Treatment of Soils Containing VOCs and OCPs at a Former Pesticide Manufacturing Facility

Summary

Bench and pilot studies were conducted to determine the applicability of EHC® Reagent for treatment of soil containing volatile organic compounds (VOCs) and organochlorine pesticides (OCPs). A total of 43,590 lbs of EHC was injected into four injection points. The injections were conducted using hydraulic fracturing. Sampling conducted 7 months after the injections showed a decrease in Toxaphene and total OCP with over 90%.

Challenge

Bench-scale tests were completed to determine the applicability of EHC for treatment of soil containing VOCs and OCPs. The bench-scale work evaluated several EHC treatment scenarios and compared straight anoxic conditions to a cycled aerobic/anoxic protocol. The testing was performed in sealed columns to simulate *in situ* conditions and prevent contact with the atmosphere.

The most effective treatment reduced the total OCPs from 46.9 mg/g to 1.1 mg/g after 117 days of treatment, representing greater than 97% reduction in total OCPs. During this same period, the VOCs, primarily xylene and ethylbenzene, were reduced by over 99%.

Solution

Given the success of this treatment technology at bench-scale, a pilot-scale demonstration project was initiated in October of 2003. The goal of the project was to reduce source zone soil concentrations of OCPs and VOCs through the *in situ* injection of EHC into the source area. A series of four applications of 1% EHC by weight with respect to the mass of soil in the treatment area was implemented. The applications were planned for intervals of between 14 and 21 days. Soil in the treatment zone was a highly weathered limestone at depths of 31' to 37'. The injection method consisted of driving rods to these depths using a direct push rig, followed by hydraulic fracturing and injection of EHC.

Figure 1 - EHC and guar mixture

Four locations were chosen for injection, with two to three depths per location. At each location a total of approximately 2,800 pounds of EHC was injected (i.e. 1,400 pounds per injection at locations with 2 depths and 930 pounds per injection at locations with 3 depths). The EHC product was delivered to the site in 25 kg bags for ease of handling and the material was handled with negligible dust creation. EHC was placed in a hopper,

and mixed in-line with a guar solution for delivery to the subsurface treatment area (Figure 1). To enhance groundwater movement through the EHC fractures, sand was introduced, at ratios of 1:2 and 1:1 sand to EHC by mass.

The product was successfully injected in each of these scenarios. Sampling of the treatment area to determine the aerial and vertical extend of the EHC injections was performed using direct push sampling equipment. The EHC layers were easily visible in the cores, whether the fracture was a hairline fracture near the tip of the fracture, or whether it was a few inches in thickness closer to the injection location (Figure 2).

Figure 2 - EHC layer injected between clay and weathered limestone

Results

Soil concentrations of Toxaphene and total OCPs were measured in June of 2004. Given the fact that OCPs bind strongly to the soil, the concentrations vary widely from one location to the next. For samples that were taken from as close to the same location and depth as possible, and for samples that showed a decrease in concentration between November 2003 and June 2004, the results are tabulated in Table 1.

Table 1. Influence of EHC Reagent on average Toxaphene and total OCP concentrations between November 2003 and June 2004 for selected samples.

	Toxaphene (µg/g)	Total OCPs (µg/g)
Average Nov 2003 Value	127.7	169.1
Average June 2004 Value	8.7	11.8
Decrease in Average Concentration	93.2%	93.0%

Four out of twelve samples showed an increase between these sampling dates, however the median concentrations of those increases were 9 µg/g and 12 µg/g for Toxaphene and total OCPs respectively. These data show that the soil concentrations of Toxaphene and total OCPs decreased significantly between the dates shown. The decrease in the average concentration of both Toxaphene and total OCPs was 93%.