

**SLOW SORPTION KINETICS OF PENTACHLOROPHENOL
ON SOIL**

by

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ABSTRACT

We investigated the slow sorption kinetics of both the protonated (neutral) and ionized (charged) forms of pentachlorophenol (PCP) on a silt loam soil using batch techniques. A multiple spiking methodology was employed to circumvent the solubility limitation of neutral PCP. Both forms of PCP reached an apparent equilibrium in about 42 h. A slow sorption stage for the protonated form was detected within 12 days (14 days total time) following the apparent equilibrium.

The partition coefficient (K_p) of neutral PCP at the apparent equilibrium was concentration dependent. It decreased from 90 L/kg to 60 L/kg with a four fold increase in the total PCP concentration, from 5 to 20 mg/L. Increasing residence times resulted in slow increases in K_p . The onset of the slow sorption kinetics was also concentration dependent. At higher PCP concentrations the slow sorption kinetics were much more pronounced. However, there was not a clear definable trend in which concentration could be correlated to K_p . Desorption studies demonstrated that the extent of hysteresis was also concentration dependent. At higher PCP concentrations, a

smaller percent of the sorbed PCP at equilibrium was desorbed. The hysteresis also increased with increasing residence time and was greater for higher concentration samples.

The ionized PCP took roughly 69 days before a discernible slow sorption stage could be detected. The hindrance of the slow sorption stage for the ionized PCP could not be attributed to differences in the apparent equilibrium sorbed concentrations. Oxidation of the soil organic matter (SOM) resulted in a substantial reduction in the slow sorption of the protonated PCP, thus suggesting the importance of PCP diffusion into the SOM. Sorption isotherms were linear out close to the solubility limit of the protonated form and nonlinear for the ionized form. Desorption and methanol extraction studies demonstrated that hysteresis of the neutral PCP is mainly a kinetic phenomenon but residual fractions do form. The ionized PCP was relatively resistant to desorption.

It was concluded that speciation of pentachlorophenol, and other ionizable organic compounds, should be considered for environmental fate modeling and when considering remediation strategies.