163a Use of Both Pressure-Swing and Concentration-Swing Frequency Response Methods to Determine Mass Transfer Mechanisms and Parameters for Pure and Mixed Adsorbates in Nanoporous Adsorbents

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Two new flow-through frequency response methods are applied to investigate adsorption kinetics for both pure and mixed gases in nanoporous adsorbents. The systems considered are N2 and O2 and their mixtures on carbon molecular sieve, CO2 and CH4 and their mixtures on carbon molecular sieve, and chloroethane with and without helium on activated carbon. Mass transfer rate mechanisms and parameters are obtained from the experimental results and the corresponding analytical solutions for the models, which consider both micropore diffusion and a surface barrier resistance. Pure-component diffusivities obtained from the pressure-swing frequency response method agree well with the main-term diffusivities of the mixture results from the concentration-swing frequency response method. The mixtures are studied at different compositions and are well described by a non-constant Fickian diffusivity model. A simple relationship is suggested for the concentration dependence of the mixture diffusivities, and it reduces to Darken's equation for pure components.