The effect of electrolysis on size dispersion of humic substances

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doi: 10.36291/HIT.2019.zubov.054

The chemical and biological activity of humic substances (HS) determines their relevance in agriculture, production of sorbents and nanocarriers of various ions, etc. At that, they are characterized by complexity and inconstancy of the composition, which limits the possibility of application. There are various ways to modify the HS. Along with a change in the ionic composition, a significant part of them is aimed at stabilizing particle sizes in solutions, because this largely determines the properties (in particular, bioavailability) of the products obtained [1]. For the purification of such preparations, an electrolysis method is effective, which can also affect the processes of the association of macromolecules. Therefore, it is of interest to consider the effect of electrolysis on inert electrodes on the dispersion of HS molecules size in solution.

Humic substances were isolated and fractionated according to [2]. The electrolysis was carried out at a current density of 250 mA / m^2 on iron electrodes in an alkaline medium at a concentration of HS 1 g / l for 6 hours. The dispersion parameters were measured by quantum correlation spectroscopy (HORIBA LB-550) at an initial concentration of HS (1 g / l) and after dilution 200 times.

The obtained data confirm that during electrolysis in an alkaline medium, anodic dissolution of iron practically does not occur. Two groups of particles were detected in the initial preparations of HS: 2-12 nm in diameter (individual macromolecules and small associates) and 200-900 nm (larger supramolecular formations). With the increase in the concentration, an equilibrium shift towards large particles is observed. After electrolysis, the polydisperse bimodal character of the particle size distribution is preserved. At the same time, the system becomes more homogeneous: HS macromolecules form associates of a smaller size (50-400 nm), and the monomolecular fraction is not determined. The revealed changes are probably due to electromagnetic and thermal effects and are explained by an increase in the number of active centers, as a result of which the tendency of HS to association increases, but smaller aggregates are formed. This allows one to expect an increase in the bioavailability of HS as a result of electrolysis.

Thus, the analysis of molecules size dispersion showed that the HS particles are in the form of agglomerates in solutions. A significant contribution of associative processes to the formation of HS properties is revealed. During electrolytic exposure, the dispersion of the particle size changes: it becomes more uniform, and the particle size decreases. This can positively affect the bioavailability of humic preparations.

Acknowledgements. The reported study was funded by RFBR according to the research project № 18-05-70087.

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