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SORPTION OF COPPER (II) AND LEAD (II) IONS BY A NEW CHELATE-FORMING IONITE BASED ON SOME COPOLYMERS OF EPOXYACRYLATES

Abstract. Sorption properties of a new chelating ion-exchange resins based on copolymers of glycidylmethacrylate (GMA) and the chelating agent 1-hydroxy ethylidene-1,1-diphosphonic acid(HEDP) are studied. The optimal sorption conditions with respect to copper (II) and lead (II) metals ions have been determined.

Key words: chelate-forming ion exchangers, chelating agents, chelates, sorption, heavy metals, ion exchange.

The main problem with the development of science and technology is pollution of the environment with ions of heavy metals, for example, water pollution is one of the most urgent. Because, the shortage of drinking water on the planet is becoming a global problem. The removal of heavy metal ions from industrial wastewater and their reuse in the production process will result in the conservation of natural water resources.

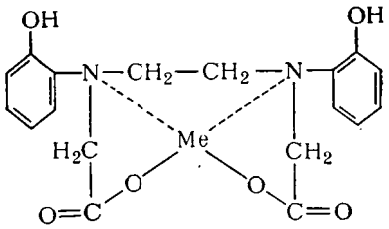
In this case, it would be useful to use ion exchangers to separate various metal ions from water. That is why the requirements for ion exchangers have been increasing lately. They should have improved ion-exchange and wide spectra of physico-chemical properties, which are insoluble in various solutions. An effective method for this purpose is the synthesis of new chelating-forming polyelectrolytes obtained from glycidyl methacrylate (GMA). In the structure of GMA, the polymer double bonds are well defined and are able to identify the reaction epoxide group and the possibility of radical ionic polymerization by the addition of various polymers [1, 2].

The greatest advantage of using ion-exchange sorption for wastewater treatment from galvanic production is the high regeneration of Cu (II), Pb (II), etc. ions in accordance with modern requirements and return of purified water to the production of these metals. Lead ions are included in the group of the most dangerous ecotoxicants that accumulate in the environment due to emissions from coal combustion in power plants, sewage from industrial enterprises (concentrating mills, metallurgical and chemical plants, mines). In this regard, there is a need to use new sorbents to remove metal ions from the solution.

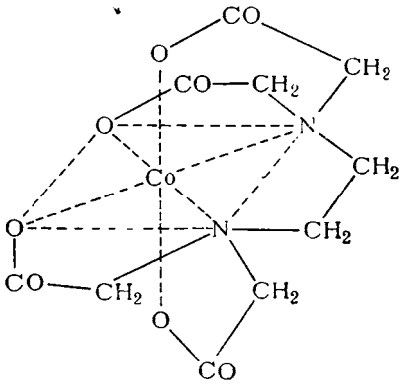
For the practical use of ion exchangers, it is necessary to study the dependence of the sorption of metal ions on the process conditions. The removal of metal ions from the solution largely depends on the concentration and pH of the solution, as well as on the kinetic activity of the ion exchangers.

We have studied and studied the processes of extraction of copper (II) and lead (II) ions from model aqueous solutions with new synthesized ion exchangers based on glycidyl methacrylate and complexonHEDP.

In the studies of Dyatlov NM. Complexes of EDTA and HED Phaving the structure of tick-shaped compounds analogous to chelating groups that contain ethylenediamine-N, N'-di (o-hydroxyphenyl) -N, N-diacetic acid (EDOFA) are shown:



EDOFA



EDTA

The resulting compounds of metal ions with complexons - complexates - have in their structure several so-called chelate cycles. The term chelate (English chelate from the Greek cilh - claw) is used to refer to the cyclic structures that result from the addition of a cation to two or more donor atoms belonging to the same molecule of the complexon. In accordance with the term chelated chelator should be presented in the form of a crab, which with its polydentate claws firmly grasps the metal ion, and the more claws, the stronger the grip [3-5].

The experimental part

Sorption properties of chelating ion exchangers were studied with respect to lead (II) and copper (II) ions from model solutions of the corresponding "hp" nitrate, sulfate salts. Samples of polymers before each series of experiments were dried in a vacuum drying oven to constant weight.

To determine the sorption capacity of the ion exchangers, a polymer weighing 0.05 g, weighted to an accuracy of 0.0002 g, was placed in a Erlenmeyer flask, then 20 ml of a solution of the corresponding metal salt were added. The method of atomic absorption spectroscopy was used to determine the concentration of metal cations [6].

Results and its discussion

It is known that when chelated ion exchangers interact with metal ions by ionic, coordination bonds, they form strong complexes. This ability of chelating-forming ion exchangers to complex formation with metal ions is due to the

presence in the polymer matrix of chemical active groups containing electron-donating oxygen and nitrogen atoms.

With increasing concentration (from 18.5 to 105.5 mg/l) of metal ions in the initial solution, the sorption capacity of GMA-St-AKN-HEDP ion exchanger for lead ion (II) increases from 10, 60 to 41 mg/g , the ion of copper (II) from 6.5 to 37 mg/g, the recovery rate reaches up to 99 and 90%, respectively (figure 1).

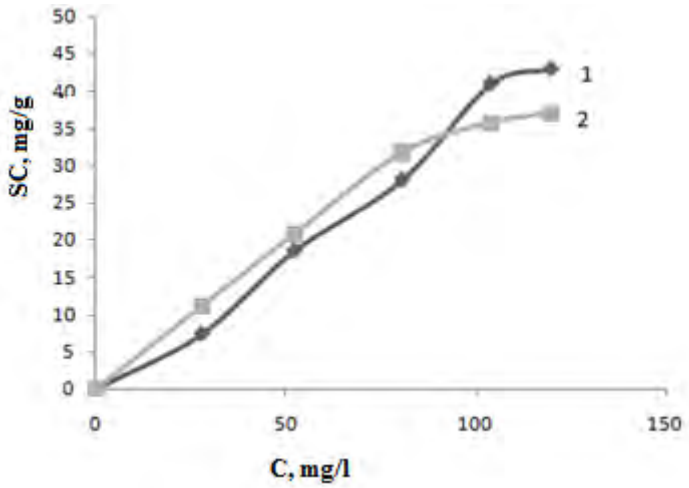


Figure 1 – Influence of the initial concentration of lead (II) 1 and copper (II) 2 ions on the sorption capacity of ion exchangers based on GMA-St-AKN-HEDP(duration of contact 7 days)

An important role in the sorption of metal ions is played by the pH medium, since a change in its value contributes to an improvement in the dissociation of the functional groups of the ion exchanger. For the ionization of GMA-ST-AKN-HEDP,

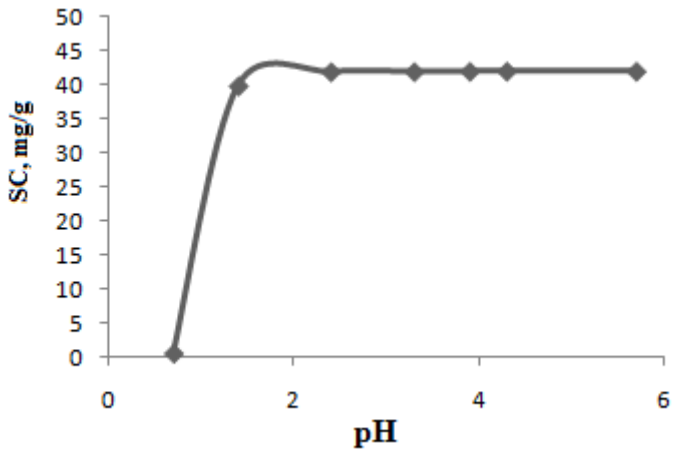


Figure 2 – Dependence of sorption capacity of ion exchanger on the basis of GMA-ST-AKN-HEDP for lead ions (II) from the pH of the solution (C_{Pb}^{2+}=102 mg /l, 7 days)

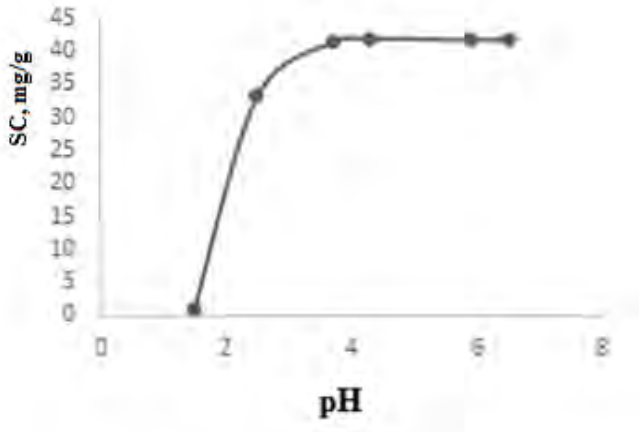


Figure 3 – Dependence of sorption capacity of ion exchanger on the basis Of GMA-St-AKN- HEDP for copper ions (II) from the pH of the solution (C_{Cu}^{2+} = 101 mg/l, 7 days)

the acidity of the solution does not particularly affect the sorption process (figure 2), since the sorption of lead ions (II) passes almost in all pH regions. The sorption capacity of the ion exchanger is 41.22 mg/g, the recovery rate reaches 95%.

The sorption capacity of the cation exchange resin GMA-St-AKN-OEDF with respect to copper (II) ions decreases somewhat with decreasing acidity of the solution. The equilibrium between a solution of $CuSO_4$ containing 101 mg/l of copper ions and cation exchanger GMA-ST-AKN-HEDP is set at pH 3.5; the sorption capacity of the ion exchanger is 41.1 mg/g (figure 3).

The tasks of creating high-performance ion-exchange processes and high-quality materials can be solved only by a detailed study of both the equilibrium and kinetic properties of ion exchangers. It can be seen from Fig. 4 that for lead ions the equilibrium state between the solution of $Pb(NO_3)_2$ containing 100 mg/l, having a pH = 3.1 and the cation exchanger GMA-St-AKN- HEDP is set for 3 hours.

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Резюме

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СОРБЦИЯ ИОНОВ МЕДИ (II) И СВИНЦА (II)
НОВЫМ ХЕЛАТООБРАЗУЮЩИМ ИОНИТОМ
НА ОСНОВЕ НЕКОТОРЫХ СОПОЛИМЕРОВ ЭПОКСИАКРИЛАТОВ

Изучены сорбционные свойства новых хелатообразующих ионитов на основе сополимеров глицидилметакрилата (ГМА) и комплексона ОЭДФ. Определены оптимальные условия сорбции по отношению к ионам металлов меди (II) и свинца (II).

Ключевые слова: хелатообразующие иониты, комплексоны, хелат, сорбция, тяжелые металлы, ионный обмен.

Резюме

Е. Е. Ергожин, Н. А. Бектенов, К. А. Садыков,
С. Б. Рыспаева, К. М. Қалмуратова, А. К. Байдуллаева

КЕЙБІР ЭПОКСИАКРИЛАТТАР СОПОЛИМЕРЛЕРІ НЕГІЗІНДЕГІ
ЖАҢА ХЕЛАТТҮЗГІШ ИОНИТПЕН МЫС (II) ЖӘНЕ ҚОРҒАСЫН (II)
ИОНДАРЫН СОРЫП АЛУ

Глицидилметакрилат және комплексон (ОЭДФ) негізіндегі жаңа хелаттүзгішиониттің сорбциялық қасиеттері зерттелді. Мыс (II) және қорғасын (II) иондары үшін сорбцияның оңтайлы жағдайлары анықталды.

Түйін сөздер: хелаттүзушіиониттер, комплексондар, хелат, ауыр металдар, ион алмасу.