Laboratory testing of temperature increases, surfactants and co-solvents as options to enhance dissolution in a brominated-solvent source zone

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Abstract
Enhanced dissolution from a brominated-solvent, DNAPL (dense non-aqueous phase liquid) source zone at a site in Western Australia was identified as a potentially feasible strategy to reduce the net flux in a groundwater plume exiting the site. Laboratory testing of increased temperatures, and addition of selected surfactants and co-solvents was undertaken to see which would maximise the solubilisation of the DNAPL tetrabromoethane (TBA) and yet limit enhanced DNAPL mobility (assessed by reductions in interfacial tension – IFT). Increased temperatures and addition of surfactants showed only modest increases in soluble TBA up to 5000 mg L⁻¹, with often dramatic reductions in IFT to zero. Co-solvents increased TBA solubilisation concentrations up to 144 000 mg L⁻¹. Ethanol was chosen for subsequent testing due to its enhanced solubilisation of TBA, up to 87 000 mg L⁻¹ at 50% ethanol, and limited reduction in IFT (7.3 mN m⁻¹). Ethanol also has cost, environmental and safety advantages.

Key words brominated solvent; co-solvent; surfactant; temperature; ethanol; DNAPL; enhanced dissolution