



**Trichloroethene (TCE) and Perchloroethene (PCE) chlorinated solvents have been responsible for the serious contamination of soils and groundwater. The occurrence of *cis*-DCE “stall”, the condition of where it appears biodegradation beyond *cis*-DCE to vinyl chloride does not occur resulting in *cis*-DCE accumulation, is often misinterpreted.**

### How do you know if your site has c-DCE “Stall”?

- 1) Evaluate the sorption relationships of the daughter products and PCE/TCE.
- 2) Determine if sulfate/sulfite are competing as terminal electron acceptors with c-DCE.
- 3) Evaluate the ORP and the pH of up-gradient, down-gradient and cross-gradient wells.
- 4) Correlate iron species with sulfate/sulfite data in unfiltered, bicarbonate extractions.

#### \*\*\*\*\*Interpreting the data\*\*\*\*\*

**Sorption:** Sorption can be defined as the interaction of a contaminant with a solid. More specifically, the term can be further divided into adsorption and absorption. The former refers to an excess contamination concentration at the surface of a solid while the latter implies a more or less uniform penetration of the solid by the contaminant.

Unfortunately, in most environmental settings, there is no information concerning the specific nature of the interaction. As a result sorption shall be used in a generic way to address both phenomena. As a general rule, assuming a chlorinated solvent is equally distributed between phases is ill advised. As hydrophobic compounds, these solvents will partition preferentially to the soils. Within a system where the pore water occupies 30% of the aquifer volume, two (2) liters of aquifer would contain 600 mL of water and 3500 grams of soil (soil is about 2.5 times more dense than water). As a result, if there was equal distribution of the contaminant between the phases, slightly less than 15% of the contaminant mass would reside within the aqueous phase. Give the hydrophobic nature of the targeted chlorinated solvents much less of the targeted contaminant's mass is found in the dissolved phase. This partitioning is strongly associated with an individual compound's solubility, as the solubility of a hydrophobic compound decreases, the absorption coefficient increases.

When evaluating the adsorption characteristics of individual compounds, using the Freundlich equation, an empirical equation that is very useful because it accurately describes adsorption data.

This equation is:

$$q_e = KC_e^{1/n}$$

$q_e$  = Surface equilibrium concentration

$C_e$  = Solution equilibrium concentration

$1/n$  = unitless constant

$K$  = Constant

Using published values for Freundlich Parameters:

|                          | $K(\text{mg/g})(\text{L/mg})^{1/n}$ | $1/n$ |
|--------------------------|-------------------------------------|-------|
| Tetrachloroethene        | 143                                 | 0.516 |
| Trichloroethene          | 56                                  | 0.482 |
| <i>t</i> -Dichloroethene | 14                                  | 0.452 |
| <i>c</i> -Dichloroethene | 12                                  | 0.587 |

Thus the individual constants for the mother and daughter compounds may accurately predict dissolved and sorbed phase changes. By assigning a correction factor for the differences in your site's soils and carbon, a calculated dissolved phase for daughter products of the dechlorination process may be calculated.

It is the decrease in hydrophobic characteristics of the compounds with each chlorine lost that is responsible for the dramatic decrease in the constant " $K$ ". Thus, as a mole of tetrachloroethene undergoes a single step dechlorination the resulting trichloroethene is nearly 66% less likely to partition to the soil phase at equilibrium. Under these conditions, although there is a c-DCE accumulation in the dissolved phase, there may be no "stall". Further, analytical evaluation is required before a determination of a "stall" is possible. For more information go to [WWW.IET-INC.NET](http://WWW.IET-INC.NET).