

# Effect of decay/degradation process in sorbed phase on multi-species contaminant transport in groundwater system

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## Abstract

Decay/degradation is an important process in both dissolved and sorbed phases that should be considered when predicting the transport of multi-species contaminants in groundwater. Most previous models for organic contaminants neglect this process because it has little effect on contaminant concentrations. However, for other multi-species contaminants such as radionuclides, the decay process in sorbed phase can greatly influence their concentrations. This study introduces a new analytical model for the two-dimensional transport of multi-species contaminants affected by decay/degradation in both dissolved and sorbed phases. The study simulates the transport of the biodegradation chain of chlorinated solvent ( $\text{PCE} \rightarrow \text{TCE} \rightarrow \text{DCE} \rightarrow \text{VC}$ ) and the radionuclide decay chain ( $\text{Pu}^{238} \rightarrow \text{U}^{234} \rightarrow \text{Th}^{230} \rightarrow \text{Ra}^{226}$ ) in two scenarios: one with decay in the sorbed phase and one without. According to preliminary results, the concentrations of contaminants in the decay/degradation chains tended to decrease in the case of decay/degradation compared with the case of no decay/degradation in the sorbed phase. For species in the biodegradation chain of chlorinated solvent, the difference in concentrations between the model with decay and without decay in the sorbed phase was only clearly observed at the fourth species (VC). Meanwhile, the concentrations of all species in the radionuclide decay chain decreased sharply in the presence of decay in the sorbed phase. This demonstrates that decay/degradation in the sorbed phase is a necessary process that should be considered when simulating the transport of multi-species pollutants in groundwater, especially the radioactive decay chain.

**Keywords:** analytical model, decay/degradation in sorbed phase, biodegradation chain of chlorinated solvent, radionuclide decay chain.