IN SITU BIOGEOCHEMICAL STABILIZATION AND FLUX REDUCTION OF MGP CONSTITUENTS USING CATALYZED PERMANGANATE.

MUELLER, JIM, MORENO, J., LAKHWALA, F., SEECH, A. (Adventus Americas, Inc., Freeport, Illinois, USA; email Jim.Mueller@AdventusGroup.com), OKIN, M. (NiSource, Columbus, Ohio), SLAGLE, H. (FirstEnergy, Morristown, New Jersey), FISHER, W. and SWEENEY, C. (Haley&Aldrich, Portland, Maine, USA).

Non-aqueous phase liquids (NAPLs) and other residuals present at former MGP and related sites can represent long-term sources of groundwater impact. In some cases these residuals cannot be physically removed due to physical or logistical constraints. Technologies that isolate or stabilize the NAPL thus reducing its ability to impact groundwater and soil vapor (*i.e.*, *in situ* source area management strategies) may represent valuable tools to address these residuals. As defined herein, *in Situ* Biogeochemical Stabilization (ISBS) represents a potential means of removing NAPL mass and reducing flux of organic and inorganic constituents of interest (COI) into groundwater thereby accelerating natural attenuation processes and preventing the phenomenon of post-treatment rebound.

ISBS entails the use of a specifically modified (catalyzed, buffered) solution of sodium permanganate ($NaMnO_4$) or potassium permanganate ($KMnO_4$) that is introduced into a targeted source zone suspected to contain residual COI. As relatively small amounts of oxidant migrate horizontally and vertically through the targeted source area, various (bio)geochemical reactions that occur between the organic COI and the oxidant cause the destruction or removal of COI residuals via a two-step process: i) oxidation and ii) dissolution. The chemical/biological oxidation processes destroy COI present in the dissolved phase. This, in turn, increases the release of COI from NAPLs into the aqueous phase. The more water soluble, lower-molecular-weight (LMW) constituents (*e.g.*, benzene, naphthalene) are treated/removed at a proportionally higher rate, thus leading to a "hardening" or "chemical weathering" of the NAPL as it steadily loses its more labile components. This increases the viscosity of the NAPL resulting in a more stable residual mass hence the flux of COI released into the dissolved phase is much reduced, and natural attenuation processes are more easily capable of managing associated plumes. ISBS treatment also physically stabilizes NAPL residuals by the formation of catalyzed manganese dioxide "crusts" or "shells" at the organic interface which decreases the permeability of the aquifer adjacent to the NAPL and further reduces the flux of COI.

Data from multiple laboratory and field studies compiled since 1997 will be reviewed showing COI mass reductions ranging from 10 to 79% within 7 to 10 days of ISBS treatment. Soil permeability/transmissivity was reduced from 70 to 98%, and the flux of COI from ISBS-treated soils into the aqueous phase was reduced from 56 to 99% within the same period of time. Calculations of the hydraulic gradient required to mobilize residual and pooled NAPL showed that the expected increase in horizontal hydraulic gradient due to amendment injection, during the brief injection period, is incapable of mobilizing NAPL whether the NAPL is in residual or pooled form. Results of various physical analyses of the ISBS "crusts" generated from ISBS treatment of MGP soils will also be presented, including scanning electron microscopy images of stabilized soils. Additional laboratory studies are planned for 2006 to replicate and supplement the results achieved to-date.

STABILIZATION AND SOLIDIFICATION TECHNOLOGIES

Corresponding Author:
Jim Mueller
Adventus Americas Inc.
2871 W. Forest Rd, Suite 2
Freeport, IL 61032
Phone: (815) 235-3506; Fax (815)235-3506
Email: jim.mueller@AdventusGroup.com