# Cometabolic Treatment of Emerging Contaminants including 1,4-Dioxane, 1,2-Dibromoethane, and N-Nitrosodimethylamine

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**Background/Objectives.** Aerobic cometabolism is increasingly being applied for the remediation of a variety of different contaminants in groundwater, including 1,4-dioxane (1,4-D), 1,2-dibromoethane (EDB), and N-nitrosodimethylamine (NDMA), as well as many different chlorinated alkanes and alkenes. This approach typically entails injecting air (or oxygen) and one of several different gases (e.g., methane, propane, ethane, ethene) that serve as primary growth substrates. Specific groups of bacteria, usually with one or more broad-specificity oxygenase enzymes, utilize the substrates and cometabolically degrade the contaminants of concern. This process is particularly attractive at sites in which initial contaminant concentrations are low and/or where the production of secondary products from anaerobic treatment approaches (e.g., sulfide, methane, dissolved metals) is undesirable. This presentation will provide an overview of the fundamentals of cometabolic treatment and examples of both successful and unsuccessful applications of this technology for various emerging contaminants.

**Approach/Activities.** A variety of different laboratory and field studies were conducted to assess and optimize cometabolic treatment approaches for emerging contaminants. Laboratory studies included the assessment of optimal primary substrates for stimulating the degradation of EDB, NDMA, and 1,4-D as well as important factors influencing to the process. Data from these studies will be summarized. Field trials were conducted to demonstrate the overall effectiveness of cometabolism for treating all three of the aforementioned contaminants. These remedial approaches will be summarized, with a focus on both the benefits and limitations of cometabolism at field scale.

**Results/Lessons Learned.** In general, propane has proven to be highly effective a s a cometabolic substrate for enhancing remediation of 1,4-D, NDMA, and EDB, as well as several different chlorinated alkenes. Other primary substrates, such as methane, ethane, and ethene, also promoted degradation of select contaminants, but were not as widely effective. Factors that can influence cometabolic biodegradation of a contaminant include groundwater pH, presence of adequate macro- and micro-nutrients, and gas purity among others. The method of distributing a primary substrate (and nutrients where applicable) is critical to the success or failure of cometabolic treatment. Biosparging and groundwater recirculation with gas addition have proven successful for field implementation. Passive approaches to gas addition, while simpler than the aforementioned techniques, generally provide limited gas distribution and can result in poor overall treatment in the field. An overview of the different amendment application technologies and field results will be provided.