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Thermophilic Biodegradation of BTEX by Sulfate-Reducing Bacterial Consortia

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Two thermophilic anaerobic bacterial consortia ALK-1 and LLNL-1, capable of degrading aromatic fuel hydrocarbons - benzene, toluene, ethylbenzene, and the xylenes (BTEX compounds), were developed from the produced water of ARCO's Kuparuk oil field at Alaska and the subsurface water at the Lawrence Livermore National Laboratory gasoline-spill site, respectively. The thermophilic bacterial consortia have potential applications in the *in situ* bioremediation of the hydrocarbons in contaminant zones that have been subjected to a thermally enhanced vapor stripping process for a rapid clean-up of fuel spills. The use of injected anaerobic thermophiles would take advantage of the persistent elevated subsurface temperatures and the depleted oxygen levels, following steam heat treatment, to enhance the removal of low levels of residual BTEX. Both consortia were found to grow on BTEX compounds as sole carbon sources at 45-75°C with 50°C being the optimum. At 50°C and a total BTEX of 3.5 mg added to sealed 50-mL serum bottles, which contained 30 mL of mineral-salts medium and the consortium, benzene, toluene, ethylbenzene, *m*-xylene, and the unresolved mixture of *o*- and *p*-xylenes were biodegraded by 22, 38, 42, 40, and 38%, respectively, by ALK-1 after 14 days of incubation. The biodegradation extents of these BTEX compounds by LLNL-1 under the same conditions were slightly less than those achieved by ALK-1. The biodegradation of BTEX by both consortia was coupled to sulfate reduction as well as H_2S generation. None was observed when sulfate was omitted from the serum bottles. This suggests that sulfate-reducing bacteria are most likely responsible for the observed thermophilic biodegradation of BTEX in both consortial cultures.

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