

Adsorption of CO₂ on Vermiculite-Derived Samples

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Streszczenie

Vermiculite was subjected to acid treatments in HNO₃, HCl, and a mixture of both acid solutions to improve its physicochemical properties for CO₂ adsorption. To assess the structural changes resulting from these treatments, all samples were characterized by XRD, XRF, FTIR, TGA, TEM, and nitrogen physisorption. Raw vermiculite and acid treated vermiculite samples have been evaluated in CO₂ adsorption processes at 1 bar and 0°C, 20°C, and 30°C. The unmodified sample exhibited a CO₂ uptake of only 25.91 mg g⁻¹, attributed to its low specific surface area and pore volume. In contrast, the sample modified with a 3 M HNO₃ solution showed the highest adsorption capacity, reaching 70.48 mg g⁻¹. The results demonstrate that the CO₂ adsorption capacity of clay can be significantly improved by acid modification. The adsorption process was modeled using various isotherm equations, including Langmuir, Freundlich, and Sips. Among them, the Sips model provided the best fit to the experimental data for acid-activated vermiculites. In general, the study confirms that both the chemical composition and the textural properties of the material play a crucial role in its CO₂ adsorption performance.

Słowa kluczowe

acid treatment, adsorption, carbon dioxide, clay mineral, vermiculite

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