Komitet za termodinamiku i fazne dijagrame Srbije

u saradnji sa:

Fakultetom tehničkih nauka u Kosovskoj Mitrovici,
Tehničkim fakultetom u Boru i
Associated Phase Diagram and Thermodynamics Committee
(Poland, Czech Republic, Hungary, Bulgaria, Slovenia, Serbia,
Montenegro, Romania, Croatia, Bosnia and Herzegovina)

DVANAESTI SIMPOZIJUM O TERMODINAMICI I FAZNIM DIJAGRAMIMA

sa međunarodnim učešćem

ZBORNIK IZVODA RADOVA

Kosovska Mitrovica,
20-21. jun 2025. god.

Dvanaesti simpozijum o termodinamici i faznim dijagramima

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Sadržaj

Plenarno predavanje:

Izvodi radova:

DTA-TGA and thermodynamic studies of walnut shells used for the biosorption of Cu^{2+} ions from synthetic solutions

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Abstract

Biosorption is a simple, economical and environmentally friendly process of removing pollutants by binding them to biological material [1]. Biological materials that can be used to remove or recover organic and inorganic substances from aqueous solutions include living or dead microorganisms and their components, seaweed, plant material, industrial and agricultural waste and natural residues [2].

In this paper, the thermodynamic analysis of the biosorption of copper ions on walnut shells, as well as the DTA-TGA analysis of walnut shells, are presented.

Thermogravimetry was used to study the thermal degradation characteristics of walnut shells. The sample was heated in an inert atmosphere from 20 to 900 °C, using a simultaneous DSC-TGA device SDT Q600 (TA Instruments). The TGA curve showed two stages of weight loss during heating. In the interval from 20 to 150 °C, a weight loss of 6.64% was recorded, which was due to the evaporation of moisture from the sample. Further weight loss of 69.05% was observed in the temperature range from 150 to 900 °C, which was due to the decomposition of hemicellulose, cellulose and lignin present in the biosorbent structure [3]. The DTA curve showed that the process was accompanied by an endothermic peak at a temperature of 279.81 °C. The total weight loss was 75.69%.

Thermodynamic studies are conducted to investigate the influence of temperature on the biosorption process and to obtain information about the feasibility, spontaneity and nature of the process [4]. Therefore, thermodynamic parameters such as the change in Gibbs free energy (ΔG^0), the change in enthalpy (ΔH^0) and the change in entropy (ΔS^0) were determined.

In order to determine the thermodynamic parameters, 0.5 g of walnut shells were brought into contact with 50 mL of a synthetic solution of copper ions with a

concentration of 0.2 g L^{-1}, at different temperatures (25 °C, 35 °C and 40 °C). The obtained results for the change in Gibbs free energy (ΔG^0) were negative at all three temperatures, indicating the feasibility of the process and spontaneous nature of the biosorption. The obtained positive value of enthalpy (ΔH^0 = 1.12 kJ mol^{-1}) indicates that the biosorption reaction is endothermic and consequently consumes energy. The negative value of entropy (ΔS^0 = -6.26 J mol^{-1} K^{-1}) indicates that there is less randomness at the interface between solid and solution.
Type of work: original research paper.

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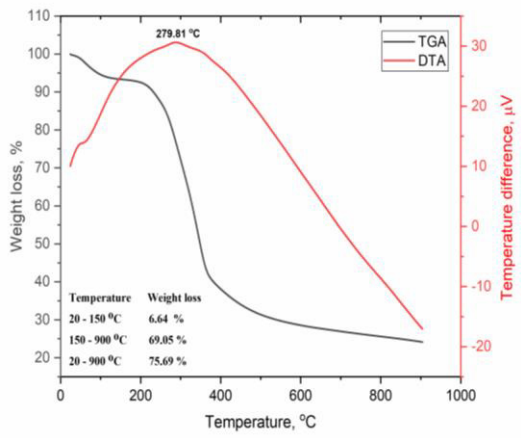
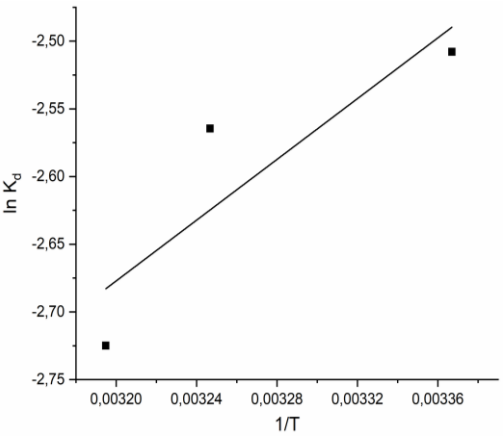
Graphical abstract:



DTA-TGA analysis of walnut shells.



Thermodynamic dependence ($ln\ K_d = f(1/T)$) for the biosorption of copper ions on walnut shells.