DCL BIOSOLV

Technical Note 3

LABORATORY TESTS

1. Product stability and microbiology

Stability tests undertaken on batches of DCL Biosolv indicated very good physical stability over a period of 11 months at room temperature. More detailed physical testing was undertaken by a specialist laboratory in Germany to determine shelf life under various environmental conditions. This included globule size analysis and viscosity which indicated excellent physical stability of the product over the 12 week test period at room temperature.

Microbiological tests were undertaken to determine the likelihood of biodeterioration occurring during storage for 8 months at both room temperature and under refrigeration at <4ºC. The results showed no significant numbers of cultural microorganisms within the product (<250 cfu/g) indicating excellent microbiological stability and resistance to deterioration.

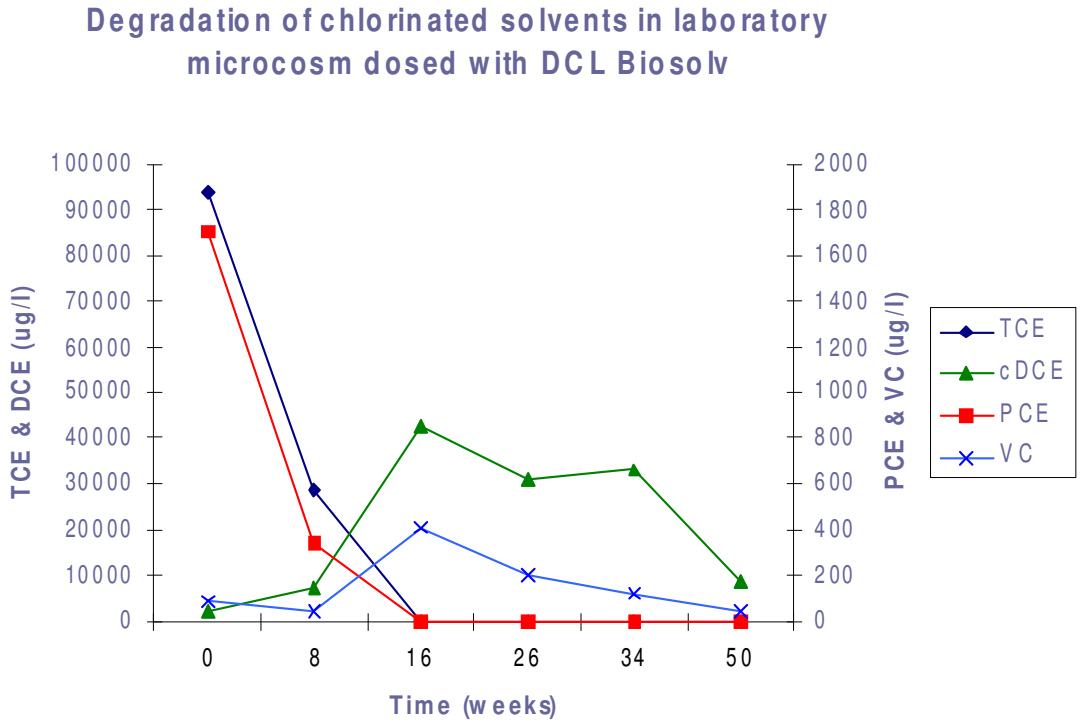
2. Microcosm simulations

Microcosm experiments were undertaken to simulate ground conditions and provide information on effectiveness of the product under controlled laboratory conditions. These simulations were established in twenty four 80 litre bins containing a uniform, synthetic, subsoil and using groundwater recovered from a historically contaminated site.

Monitoring results indicated rapid establishment of optimal conditions for anaerobic degradation of chlorinated solvent contaminants. Immediately after dosing with DCL Biosolv, oxidation-reduction potential (ORP) values were all positive and varied between +46.1 mV and +154.3 mV. ORP values generally remained positive in the non-dosed controls, however values in microcosms dosed with DCL Biosolv fell significantly to strongly negative values, as expected. For example, at a dose rate of 1,000 mg/l, an initial value of +113.1 mV was recorded which fell to -204.5 mV after four weeks. Very low concentrations of dissolved oxygen were recorded in the dosed microcosms, generally in the range 0.1 – 0.3 mg/l.

Initial trichloroethene (TCE) concentrations varied between 53,000 and 110,000 µg/l with an average of 87,000 µg/l. Tetrachloroethene (PCE) starting concentrations were lower,

in the range 1,000 to 2,800 µg/l. Chemical analysis revealed very high rates of TCE degradation (up to >99.9% after 8 weeks). Temporary increases in the degradation intermediates cis-1,2 dichloroethene (cDCE) and vinyl chloride (VC) were evident, as expected. The graph below illustrates the rapid reduction in TCE and PCE concentrations and the trends in appearance and ultimate degradation of the intermediates cDCE and VC.



Increasing the dosage rate of DCL Biosolv resulted in greater losses of TCE. For example microcosms MC5A and MC5B, each containing 10,000 mg/l of DCL Biosolv, had respective TCE concentrations of 240 and 6.5 µg/l after 8 weeks. This represents 99.8% and >99.9% losses, respectively. Significant reductions were also evident at lower dosage levels, for example MC4B (dose rate 5,000 mg/l) showed an 85.4% reduction from 110,000 µg/l to 16,000 µg/l.

TCE in all dosed microcosms fell to very low levels after 16 weeks with an average residual concentration of 15 µg/l (range 9.4 – 15 µg/l) representing a loss of 99.98%.