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STUDIES REGARDING PHENOL AND 4-CHLOROPHENOL SORPTION BY SURFACTANT MODIFIED ZEOLITES

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Abstract

Phenols and chlorophenols are contaminants in soils, sediments, surface waters and groundwater, largely because of their worldwide utilization in the last 50 years as wood preservatives and general biocides in industry and agriculture. The toxicity of chlorophenols and their persistence in the environment require advanced treatment techniques for their removal.
This study presents the results of a comparative evaluation of the adsorption of phenol and 4-chlorophenol from aqueous solutions, on surfactant modified zeolites (SMZ). Surfactant modified zeolites (SMZ) are produced by treating zeolites with large cationic surfactants (quaternary amines). These bulky organic cations exchange selectively with the native inorganic cations from the zeolite, to form a stable, organic-rich coating on the external surface of the zeolite. Surfactant modification alters considerably the chemistry of the zeolites surface, allowing the zeolites to sorb nonpolar organic pollutants and anions, for which untreated zeolites have little affinity.
In this study, a natural zeolite from Romania, containing mainly clinoptilolite has been treated with a 0.02 M solution of hexadecyltrimethylammonium chloride (HDTMA). The unmodified zeolitic material possesses an insignificant adsorption capacity for phenol and 4-chlorophenol. In the SMZ, HDTMA molecules form a hydrophobic layer on the zeolite external surface, increasing the adsorption capacity of the natural zeolite for organic pollutants.
Batch studies were performed to evaluate the influence of various experimental parameters such as contact time, adsorbent dose and initial pollutant concentration on the removal of phenol and 4-chlorophenol.
Two kinetic models have been used to investigate the adsorption of phenol and 4-chlorophenol on surfactant modified zeolites. Good correlation coefficients have been obtained for the pseudo-second order kinetic model. Freundlich and Langmuir isotherm models have been used for the analysis of the adsorption equilibrium; the equilibrium data were best represented by Freundlich isotherm. It was also found that the adsorption capacity of SMZ was higher for 4-chlorophenol then for phenol. Removal efficiencies varied from 41 to 80% for phenol and from 82 to 98% for 4-chlorophenol.

Key words: 4-chlorophenol; adsorption; isotherm; phenol; zeolites

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