Colorado State University
Civil and Environmental Engineering
CCH
Center for Contaminant Hydrology

REMEDIATION OF HYDROCARBON IMPACTED MEDIA:

SOIL MIXING WITH CHEMICAL OXIDANTS AND STABLIZING AGENTS

INTRODUCTION

A common challenge at many sites is managing media containing residual hydrocarbons such as fuels, lubricants, and wood treating oil. Building on this, the Center for Contaminant Hydrology at Colorado State University (CSU) is working on an innovative technology using conventional soil mixing techniques to deliver chemical oxidants and stabilizing agents into hydrocarbon impacted media.

The overarching themes are using 1) reactive media to deplete the most soluble constituents such as BTEX, MTBE, and naphthalene, 2) stabilizing agents to reduce the permeability of the treated media and/or adsorb any remaining contaminant, and 3) soil mixing to achieve uniform delivery of reagent to the targeted media. By combining benefits of contaminant mass depletion with reduced permeability, this technology effectively achieves two treatments in one application. The primary benefit is a substantive reduction in contaminant discharge from treated soils into surrounding groundwater.

The following includes background information, an overview of laboratory and field studies, a conceptual design for a large-scale field application, and a list of individuals to contact for more information.

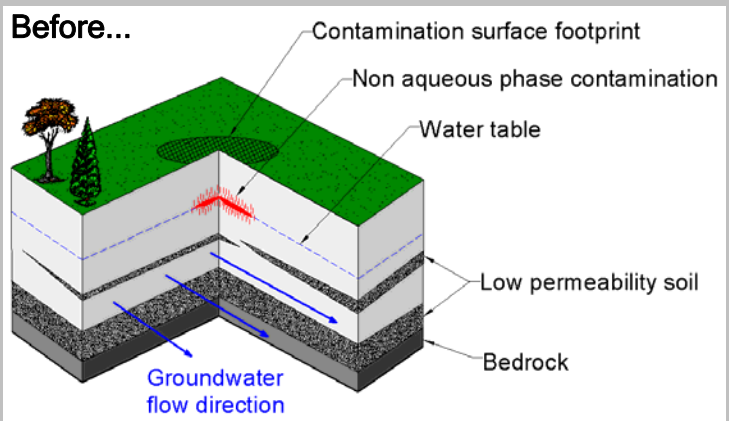
BACKGROUND

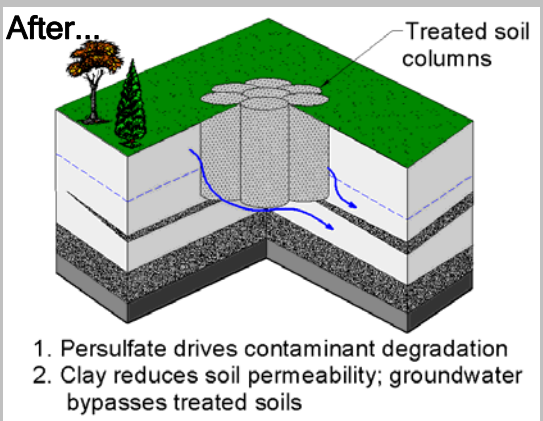
In 2003, DuPont donated patents to CSU for admixing zero valent iron and clay (ZVI-Clay) for chlorinated solvents releases. Through numerous laboratory studies and four full-scale field applications this technology is emerging as a promising solution for chlorinated solvent source zones.

Building on this theme, we are adapting the ZVI-Clay technology to address hydrocarbons. The primary modification is using chemical oxidants as the reactive media as opposed to chemical reductants (zero valent iron). ExxonMobil, Suncor Energy, and ConocoPhillips provide financial support for this work.

Our current focus is finding hydrocarbon-impacted sites that could benefit from this technology. Our goal is to further advance a remedial technology that holds the promise of being an effective and cost practical solution for a large set of sites with residual hydrocarbons.

CONDITIONS BEFORE AND AFTER TREATMENT

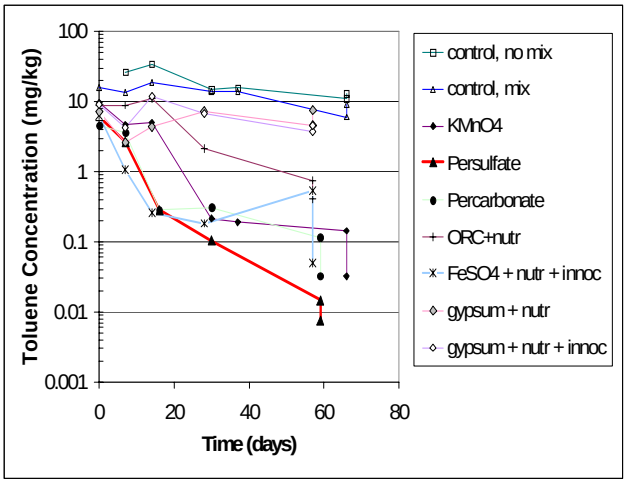




LABORATORY STUDIES

A proof of concept experiment was conducted using soils from the Suncor Refinery in Colorado. The soils were spiked with toluene. Subsequently, a bench-scale mixing platform was used to admix the soils with various types of reactive media and kaolin clay. A total of nine columns were prepared in the lab. Concentrations of toluene in the soils were determined over a 65-day period. Results indicate up to 99.9 percent depletion of toluene using persulfate as the reactive media.

Laboratory column studies



Total toluene concentration in soils versus time

FIELD STUDIES

Building on the lab studies, eight 3–foot diameter test columns were completed at the Suncor Refinery in September of 2005. Reactive media included gypsum, ferric sulfate and persulfate. After four months the best results were achieved using persulfate. These including:

- 72% removal of total volatile and semi volatile compounds,
- 99.4% removal of BTEX, and
- 99.9% removal of naphthalene.

Further mass reduction is anticipated with time. Additional samples will be collected to evaluate removal at after twelve months.

Mixing of 3-foot diameter test columns at the Suncor refinery

CONCEPTUAL DESIGN

Students at CSU recently completed a conceptual design for a full-scale application of persulfate-clay for a closed refinery. The objective was to address a petroleum LNAPL smear zone adjacent to a river. The envisioned benefits are depletion of contaminants and deflection of groundwater flow beneath the LNAPL.

FOR MORE INFORAMTION

For more information and technical support please contact the CSU Center for Contaminant Hydrology:

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