MAGNETIC COMPOSITE MATERIALS: SORPTION AND DETOXIFYING PROPERTIES IN RELATION TO ANTIBIOTICS

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Fluoroquinolones are synthetic broad-spectrum antimicrobial compounds used in medicine and veterinary medicine [1]. Fluoroquinolones are not destroyed in the body and, as a result, enter the environment in large quantities from wastewater from sewage treatment plants, medical facilities, factories, waste from the production of pharmaceuticals, etc. The present study is devoted to the development of nanocomposite sorbents based on nanoparticles (NPs) of magnetite (Fe3O4) modified with aminoorganosilanes (tetraethoxysilane, TEOS and 3-aminopropyltriethoxysilane, APTES), and the study of their microstructure and detoxifying properties with respect to ciprofloxacin (CIP) in the presence of dissolved organic matter. The Fe3O4 nanoparticles as a core and organosilanes as a protective and functional shell were chosen thanks to synthesis simplicity and high magnetic characteristics compared to other iron oxides and the formation of covalent bonds on the Fe3O4 surface respectively [2]. Humic acids (HA) were chosen as a model of dissolved organic matter.

The study of the microstructure and phase state of Fe3O4/TEOS/APTES nanoparticles by X-ray phase analysis showed that the average sizes of nanoparticles calculated by the Scherrer equation are 16, 10, and 9 nm for bare magnetite, Fe3O4/TEOS, and Fe3O4/TEOS/APTES NPs, respectively. The functionalization of TEOS and APTES of magnetite nanoparticles leads to a decrease in the content of stoichiometric Fe3O4 from 78.8% for the initial one to 67.3 and 42.4%, respectively. The modification of TEOS and APTES leads to an increase in the specific surface area from 64 to 119 m2/g according to the data of the low-temperature nitrogen adsorption method (77 K). When studying the mechanism of stabilization of NPs by alkoxysilanes by infrared spectroscopy, the presence of absorption bands for the following bonds was revealed: Fe-O-Si bonds (692, 583 cm-1) [3], indicating the appearance of bonds between the surface of TEOS and Fe3O4 , Si-O-Si bonds (1056 cm-1) [3], indicating incomplete polymerization of TEOS and APTES, NH2- (790, 1633, 3424 cm-1) [4] or OH groups (1633, 3424 cm-1) [3] , which are almost completely located inside the silicon framework. According to UV and visible spectrophotometry data, the concentration of sorbed CIP decreases from 49 to 8% at pH from 6 to 8, respectively. The addition of HA leads to an increase in the amount of sorbed CIP from 18 to 64 % due to the contribution of the HA functional groups.

The assessment of the detoxifying ability of the MTA nanoparticles towards ciprofloxacin showed an increase in the survival rate of *Paramecium caudatum* ciliates, which correlates with sorption experiments. At the same time, the presence of the humic acids does not significantly increase the inhibition of *P. caudatum* due to formation of intermolecular complexes of nanoparticles with humic substances.

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