In-Situ Persulfate Oxidation of Soil Contaminated with Hydraulic Oil at a New Jersey Site

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Background

Non-aqueous phase liquids (NAPLs) such as hydraulic oils are frequent sources of contamination in the soil subsurface. The immiscibility of these organic contaminants with water results in pore space entrapment within the soil matrix and persistence of the pollution over long periods of time. This study investigates whether alkaline-activated persulfate oxidation treatment sufficiently lowers the contamination levels below the New Jersey Extractable Petroleum Hydrocarbons (EPH) regulatory criteria for a site contaminated with hydraulic oil.

Objectives

- **Batch Reactor Tests**
  - Evaluate if surfactant pre-flush improves persulfate performance
  - Determine optimal persulfate dosage
- **Field Application**
  - Decrease contaminant levels below EPH limit of 17,000 mg/kg (Category 2 EPH petroleum products) for the 50 by 60 ft treatment area

Methods

Batch Reactor Tests

TASK Pre-Flush → Persulfate – Klozur Solution → 4-Day Reaction Time → Separate Phases → Lab Analysis

Field Application

Injection Events
- 3 injection galleries
- 3 ft BGS trenches to target 3-6 ft BGS

3 wks

Analysis
- ORP, DO, pH measured
- EPH, sodium, sulfate, & persulfate determined

Methods

Figure 1: Injection Gallery

Figure 2: Injection Manifold

Batch Reactor - Results

Table 1: Bench Scale Testing Results

Sample ID	EPH, mg/kg	% EPH Reduction
C-M-2 *(control)*	1100	-
M-PERS-S *(40% g/kg pers.)*	370	66%
M-PERS-W	1.5	-
M-PERS20-S	870	20.90%
M-PERS20-W	2.3	-
M-PERS60-S	970	11.80%
M-PERS60-W	2.4	-
M-PERS80-S	950	13.60%
M-PERS80-W	1.9	-
M-TASK-PERS-1-S	670	39%
M-TASK-PERS-1-W	45	-
M-TASK-PERS-2-S	570	48%
M-TASK-PERS-2-W	44	-

Batch Reactor - Conclusions

- TASK surfactant pre-flush does not enhance EPH reduction
- Very low EPH concentration in water phase → persulfate oxidation effective
- 40 g/kg soil best persulfate dosage

Field Application - Results

Table 2: 150 g/L of Oxidant Injected in Vadose Zone

Historical Avg, mg/kg	Post-Ox Avg, mg/kg
43,250	11,460 *(-73.5%)*

Table 3: Remaining Exceedances

Sample Label	EPH, mg/kg	% Exceedance
SB-2 (6'-6.5')	21,700	27.65%
SB-3 (4.5'-4.5')	17,700	4.12%

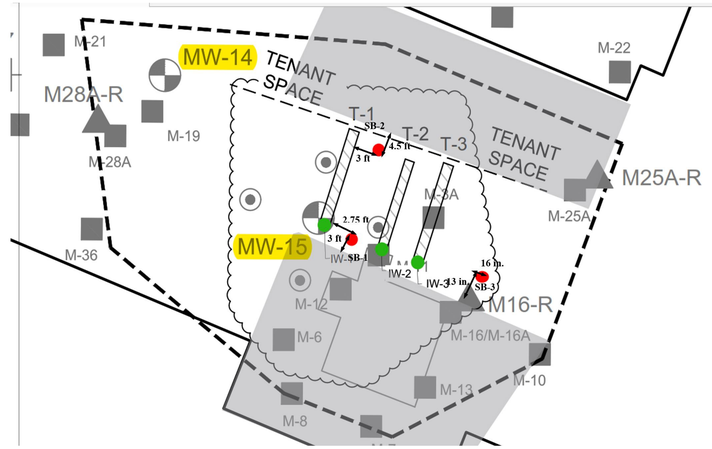

Figure 3: Site Map

Field Application - Conclusions

Overall EPH Reduction in Soil: 73.5%

- Alkaline activated persulfate treatment was effective in reducing hydraulic oil concentration (EPH)
- Additional treatment is ongoing