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Stimulated Anaerobic Degradation of Petroleum Hydrocarbons

The aerobic degradation of petroleum hydrocarbons has been well demonstrated. Ex-situ aerobic degradation is straightforward, however, the in-situ transport properties of oxygen are poor due to low solubility and high reactivity. During the past ten years advances have been made exploiting anaerobic microbial consortia for the degradation of petroleum and other hydrocarbons. The biological reduction of nitrate, ferric iron, and sulfate can support the anaerobic oxidative degradation of petroleum hydrocarbons. Transport properties are favorable, since they all form bioactive soluble inorganic salts that have limited inorganic reactivity.

Field work has been done by the EPA and ARCADIS G&M using nitrate salts to stimulate the biodegradation of BTEX. Ferric iron and sulfate driven anaerobic oxidation of petroleum hydrocarbons has also been well demonstrated. However, the focus has been on iron and sulfate in naturally occurring forms and concentrations. ARCADIS G&M is beginning to use supplemental iron and sulfate salts to stimulate the anaerobic oxidation of petroleum hydrocarbons. The simultaneous use of ferric iron and sulfate has the additional benefit of yielding insoluble iron sulfide (pyrite) as the final product of the reactions.

Iron chelating agents can be used with these systems. Synthetic chelators are available, however, soluble humic or fulvic materials offer powerful chelating capacity in a form that is native to natural biogeochemical systems. Two advantages present themselves: first, these are highly mineralized and are refractory to further biodegradation; and secondly, the iron chelating capacity is extremely strong, yet the iron in these complexes is labile to biological processes.