

## Case History R-3



### Chemical Oxidation of VOCs - *Ex Situ* Soil Treatment

#### OBJECTIVE

This pilot scale study designed and undertaken by RemedX compared chlorinated hydrocarbon (CHC) destruction by three chemical oxidant additions: solid permanganate, permanganate solution and RegenOx™ under identical treatment conditions. Treatment effectiveness of the additions were compared with each other and with an oxidant-free (water only) control to quantify physical losses such as volatilization during soil mixing. The results from this pilot study will be used to evaluate the feasibility of a full scale *ex situ* soil treatment application.

#### PILOT TEST METHODS

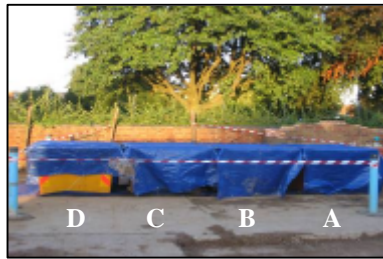
##### 1. SOIL HOMOGENIZATION

An excavator mixed the bulk soil.



##### 2. SOIL SPLIT INTO 4 SKIPS

The bulk soil was split and labelled by oxidant treatment.



SKIP A – KMnO<sub>4</sub> Powder  
SKIP B – KMnO<sub>4</sub> Solution  
SKIP C – RegenOx™  
SKIP D – None/Control

##### 3. BASELINE SAMPLING

Baseline samples were obtained with a hand auger at 0.15 m depth and field PID readings were taken to confirm homogenization. For each skip, 2 composite samples of 5 prior samples were analyzed for Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (sVOCs), Soil Moisture, Total Organic Carbon (TOC) and grain size. The baseline sampling indicated the soil homogenization process had been effective.



##### 4. OXIDANT DELIVERY AND SOIL MIXING

In Skip A, permanganate powder was added and mixed with the excavator. In Skip B, permanganate solution was sprayed and mixed with the excavator. In Skip C, RegenOx™ oxidant powder (Part A) and RegenOx™ activator gel (Part B) were added by hand and then mixed with the excavator. Skip D was the untreated control.



RegenOx™  
Part A



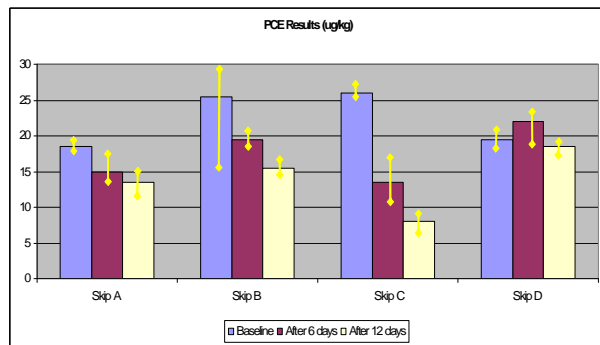
RegenOx™  
Part B



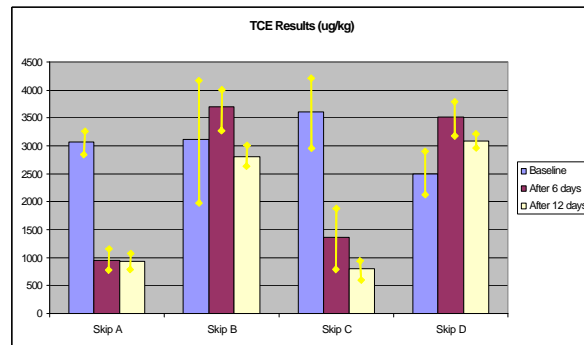
Reaction

## RESULTS

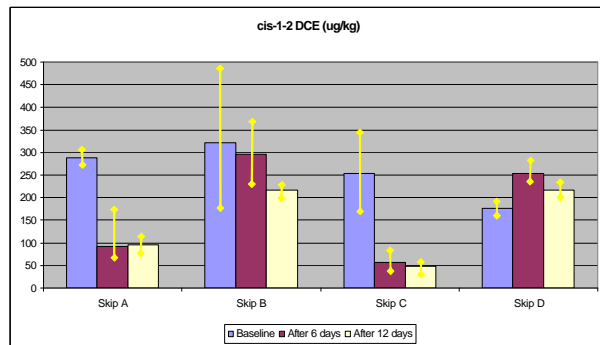
Little or no reduction of any contaminant was observed in either the permanganate solution treatment or the control over the 12 day test period. In contrast, significant reductions in trichloroethene (TCE) and cis-1,2 dichloroethene (DCE) were measured in Skips A (permanganate powder) and Skip C (RegenOx™). Significant reductions of perchloroethene (PCE) and trichloroethane (TCA) were also observed in Skip C (RegenOx™) as compared with the other treatments. This was most marked for TCA where an 80% reduction was observed in the RegenOx™ treatment whilst other treatments did not differ significantly from the control (no treatment). The likely reason for unsatisfactory results in Skip B (permanganate solution) was the limited amount of oxidant delivered due to the high moisture content of the soil. The results showed no significant changes in total organic carbon (TOC) and moisture in any of the samples, regardless of treatment.



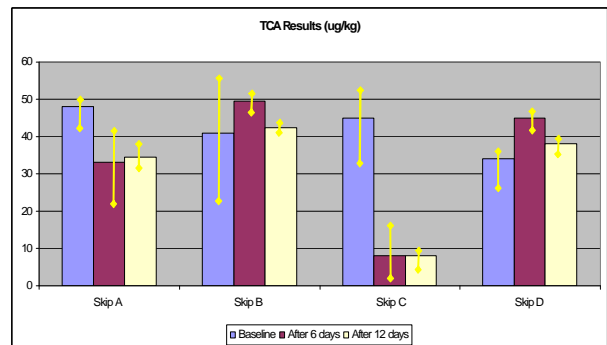
**KMnO<sub>4</sub> powder**      **KMNO<sub>4</sub> solution**      **RegenOx™**      **Control**



**KMnO<sub>4</sub> powder**      **KMNO<sub>4</sub> solution**      **RegenOx™**      **Control**



**KMnO<sub>4</sub> powder**      **KMNO<sub>4</sub> solution**      **RegenOx™**      **Control**



**KMnO<sub>4</sub> powder**      **KMNO<sub>4</sub> solution**      **RegenOx™**      **Control**

## CONCLUSIONS

- RegenOx™ can be effectively used for *ex situ* soil treatment with less material handling problems than liquid permanganate solution.
- Both Skip A (powdered permanganate) and Skip C (RegenOx™) showed good reductions of TCE and DCE.
- RegenOx™ treated a wider range of CHCs than permanganate, with statistically better results for DCE, PCE and TCA and evidence of on-going contaminant reduction through the test period.

## CONTACTS

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