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SEPARATION OF Cu (II) AND Ni (II) IONS FROM TECHNOLOGICAL SOLUTIONS USING POLYVINYL CHLORIDE-BASED ION EXCHANGER

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Abstract:

Ion exchange materials are widely used on an industrial scale in the purification of the environment from various toxic metal ions, in hydrometallurgy, as well as in the separation of intermediate metal ions from geological minerals. Also, the exchange capacity of copper and nickel ions under static and dynamic conditions has been calculated for a new polycomplex containing amino and sulfur groups.

Keywords: hydrometallurgy, polyvinylchloride plastic compound, polyampholyte, sorption, copper ion, nickel ion.

INTRODUCTION. Nowadays, the study of sorption of ions from aqueous solutions by various ion exchangers is of great scientific and practical importance. Containing the strongest acidic group, a specific cationic property, as well as a secondary and tertiary amino group with an anion exchanger is the main method of water softening used in desalting water of various industrial tar, in hydrometallurgy, in obtaining precious metals, in concentrating solutions, in water preparation for household and food industry [1, 2]. Until now, the sorption of Cu^{2+} and Ni^{2+} ion exchangers for the separation of non-ferrous metals has been studied in hydrometallurgy. Several typical studies have been carried out on the physicochemical properties of some such tar and their principles of operation, equilibrium in solutions, its equilibrium thermodynamics and kinetics [3].

MATERIAL AND METHODS. In this work, the properties of adsorption of copper (II) and nickel (II) from artificial solutions under static conditions were studied by a new polycomplexon containing sulfo and amino groups based polyvinylchloride. Researches were conducted on sodium ions by the artificial solutions prepared from water soluble salts of water $Cu(NO_3)_2$ and $Ni(NO_3)_2$. The change in the initial and after sorption concentration was determined using a Microplanshed Rated Enspire Perkin Emler spectrophotometer (USA). At the same time, factors affecting the sorption process were investigated depending on the concentration of the solution, temperature and time.

RESULTS AND DISCUSSION. Based on the obtained results, the adsorption limit and the sorption stability constant were calculated using the Langmuir equation: $\frac{1}{q_e} = \frac{1}{q_\infty} + \frac{B}{q_\infty} \cdot \frac{1}{C_e}$ [4]. The thermodynamic parameters of the system (enthalpy, entropy, and free energy) were calculated using the equilibrium constant of the sorption process.

Table 1

The absorption factors of copper(II) and nickel (II) ions by polyampholyte and change of thermodynamic parameters

Metal ions	T, K	q_∞, mmole/g	K, l/mmole	$-\Delta G$, J/mole	$-\Delta H$, J/mole	$-\Delta S$, J/mole·K
Cu(II)	313	1,77	8,2	8740	8500	26,5
	323	1,98	9,3	12754		38,5
	333	2,73	9,8	13628		41,2
Ni(II)	313	1,42	4,3	7902	8000	23,5
	323	2,28	4,8	8154		24,2
	333	3,43	5,5	8407		25,0

As shown in the table, the decrease in free energy, enthalpy and entropy of the system indicate that the ions Cu^{2+} and Ni^{2+} are absorbed into the ion exchanger in an independent way. With an increase in the temperature of the sorption medium, the increase in A_∞ and the equilibrium constants of sorption, as well as the absorption of metal ions to ion exchangers, is carried out using chemical sorption. If during the lowering of the enthalpy value the Cu^{2+} ions have negative values than the Ni^{2+} ions, then the Cu^{2+} ions form more coordination bonds than the Ni^{2+} ions.

Dynamic sorption processes have also been studied for the use of ion exchangers in dynamic conditions in industrial plants. Figure 1 below shows the dependence of the concentration of metal ions in the solution leaving the column on the volume of solution passing through the sorbent.

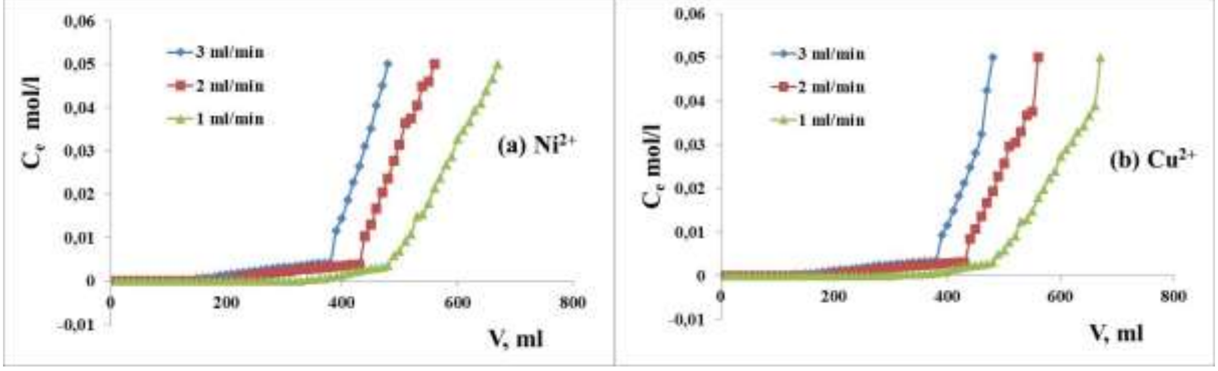

Figure 1. Dependence of the dynamic sorption value of (a) Ni^{2+} and(a) Cu^{2+} ions on the PVC-based polyampholyte on the rate of transition. (C_M = 0.05 mol/l)

As can be seen from these figures 1 - (a, b), the sorption of metal ions into the polyampholyte increased with a decrease in the rate of transition of the solutions from the column. This is due to the increased exchange of metal ions in the salt solution with the functional groups of the ion exchange sorbent.

As mentioned above, one of the requirements for ion exchange materials used in industry is recycling in this ion exchange process. That is, it resorbs its sorption properties when it is desorbed and regenerated after sorption. Sorption and desorption of Cu^{2+} and Ni^{2+} ions on PVC-based polyampholyte was performed 6 times, the results of the study are as follows.

Table 2

Repeated sorption of Cu^{2+} and Ni^{2+} ions under dynamic conditions on PVC-based polyampholite

№	**F,** ml/min	**V, ml** (solution volume)	**V, ml** (ionite volume)	**DEC** mol-equv/m³	**CDEC** mol-equv/m³	α
Cu⁺⁺						
1	1	720	30	**972**	**1200**	0,81
2	1	720	30	**972**	**1200**	0,81
3	1	720	30	**972**	**1200**	0,81
4	1	720	30	**972**	**1200**	0,81
5	1	720	30	**972**	**1200**	0,81
6	1	700	30	**933**	**1167**	0,88
Ni ⁺⁺						
1	1	590	30	**836**	983	0,85
2	1	590	30	**836**	**983**	0,85
3	1	590	30	**836**	**983**	0,85
4	1	590	30	**836**	**983**	0,85
5	1	590	30	**836**	**983**	0,85
6	1	560	30	**765**	**933**	0,82

In Table 2, the dynamic exchange capacity(DEC) and dynamic exchange capacity (CDEC) value did not change as a result of desorption with hydrochloric acid for the use of repeated sorption of Cu^{2+} and Ni^{2+} ions from technological solutions to polyampholyte.

CONCLUSION. This proves that ionite is a polyampholyte with high physicochemical properties. Therefore, this ionite can be offered for use in the treatment of wastewater from industrial plants for use in a number of imported industrial ionites.

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