
Vapor-Phase Sorption Kinetics for Tetrahydrofuran, Tetrahydropyran, and 1,4-Dioxan by Al³⁺- and Cr³⁺-Exchanged Montmorillonite

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Abstract: The rate of vapor-phase sorption of tetrahydrofuran (THF), tetrahydropyran (THP), and 1,4-dioxan (DIOX) onto a Wyoming montmorillonite saturated with Al³⁺ or Cr³⁺ has been studied by isothermal gravimetry in the temperature range 18° to 105° C using samples of different weights and grain-size distributions. The rate of sorption for all the cyclic ethers increased with decreasing sample and grain size, demonstrating that inter-, rather than intraparticle mass transfer was rate-determining. Optimization of the sample parameters (2 mg sample of <45- μ m grain size, pretreated at 120° C yielded integral diffusion coefficients at 18° C of 0.5×10^{-14} m²/s for DIOX for the Cr³⁺-clay to 3.5×10^{-4} m²/s for THF for the Al³⁺-clay; however, no temperature or cationic dependence of the cyclic ether uptake was observed. In general, the rate of sorption of the cyclic ethers increased as THF \geq THP > DIOX indicating that the sorption rate of THF and THP was dependent on concentration or that DIOX sorption was retarded by bidentate coordination to aluminum ions at the edges of the clay platelets.

Key Words: Adsorption • Cyclic ethers • Diffusion • Montmorillonite • Vapor

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