Microbial Community Dynamics in a Permeable Reactive Barrier using Real-time PCR Technique

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ABSTRACT
This study was conducted with the application of denaturing gradient gel electrophoresis (DGGE), and real-time quantitative polymerase chain reaction (real-time PCR) molecular biotechnology for monitoring the permeable reactive barrier (PRB) in the relation with BTEX decomposition efficiency and the distribution of microbial community. Various amounts of nitrogen nutrients and BTEX were added to examine the treatment efficiencies. It was shown that the high sodium nitrate amount had improved the BTEX removal, which was an evidence of effects on BTEX treatment. The results of benzene and toluene removal efficiencies revealed that it was completely degraded for both two compounds at the concentrations of 20, 40 and 80 ppm. Increasing the concentrations of these two compounds to 120, 160, 240 and 320 ppm resulted in the decreasing in treatment efficiencies, and the concentrations remained 40, 60, 65, 90 and 100 % for benzene, and 10, 40, 55, 90 % for Toluene, respectively. Furthermore, the microbial variations at various concentrations were consistent via optical density (OD), DGGE analysis and real-time PCR results. Each column test was conducted for 20 days to investigate the effectiveness of oxygen releasing compound (ORC). It was indicated that the highest dissolved oxygen was achieved, which was 5.08 mg/L (equal to 0.25 mg O2/day/g-ORC).

The results of long-term stability tests of oxygen releasing from PRB system showed that: (1) Oxygen released from ORC was sufficient for the demand of bacteria. (2) In shock-loading of BTEX tests, the removal efficiencies were reduced by 21%, 19%, 17% and 10 % for benzene, toluene, ethylbenzene and xylene, respectively. (3) Removal efficiencies were then recovered in the ascending order of as follow: xylene> ethylbenzene> benzene> toluene. (4) ORC can be used for 40 days. (5) DGGE analysis showed the changing in the microbial community structure before (13 groups) and after shock-loading (reduced to 9 groups), that implied the shock-loading was harmful to bacteria. (6) The results from real-time PCR in the study of catechol 2,3-dioxygenase gene revealed that the quantification of this gene has been declined after shock-loading, but it was latter well again at the 79th day.

Keywords : denaturing gradient gel electrophoresis、real-time PCR、permeable reactive barrier、bioremediation
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