



SYNTHESIS OF COMPLEX-GENERATING SORBENT BASED ON DIETHYLDITHIOCARBAMATE

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Abstract. In this article, the optimal conditions for the synthesis of a complex-forming sorbent based on urea, formaldehyde and diethyldithiocarbamic acid have been determined. In this case, the initial substances were taken in the ratio of 1:1:2.5 mol, the temperature was 40°C and 80-95°C and the environment (pH=8-10) was carried out, and as a result, the yield of the reaction was 90%. Properties such as moisture content of this obtained sorbent, bulk density, static exchange capacity of sorbent and density of sorbent in hydrated state were determined. IR-spectroscopic analysis of the obtained sorbent and the complex formed by it with metal was studied.

Keywords: sorbent, urea, formaldehyde, diethyldithiocarbamic acid, IR-spectrum.

Introduction

Sorbents are widely used in hydrometallurgy as sorbents for concentrating various metal ions and neutralizing waste solutions containing heavy metal ions [1].

Direct heteroarylation of phenol fragments in the polymer chain with 1,2,4-triazine is a new method, that allows the modification of polymers by replacing the hydrogen in the phenol ring with sufficiently complex chelating groups in one reactor [2]. Ion exchange resins are used in many industries and have important practical importance [3]. The year-by-year increase in the demand for ion-exchange resins in the world market is related to the lack of clean water in the world, urbanization, industrialization, and other factors [4]. Synthesis of complex-forming ionite with high sorption parameters for the separation of a small amount of scandium ions in the solution is presented [5].

The method of obtaining new, chelating sorbents with layers of nickel acetylacetonate, nickel-malon, and acetoacetic esters welded by the method of sequential arrangement of molecules on the surface of silica gel is presented. Their structure and chromatographic description were studied using physicochemical methods [6]. The sorption properties of some Purolite chelated resins concerning rhodium (III) ions were studied. In this case, 3 different brands of resins with different functional groups were selected - S-920 with thiourea group, S-108 with amino group, and S-895 with polyamine group [8]. When sorption was studied

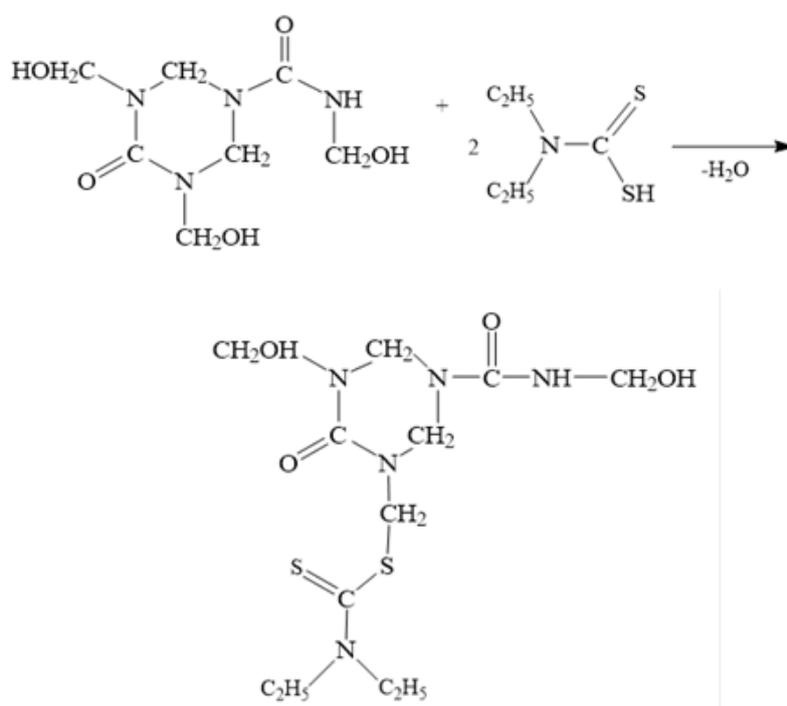
under static conditions at a temperature of 75 C, the sorption capacity of sorbents to rhodium (III) ion was determined to be S-895 – 54, S-920 – 33, and S-108 – 26 mg/g [9,10].

Experimental part

Materials. In the synthesis of complex-forming sorbent from this research work, "pure" and "chemically pure" brand reagents were used for synthesis based on urea, formaldehyde and diethyldithiocarbamic acid, and all reagents were purchased from "Merit Chemicals".

Methods. The structure of this sorbent and the structure of the complex formed by it with metals were determined by IR-spectra.

Synthesis of sorbent. As a continuation of the above studies, lead diethyldithiocarbamate was first treated with the hydrochloric acid solution, the resulting precipitate was filtered and separated, and the filtrate was used for synthesis. In this case, 40 ml (0.5 mol) of formalin was added to the reactor at a temperature of 40oC, sodium hydroxide solution was added until the medium became weakly alkaline (pH=8-10), and 12 g (0.2 mol) of urea was added to it and stirred at a temperature of 80-95oC. It was heated for 30-45 minutes. A solution of diethyldithiocarbamic acid (7.3 g, 0.02 mol) was added dropwise to the resulting viscous mixture and mixed well. When the temperature increased to 95-100°C, a tar-like mass was formed. The resulting resinous mass was placed in a porcelain bowl and dried in a drying cabinet at a temperature of 90oC for one day. After the dried polymer was crushed, the low molecular weight substances were washed first with 5% NaOH solution and then several times with distilled water until they became neutral. As a result, a white granular mass consisting of small pores was formed. The product yield was 90%.



Results and Discussion

IR-spectroscopic analysis of sorbent. IR spectroscopic studies were carried out on IRTracer-100 SHIMADZU infrared Fure spectrometer (Japan) (range 400–4000 cm^{-1} , error - 4 cm^{-1}) sorbent in powder state. The interpretation of the spectra was carried out with the help of basic software, which performs automatic measurement of spectra, has tools for graphical

display of spectra and their parts, and organizes work with the user's spectrum library. In the experiment, "clean" and "chemically clean" brand reagents were used. Reagent solutions were prepared by dissolving the specific sample in known volumes of solvents[11].

The IR spectra of the obtained compound contain lines in the 3329.14 cm^{-1} region corresponding to the vibrational frequencies of CONHR secondary amide groups (bonded NH_2 groups, in one region). The appearance at 1622.13 cm^{-1} indicates a $-\text{C}=\text{O}$ bonded group, and at 1555.55 cm^{-1} we observe resolved resonances of R_2NH secondary amine groups. We observe $-\text{CH}_3$ groups in the region of 1381.03 cm^{-1} . In the region of 1249.87 cm^{-1} , there is a strong bond $-\text{S}=\text{S}$ in thiocarbonates.

In studying the structure and main properties of the three-dimensional structure of the obtained ion exchange polymers, it was found necessary to use physicochemical methods as well as chemical analysis methods. IR spectroscopy was used to establish the structure of the obtained ion exchangers[12].

Symmetric vibrational frequencies of ether groups are formed in the area of 1136.07 cm^{-1} , deformational vibrations of amino acids are formed in the area of 1022.27 cm^{-1} , and S-N uneven vibrational frequencies are formed in the area of 754.17 cm^{-1} .

IR-spectroscopic analysis of KF-DT sorbent.

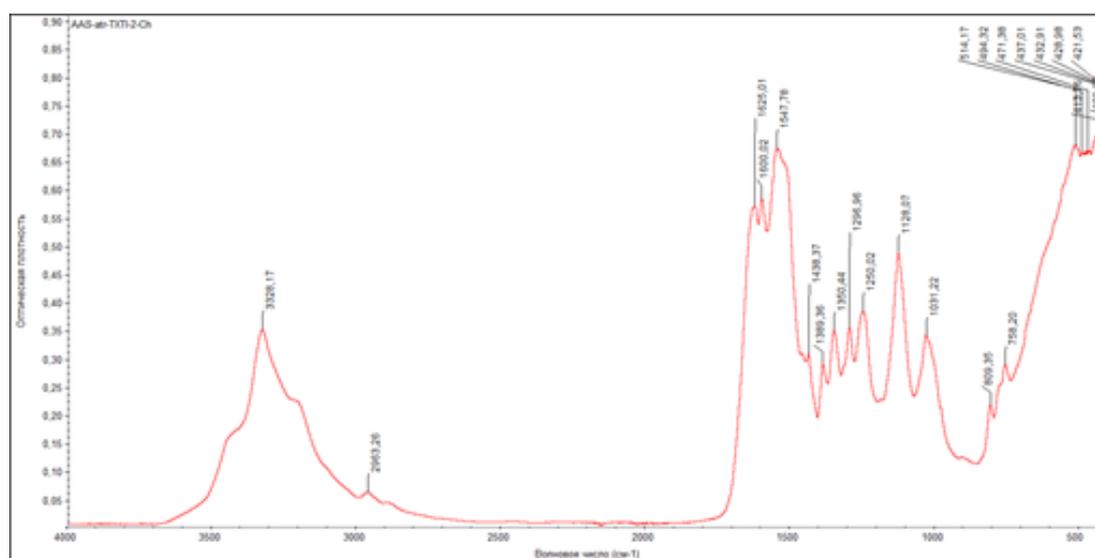


Figure 3.2. IR spectrum of KF-DT sorbent

The IR spectra of the obtained compound contain bands in the 3328 cm^{-1} region corresponding to the stretching vibrations of the primary amido groups. In the 1625 cm^{-1} region, the appearance of lines indicates a bonded $\text{C}=\text{O}$ group, and in the 1547 cm^{-1} region, we observe $-\text{NH}$ groups. In dithizone, the bonded secondary amino groups with aromatic rings appear in the 1350 cm^{-1} region and show the bonded $\text{C}=\text{C}$ group in the 1250 cm^{-1} region (Figure 3.2).

Conclusion.

Optimum conditions for synthesizing a complex-forming sorbent based on urea, formaldehyde, and diethyldithiocarbamic acid were studied. The structural structure of the obtained sorbent was analyzed using IR-spectra and its approximate structural formula was proposed.

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Authors' Declaration

- Conflicts of Interest: None.

- We hereby confirm that all the Figures and Tables in the manuscript are ours.

- Ethical Clearance: The project was approved by the local ethical committee in American Journal of Engineering, Mechanics and Architecture.

Authors' Contribution Statement

Chorieva N.B: Writing – Original Draft. Turaev Kh.Kh: Reviewing and editing paper. Kasimov Sh. A: Reviewing and editing paper. Abdullaeva I.Kh.: Writing – Original Draft, Conceptualization, Investigation, Visualisation.

References:

- 1.Исмаилов И.И., Джалилов А.Т., Аскарлов М.А. Химически активные полимеры и олигомеры. – Ташкент: -Фан, -1993. -232 с.
- 2.Pestov A.V., Slepukhin P.A., Yatluk Y.G., Charushin V.N., Chupakhin O. N. Synthesis of chelating polymer solvents by using the S[N]{H} // J. Appl. Polym. Sci., -2012, -V.125, -№ 3, -p. 1970-1978.
- 3.Пахнутова Е. А., Слизов Ю. Г. Синтез и исследование структурных и хроматографических характеристик хелатсодержащих сорбентов на основе силикагелей // Ж. прикл. химии, 2013, Т. 86, № 4, с. 567-572.
- 4.Лукиша Т.В., Адеева Л.Н., Борбат В.Ф. Исследование кинетики сорбции ионов скандия из солянокислых растворов хелатной смолой Purolite S-957 // Омск. науч. вестн. -2011, -№3, -с. 312-314.
- 5.Yulchieva M. G, Turaev Kh. Kh, Kasimov Sh.A, Nabiev D. A, Chorjeva N. B. Research on the Synthesis of Nitrogen-Containing Sorbents. International Journal of Engineering Trends and Technology. Volume 71 Issue 8, 161-167. <https://doi.org/10.14445/22315381/IJETT-V71I8P214>.
- 6.Chorieva N. B., Ermuratova N., Turaev Kh. Kh, Kasimov Sh.A. Synthesis and research of chelate forming sorbent based on carbamide, formaldehyde, ditizone. Chemistry and chemical engineering. Vol. 2020 : No. 4 , Article 4. DOI: 10.51348/RWHC6586.
7. Kasimov Sh.A et all. ИК спектроскопические исследование и квантово-химические характеристики азот и фосфорсодержащего полимерного лиганда // Universum: Химия и биология : электрон. научн. журн. 2019. № 6(60). URL: <http://7universum.com/ru/nature/archive/item/7400>.
- 8.Джалилов А.Т., Тураев Х.Х., Касимов Ш.А. Синтез сорбента на основе ди-(2-аминоэтила)-дитифосфата калия и эпихлоргидрина // Universum: химия и биология электронный научный журнал, -Россия, -№9 (39), -сентябрь, -2017.
- 9.Nomozov A, K, et.all. Salsola Oppositifolia acid extract as a green corrosion inhibitor for carbon steel. Indian Journal of Chemical Technology. 2023, 30, 872-877. <https://doi.org/10.56042/ijct.v30i6.6553>.

10.Nomozov A.K et all. Study of processe of obtaining monopotassium phosphate based on monosodium phosphate and potassium chloride. Chemical Problems. 2023 no. 3 (21). DOI: 10.32737/2221-8688-2023-3-279-293.

11.Muratov B A, Turaev Kh Kh, Umbarov I A, Kasimov Sh A, Nomozov A K. Studying of Complexes of Zn(II) and Co(II) with Acyclovir (2-amino-9-((2-hydroxyethoxy)methyl)-1,9-dihydro-6H-purine-6-OH), Int J Eng Trends Technol. 2024; 72(1); 202-208. <https://doi.org/10.14445/22315381/IJETT-V72I1P120>

