EFFECT OF TEMPERATURE ON SORBENTS

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ABSTRACT

The information presented in this work is of great practical importance. With its help, the production process of sorbents for wastewater treatment becomes easier and does not require a lot of time, thereby helping the ecological development of the Republic of Uzbekistan. The experiments carried out during this work allow us to open the prospects of using natural clay materials, thiourea and polyethyleneimine for efficient and ash treatment of waste water of industrial enterprises.

Key words: *metallurgy, mechanical engineering, metal, waste water, copper, cadmium, lead, mercury, zinc, ion.*

Introduction. In the last 20 years, researchers have been increasingly interested in developing new methods and materials for the extraction of hazardous pollutants from wastewater. Heavy metal pollution is the most common problem in the aquatic environment due to its persistence and toxicity. High consumption of heavy metals in addition to sodium causes various diseases: nausea, abdominal pain, gastrointestinal disorders, neurological dysfunction, hemolysis, liver and kidney damage. Metallurgy, machine-building, and metal processing industry are the main sources of environmental pollution with heavy metal ions, their wastewater contains ions of copper, cadmium, lead, mercury, zinc, and others. The problem of cleaning surface and wastewater from heavy metals is the main problem of protection of the external environment, since HM causes great damage to the biosphere.

In addition, this research aims to develop cost-effective technologies for the separation of metal ions from wastewater. The most effective method of sorption cleaning is considered, as well as the most effective sorbents, natural mud materials are selected, their modification with various substances increases their sorption properties.

The process of sorption of cadmium and lead ions using modified sorbent was studied at three temperatures: 277 K, 298 K and 308 K.

Studying the effect of temperature allows to calculate the sorption rate

constants, sorption rate and activation energy of the process, the results of which are presented in Figures 1 and 2 and Table 1.

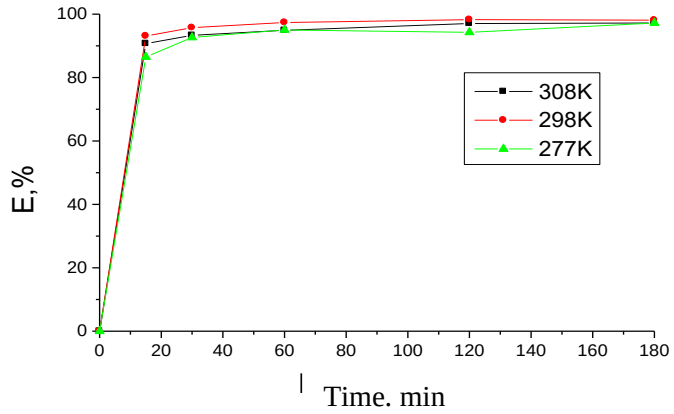

Fig. 1 Time dependence of the extraction rate of –Cd^{2+} ions by BG+PEI sorbent at different temperatures (pH = 6, C_{isx} = 100 mkg/ml, C_{pzi} = 0,1%).

Time dependence of Risunok 2-$P2^{2+}$ ion extraction rate of BG+PEI sorbent at different temperatures. (pH = 6, C_{isx} = 100 mkg/ml, C_{pzi} = 0,1%).

The data presented in Figures 1 and 2 show that the temperature change has little effect on the ion sorption process. This mechanism of chemisorption is the formation of a complex between the sorbent and the sorbate shows.

Table 1 - kinetic characteristics of sorption of –Cd^{2+} and Pb^{2+} ions with modified bentonite.

Metal ion	T, K	K, min^{-1}	w, mkg/ml*min	E_a, kJ/mol
Cd^{2+}	277	0,062 ± 0,002	1,22	5,285
	298	0,079 ± 0,004	1,38	
	308	0,082 ± 0,001	1,63	
Pb^{2+}	277	0,041 ± 0,001	0,47	12,795
	298	0,047 ± 0,002	1,94	
	308	0,064 ± 0,003	2,22	

The data in Table 1 show that the rate constants of the process increase with increasing temperature. It is active due to the increase in the rate of sorption, the extimol, the increase in the activity of TM ions in the solution, as well as the disruption of some internal bonds on the surface of the sorbent.

The most important characteristics of adsorption isotherms at different temperatures were calculated to determine thermodynamic properties such as equilibrium constants, enthalpy, entropy and Gibbs energy.

According to Table 2, the optimum temperature is 308 K for cadmium ions and 298 K for lead ions, where the equilibrium constants and maximum adsorption values are maximum. The data in the table show that the correlation coefficients for cadmium ion and lead are close to unity according to the Langmuir theory for all temperatures.

2 tables - Characteristics of adsorption isotherms of metal ions with modified sorbent at different temperatures.

Metal ion	Langmuir theory				Freundlich theory		
	T,K	K, l/mg	A_∞, mg/l	R^2	β	1/n	R^2
Cd^{2+}	277	0,2682	15,6	0,965	5,05	4,2	0,836
	298	0,1422	15,8	0,973	5,82	4,8	0,847
	308	0,1854	17,8	0,998	4,78	3,23	0,968
Pb^{2+}	277	0,460	5,8	0,923	2,26	0,51	0,888
	298	0,1082	11,6	0,941	1,48	0,73	0,783
	308	0,92	6,7	0,867	3,45	0,98	0,640

Of metal ion adsorption onto BG+PEI sorbent effect explanation for thermodynamic indicators counting from: Gibbs free energy (ΔG), enthalpy (ΔH) and entropy (ΔS).

Positive values of Gibbs free energy indicate that the sorption of Cd^{2+} and Pb^{2+} ions on the surface of the sorbent is not simultaneous.

A positive entropy value for lead ion indicates an increase in randomness at the solid/liquid interface during adsorption. A negative value of the entropy change indicates a decrease in randomness at the solid/liquid interface during sorption.

Based on the results of the study of the effect of various factors on the sorption of Cd^{2+} and Pb^{2+} ions, the optimal values of the sorbent were determined: the optimal concentration of modified PEI in the sorbent was 0.1% at T=298 K, and the mass of the sorbent was equal to 6 for cadmium and lead in 100 ml solution for 1 gram.

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