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Cr⁶⁺ adsorption by modified vermiculite

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Abstract: Cr⁶⁺ adsorption by modified vermiculite

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This work aimed at investigating the adsorption of Cr⁶⁺ in water by exfoliated vermiculite. The adsorbant tested in this experiment was a vermiculite (from China) which has been subjected to heating at 1000 °C for 1 minute, resulting in an exfoliated vermiculite.

Three effects were studied: 1) contact time; 2) initial concentration of Cr⁶⁺; 3) adsorbent mass. Samples were analysed by X Ray Fluorescence (XRF), X Ray Diffraction (XRD) and the solutions with Inductively Coupled Plasma Mass Spectrometry (ICP-MS) to quantify the adsorbed Cr⁶⁺ by the vermiculite.

Results from XRD diffraction showed a conversion of vermiculite into flogopite after heating at 1000°C for 1 minute because of: 1) high content of potassium, 2) dehydration and 3) structural re-ordering; after the contact of vermiculite with Cr⁶⁺, the mineral structure did not change. The adsorption of Cr⁶⁺ was studied by Langmuir, Freundlich and Dubinin-Kaganer-Radushkevich (DKR) isotherm models. DKR model, indicative of a cooperative process, described adsorption equilibrium better than the other two models and the maximum adsorption capacity obtained was of 2.81 mol/g. Kinetic was studied using pseudo-first and pseudo-second order kinetic models, with a better description of the process by pseudo-second order model with correlation coefficient almost unitary (R²=0.9984; other kinetic parameters were k₂=0.0015 and the absorption initial rate

of $0.2 \times 10^{-8} \text{ mg g}^{-1} \text{ h}^{-1}$).

The present study demonstrates the effectiveness of modified vermiculite adsorbents for the treatment of hexavalent chromium-contaminated waters and that its adsorption depends on the experimental conditions (such as contact time, initial concentration of Cr^{6+} and adsorbent mass).