The iron oxide sorbent modified with lanthanum(III) ions in the context of arsenic removal

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Removal of arsenic compounds from the groundwater is an important aspect of environmental protection. Adsorption seems to be the most appropriate way to combat the problem of arsenic contaminated aquatic systems. Removal of arsenate ions on the Arsen X^{np} sorbent has been studied. This sorbent combines the unique structure of hydrated iron nanoparticles dispersed in a polymer matrix with the sulfonic groups. In addition, the adsorption properties of pure adsorbent and those with the previously adsorbed lanthanum were compared.

The modification of the sorbent consisted in adsorption of lanthanum(III) ions from aqueous solution ($t = 6$ h, $c_o = 100$ mg/dm^3, pH = 4) and then drying the sorbent at 313 K within 24 hours. In that way the modified X^{np}-La(III) sorbent was obtained. The kinetic parameters were determined using the pseudo-first order (PFO) and pseudo-second order (PSO) models. The equations of Langmuir and Freundlich isotherms were used to determine the isotherm parameters. The raw and modified sorbent was characterized by the Fourier-transform infrared spectroscopy (FTIR) analysis, determining nitrogen adsorption-desorption isotherms at 77 K, scanning electron microscopy (SEM) and the point of zero charge was also assessed.

The work proved that the previous adsorption of lanthanum(III) ions on the iron oxide sorbent contributed to an increase in the sorption efficiency of arsenic(V) ions. The maximum sorption capacity for arsenic ions was over 2.5 times greater after the modification. What is more, Arsen X^{np}-La(III) caused complete arsenate(V) ions removal from the solution of 50 mg/dm^3 in a relatively short time (about 120 minutes). It was also found that after the modification the sorbent can be successfully reused for the purification process of water contaminated with arsenic. After 3 cycles of adsorption and desorption, no significant decrease in the process efficiency was observed. All these factors confirm that lanthanum-modified Arsenic X^{np}-La(III) achieves better results than the unmodified Arsen X^{np} and is a very promising material in the context of arsenic removal from contaminated water systems.