Acclimation, Isolation, and Growth Conditions for Gasoline Oxygenate Degrading Culture

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ABSTRACT

The objectives of the research are to investigate the acclimation, isolation, and growth conditions for gasoline oxygenate degrading culture. Specially, the experiments are to study the biodegradation of MTBE and other organic contaminants in the environment. The MTBE degrading mixed culture was derived from an acclimated sludge, which was originally maintained on isopropanol and MTBE at equal amount, and finally shifted to on MTBE as the sole carbon source in an air-lift reactor. After yielding the MTBE degrading mixed culture, the experiments to study MTBE degradability in the presence of other substrates including BTEX, TAME, ETBE, Ethyl ether, and TBA were conducted in 250 ml amber glass bottles. The final stage of the research is to develop MTBE degrading pure cultures through isolating and screening procedures from the MTBE degrading mixed culture. In addition, the accumulation of reaction by-products and MTBE biodegradability by the isolated pure culture were examined. Results of batch substrate removal experiments shown that: (1) An aerobic mixed culture capable of degrading MTBE as a sole carbon and energy source was developed from an acclimated activated sludge, initially using isopropanol as a co-substrate. It was also found the solution pH in the air-lift reactor consistently decreased after five months acclimation; (2) MTBE with concentration of 7.2ppm was completely removed within two weeks, and there is no inhibition occurred for the initial MTBE concentration as high as 288ppm; (3) Biodegradation of the targeted compounds by the mixed culture in order of removal rate was: toluene, benzene, ethyl benzene, p-xylene, ethyl ether, MTBE, TAME, and ETBE; (4) Mixtures of MTBE and benzene, or toluene showed inhibited the removal of MTBE. It was not degraded for MTBE until benzene or toluene were degraded completely, and MTBE was degraded completely in the final; (5) Biodegradation experiments with mixtures of MTBE and TBA, TAME, or ETBE showed good removals; (6) The mixed cultures still can degrade MTBE after the incubation of benzene or toluene; (7) The MTBE biodegradation rate for a pure culture is higher than for a mixed culture, and the pure culture was shown to degrade up to 4.09mg MTBE within a 6-hour period, whereas TBA was formed as a transient metabolic intermediate during the breakdown of MTBE; (8) The maximum specific growth rate and the saturation constant are 0.000778hr-1 and 0.029mg/L at MTBE concentration of 30mg/L. However, high MTBE concentration (60 mg/L) was slightly inhibitory to growth of the mixed culture.

Keywords : MTBE ; acclimation ; air-lift reactor ; batch biodegradation ; screening

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