Geophysical Research Abstracts
Vol. 19, EGU2017-2814, 2017
EGU General Assembly 2017

Degradation of perchloroethene by combined application of microorganisms and zero valent iron particles

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Chlorinated hydrocarbons (CHCs) are especially toxic pollutants which are frequently found at contaminated sites in urban areas which are densely covered with buildings. In specific in such areas, in-situ technologies are favourable since conventional remediation technologies as excavation are often not applicable. This project examines a combination of two in-situ remediation methods, in which the biotic degradation via bacteria (dehalococcoides) is combined with abiotic degradation by zero-valent iron particles (ZVI). ZVI particles are injected into the aquifer where CHC-molecules are reductively dechlorinated. However Fe(0) is also oxidized by reaction with water leading to generation of H_2 without any CHC degradation. To achieve biotic degradation often strictly anaerobic strains of the bacteria Dehalococcoides are used. These bacteria can dechlorinate CHC by utilizing H_2. By combining these processes the H_2, produced during the anaerobic corrosion of Fe(0), could be used by bacteria for further CHC degradation.

Different Fe(0) particles (nano- and micro-scale) were combined with microbial dehalogenation for dehalogenation of perchloroethene (PCE) in batch experiments. PCE degradation rates and H_2 production rates of the different particles and cultures were determined. Additionally an artificial aquifer (approximately 1.0 x 0.5 x 0.5 metres) was established. This aquifer was spiked with PCE and subsequently treated with Fe(0) particles and microbial. Molasses was added to facilitate microbial dehalogenation.

Preliminary results showed that all H_2 evolved during oxidation of Fe(0) were used by the associated microbial community. Nevertheless the overall dehalogenation of chlorinated compounds as well as the production of methane was hardly influenced by the addition of Fe(0), at least not over the experimental period of 28 days. Independent if Fe(0) was added or not all chlorinated compounds were dehalogenated whereby ethene and ethane were the only end products.