Methanotrophs assisted bentazone degradation

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Methanotrophs assisted bentazone degradation

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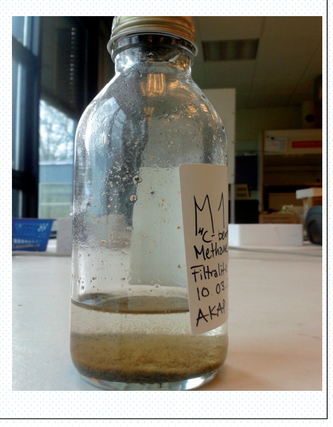
Introduction

Drinking water is increasingly threatened by contamination from pesticides and pesticide metabolites, including **bentazone**, a thiadiazine herbicide persistent in groundwater. Anaerobic groundwater often contains methane, which is easily oxidized by **methane-oxidizing bacteria** (**MOB**) upon groundwater aeration. These bacteria have known **cometabolic degradation** properties against some class of organic contaminants.

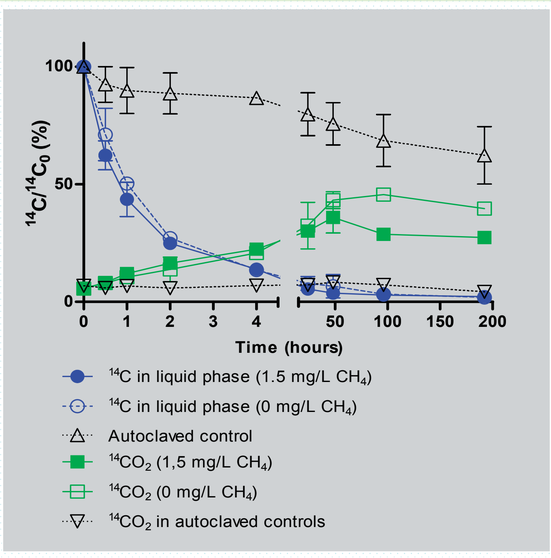
Goal: Test whether MOBs enriched from rapid sand filters can cometabolically degrade bentazone.

Materials and Methods

- Material from rapid sand filters used to enrich methanotrophic culture in continuous - flow lab scale reactors
- Batch assay of bentazone removal & mineralization
- ^{14}C carbonyl-labeled bentazone in concentrations ranging from 0.2 to 2000 ug/L with and without methane (triplicates)
- Abiotic controls (autoclaved Filtralite)
- Methane analysis – GC-FID

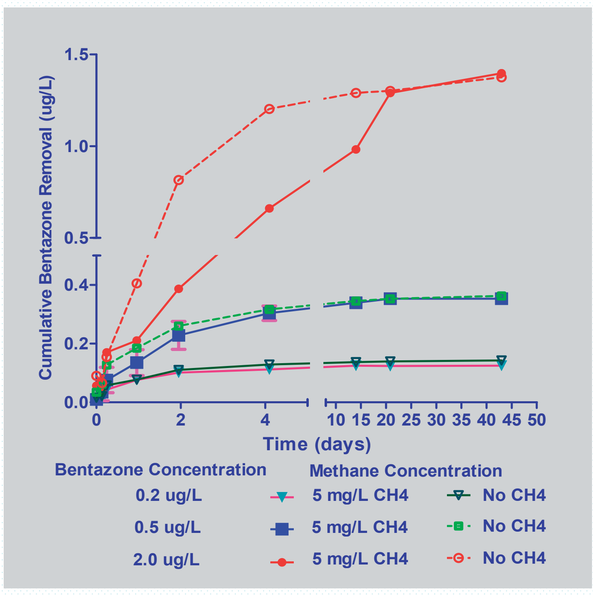


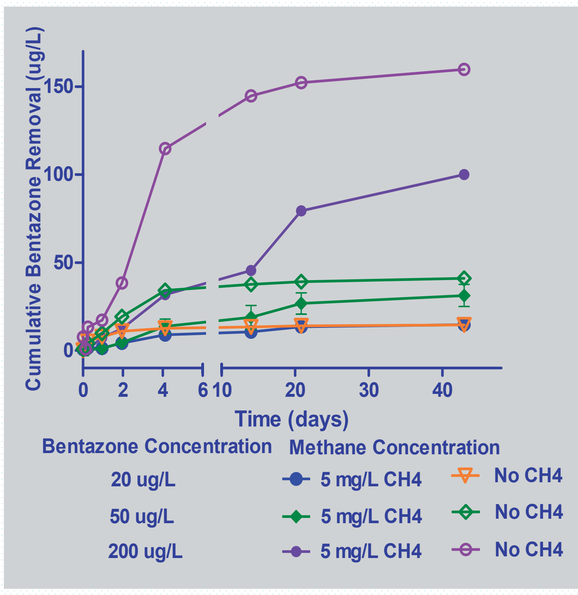
Bentazone Removal & Mineralization



- No effect of CH_4 in removal kinetics.
- Higher total mineralization in the absence of CH_4

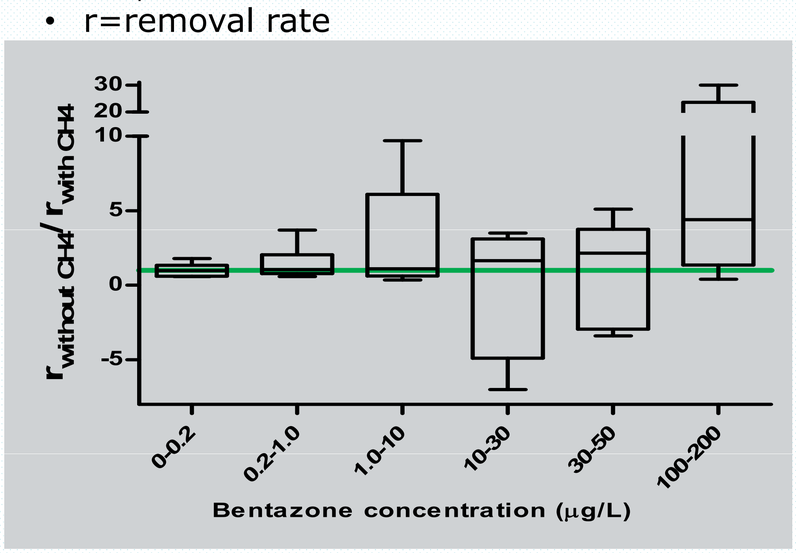
Concentration Effect



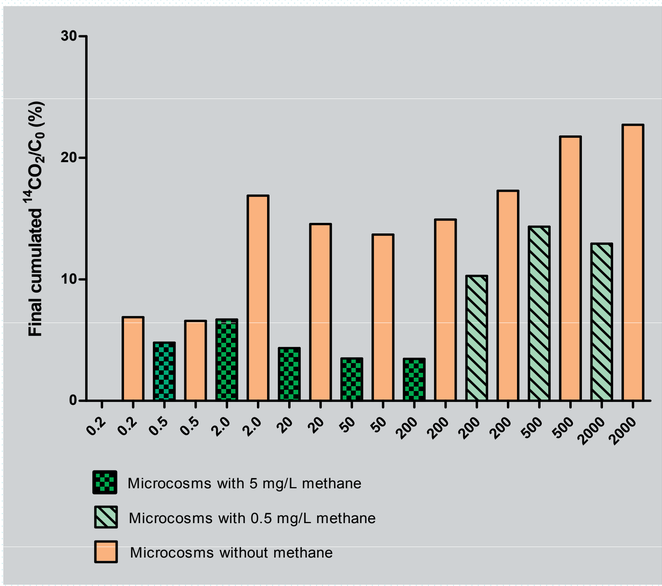


CH_4 effect – Enzyme competition

- CH_4 concentration maintained at 5 mg/L
- r=removal rate

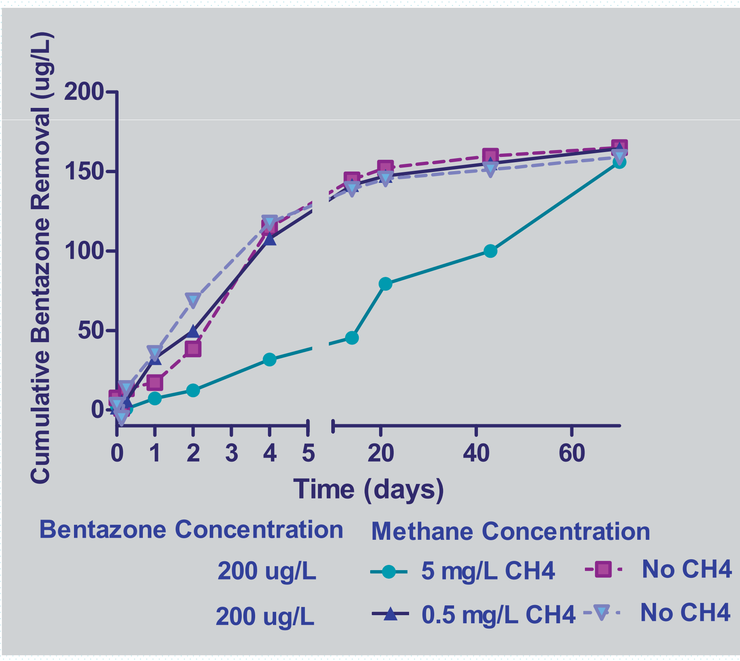


- At low bentazone concentrations, the effect of methane is not significant
- The higher the bentazone concentration, the higher the ratio of removal without CH_4/with CH_4



- Removal in all concentration ranges
- Slower removal rate in the presence of CH_4
- Delay observed at high CH_4 concentrations

- Effect of methane observed in high CH_4 (>0.5 mg/L) concentrations



Conclusions

- Microbial communtiy fed only with methane in drinking water for > 1 year shows efficient and stable bentazone degradation in all concentration ranges
- Two possible removal patterns: (a) not inhibited by methane at low bentazone concentrations, (b) methane-inhibited at high concentrations
- Not consistent pattern with the typical cometabolic process
- Methane's presence slows down bentazone degradation process unless present in low concentrations (<10 µg/L)
- Observed competitive inhibition between methane and bentazone