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BIOREMEDIATION OF AQUIFERS POLLUTED BY CHLORINATED ALIPHATIC HYDROCARBONS: SELECTION AND CHARACTERIZATION OF AN INDIGENOUS MICROBIAL CONSORTIUM FOR A PACKED BED REACTOR *ON-SITE* PROCESS

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Abstract

The aim of this work was to develop a high-performing microbial consortium capable to degrade trichloroethylene (TCE) and 1,1,2,2-tetrachloroethane (TeCA) via aerobic co-metabolism in packed bed reactors (PBRs).
To this goal, five groundwaters were sampled from different monitoring wells in an aquifer contaminated by TCE and TeCA, and 25 119-mL batch tests were set up to test five different growth substrates: methane, propane, butane, pentane and phenol. Substrate and oxygen were periodically re-added. TCE and TeCA were spiked at increasing concentrations in order to select microorganisms able to rapidly degrade TCE and TeCA. Preliminary DGGE analysis showed appreciable differences in the microbial populations enriched.
Butane was identified as the best-performing growth substrate, and a high-performing butane-growing consortium (B4) was selected for the subsequent continuous-flow tests. The selection was made on the basis of the substrate, TCE and TeCA specific biodegradation rates. Consortium B4 showed a specific rate of 129 $L/g_{protein}/day$ for TCE and 2.6 $L/g_{protein}/day$ for TeCA. The first value is comparable to the rates attainable in active carbons adsorption processes, with the great advantage of the total mineralization of the chlorinated hydrocarbons. The highest co-metabolized concentrations were 10 mg/L for TCE and 3 mg/L for TeCA. Specific tests aimed at developing and calibrating a kinetic model of substrate consumption and TCE/TeCA degradation are in progress.
Attached-cell preliminary tests showed the ability of consortium B4 to form a stable biofilm on porous carriers. The attached biomass was able to utilize butane as carbon source and to biodegrade TCE and TeCA.
In order to select the most suitable biofilm carrier for TCE/TeCA aerobic cometabolism by B4 in a PBR, 4 1-L glass columns were filled with 4 types of porous biofilm carriers. Fluid dynamics tests were performed with oxygen, TCE and TeCA in order to estimate the longitudinal dispersivity, the effective porosity and the TCE/TeCA retardation factor of each tested carrier. Four liters of a suspension of consortium B4 were produced in a fermentor in order to colonize the 4 glass columns. Continuous-flow tests of TCE and TeCA cometabolism by biofilms of consortium B4 are in progress, and will be utilized to select the best-performing carrier.

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