Adsorption of 2,4- Dichlorophenol by Single Walled Nanotubes (SWNTs) and Powdered Activated Carbon (PAC): Assessment Using a Membrane Supported Fixed Bed Reactor

by

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ABSTRACT

Carbon nanotubes have shown great potential as sorbents for removal of pollutants in water and wastewater treatment. However, whereas a good deal of research has been done to evaluate adsorption uptake, little research has addressed sorption kinetics. In addition, there is a need for more data on adsorption properties when in competition with dissolved natural organic matter (NOM). The goal of this research is to compare the absorption properties of single-walled carbon nanotubes (SWNTs) and a mesoporous powdered activated carbon (PAC) in the presence and absence of NOM. Batch sorption experiments were conducted using 2,4-dichlorophenol as a model organic contaminant to obtain adsorption isotherms both in the presence and absence of NOM. These results were modeled using the Freundlich isotherm equation to obtain isotherm parameters. Results from the batch isotherm experiments indicate that PAC is more effective in the removal of 2,4-dichlorophenol than SWNTs. Results also indicate the presence of natural organic matter had little effect on the absorption properties of PAC; however, the presence of NOM significantly lowered the absorption potential of SWNTs. Fixed bed experiments were also conducted to compare breakthrough curves of 2,4-dichlorophenol using powdered activated carbon and SWNTs as absorbents. To account for non-constant pattern conditions, the experimentally obtained fixed bed reactor (FBR) breakthrough curves were modeled using the pore surface diffusion model (PSDM). To limit the number of calibration parameters, the pore diffusion mechanism was not considered; this was accomplished by choosing a sufficiently low pore diffusion coefficient. Therefore, intraparticle transport was modeled as homogeneous surface diffusion, with the resulting model equivalent to the homogeneous surface diffusion model (HSDM). The model was implemented in the Addesigns^{TM} design software for Windows, treating the film and surface diffusion coefficients as calibration parameters. Further research will compare the competitive effects of NOM in fixed bed reactors.