Sorption and Desorption Behavior of Aromatic Amine in Solvent-Sediment Systems

by

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Abstract

The sorption and desorption behavior of benzidine from Lake Macatawa (Holland, MI, USA) sediment was investigated in this study using batch method. Eight solvents were tested as the extracting reagents: deionized water (DI), calcium chloride in DI water ($CaCl_2$), sodium hydroxide in DI water (NaOH), acetonitrile (ACN), a mixture of acetonitrile and ammonium acetate in DI water (ACN-NH_4OAc), methanol (MeOH), hydrochloric acid in DI water (HCl), and ammonium acetate in DI water (NH_4OAc). These solvents are proposed to react with sediment-associated benzidine by different mechanisms (*e.g.,* cation exchange, hydrophobic partitioning, and covalent binding).

Sorption isotherm experiments were conducted in these eight solvents with seven days, three weeks, or two months of contact times. Nonlinear isotherms were observed for all of the solvents investigated. Several sorption models were applied to fit the experimental data. The Distributed Reactivity Model and Freundlich model simulated the data better than other models used in the study. In addition, sorption experiments of benzidine were conducted with three sediments at various pH values ranging from 2.7 to 6.9. A sorption model composed of three sorption mechanisms was used to simulate the data. The model fit the experimental well, and the fitting parameters are in good agreement with literature values. This model strategy provides an alternative way to predict the fate processes of aromatic amines in ecosystems.

After the sorption of benzidine onto the sediment, the desorption behavior of sediment-associated benzidine in the selected solvents was evaluated under either unsaturated or saturated conditions. The contact times of seven days, three weeks, two months for experiments under unsaturated conditions, and three weeks, two months, and

six months for those under saturated conditions, respectively, were used in the study. A two-stage desorption model and a three-stage desorption model were subsequently applied to simulate the experimental data. Both models gave good fit to the desorption data. Sequential desorption experiment was performed to reveal the overall extraction efficiency for all the solvents. Results from desorption studies demonstrated low total extraction efficiencies of less than 50% in all the solvents, suggesting that benzidine was highly desorption resistant.