

Development of Kaolin-Based Adsorbents Functionalized with Surfactants for Mycotoxin Removal

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Abstract

Modification of clays with cationic surfactants leads to the formation of organomineral materials with an enhanced affinity for weakly polar organic molecules. In this study, kaolin from Rgotina (southeastern Serbia) was modified using the long-chain cationic surfactants octadecyldimethylbenzylammonium (ODMBA) chloride and hexadecyltrimethylammonium (HDTMA) bromide at different levels of modification corresponding to 25, 50, and 90% of the cation exchange capacity of kaolin. The raw kaolin and the obtained organokaolinites were characterized using various physicochemical methods. The characterization results showed that the modification process did not alter the fundamental kaolinite structure but occurred predominantly on the mineral surface.

The adsorption properties of the organokaolinites were evaluated toward the mycotoxins zearalenone (ZEN) and ochratoxin A (OCHRA). The effects of pH, solid-phase concentration, and initial mycotoxin concentration on the adsorption process were investigated. Unmodified kaolin exhibited low adsorption capacity, whereas surfactant modification significantly enhanced the adsorption efficiency for both mycotoxins. The results indicated that pH had no significant effect on ZEN adsorption, while its influence on OCHRA adsorption was more pronounced at lower solid-phase concentrations. The nonlinear adsorption isotherms obtained suggest a complex adsorption mechanism involving a combination of hydrophobic and electrostatic interactions between the mycotoxins and the organokaolinite surface. The results demonstrate that surfactant-modified kaolins represent promising adsorbents for the efficient removal of mycotoxins.

Keywords: clay, modification, adsorbent, mycotoxins.

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