Sorption of ciprofloxacin using humics-coated Fe_3O_4 nanoparticles

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In recent decades, water quality became a crucial issue also in developed countries due to identification in surface and drinking waters of new classes of pollutants, which were previously ignored. Among them antibiotics are of great concern due to their increased consumption, long-term stability in water and soil, and poor efficiency of recovery at conventional water treatment facilities. Ciprofloxacin (CIP) is a fluoroquinolone antibiotic with a broad spectrum of action, which is more often found in surface and wastewaters as compared to other antibiotics. One of the most commonly used method for the removal of CIP from wastewater is adsorption. This study is aimed to estimate surface-dependent effect of humics-conjugated magnetite (Fe_3O_4-HA) on sorption of ciprofloxacin.

The nanoparticles of magnetite were synthesized *in situ* by oxidative alkaline hydrolysis of the iron (II, III) powder precursors into humics medium. The synthesized particles prepared at different humics concentration (10, 20, 40 wt%) were characterized using X-ray powder diffraction (XRD), scanning electron microscopy (SEM), Mossbauer and FTIR spectroscopy, DLS and BET analysis. The CIP recovery was studied from 0.1 mM solution at solid:liquid ratio 1:1000, pH 7.5, and the contact time 24 h. The equilibrium concentration was determined spectrophotometrically.

The results showed that the size and specific surface of nanoparticles depended upon the humics concentration. XRD results indicate that the addition of HS into Fe_3O_4 nanoparticles media have not changed the crystal structure of nanoparticles, but the intensity of the peaks is reduced with using of HA. The average crystal size of the nanoparticles calculated from the diffraction peak half-widths according to Scherrer's equation for the Fe_3O_4-HA in concentrations of 10-40 wt.% decreased from ~17 nm to ~10 nm, respectively. Moreover, Fe_3O_4 conjugation with humics lead to increase specific surface from 117 to 142 m^2/g for the Fe_3O_4 and the Fe_3O_4-HA20 accordingly.

The sorbents under study are characterized by a high sorption capacity regarding to ciprofloxacin. The results obtained indicate that the adsorption of CIP by the Fe_3O_4-HA20 is largely enhanced in comparison with the bare Fe_3O_4.

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