

Mustard Contaminated Soil: Understanding the mechanisms and parameters governing contaminant behaviour and biodegradation

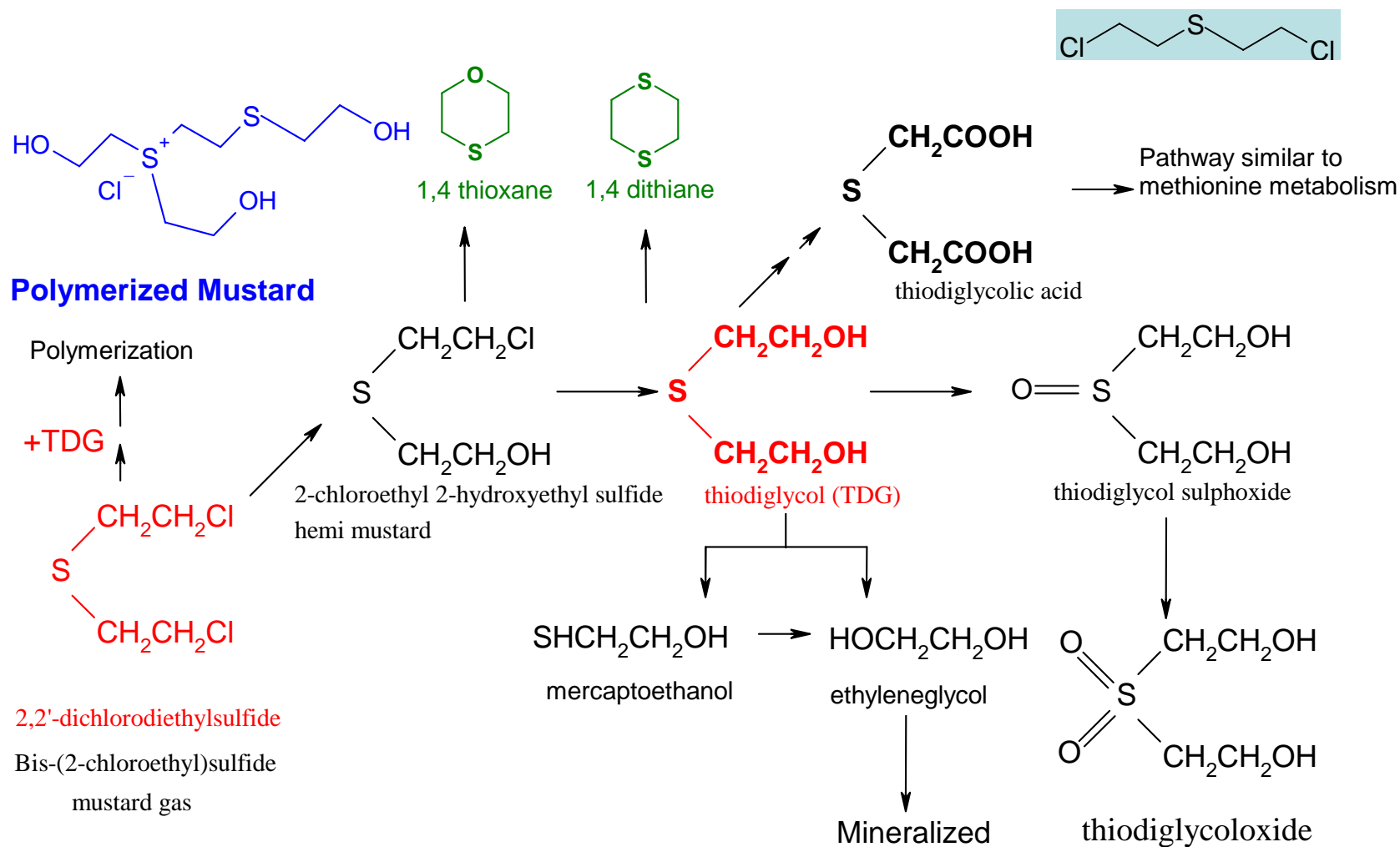
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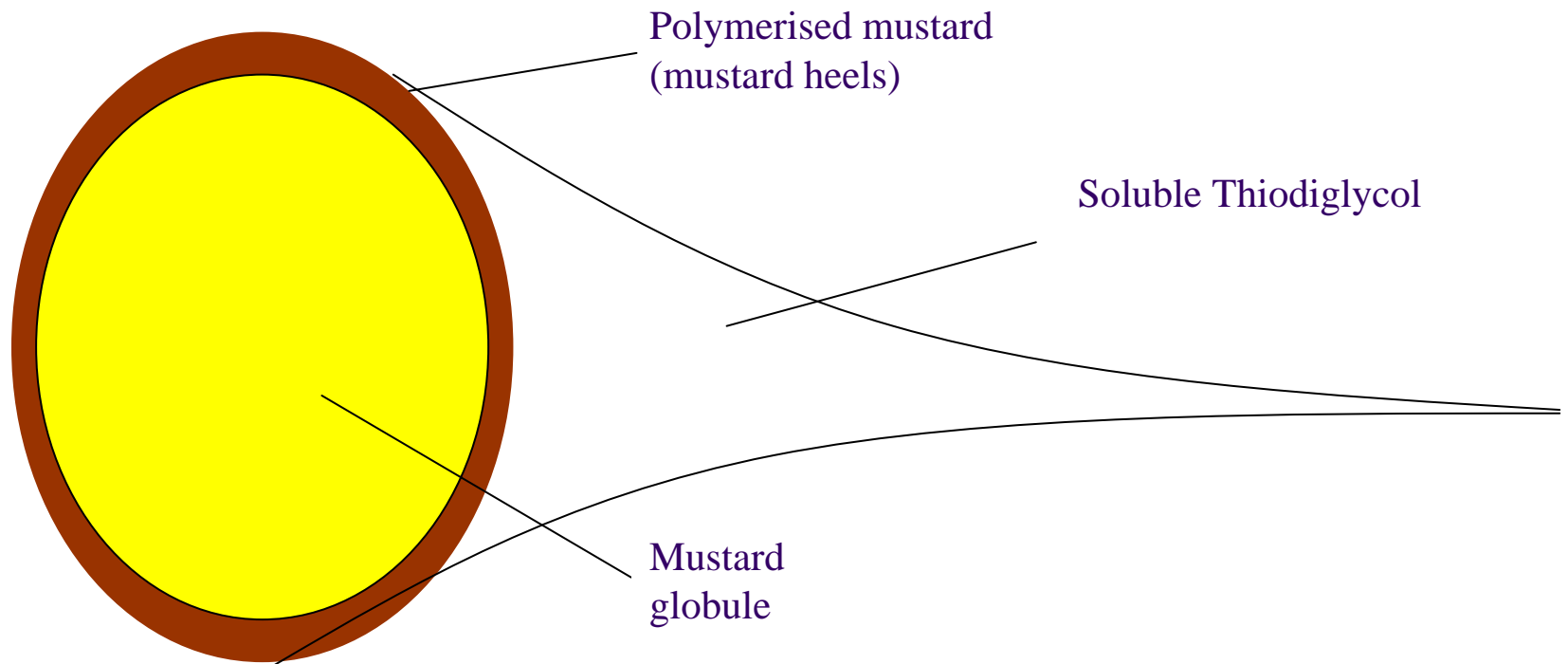
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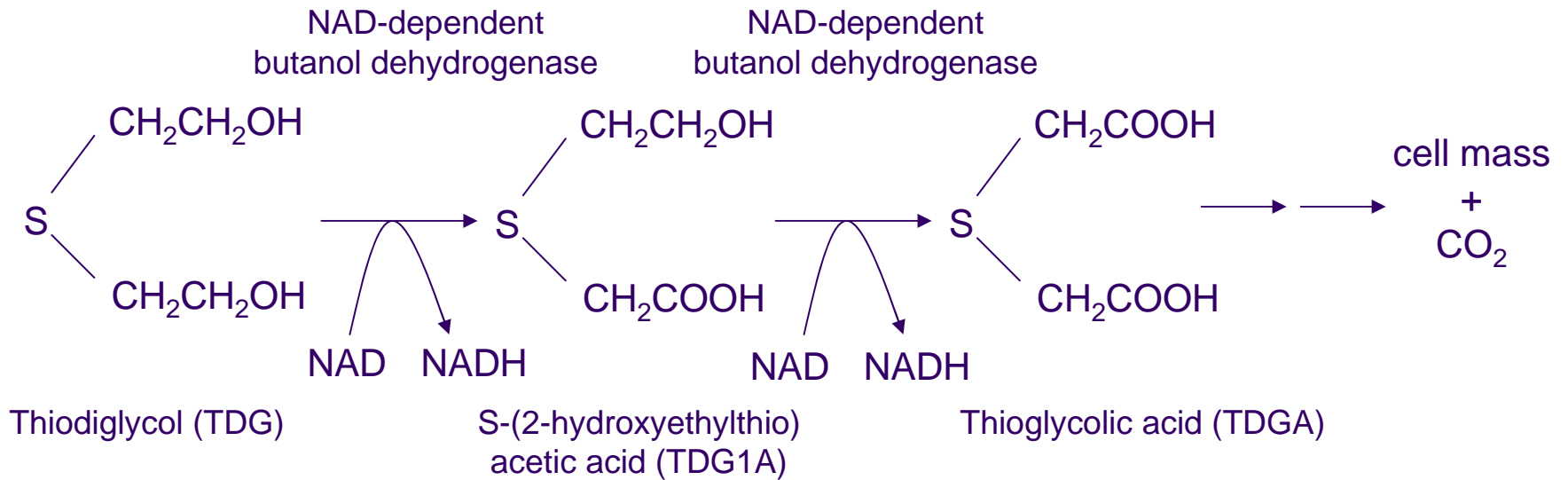
Fate of Mustard Gas in the Environment



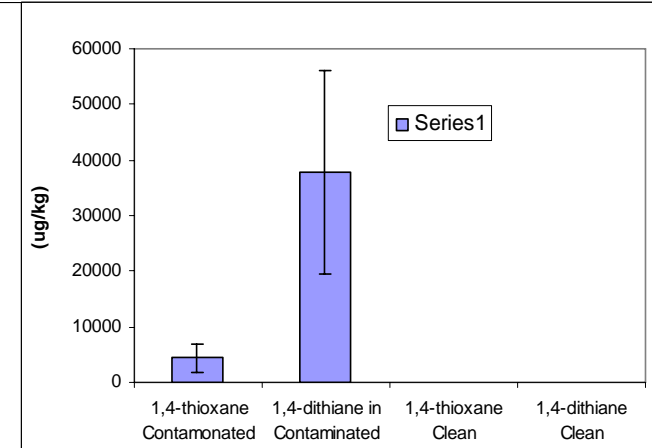
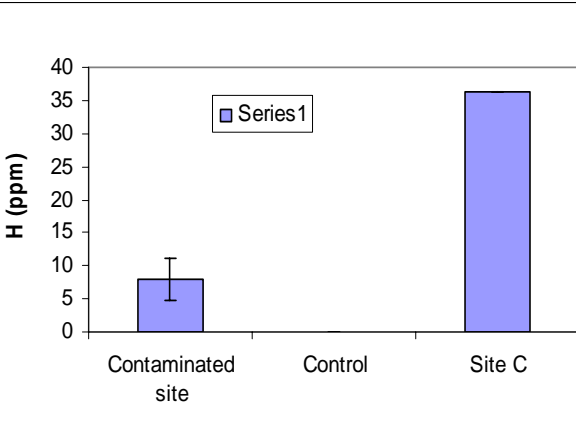
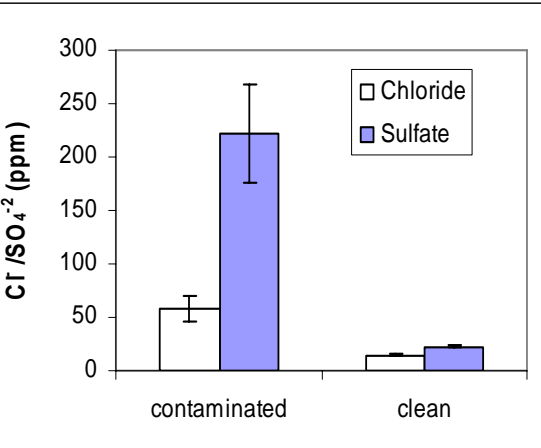
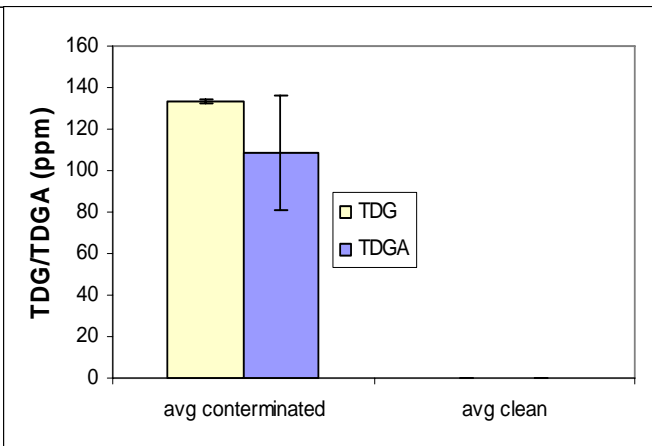
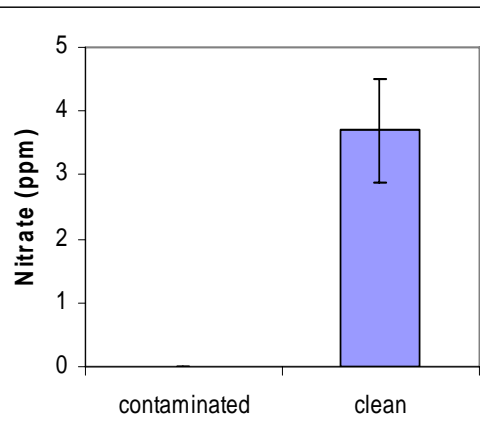
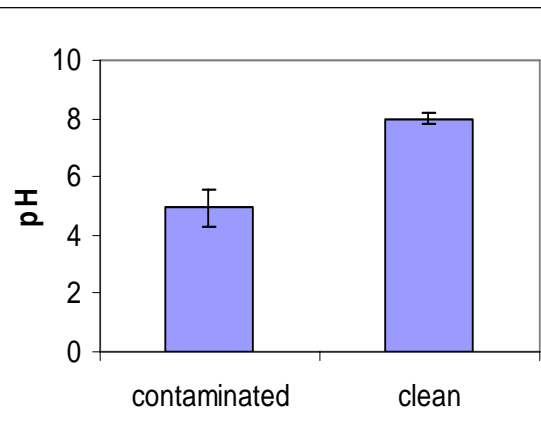
Mustard gas behaviour in soil / aqueous solution



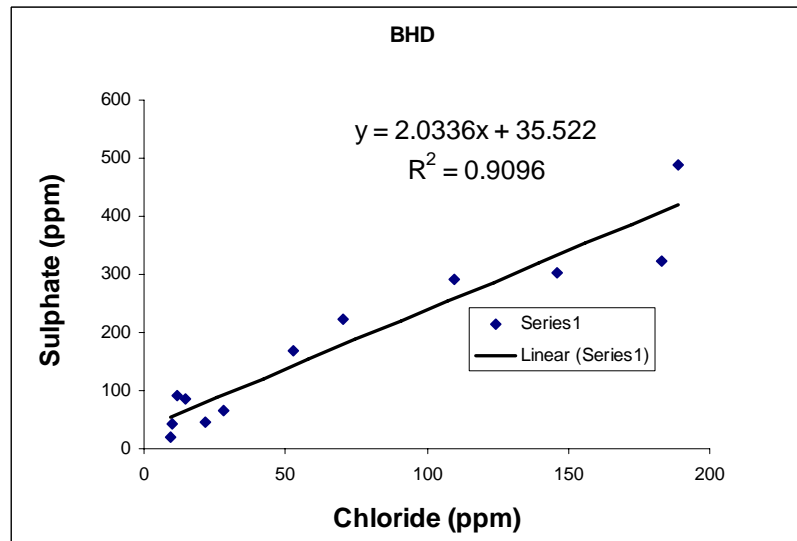
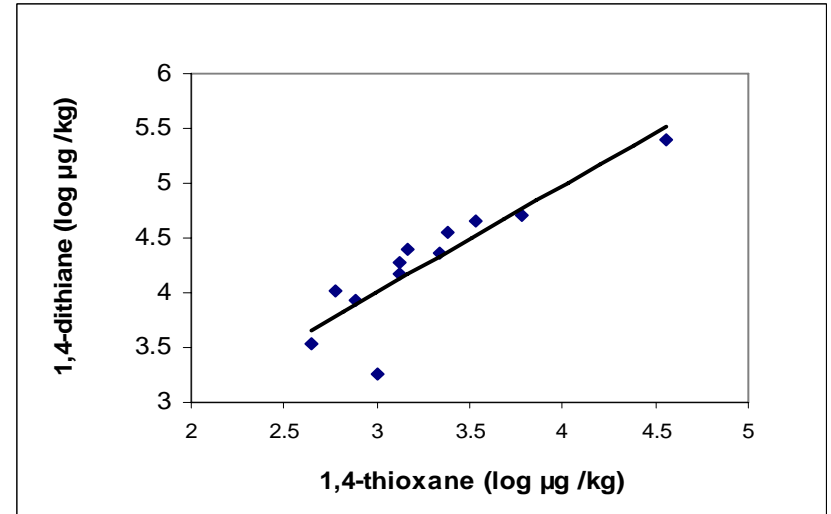
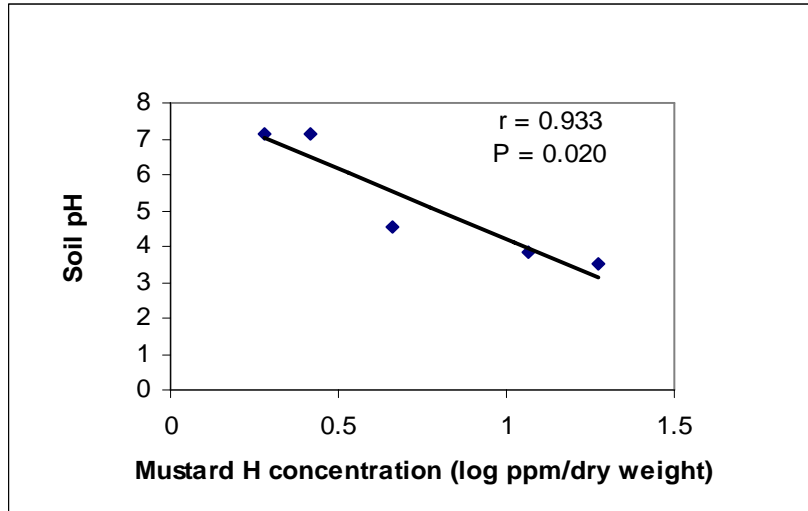
Microbial enzymatic degradation of mustard gas hydrolysis product - thiodiglycol



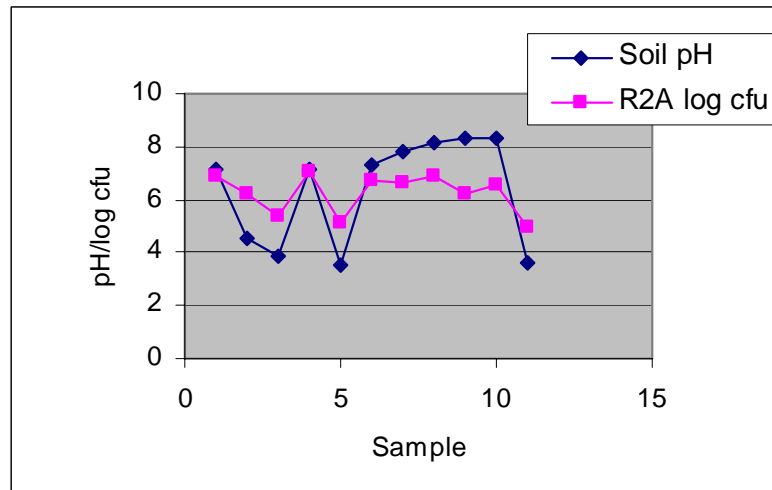
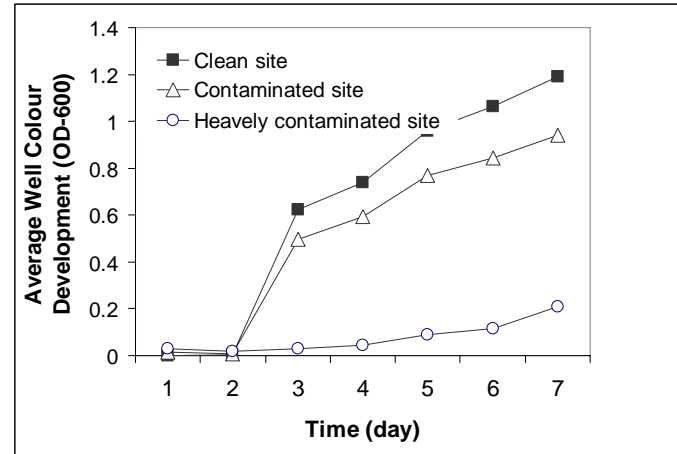
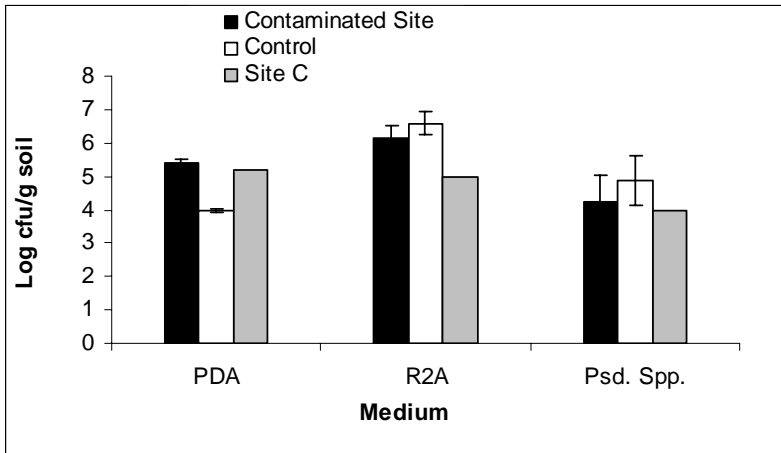
Soil chemistry on contaminated site



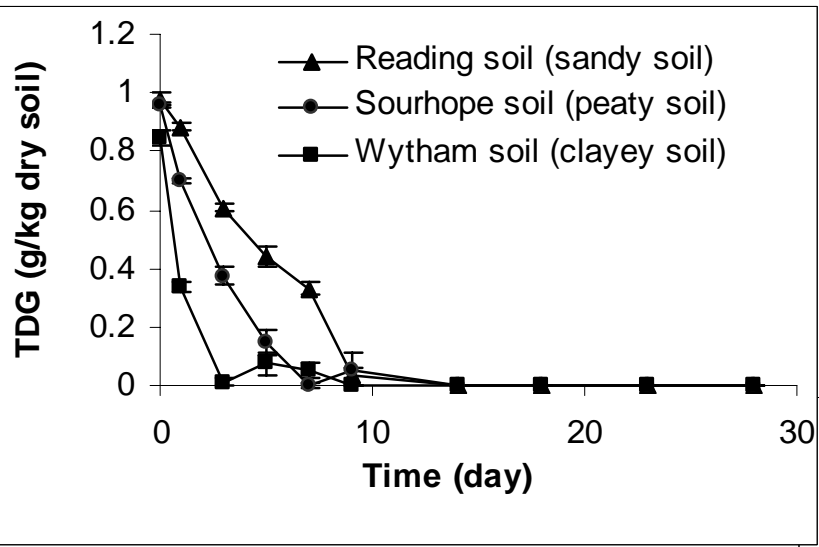
Relationship between nutrients, pollutants and microbial physiology



Microbiology on Contaminated Site

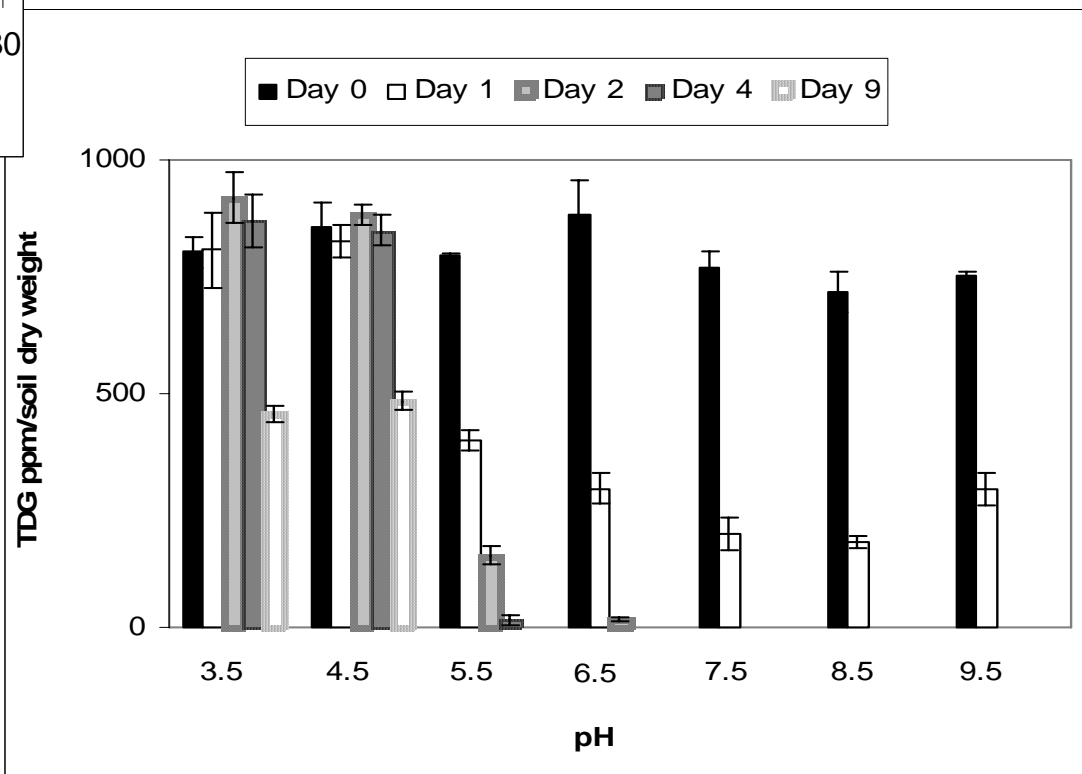


Biodegradation Thiodiglycol in soils

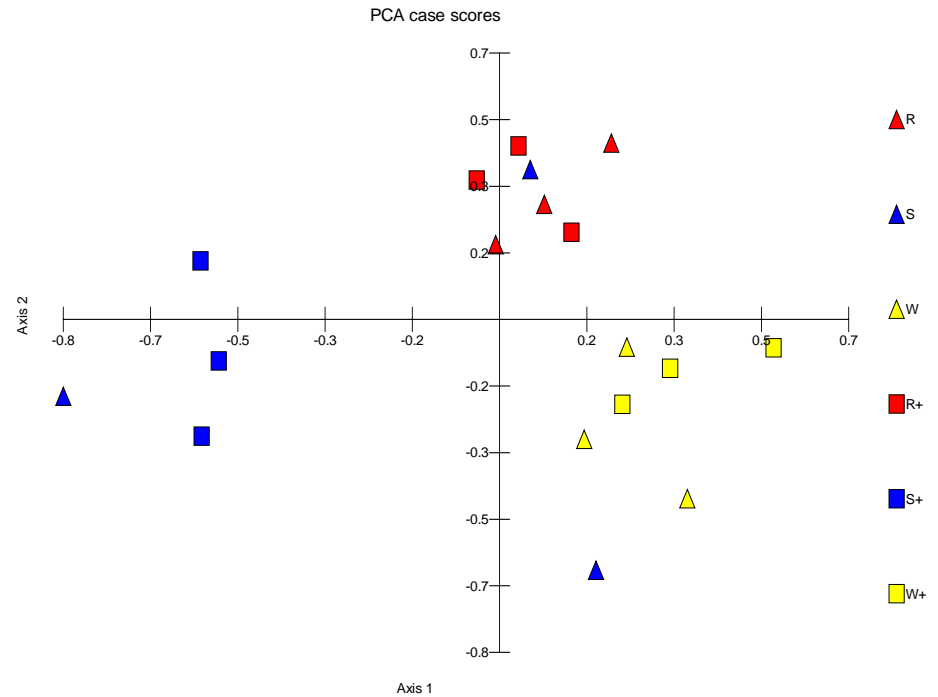
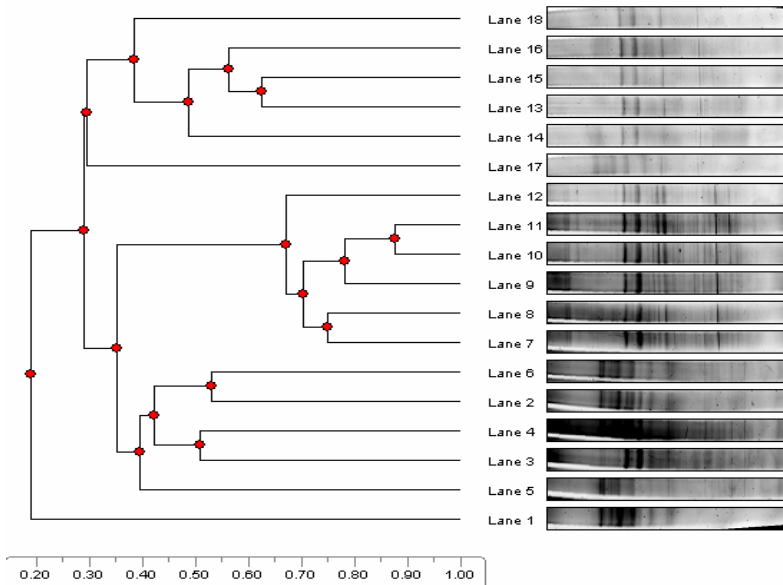


TDG consumed within 10 days by three soil, which never contaminated by mustard gas

Optimum pH for TDG Degrading was 8.5



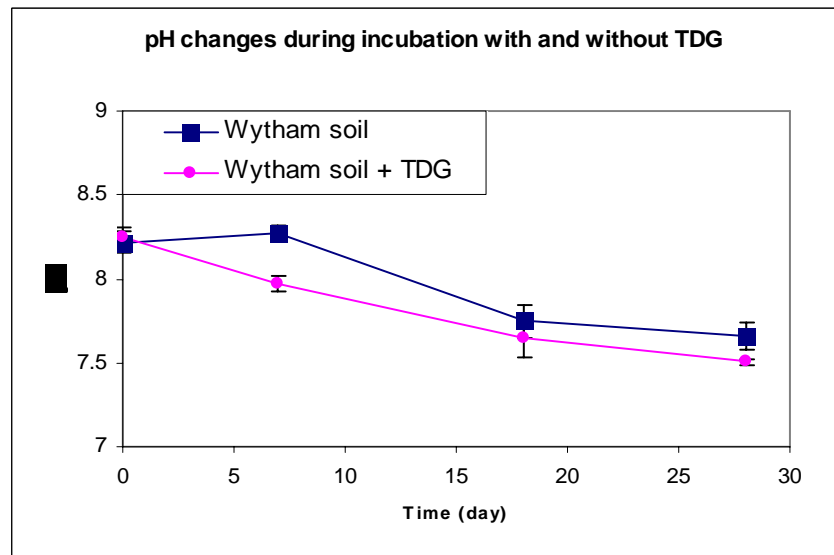
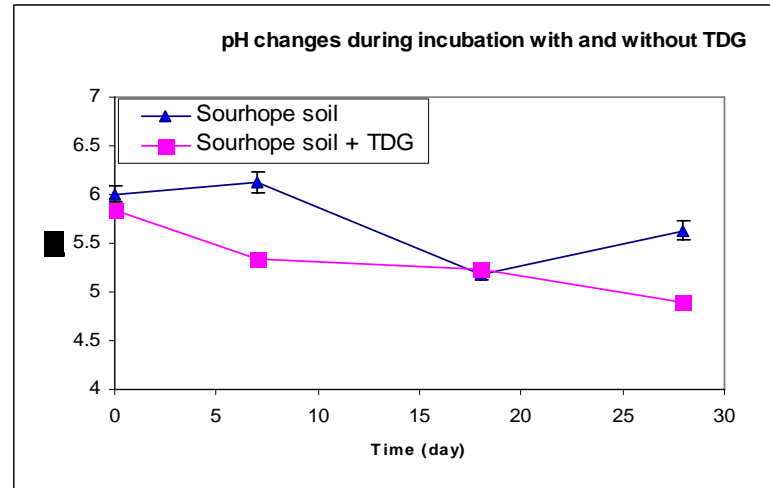
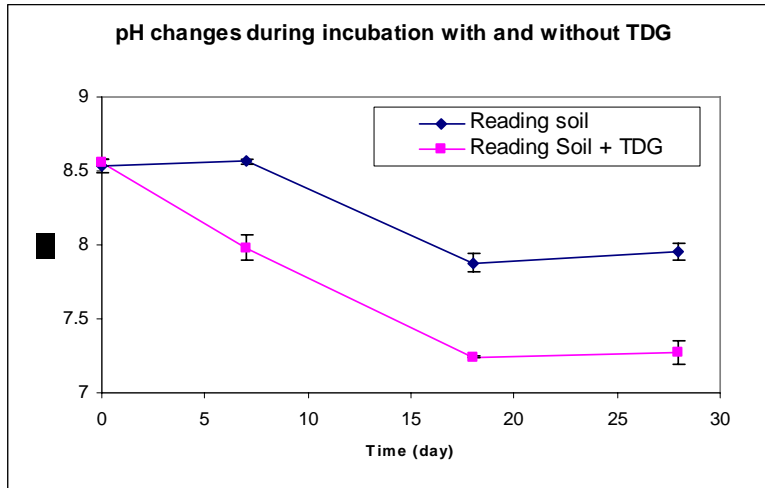
Impact of Thiodiglycol on Soil Microbial communities



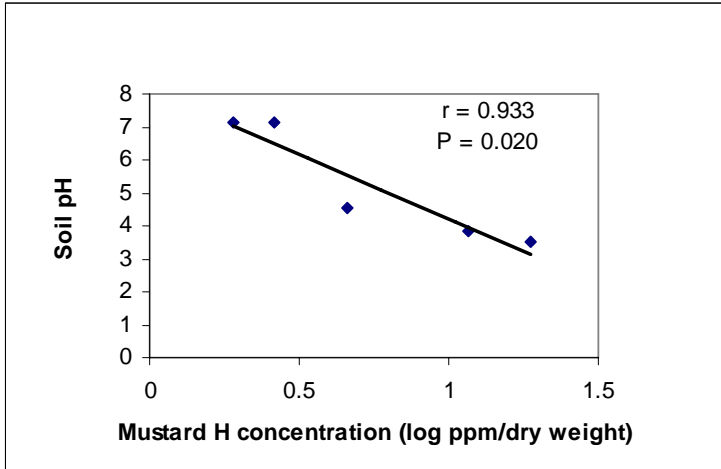
TDG has no significant impact to soil microbial community structure assessed by DGGE profile

TDG has no significant impact to soil community level physiological profile assessed by Biolog Eco plate and analyzed by Principle Component Analysis (PCA)

Soil pH changes during DTG Degradation

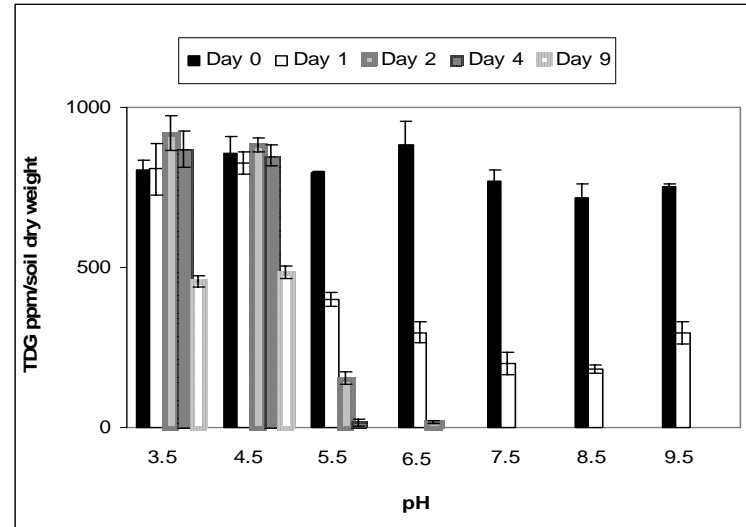


Overcome Constraints to Bioremediation-pH control and aeration

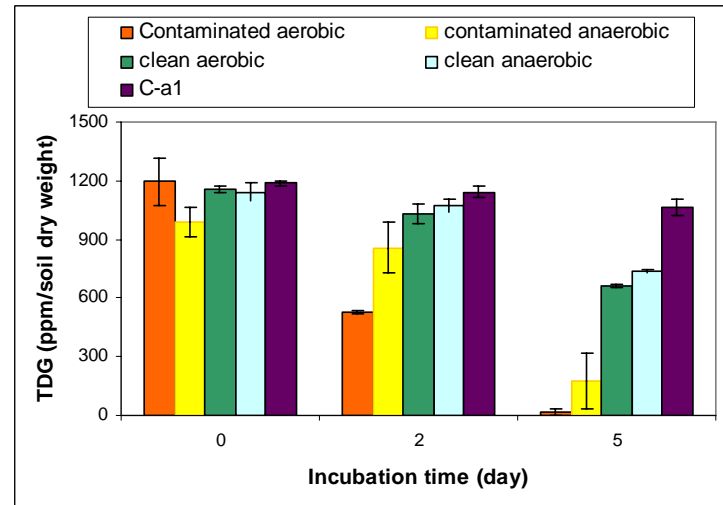


pH was low at contaminated site and was negatively correlated to mustard gas concentration

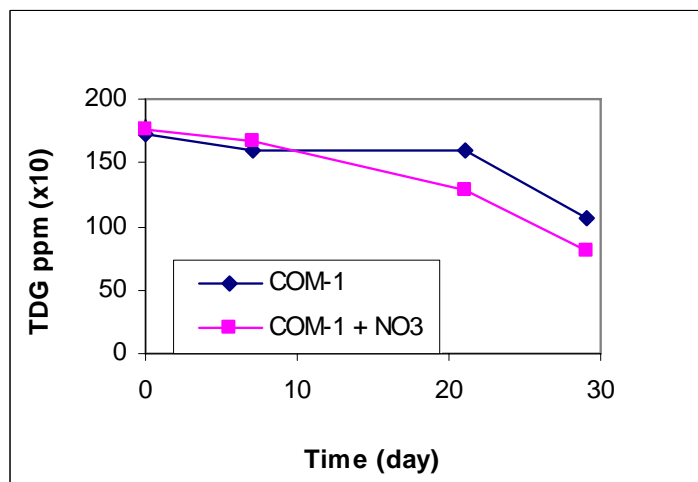
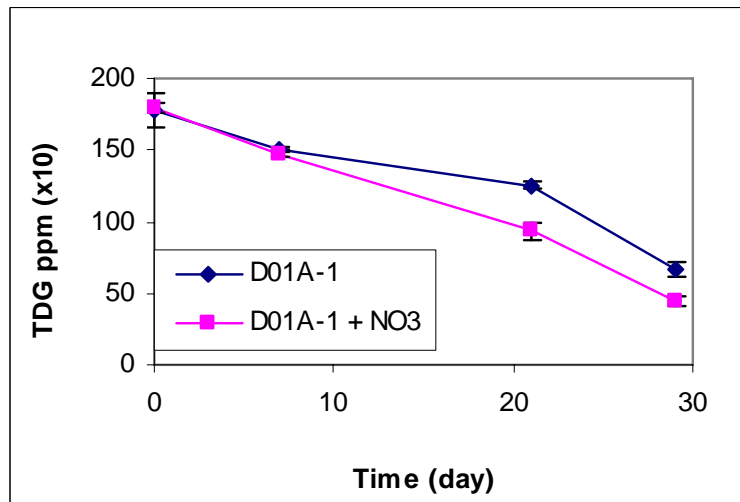
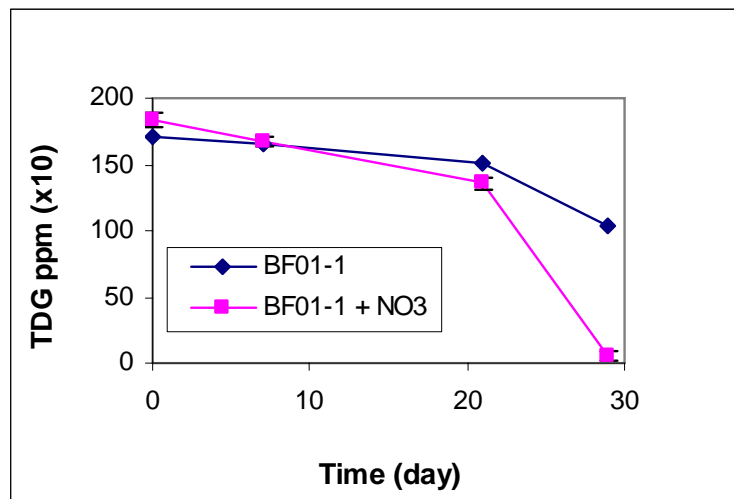
Aeration enhance biodegradation TDG by soils from contaminated site



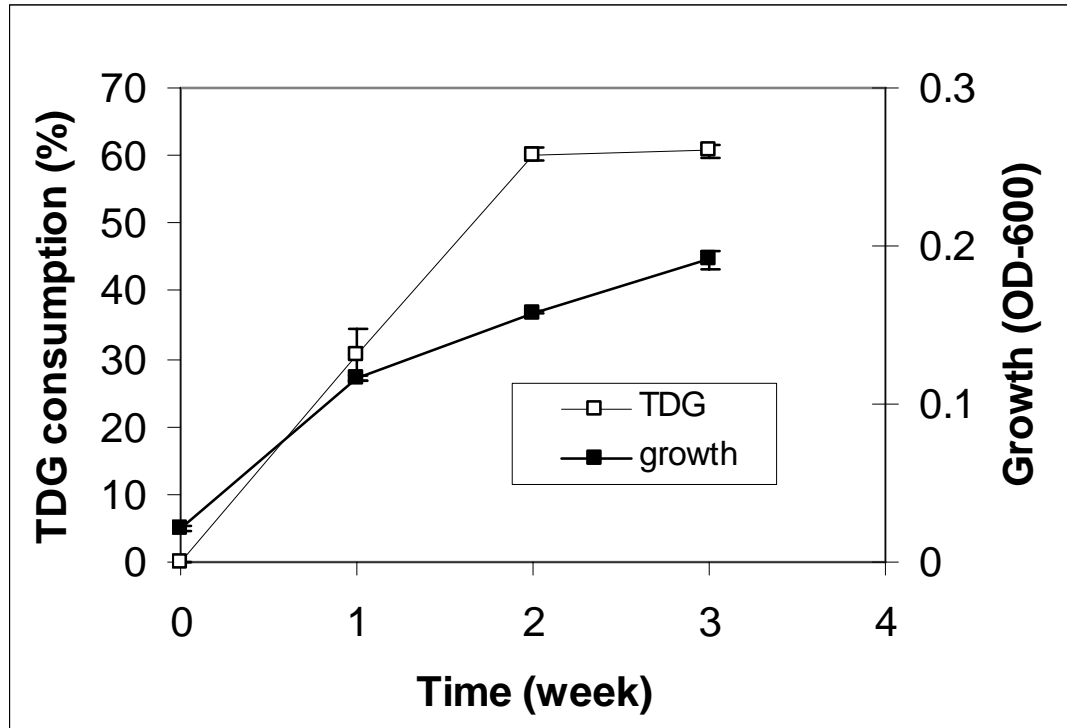
Optimum pH for degrading TDG is 8.5



Overcome Constrains to Bioremediation- Addition nitrate enhance biodegradation TDG by soils from contaminated site



TDG Degradation by Bacterial Consortium Isolated from Clean Soil

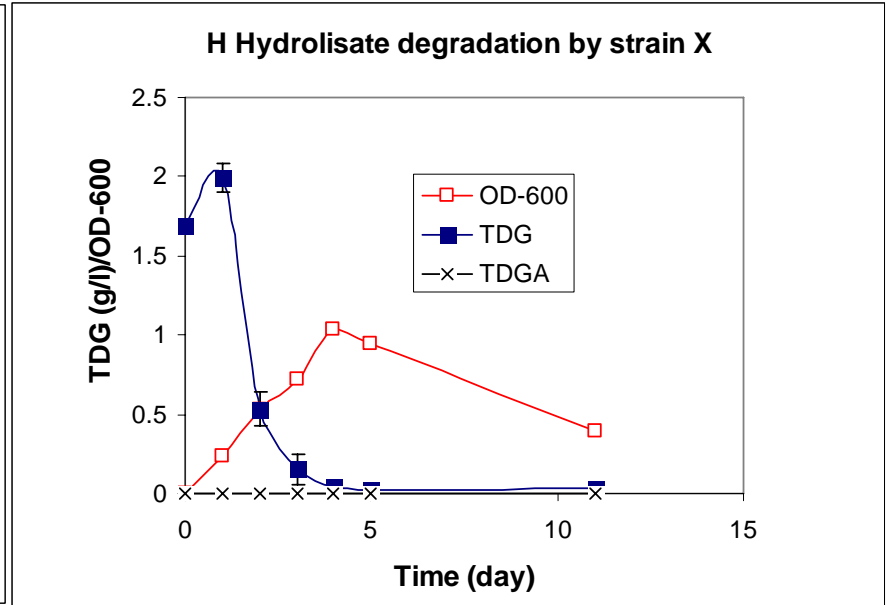
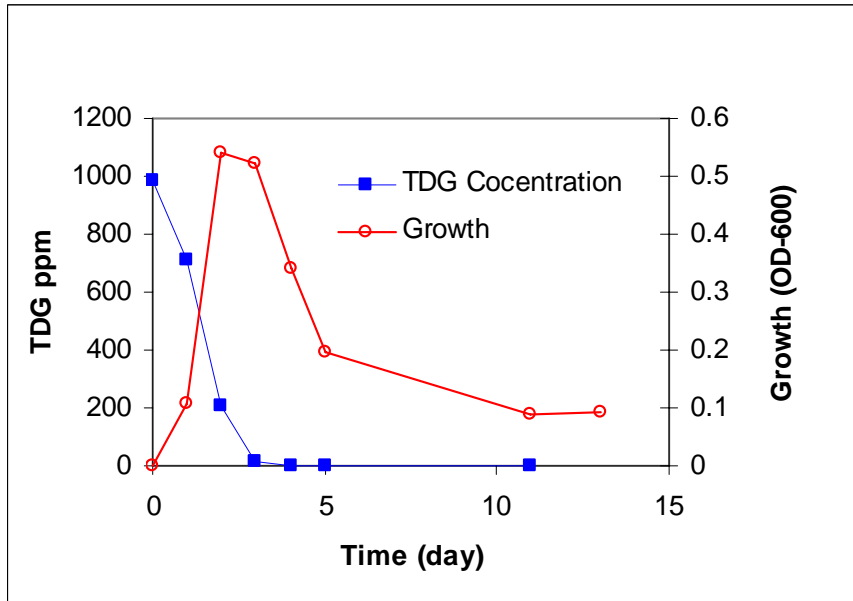


Rhizobium sp, Achromobacter sp, and Stenotrophomonas sp. Co-culture

Achromobacter (*Achromobacter starkeyi*) can degrade methionine by cleavaging C-S bound

Short-chain alcohol dehydrogenase in *Rhizobium* and *Stenotrophomonas maltophilia*

TDG Degradation by Bacterial Strain Isolated from contaminated site



Summary

- ◆ High H concentrations lowered the pH which in turn inhibited biodegradation. The optimal pH for biodegradation of thiodiglycol (TDG), is pH 8.5.
- ◆ The high sulphate and chloride concentrations detected were attributed to the mineralisation of H.
- ◆ The low oxygen and nitrogen levels observed in the soil inhibited biodegradation.
- ◆ Microbial communities were less diverse and active in contaminated soil than in clean soil.
- ◆ In clean soil, a consortium of three bacteria, *Rhizobium* sp, *Achromobacter* sp, and *Stenotrophomonas* sp was needed to degrade TDG. However, a bacterial strain was isolated from contaminated soil that was capable of utilising TDG as a sole carbon source.
- ◆ Aeration, liming and fertilizing, should accelerate destruction of TDG.
- ◆ No degradation products, or degrading microorganisms, for 1,4-dithiane and 1,4-thioxane were found in the soil. This was probably because of the low solubility and low bioavailability of these compounds.

Acknowledgement

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