Unraveling the mechanisms of microbial reductive dechlorination of chlorinated ethenes under saline conditions

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Background

- Trichloroethylene (TCE) is a volatile organic compound that has been widely used in many industries as a solvent, specifically, for refrigerants and metal degreasers
- TCE is the most frequently detected volatile organic compound (VOC) in groundwater
- TCE can be biologically degraded via reductive dechlorination through cis-DCE, vinyl chloride, and ethene
- Only members of the genus *Dehalococcoides* (*Dhc*) and *Dehalogenimonas* (*Dhgm*) are known to completely dechlorinate PCE and TCE to environmentally benign ethene

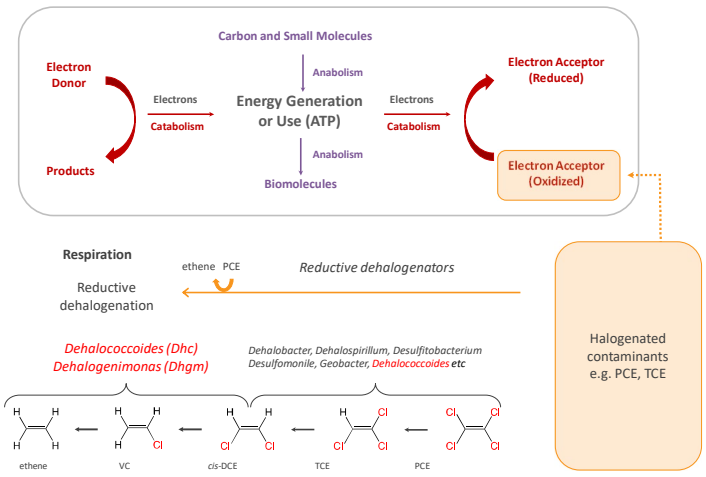
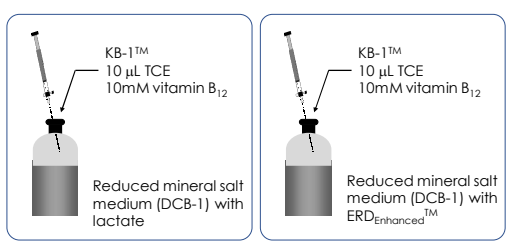


Figure 1. Conceptual model of reductive dehalogenation

- Experiments will be conducted using the *Dhc* consortium KB-1™
- First goal is to examine the effect of salinity on TCE degradation
- Second goal is to test the commercial biostimulate ERD$_{Enhanced}$™ to enhance the survival of *Dhc* in saline conditions

Materials and Methods



- All conditions were done in triplicates
- Salt concentrations were added after the media was prepared in the cases of 0.5%, 1%, 2% and 3% NaCl ERD$_{Enhanced}$™ using a 25% NaCl solution

Results

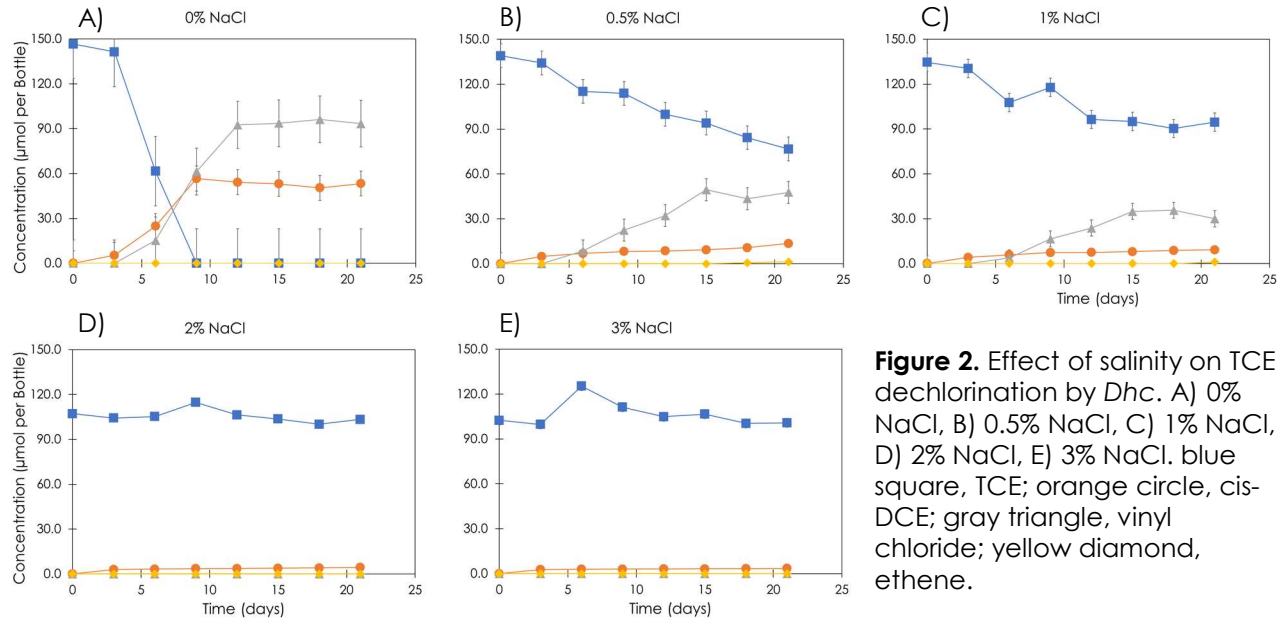


Figure 2. Effect of salinity on TCE dechlorination by *Dhc*. A) 0% NaCl, B) 0.5% NaCl, C) 1% NaCl, D) 2% NaCl, E) 3% NaCl. blue square, TCE; orange circle, cis-DCE; gray triangle, vinyl chloride; yellow diamond, ethene.

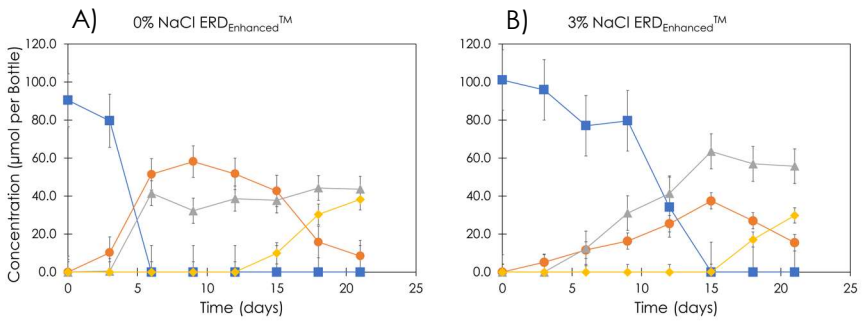


Figure 3. Effect of ERD$_{Enhanced}$™ on TCE dechlorination by *Dhc*. A) 0% NaCl ERD$_{Enhanced}$™, B) 3% NaCl ERD$_{Enhanced}$™. Blue square, TCE; orange circle, cis-DCE; gray triangle, vinyl chloride; yellow diamond, ethene.

Conclusions

- Degradation of TCE did not occur in saline concentrations above 2% NaCl
- ERD$_{Enhanced}$™ sped up the dechlorination process at 0% salinity and was able to produce ethene in the 3% salinity condition
- Two hypotheses are put forth by the authors which allow the degradation of chlorinated ethenes in high salinity concentrations: osmoprotectants or biofilm formation

Future Research

- Understanding the role of biofilm and what potential it could have regarding *Dhc*
- Investigating autoinducer-2 (AI-2) as the signaling molecule for biofilm formation
- Examining the effects of different concentrations of osmoprotectants and/or ERD$_{Enhanced}$™
- Examining the degradation of chlorinated ethenes from *in situ* aquifer samples

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