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Editorial

In 1987, Dunja Grbic-Galic and Timothy Vogel published a seminal article showing for the first time conclusively that toluene and benzene can be mineralized in anaerobic enrichment cultures (1). This observation was against the prevailing dogma, namely that aromatic hydrocarbons cannot be degraded in the absence of molecular oxygen. Therefore, this work was initially received with skepticism. Today, 13 years later, anaerobic mineralization of aliphatic and aromatic hydrocarbons has been widely accepted as an environmentally important process. Natural attenuation has been accepted as a remediation alternative at many fuel contaminated sites. Numerous metabolically and phylogenetically diverse microbes have been isolated in pure culture, and we are beginning to understand some biochemical and genetic mechanisms involved in anaerobic alkybenzene degradation. Specific metabolic markers and phylogenetic probes have been identified that can be employed in field applications to demonstrate conclusively the occurrence of *in situ* anaerobic mineralization of alkylbenzenes. The basic understanding of these microbial processes helped greatly in designing successful remediation and monitoring procedures for the *in situ* bioremediation of fuel-hydrocarbon anaerobic aquifers.

Yet, many aspects of anaerobic mineralization of fuel hydrocarbons and related compounds are still unsolved. The microbes and the molecular mechanism(s) of anaerobic mineralization of benzene, which is the most water-soluble aromatic component of fuel gasoline, awaits elucidation. Interesting hints are coming from studies on anaerobic naphthalene degradation. The biochemical mechanism(s) of anaerobic mineralization of long chain alkanes is unresolved at this time, but readily growing sulfate-reducing and denitrifying bacteria have been isolated. Anaerobic oxidation of methane has now been accepted to be an environmentally significant process, and potential members of a microbial community have been identified. Although much of the research on anaerobic hydrocarbon degradation has been motivated by environmental engineering objectives to restore the quality of gasoline-contaminated aquifers, the presence of fuel additives, which are also associated with gasoline contamination, has become of even more recent concern. Having recognized that the anti-knocking agent tetraethyl lead represents a significant source of lead in the environment, and mandated by the 1990 Amendment of the Clean Air Act, tetraethyl lead was banned. In an effort to further reduce air pollution, gasoline was then supplemented in many locations with an oxygenate, methyl *tert*-butyl ether (MTBE). Much research had focussed on the fate and chemistry of MTBE in air, however, investigations on its microbial and abiotic transformation in aqueous, e.g., subsurface, environments were incomplete. Because of its high water solubility, MTBE is now a dominant drinking water contaminant in gasoline-contaminated aquifers in the Western and Northeastern United States. Although MTBE degradation by aerobic microorganisms is now observed, its general recalcitrance under aerobic and anaerobic conditions was predictable. Because of the taste and odor threshold of MTBE and its potential carcinogenicity, this oxygenate is being eliminated from gasoline. In some locations it may be replaced by ethanol. Despite serious efforts to prevent gasoline spills and leaks of underground storage tanks, fuel gasoline will find its way into natural environments and into surface waters in the future. It remains to be seen (and to be tested) how the presence of a readily degradable compound (ethanol) in gasoline hydrocarbons will affect the pattern of *in situ* hydrocarbon utilization under both aerobic and anaerobic conditions.

The objective of this special issue is to provide the practicing environmental engineer as well as the microbiologist and environmental scientist with a comprehensive, useful collection of recent reviews and relevant articles on

'Anaerobic Degradation of Fuel Components'. Her untimely death in 1993 denied Dunja Grbic-Galic the opportunity to participate in the rapid and exciting development of this research field. I, thus, want to dedicate this special issue to her in memory of her special contributions to this topic.

Reference

Grbic-Galic D & Vogel TM (1987) Transformation of toluene and benzene by mixed methanogenic cultures. Appl. Environ. Microbiol. 53: 254–260

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Guest Editor