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Study of kinetics of Fe^{2+} sorption from aqueous solution by layered double hydroxides with hydrotalcite structure

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Abstract

The paper is concerned with kinetics of ferrous ions sorption from aqueous solution by layered double hydroxides (LDH) with hydrotalcite structure. Magnesium-aluminium and magnesium-iron layered double hydroxides in carbonate forms were synthesized by the method of components co-precipitation from a solution at variable pH. The synthesized materials were characterized by a set of physical-chemical techniques such as X-ray diffraction, thermogravimetry and differential scanning calorimetry, atomic absorption spectroscopy, low temperature nitrogen adsorption and thermodesorption. All results obtained confirmed the formation of well-crystallized layered double hydroxides with hydrotalcite structure as the single phase. Kinetics of sorption of iron(II) ions was investigated by the method of limited solution volume. Mohr's salt was used as a source of ferrous ions. The determination of iron content in solutions after sorption was carried out photometrically using the method base on formation of colorful complex of iron with 5-sulfosalicylic acid in ammonia solution. The data obtained give an evidence that the synthesized materials possess high sorption activity towards Fe^{2+} ions. The equilibrium in the system "aqueous salt solution – LDH" was shown to be achieved faster for magnesium-iron hydroxide than for magnesium-aluminium hydroxide; it could be due to more developed surface of the magnesium-iron sample. Resulting kinetic curves were analyzed by means of diffusive and kinetic models. The analysis of graphs plotted according to known models of diffusive kinetics allowed to conclude that the process of sorption of ferrous ions occurred in mixed diffusion controlled regime. Application of models of chemical kinetics permitted to establish that the kinetics of sorption of Fe^{2+} ions could be adequately described by pseudo-second order equation for both synthesized layered double hydroxides. On the base of the set of the data obtained one can conclude that the process of sorption of ferrous ions from aqueous solution under experimental conditions is not caused only by precipitation of iron compounds on the surface but it probably involves the diffusion of cations into the particles of layered double hydroxides.

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