zero order of reaction. Rate of a reaction does not depend on initial components concentration and is defined by process of Hg (II) ions diffusion to organic ligands. High correlation of a HA sorption capacity to Hg (II) ions is observed: with the nitrogen content and maintenance of amino groups (according to a ^{13}C -NMR, element composition) and negative correlation – with degree of HA aromaticity. It testifies to primary binding of Hg (II) ions by amino-acid fragments of a HA molecule peripheral part. When concentration of Hg (II) ions increases, binding proceeds on carboxylic and phenolic groups of a molecule nuclear part. Higher order of kinetic models reaction and FTIR spectroscopy data testify to it. Comparison of FTIR spectra of HA preparations and mercury humates, shows that Hg (II) ions binding in humate complexes is carried out mainly by -COOH. Reduction of a spectral line intensity not ionized -COOH at $1700-1720 \text{ cm}^{-1}$ and intensity increases of dissymmetric valency vibration at $1610-1650 \text{ cm}^{-1}$ diagnose increase in a share of the carboxylate-ion connected by mercury. Inclusion alcohol and phenolic -OH groups in complexing process with increase Hg (II) ions concentration is shown. Maximum of HA sorption capacity reaches 0.49 mmol Hg (II) on 1 g of a preparation. The further concentration increase of an element (more than 0.51 mmol/dm^3) conducts to formation hydroxide mercury complexes and to physical sorption by HA surface. Thus it is established that soil formation binding of Hg (II) ions in natural concentration is carried out mainly by -COOH groups of amino acids of HA hydrolytic part in the tundra conditions. Humic acid with high aromaticity has more degree of binding with Hg (II) ions under the technogenic pollution.

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