ADSORPTION OF CRYSTAL VIOLET FROM SOLUTIONS

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Under conditions of ongoing military actions, the issue of drinking water quality in Ukraine has intensified and reached a global scale, remaining highly relevant. It should also be noted that water in the countries of the European Union is officially recognized as the primary food product [1]. Moreover, one of the key objectives of sustainable development (Sustainable Development Goal 6) to be achieved by 2030 is to ensure the availability and sustainable management of water supply and sanitation for all [2].

Among the disadvantages of using crystal violet are its carcinogenic properties and the difficulty of controlling its presence in the environment. These issues are associated with its high resistance to microbial degradation and its ability to persist in various environmental media. In addition, crystal violet may cause moderate eye irritation and can even lead to prolonged damage to the cornea and conjunctiva. Inhalation of this dye may result in irritation of the respiratory tract as well as symptoms such as nausea, diarrhea, headache, dizziness, and pain. Prolonged exposure to crystal violet can also negatively affect mucous membranes and the organs of the gastrointestinal tract [3].

In this study, zinc ferrite was synthesized using a sol–gel method combined with an autocombustion process, and the adsorption of crystal violet dye from aqueous solutions onto the surface of $ZnFe_2O_4$ was investigated.

Figure 1 illustrates the adsorption isotherm of the dye on the $ZnFe_2O_4$ surface. The concentration of crystal violet solutions before and after adsorption was determined photocolorimetrically at a wavelength of 540 nm.

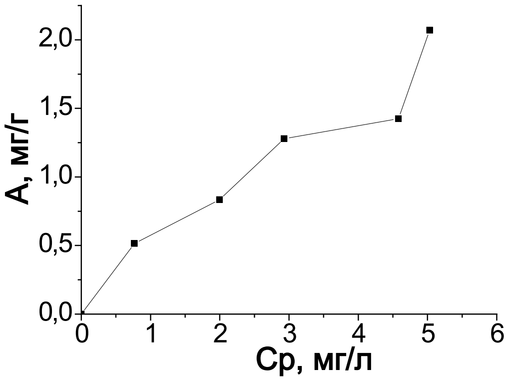

Fig. 1. Adsorption isotherm of crystal violet on the $ZnFe_2O_4$ surface

It was established that the adsorption capacity (A) is 2.07 mg/g, while the removal efficiency (R, %) reaches 49.69 % at an initial dye concentration (C_0) of 10 mg/L. The shape of the isotherm curve resembles Langmuir-type isotherms (L3-type) according to the Giles classification [4]. This type of isotherm indicates weak interactions at the adsorbate–adsorbent interface, which is characteristic of nonporous adsorbents with relatively homogeneous surfaces.

It was also determined that the adsorption isotherm of crystal violet is better described by the Freundlich model than by the Langmuir model, as evidenced by the correlation coefficient ($R^2 = 0.922$). This suggests that the adsorption of the dye occurs on heterogeneous surface sites with a non-uniform distribution of adsorption energies.

References

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