C57 Perception vs. Reality: Countering Claims of Co-Solvency Effects Using Good Science

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The goal of this presentation is to provide a reference for other practi- tioners who encounter similar challenges during investigations of ground water contamination.

This presentation will impact the forensic science community by demonstrating the use of fundamental organic chemistry principles and straightforward testing methods to overcome a persistent misconception about ground water contamination and solubility.

A groundwater plume of trichloroethene (TCE) and its degradation products was found to intersect a plume of manufactured gas plant (MGP) contaminants and MGP-DNAPL. It was alleged that the presence of TCE had reduced the viscosity of the MGP-DNAPL and increased its ability to flow in the subsurface. This assumption implied that, as a solvent, TCE had increased the dissolution of BTEX compounds and PAHs from the non-aqueous phase into the dissolved phase.

Initially, a literature review was conducted to understand the conceptual model. Our team then developed an approach to quantify any effects that TCE might have on the viscosity and solubility of the MGP-related constituents. The method of standard additions was employed for the viscosity evaluation: TCE was added in increasing concentrations and viscosity measurements were taken. No significant changes in viscosity were measured at the TCE concentrations known to exist within the groundwater plume, or within the MGP-DNAPL. A decrease in MGP-DNAPL viscosity was only observed at concentrations that were orders of magnitude greater than those observed in groundwater. For the solubility evaluation, samples of MGP-DNAPL containing TCE and its degradation products were tumbled with laboratory-pure water, and both phases were analyzed to develop a distribution coefficient. The results confirmed that TCE in groundwater can- not increase the dissolution of the MGP-DNAPL constituents from the non- aqueous phase. The laboratory work confirmed the conceptual model, and conclusively demonstrated that TCE in groundwater cannot have co-solvent effects on hydrocarbons in the non-aqueous or dissolved phases.

The methods employed were not complex, innovative or challenging. The greatest challenge was to overcome the misperception that TCE retains solvent-like properties when dissolved in groundwater. Direct testing confirmed our understanding of fundamental organic chemistry principles. It is hoped that this demonstration can serve as a reference for other practitioners who encounter similar challenges.

Co-Solvency, TCE, DNAPL

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