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SYNTHESIS OF IONITES BASED ON CREMNISOLE

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ABSTRACT

In this work, has been studied the effect of concentration on the copolymerization reaction of N-vinylmorpholine and acrylic acid. A composite sorbent based on the obtained copolymer and colloidal silicon has been synthesized and its sorption properties have been studied.

АННОТАЦИЯ

В данной работе изучено влияние концентрации на реакцию сополимеризации N-винилморфолина и акриловой кислоты. Синтезирован композиционный сорбент на основе полученного сополимера и коллоидного кремния и изучены его сорбционные свойства.

Keywords: dinitrilasobisisobutyric acid (DAA), acrylic acid N-vinylmorpholine, DMPA, copolymerization.

Ключевые слова: динитрил азобисизомасляной кислоты (ДАК), N-винилморфолина акриловой кислоты, ДМФА, сополимеризация.

To date, efficient and economical methods for the separation of rare and non-ferrous metals based on the use of nitrogen-fixing sorbents are being developed and put into practice. High sorption activity is exhibited by ion-exchange and complex-forming sorbents that retain various electron pairs of nitrogen, phosphorus, and sulfur reserve groups: aliphatic and aromatic amino groups, pyridine, pyrazole, and other components. The sorption capacity of such sorbents depends on a number of factors, in particular, on the number and nature of functional groups, the nature of the sorbed ion, and sorption conditions [1; 3; 4].

In addition to functional groups, the operational properties of adsorbents also depend on the structure of

the sorption material. The nature of the organopolymer or inorganic matrix mainly determines the chemical and mechanical stability of the sorbents, as well as the kinetics of the adsorption process. In this regard, hybrid sorption materials with desired structural and chemical properties have a great advantage [2; 5; 6; 7; 9].

One of the ways to easily influence the composition, structure, and properties of hybrid sorption materials is the synthesis of inorganic and organic matrices by the sol-gel method. Sol-gel synthesis products are characterized by high mechanical strength and thermal stability. Polymer compounds that retain nitrogen atoms in their macromolecules not only increase the high

efficiency of metal separation, but also improve the technical properties of hybrid materials [8; 10; 11; 12].

Polymer composites, formed as a result of a combination of components of different chemical nature, represent a new class of composite materials with characteristics that exceed those of individual components. As a result of the composite effect, they exhibit unique mechanical, magnetic, optoelectronic properties, high chemical and thermal stability, and resistance to UV radiation. The transition to the nanometer range of sizes of the individual components of the system has a significant effect on the properties of such composites [13; 14].

An extensive group of organic-inorganic composites is made up of materials based on silicon dioxide, obtained as a result of a sol-gel process with the participation of colloidal silicone in the presence of functional organic compounds. The use of this approach makes it possible to introduce into the synthesized composites an almost unlimited number of functional compounds, including thermodynamically incompatible ones. This applies, first of all, to three-dimensional structures, which are (semi) interpenetrating polymer networks, consisting of chemically unrelated, but inseparable due to the mechanical interlacing of chains, components [15; 16; 17]. The main role of the organosilicon precursor in such systems is reduced to the regulation of the structure formation process of the composite, the ability to control the size of nanoparticles and the physical and technical characteristics of the

material. In this case, the silicon component of the composite - silicon dioxide - does not contain functional groups. Functional organic low- or high-molecular compounds act as carriers of chemically active fragments [18; 19].

Experimental part

The process of copolymerization of N-vinylmorpholine (N-VM) and acrylic acid (AA) has been performed in DMFA in various molar ratios (Table 1) for 6 hours at 60°C in the presence of the DAA initiator. The process of radical copolymerization occurs due to the vinyl groups. The resulting copolymer has been precipitated twice and dried in vacuo to obtain a homogeneous mass.

The resulting white powdered copolymer is soluble in solvents such as alcohol, DMFA (dimethylformamide), DMSO (dimethyl sulfoxide).

To obtain a composite sorption material, the originally obtained copolymer N-VM and AA has been dissolved in ethyl alcohol at room temperature and heated with the addition of colloidal silicon. In this case, the crystallization process proceeds with the transition of the copolymer and colloidal siliconol from the sol state to the gel state, and the process ends with precipitation. The resulting solid compositional sorption material has been washed with distilled water and dried in a drying cabinet to obtain a constant mass.

Table 1.

The effect of concentration on the copolymerization of N-VM (M_1) and AA (M_2) (DMF, DAA-1% by mass, 60°C, 6 hours)

Mole share of reagents		Output %	Average molar mass of the copolymer (M)
M_1	M_2		
N-VM (M_1)-AA			
0.1	0.9	44	110 000
0.2	0.8	47	130 000
0.3	0.7	52	145 000
0.4	0.6	53	155 000
0.5	0.5	58	165 000
0.6	0.4	59	177 000
0.7	0.3	61	200 000
0.8	0.2	65	266 000
0.9	0.1	70	300 000

In a cryoscopic study of the molecular weight of the obtained sorbent, it has been found that not only the yield, but also the molecular weight of the polymer changed with a change in the ratio of reagents.

The sorption properties of d-metal ions are analyzed under static conditions in the mother liquor. It has been established that hydrochloric acid forms an acid complex with Pt (IV) ions. With an increase in the acidity of the solution, sorption decreases, which may be due to an increase in the number of ions associated with a free pair of electrons. This is explained by the fact that the

adsorption of the d-metal ion is subject to the solvation-coordination mechanism. After 95-100 minutes, complete sorption of ions in a solution of 1 mol/l hydrochloric acid is observed. Experiments with nickel and palladium ions have been carried out in the same order, but it has been noted that the sorption properties were low. It has been established that the sorption activity increases and reaches a maximum at 60°C.

The synthesized sorbents are characterized by good sorption capacity for nickel, palladium and platinum.

Conclusions

The influence of the concentration of monomers on the reaction of radical copolymerization of N-VM and AA in the presence of AA has been studied. From the

results obtained, it has been found that the optimal concentration for the copolymerization reaction of N-VM- AA under constant conditions is 0.9:0.1.

It has also been found that sorption in a 1 molar solution of hydrochloric acid at 60°C reaches a maximum after 95-100 min and that the synthesized composite ion exchanger can be used.

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