Product Sheet

ISGS® TECHNOLOGY

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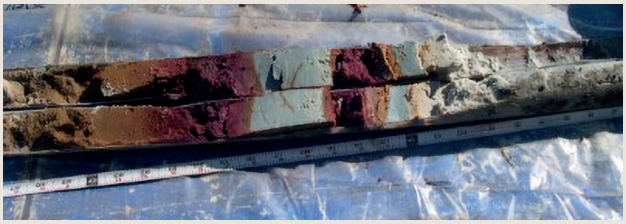
ISGS® TECHNOLOGY FOR NON-AQUEOUS PHASE LIQUIDS (NAPL)

Evonik's **ISGS® Technology** utilizes a permanganate-based solution to geochemically stabilize non-aqueous phase liquids (NAPL) in the aquifer. Permanganate and other proprietary reagents are selected depending upon the particular characteristics of each location and custom mixed on site into an aqueous solution that can be injected into an aquifer either through existing wells or direct push technology. As the solution migrates through the treatment area it oxidizes contaminants yielding partial mass removal. This in situ geochemical stabilization (ISGS) technology also reacts with contaminants in the treated area thereby coating NAPL surfaces with stable mineral precipitates that reduce mass flux.



Soil core from a site in Gainesville, Florida treated with ISGS® TECHNOLOGY.

THE SOUND SCIENCE OF ISGS®

In the presence of an organic compound (R), permanganate reacts to yield an oxidized intermediate, carbon dioxide, and manganese dioxide:

$R + MnO_4 \rightarrow MnO_2 + CO_2$ or ROx

Proprietary additives are added to the solution to form mineral "crusts" or "shells" that are similar to birnessite $(Na_{0.3}Ca_{0.1}K_{0.1})(Mn^{4+},Mn^{3+})_2O_4 \cdot 1.5\ H_2O$, which is an oxide mineral of manganese along with calcium, potassium and sodium.

Field Data from a field application of an ISGS® formulation at a site in Denver, CO are summarized on the following tables:

Contaminant (mg/kg)	Average (n=4) Background	Average (n=4) Treated	% Mass Reduction
LMH PAHs	7,633.50	5,996.75	21
HMW PAHs	1,961.55	1,744.55	10
TOTAL PAHs	9,595.05	7,771.30	19
PENTA	236.00	55.67	76
TOTAL CPs	**284.48**	**59.25**	**79**

Table 1 Mass Reduction following a single ISGS® Treatment

Contaminant (mg/L)	Average (n=4) Background	Average (n=4) Treated	% Flux Reduction
LMH PAHs	34.41	12.75	73
HMW PAHs	6.05	0.11	99
TOTAL PAHs	40.46	12.86	79
PENTA	18.91	9.66	49
TOTAL CPs	**23.38**	**10.41**	**56**

Table 2 Mass Flux Reduction following a single ISGS® Treatment

KEY BENEFITS

When released into the environment, chlorinated solvents, coal tar, creosote and heavy crude oil are frequently present as DNAPL and represent a long-term secondary source of contamination. Physical removal or in situ remediation of DNAPL is not always practicable due to the depth of contamination, aquifer geology or the presence of physical surface structures. In these cases hydraulic containment (e.g., long-term pump-and-treat) or in situ stabilization is the only viable remedial action. ISGS® Technology can represent a more effective and cost-efficient alternative to conventional cement stabilization since the aqueous solution can be injected into an aquifer where it will follow preferred flow paths.

Representative ISGS® chemical costs:

Site Location	Geology	Delivery Method	Contaminants	Approx. Cost – $USD/M³
Denver, CO	Dense Alluvium	Fixed Wells	PAHs, Pentachlorophenol	$40 – 50
Dolomite, AL	Fractured Karst	Direct Push	Phase Separated Creosote	$45 – 50
Gainesville, FL	Sand/Silt	Direct Push and Fixed Wells	Phase Separated Creosote	$60 – 75

For more information and detailed case studies, please visit our website.

Evonik Operations GmbH
Smart Materials
Active Oxygens Business Line
Soil & Groundwater Remediation

remediation@evonik.com
www.evonik.com/remediation

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