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Comparing Effects of Chemical Amendments on 1,4-Dioxane Biodegradation

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Background/Objectives. 1,4-Dioxane, a widely used stabilizer for chlorinated solvents, a probable human carcinogen, and part of the U.S. Environmental Protection Agency (U.S. EPA)'s Unregulated Contaminant Monitoring Rule (UCMR3), was detected in ~6.7% of the U.S. public water supplies at concentrations above the drinking water health advisory level of 0.35 µg/L, according to a recent survey. Microbial bioremediation shows promise in removing this emerging contaminant from the environment. Previous studies have shown that a variety of chemicals may induce microbial enzymes that mediate 1,4-dioxane degradation. However, it is not clear which chemical is the best inducer, resulting in the fastest removal of 1,4-dioxane. The objective of this research is to compare the effects of eight chemicals on the 1,4-dioxane-degrading capacity of a microbial consortium obtained from a biological reactor that was previously shown to efficiently degrade 1,4-dioxane. The eight chemicals are tetrahydrofuran (THF), phenol, butanone, acetone, 1-butanol, 2-butanol, acetate and ammonia.

Approach/Activities. Serum bottles containing 1,4-dioxane-contaminated water were inoculated with the 1,4-dioxane-degrading microbial consortium. 1,4-Dioxane and one of the eight chemical amendments were then added into each bottle. The concentrations of 1,4-dioxane, the chemical amendments, and the volatile suspended solids (VSS) were monitored during the experiment. Biomass was sampled every 10 days for microbial community analysis, and quantitative polymerase chain reaction (qPCR) was applied to quantify the number of functional gene copies involved in 1,4-dioxane degradation.

Results/Lessons Learned. The results showed that THF was the best enzyme inducer, meaning that the bottle amended with THF resulted in the fastest 1,4-dioxane removal. The number of *Rhodococcus* ruber significantly increased after 20 days in the bottles amended by THF in duplicate experiments. Two functional genes associated with 1,4-dioxane degradation increased by ~10^5 times after 20 days. Other strategies to enhance the biodegradation of 1,4-dioxane will be briefly discussed in the presentation.