

APPLYING MAGNETOSENSITIVE NANOCOMPOSITES FOR REMOVING OF Hg²⁺ FROM AQUEOUS SOLUTIONS

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The accumulation in ecosystems and water objects of such pollutants as toxic organic compounds, ions of heavy metals, dyes and other harmful for all living beings substances indicates the problem of their even partial removal extremely important. The development of ecotechnology stimulated the search for and implementation in practice of new effective sorption technologies. The selection of ions of Hg²⁺ as the object to study the adsorption behavior due to the peculiarities of toxicokinetics and toxicodynamics of these cation.

That is why we have synthesized highly dispersed composites based on magnetite with coatings and the choice of tetraethoxysilane and n-butylacetoacetate as modifiers due to the possibilities of creating polymer shells, which would improve the adsorption indexes of the composite [1]. The synthesis of magnetite was carried out by gel-sol method of Elmore. For modification used as the basis of magnetite with a specific surface of 99 to 100 m²/g and a crystallite size of 30-50 nm. The adsorption-desorption properties of magneto-sensitive composites regarding ions from aqueous solutions in the dynamic mode at room temperature were investigated. Aqueous solutions Hg²⁺ of appropriate concentrations were prepared from salts Hg(NO₃)₂. Samples of composites weighing 0.03 g were filled with a solution of appropriate concentration, V=5ml. Investigation of the adsorption properties of the sorbents in aqueous environment of pH was carried out (C(Hg²⁺) =42 mg/l) in the pH range of 2.7 to 7.7. An acetate-ammonia was used as a buffer solution. To study the kinetics of adsorption C(Hg²⁺) =36 mg/l at pH-2,7. The contact time is 15-180 minutes. The solutions with C(Hg²⁺)=1-40 mg/l were prepared to determine the adsorption capacity and construction of isotherms. Desorption was performed on samples after adsorption in aqueous solution and 0,1; 0,5; 1N solutions of HNO₃.

For all surfaces the maximum index of the extraction degree is observed at pH=2,7. Increasing pH leads to decreasing in the degree of extraction and adsorption capacity (Fig. 1, *a*). On all surfaces the maximum indexes of the degree of extraction is attained quite quickly, within 30-60 minutes (Fig. 1, *b*).

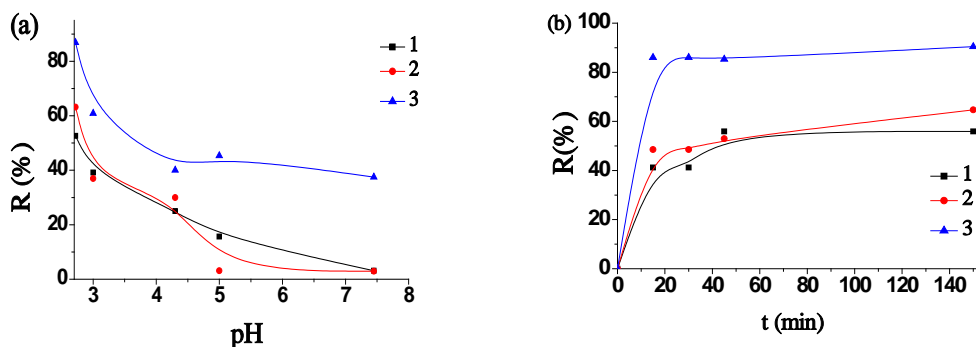


Fig. 1 Dependence on pH (*a*) and kinetics (*b*) adsorption of ions Hg^{2+} on the surfaces Fe_3O_4 (1), $\text{Fe}_3\text{O}_4/\text{SiO}_2$ (2) and $\text{Fe}_3\text{O}_4/\text{TiO}_2$ (3) .

For Fe_3O_4 at 298 K $A_{max} = 3.5$ mg/g under the conditions of the experiment. After modification of magnetite TEOS, adsorption capacity of the surface slightly increases the $A_{max} = 4.2$ mg/g. High adsorption properties of the surface of $\text{Fe}_3\text{O}_4/\text{TiO}_2$, for $\text{Fe}_3\text{O}_4/\text{TiO}_2$ at 298 K $A_{max} = 5,8$ mg/g are observed. A characteristic feature of the isotherms describing the adsorption process, is the availability of concave initial phase and two plateaus, which are formed at higher concentrations of Hg^{2+} , as with increasing concentration there is a saturation of the monolayer and formation of multimolecular layer due to the complexation on the surface of the adsorbent, which leads to the emergence of the second plateau. Such adsorption has a certain effect on the degree of extraction of ions Hg^{2+} . At low concentrations there is an increase in the degree of extraction (the first plateau). With further increase of concentration the degree of extraction (the second plateau in the isotherm) decreases. When the concentrations of ions $\text{Hg}^{2+} = 10$ mg/l is observed a significant increase in R index for the surface of Fe_3O_4 is up to 70%. For $\text{Fe}_3\text{O}_4/\text{SiO}_2$ and $\text{Fe}_3\text{O}_4/\text{TiO}_2$ is also characterized by an increase in R with the increase in the concentration of Hg^{2+} .

1. Shpak A.P., Gorbyk P.P. (eds.). Nanomaterials and Supramolecular Structures. Physics, Chemistry, and Applications. – Springer: 2009. – 425 p.