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# TREATMENT OF WASTEWATER USING A SORBENT BASED ON THERMALLY ACTIVATED OPOKA MINERAL AND CHEMICALLY MODIFIED CAMELTHORN TREE.

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In our study, the treatment processes of wastewater from “Elektrokimyozavod” JSC were investigated using a combination of thermally activated opoka (0.5%) and sorbent based on camelthorn tree chemically modified in an alkaline medium. It was found that increasing the amount of sorbent had a clear effect on the residual content of heavy metal ions. When the camelthorn tree sorbent was added at 0.04%, the concentration of metals in the water was high, with Cu – 14.49 mg/l, Ni – 19.20 mg/l, Co – 2.48 mg/l, Zn – 0.48 mg/l, Sr – 0.28 mg/l, and Cr – 1.20 mg/l. When the sorbent amount was increased to 0.08%, a decreasing trend was observed for all elements: Cu decreased to 8.43 mg/l, Ni to 11.88 mg/l, Co to 1.66 mg/l, Zn to 0.29 mg/l, Sr to 0.17 mg/l, and Cr to 0.81 mg/l. These results indicate that in an alkaline medium, the porous structure of the chemically modified camelthorn tree sorbent opens up, and its active hydroxyl and carboxyl groups begin to bind metal ions. At this stage, the sorption process becomes more active, meaning the active sites of the sorbent exhibit strong adsorption capacity toward metal ions. In the next stage, when the sorbent was added at 0.1%, the residual concentrations of all elements sharply decreased, reaching Cu – 2.37 mg/l, Ni – 4.57 mg/l, Co – 0.83 mg/l, Zn – 0.11 mg/l, Sr – 0.05 mg/l, Mo – 0.29 mg/l, and Cr – 0.43 mg/l. These results show that precisely at a sorbent amount of 0.1%, the camelthorn tree sorbent demonstrates a synergistic effect with thermally activated opoka.

Although the amount of metal ions continued to decrease when the sorbent was added at 0.11% and 0.12%, the rate of decrease was not significant: Cu – 1.64 to 1.46 mg/l, Ni – 3.69 to 3.47 mg/l, Co – 0.73 to 0.71 mg/l, Zn – 0.08 mg/l, and Cr – 0.38 to 0.37 mg/l. At these stages, the active sites of the sorbent had nearly reached the saturation point, and the activation of new adsorption sites was limited. In particular, for the elements Se, Mo, and Al, the changes after the 0.1% level were minimal, indicating that the main portion of their adsorption occurred during the earlier stages. At a sorbent amount of 0.13%, the concentrations of all elements stabilized, remaining at Cu – 1.35 mg/l, Ni – 3.34 mg/l, Co – 0.69 mg/l, Zn – 0.07 mg/l, Sr – 0.04 mg/l, and Cr – 0.36 mg/l. These results allow us to conclude that at 0.1% camelthorn tree sorbent and 0.5% opoka mineral, the majority of heavy metals are removed from the wastewater, and the adsorption process reaches the equilibrium stage.

From the data, it is clearly observed that the degree of purification of heavy metal ions from the wastewater of "Elektrokimyozavod" JSC steadily increased depending on the amount of sorbent based on camelthorn tree modified in an alkaline medium. In the initial stage, when the sorbent amount was 0.04%, the adsorption process showed initial activity, with removal rates of Cu – 82.06%, Ni – 75.65%, Co – 71.97%, Zn – 78.43%, Sr – 83.39%, and Al – 88.91%. These results indicate that the sorbent's porous structure had not yet been fully saturated with metal ions. However, even at this stage, the sorption process had already begun due to the presence of 0.5% opoka mineral, and a significant portion of the metals was removed through mechanical entrapment. When the sorbent amount was increased to 0.08%, the adsorption efficiency significantly improved for all elements: Cu – 87.28%, Ni – 84.72%, Co – 78.23%, Zn – 83.62%, Sr – 87.70%, and Al – 94.57%. At a sorbent concentration of 0.1%, the adsorption process reached its most active point.

At this concentration, the adsorption process occurs not only with high efficiency but also with stable equilibrium. As a result, the amount of heavy metals in the water is reduced to environmentally safe levels, making it possible to reuse the treated water in technogenic processes or agriculture. Therefore, the use of 0.1% camelthorn tree sorbent modified in an alkaline medium, together with 0.5% thermally activated

opoka, represents a scientifically grounded and practically effective optimal treatment technology.

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