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H_2 Gas Charging of Zero-Valent Iron and TCE Degradation

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ABSTRACT

Granular zero-valent iron (ZVI) has been widely used to construct permeable reactive barriers (PRB) for the *in situ* remediation of groundwater contaminated with halogenated hydrocarbons. In the anaerobic condition of most groundwater flow systems, iron undergoes corrosion by water and results in hydrogen gas generation. Several studies have shown that some of the hydrogen gas generated at the iron/water interface can diffuse into the iron lattice. Hydrogen gas also can be an electron donor for dechlorination of chlorinated compounds. In this study, the possibility of hydrogen gas bound in the lattice of ZVI playing a role in dehalogenation and improving the degradation efficiency of ZVI was evaluated. Two different granular irons were tested: one obtained from Quebec Metal Powders Ltd (QMP) and the other from Connelly-GPM. Ltd. For each type of iron, two samples were mixed with water and sealed in testing cells. Since the rate of hydrogen entry varies directly with the square root of the hydrogen pressure, one sample was maintained for several weeks under near-vacuum conditions to minimize the amount of hydrogen entering the iron lattice. The other sample was maintained for the same period at a hydrogen pressure of over 400 kPa to maximize the amount of hydrogen entering the iron lattice. The degradation abilities of the reacted ironsand the original iron materials were tested by running several sets of batch tests. The results of this study show little to no improvement of inorganic TCE degradation reactions due to the presence of lattice-stored hydrogen in iron material. This is probably due to the high energiesrequired to release hydrogen trapped in the iron lattice. However, there are certain chemical compounds that can promote hydrogen release from the iron lattice, and there may be bacteria that can utilize lattice-bound hydrogen to carry out dechlorination reactions.

KEYWORDS

Granular Zero-Valent Iron; Hydrogen; TCE Remediation; Groundwater

Cite this paper

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