Enhanced Control of Microbial Cometabolism of Organic Pollutants

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Background and Objectives

- In-situ bioremediation methods cause high amounts of microbial growth near substrate injection points, which leads to bioclogging.
- Bioclogging in soil pores reduces permeability and artificial recharge in the subsurface.
- Microbial inhibitors, such as acetylene, may be used to control bioclogging where aerobic cometabolic processes are occurring
- The objective of this research is to determine the effect of acetylene on biomass production in TCE cometabolizing cultures.
- Additionally, we sought to verify if our culture could degrade 1,4-Dioxane, a common co-contaminant at TCE contaminated sites.

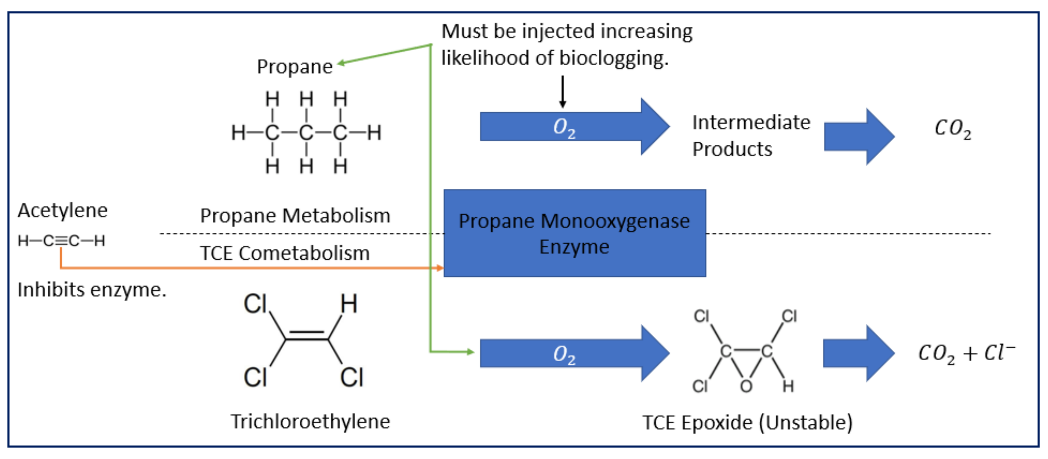

Figure 1: Acetylene-Modulated Propane-Fed TCE Cometabolism

Methodology

Acetylene Inhibition of TCE Aerobic Cometabolism:

- Two propane-fed microbial cultures used
  - *Mycobacterium austroafricanum* JOB5
  - Soil-derived propane-oxidizing mixed culture
- Cultures exposed to acetylene gas (5% v/v in headspace) for different lengths of time
  - 0, 1, 2, 4, and 8 days

1,4-Dioxane Degradation Experiment:

- Soil-derived propane-oxidizing mixed culture

Treatment	Propane (mM)	Oxygen (μM)	1,4-dioxane (μM)	Purpose
A	0	53.5	5000	Verify if culture will degrade metabolically
B	13.4	13.4	50	Verify if culture will degrade cometabolically
C	13.4	13.4	50	Oxygen and propane consumption control
D	13.4	13.4	50	Abiotic control

Experimental Results

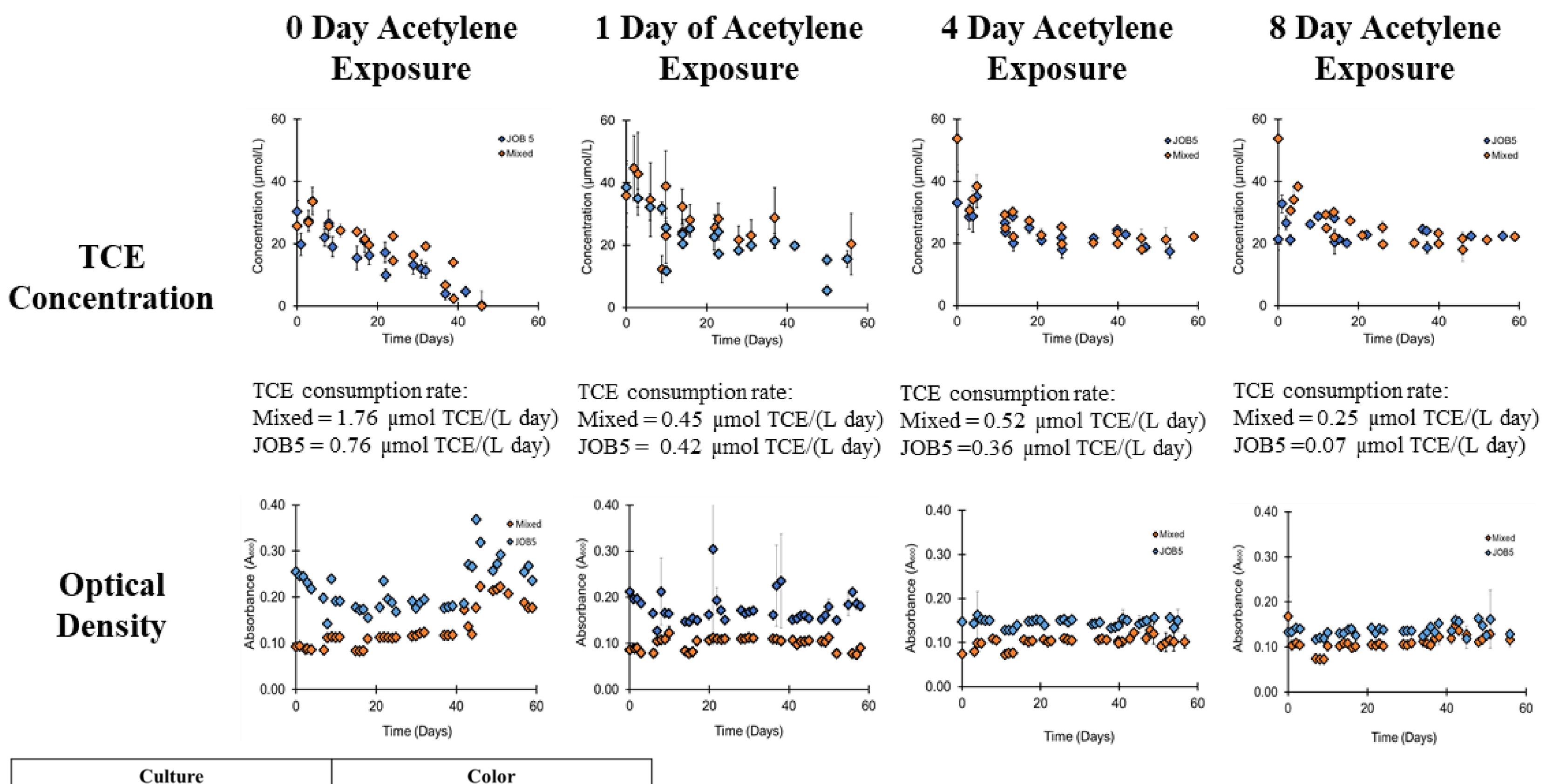

Figure 2: Aerobic Cometabolism Experimental Results

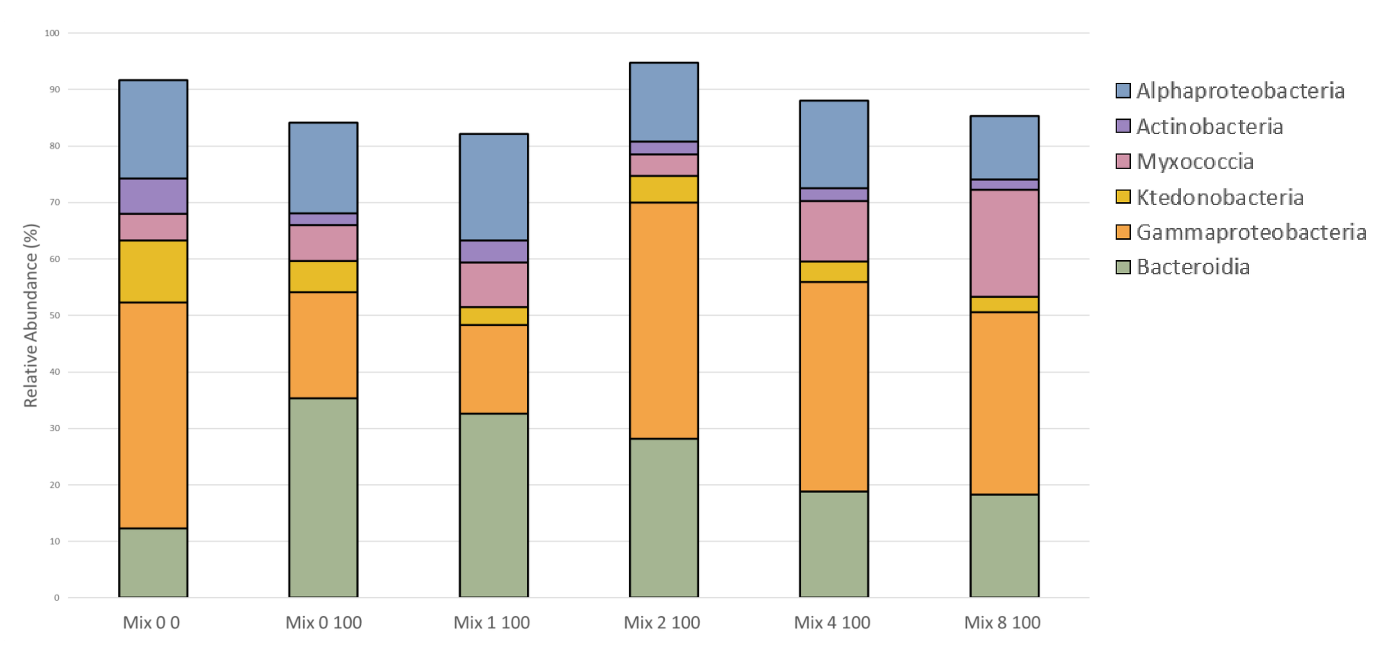

Figure 3: Top Six Most Abundant Classes in Mixed Culture

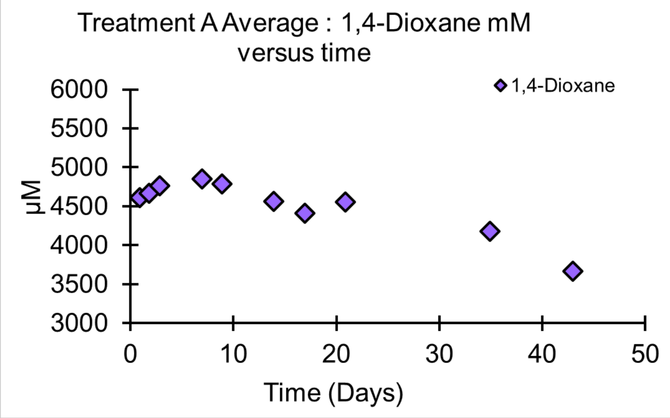

Figure 5: Metabolism Treatment of 1,4-dioxane Concentrations Over Time

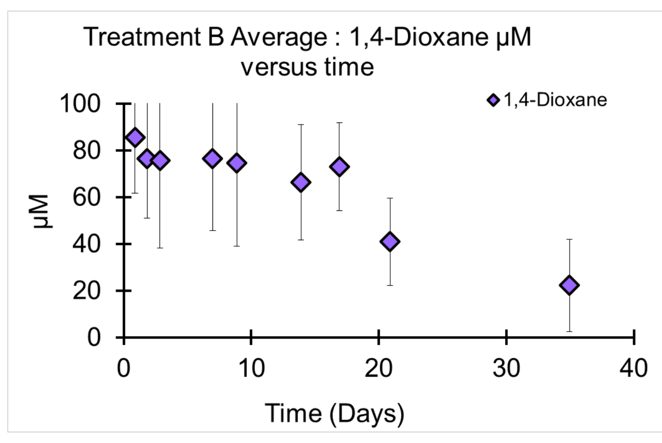

Figure 6: Cometabolism Treatment of 1,4-dioxane Concentrations Over Time

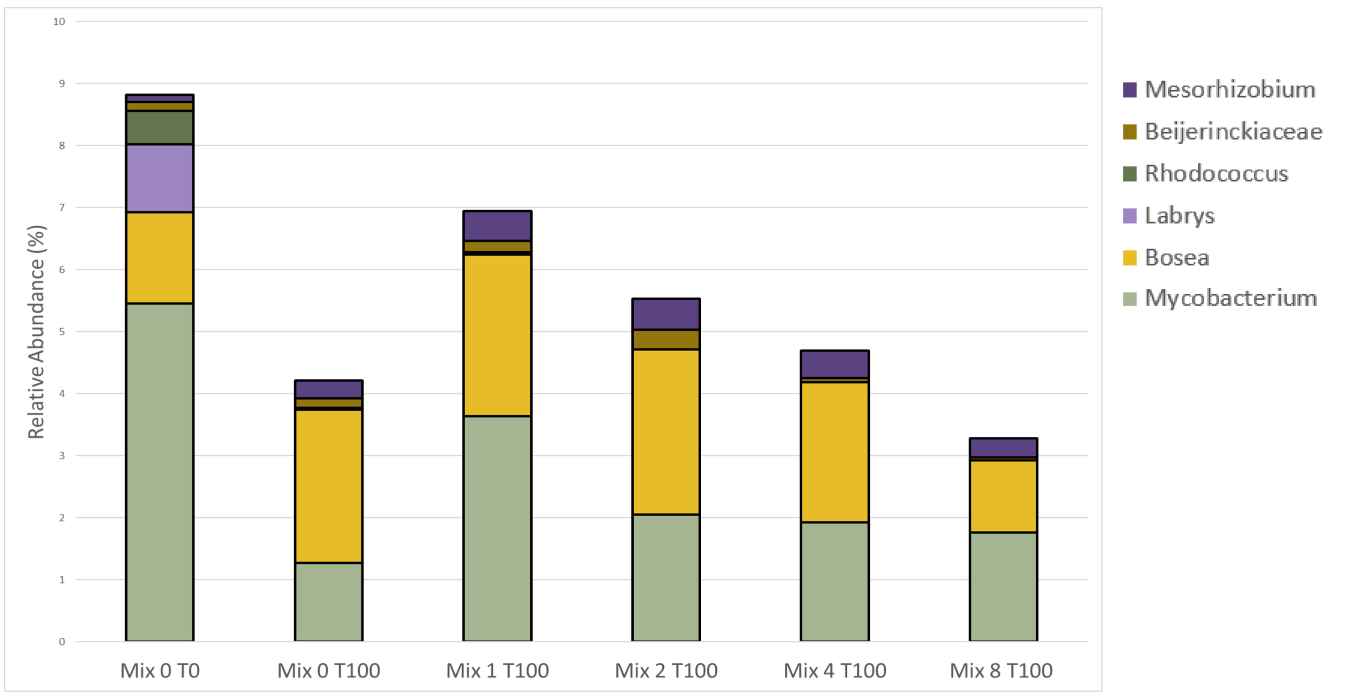

Figure 4: Top Six Most Abundant Propane Consuming Genera

Key Findings

Acetylene Inhibition of TCE cometabolism

- With an increase in the exposure time of acetylene the following decrease:
  - Biomass production rates-Optical Density and Protein Data
  - Propane and Oxygen consumption rates
  - TCE degradation rates

1,4 Dioxane Degradation Experiment

- Degradation rate of 1,4-dioxane concentrations for Treatment A (metabolism):
  - 12.57 μM/day
- Degradation rate of 1,4-dioxane concentrations for Treatment B (cometabolism):
  - 1.85 μM/day