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TECHNOLOGY OF SYNTHESIS OF LIGANDS BASED ON LOCAL RAW MATERIALS

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Abstract. In this article, the physico-chemical basis of the synthesis of complex-forming polymer ligand ionites containing nitrogen, sulfur, oxygen, and phosphorus is analyzed. The sorption abilities of the synthesized polymer ligands were studied on Cu (II), Zn (II), Cd (II), Ag (I) ions, and the effect of the medium pH was studied. According to the results of metal sorption studies, static exchange capacities of ligands (mg-equiv/g) was studied.

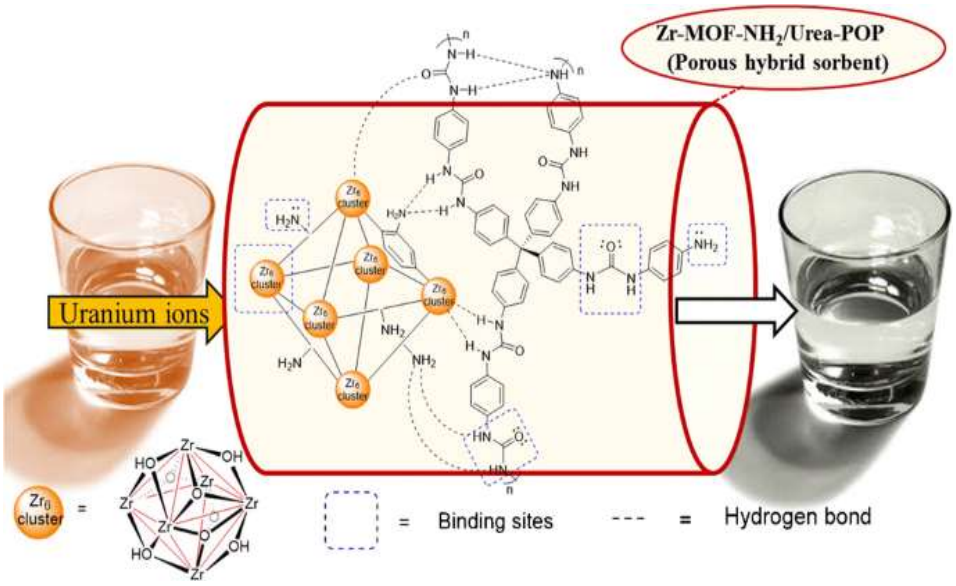
Keywords: nitrogen, sulfur, oxygen, phosphorus, polymer ligand, ions.

Introduction.

Global production of synthetic sorbents has doubled over the past decade. 15% of produced ionites are used in the treatment of thermal power plants, nuclear power plants and industrial waste, 9% in chemical technologies, 6% in the food and pharmaceutical industry, and the rest in other areas[1].

In today's world, synthesizing new types of sorbents, determining the sorption properties of metal ions, and using them to extract precious metal ions from solutions, the composition, structure, and physical-chemical properties of chemical compounds are among the urgent tasks of inorganic chemistry[2]. In conducting research on the synthesis of complex-forming sorbents, based on local raw materials, synthesis of sorbents containing sulfur, nitrogen, oxygen and phosphorus donor atoms, which have the property of forming complexes with various metal ions in solution, and using them to effectively concentrate the ions of rare and non-ferrous metals and the development of separation methods is one of the urgent problems[3]. In this article, the physico-chemical basis of the synthesis of complex-forming ionites containing nitrogen, sulfur, oxygen, and phosphorus based on epichlorohydrin and formaldehyde is analyzed. Accordingly, in order to control the properties of the synthesized sorbent and improve its performance, a polycondensation type sorbent (ion-machine complexite) was obtained as a result of polymer analog changes[4].

The following study shows the use of a sorbent synthesized on the basis of amino acids for the purification of radioactive water. This sorbent has been found to have a high selectivity mainly for uranium and zirconium. According to the results of the analysis, it was determined that the composition of the sorbent has the chemical formula UiO-66-NH_2/urea-POP and $Zr_6O_4(OH)_4(L)6$ (L = 2-aminoterephthalate (BDC-NH_2)[5].



Purification of Uranium and Zirconium in radioactive waters using sorbent.

The framework is achieved by the formation of coordination bonds between the BDC-NH_2 linkers and the hexanuclear $[Zr_6O_4(OH)_4]_{12}$+ nodes.

In order to determine the optimal conditions for the synthesis of a complex-forming sorbent based on the self-polymerization of epichlorohydrin with potassium di-(2-aminoethyl)-dithiophosphate, the influence of factors such as the ratio of initial components, temperature, and reaction duration on the polymerization process was studied[6]. As a result of the study of the influence of the temperature of the synthesis conditions on the properties of the obtained sorbent, it was found that the duration of the polymerization reaction at a temperature of 70 ^{0}C is 3 hours, and the exchange capacity of the ionite is 3.52 mg-eq/g. This indicates that the activity of active substances is less at the given temperature. If the reaction temperature is increased to 100 ^{0}C, the polymerization process accelerates and the reaction duration decreases to 0.6 hours. However, in this case, the permeability and exchange capacity of ionite also decreases. It can be seen that the ionite structure obtained at a given temperature is more dense, as a result of which the mobility of ionogenic groups becomes difficult. 80 ^{0}C was selected for the optimal temperature of the polymerization reaction, and the duration of the reaction is 1.8 hours. The static exchange capacity of the obtained ionite in 0.1 N NaOH solution reaches 4.71 mg-eq/g [7].

In the synthesis of ionites, studies were carried out taking into account all the requirements for ionites in the hydrometallurgical industry. As mentioned, the study of sorption, physico-chemical, kinetic and mechanical properties of ionites, as well as their advantages and disadvantages, is of great scientific and practical importance.

The influence of the medium rN on the sorption of Cu (II), Zn (II), Cd (II), Ag (I) ions in the synthesized polymer ligands was studied (Fig. 1). According to the results of the study of metal sorption, the static exchange capacities of ligands (mg-equiv/g) in the optimal environment pH values are as follows:

L^3: Cu - 4,5 (pH=5); Zn - 2,9 (pH=6); Cd - 3,7 (pH=6); Ag - 4,6 (pH=4);

L^4: Cu - 4,2 (pH=6); Zn - 2,3 (pH=6); Cd - 3,4 (pH=6); Ag - 4,5 (pH=4).

The degree of sorption of studied metal ions on ligands increases in the following order: Zn (II) < Cd (II) < Cu (II) < Ag (I).

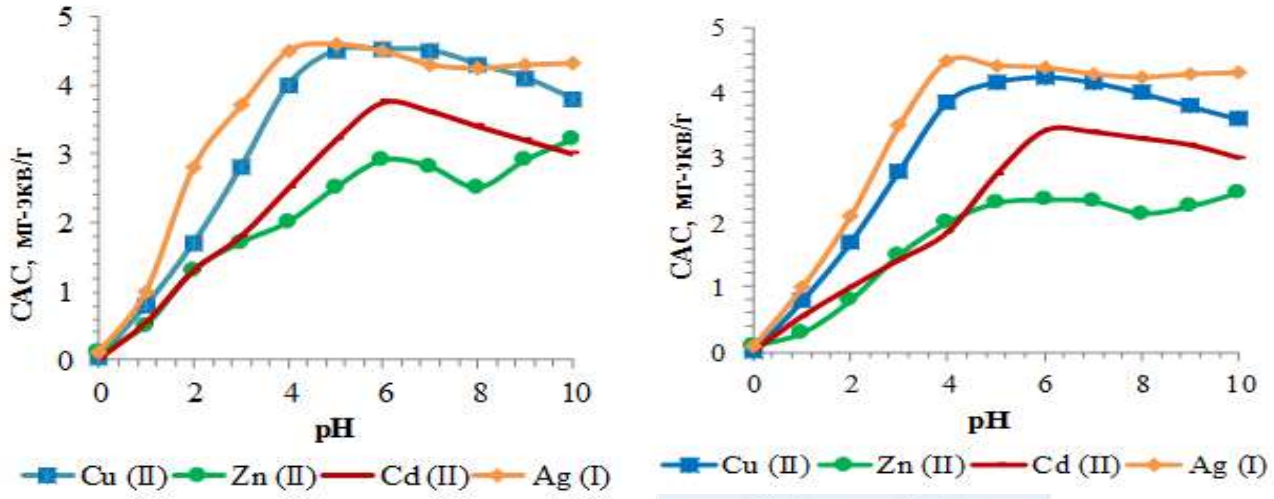


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Figure 1. Dependence of sorption of Cu (II), Zn (II), Cd (II), Ag (I) on L3 (a) and L4 (b) on the size of medium pH(C_{Me}=0,1 н, $m_{сорб}$=0,1 г, τ=2 с, V=10 ml).

Table-5.

Data on the comparison of synthesized polymer ligands (sorbents) with some industrial sorbents

Sorbent	Functional group	Total sorption capacity, mg-equiv/l	Particle size, mm	Powder weight, g/l
L[3]	=NH; –$PO_2S(SH)$	5,6	0,4-0,8	570
L[4]	=N-; –$PO_2S(SH)$	5,3	0,55-0,85	620
Purolite S950[1]	–$CH_2NHCH_2PO_3$	4,7	0,4-0,65	669
Lewatit TP260 Monoplus[2]	–$CH_2NHCH_2PO_3$	5,7	0,52-0,6	690
АФИ-22[3]	–$N(CH_2CH_2OP{=}N–)_2$ OH	3,6	0,63-1,0	405

1"Purolite International Limited", England; 2"Bayer AG", Germany; 3 All-Russian Research Institute of Chemical Technology, Russia.

Properties of synthesized polymer ligands were compared with industrial sorbents. As can be seen from Table 5, the properties of the obtained polymer ligands are not inferior to sorbents produced abroad and effectively used in various industries.

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