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SEM ANALYSIS AND THERMAL PROPERTIES OF SYNTHESISED SORBENT BASED ON UREA, FORMALDEHYDE, CITRIC ACID

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Abstract: Worldwide, wastewater is characterized by pollution, a great danger to the environment and all forms of life.Therefore, before draining contaminated water, it must be properly treated to mitigate its harmful effects. This work studied the thermal analysis of the sorbent obtained for wastewater treatment on the basis of urea, formalin and citric acid, as well as the complex compound formed by it with heavy metals contained in wastewater. The article presents an analysis of differential thermal analysis (DTA) and thermogravimetric (TG) analyses of urea, formalin, and citric acid-based sorbents. The results of the curve from the differential thermal analysis (DTA) and thermogravimetric (TG) representation of the synthesized sorbent have been analyzed. The process of thermal decomposition is a complex stage of many stages, which goes away with the release of intermediate products. The thermal decomposition of sorbent complexes with certain metal ions is also significantly influenced by the presence of a metal and the components of complex compounds. The thermal decomposition of sorbent complexes with certain metal ions is also significantly influenced by the presence of a metal and the components of complex compounds. Thermal analysis of the complex formed by kfl-sorbenting Zn(II) has been studied. Thermal analysis of the complex formed by sorbenting Zn(II), obtained on the basis of urea, formalin, and citric acid, has been studied. Based on the analysis of the results, it was concluded that compounds such as H2O, NH3 CO, and CO2 are formed from different functional groups during the degradation of sorbent obtained on the basis of urea, formalin, and citric acid. An analysis of the polyfunctional complex-forming sorbent in a scanning electron microscope is given.

Keywords: Sorbent, thermal analysis (DTA) and thermogravimetric (TG) analysis, endothermic, exothermic, differential scanning calorimetry, SEM.

Introduction. Research work is being carried out on a global scale on the synthesis of complexing sorbents and the sorption separation of metals from complex solutions based on them. In this field, the synthesis of complex multifunctional sorbents containing nitrogen, oxygen, and sulfur, their properties, determination of the sorption capacity of sorbents under dynamic and static conditions, study of the influence of various factors on sorption and desorption processes, and their use for separation of technological solutions are carried out. Special attention is paid to the purification of heavy and toxic metal ions, the separation of metals from complex solutions, the selective separation of metals in the form of complex compounds, and the determination of the sorption abilities of sorbents in various aggressive environments. Sorbents are mainly obtained by a polycondensation reaction, the purpose of which is to systematize the properties of sorbents and ensure their effective operation [1]. The same researchers synthesized Cu(II)

metal complexes with 3-nitro-4-aminobenzoic acid and studied their sorption by 3D metals [2].

Chelating fibrous ionites containing nitrogen and phosphorus are effective sorbents for sorption from aqueous solutions containing heavy metal ions; however, they do not provide high selectivity with respect to Cu2+ and Co2+ ions [3], but compounds containing nitrogen-containing amino or imine groups have high selectivity in the purification of such ions due to their chelating properties. For this purpose, based on practical experiments, it was found that the sorbent gives a higher efficiency than N-(2-carboxyethyl) aminomethyl polystyrene [4].

The article considers and analyzes the patterns of sorption of heavy metal ions on various types of polymers and mineral sorbents. The main factors influencing sorption processes are shown. Comparative data on the sorption of heavy metal ions depending on various factors are presented. The main attention is paid to the practical direction of research in this direction [5].

The equilibrium kinetic properties of a protein sorbent with respect to Cu^{2+}, Fe^{2+}, Zn^{2+}, Cd^{2+} ions have been studied. It has been established that the level of metal extraction depends on their structure and the pH level of the medium [6]. Nitrogen-containing and sulfur-containing polyampholite based on polyvinyl chloride were used in the work. The pattern of sorption of Cu^{2+} and Ni^{2+} ions in polyampholite storing nitrogen and sulfur under static conditions has been studied. Based on the results of the research, the thermodynamic parameters of the sorption process were calculated: changes in the values of free energy (ΔG), enthalpy (ΔH), and entropy (ΔS) of the system were determined [7].

Methods. To test the thermal stability of synthesized complex multifunctional sorbents, differential thermal and thermogravimetric methods were used (DTG-60, SIMULTANEOUS DTA-TG APARATUS SHIMADZU, Japan). In order to obtain similar information, a thermal analysis was performed. Changes occur under the influence of different temperatures, i.e., they determine at what temperatures mass loss occurs and which groups due to decomposition of 10 degrees per minute. Newly synthesized sorbents with nitrogen and oxygen content and complexing sorbents based on them were studied using a MIRA 2 LMU scanning electron microscope equipped with an INCA Energy 350 energy dispersive microanalysis system. A scanning electron microscope provides information about the degree of reaction of substances and the structure and composition of the near-surface layers from a scaled image of the sample at 1:100, 1:200, 1:500, and 1:1000.

Results. The results of differential thermal analysis (DTA) and thermogravimetric (TGA) visualization of a sorbent based on urea, formalin, and citric acid are analyzed. According to the results of the DTA, endothermic peaks were formed at 136.46 °C and 411.72 °C and exothermic peaks at 246.01 °C and 434.81 °C. The TG curve basically gives 2 peaks in the temperature range of mass loss. The first temperature of mass loss is 72.27–300.69 °C; 12.918 mg of mass was lost in 12.76 minutes, which is 68.826% of the total mass. The second mass loss temperature ranged from 301.51 to 598.38 °C, and it took 30.18

minutes to reduce the mass of the sample by 3.643 mg. This was 19.410% of the total mass. The complete decomposition of the sorbent based on urea, formalin, and citric acid took 68.78 minutes. Based on the results presented in Figure 1, it is concluded that when the CFL sorbent decomposes, compounds such as H_2O, NH_3 CO, and CO_2 are formed from different functional groups.

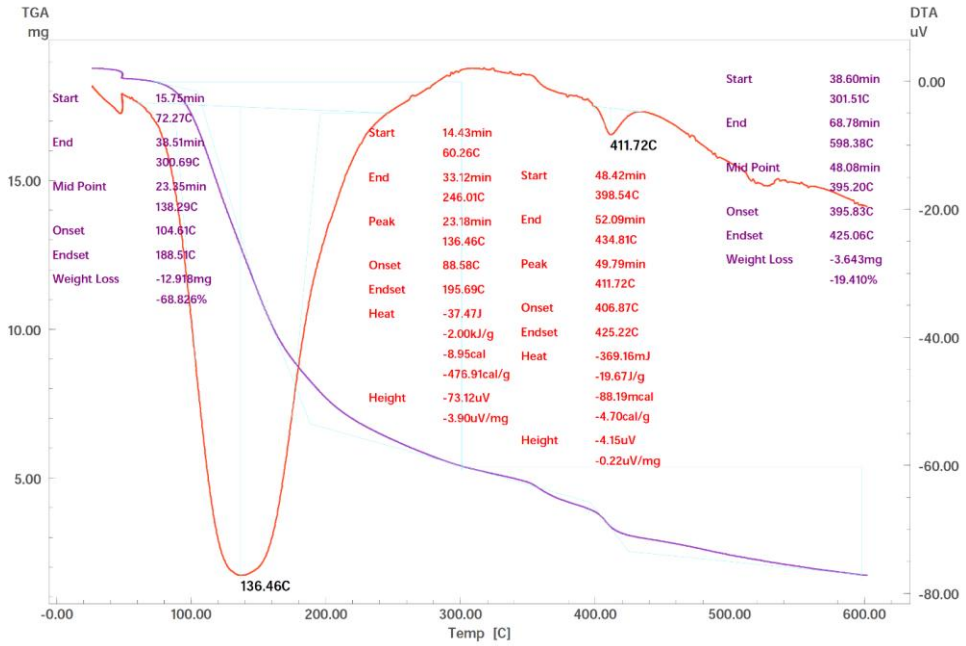

Figure 1. Graph of thermal analysis of a sorbent based on urea, formalin, and citric acid.

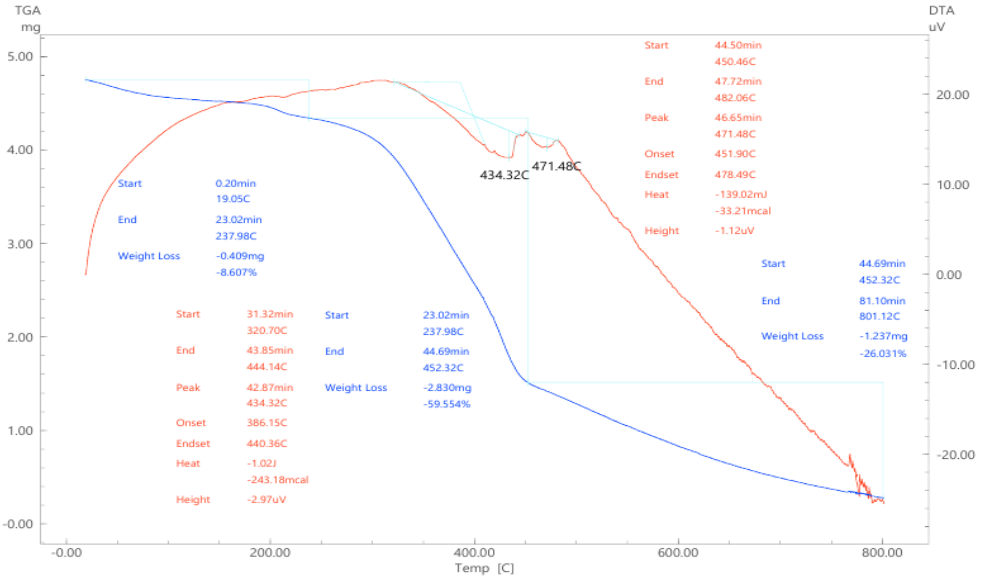

Figure 2. Graph of thermal analysis of a metal complex formed by a sorbent based on urea, formalin, and citric acid with Zn(II).

According to the results of the SEM studies, the remains of unreacted starting substances are not visible on the images of a sample of a new sorbent based on urea, formalin, and citric acid at scales of 1:200 and 1:1000. During the research, it was found

that the reaction went through to the end, and it was possible to obtain information about the composition of the elements of substances formed in a parallel reaction. The results are presented in Figures 3, 4.

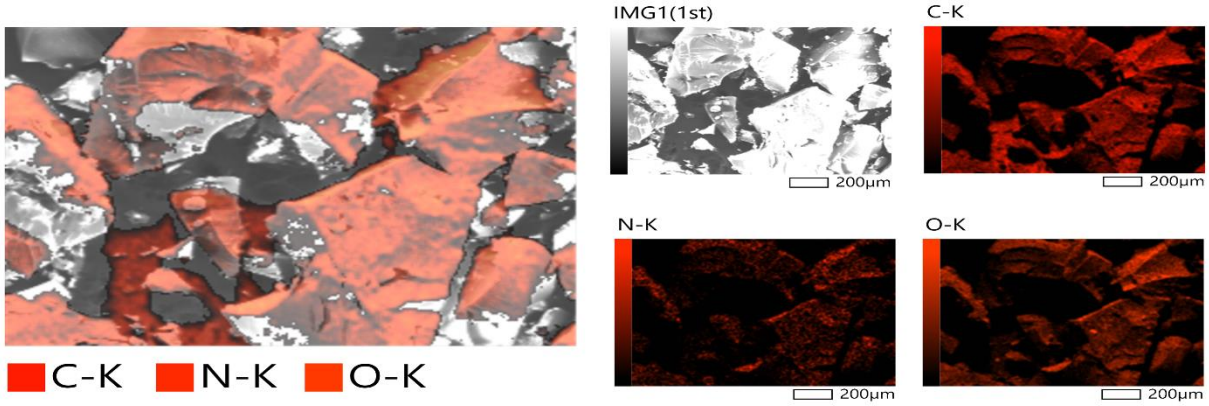

Figure 3. SEM image of a complexing sorbent based on urea, formalin, and citric acid.

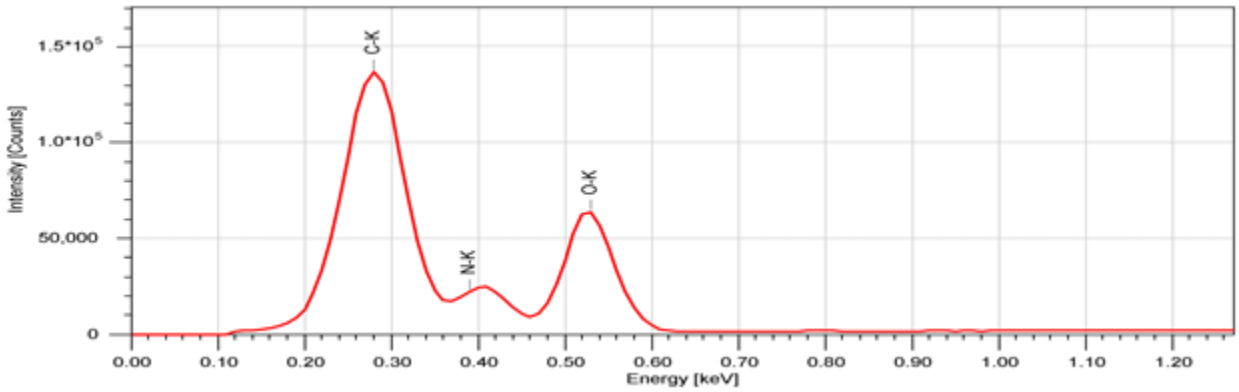

Figure 4. An image of the elemental analysis of a complexing sorbent based on urea, formalin, and citric acid in SEM.

Discussion. In our republic, certain scientific and practical results have been achieved in the production of products of the chemical industry, in particular, in the selective separation of colored and rare metals from the composition of solutions and in obtaining sorbents applied to the treatment of wastewater from heavy metals. This article, cited by the authors, examines the problem of pollution and self-purification of water bodies from compounds of heavy metals. The process of sorption of heavy metal compounds (Cu (II), Zn (II), Pb (II), and Cd (II)) by tub sediments of different compositions has been studied. In the course of laboratory studies, the rate of sorption was obtained by equilibrium constants and lower sediments of heavy metals. The data obtained has been found to be necessary to predict water quality as a result of contamination of the water object by industrial wastewater.

Conclusion. Based on the results of the analysis, it was concluded that the decomposition of sorbents based on urea, formalin, and citric acid forms compounds such as H_2O, NH_3, CO, and CO_2. The complete decomposition of the based on urea,

formalin, and citric acid sorbent took 68.78 minutes. The analyses obtained showed that on the SEM images of the sorbent sample of the new composition of the complex, enlarged at a scale of 1:1000 times, the remains of unreacted starting substances are not visible. This made it possible to obtain information about the completion of the reaction and, in parallel, about the elemental composition of the substances formed during the reaction. It was found that the starting substances reacted completely during the formation of the sorbent.

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