Zero valent iron reduces toxicity and concentrations of organophosphate pesticides in contaminated groundwater - DTU Orbit (15/04/2019)

Zero valent iron reduces toxicity and concentrations of organophosphate pesticides in contaminated groundwater

The potential of zero valent iron (ZVI) for remediation of contaminated groundwater from an abandoned chemical disposal site was examined through batch and column experiments. The key contaminants were organophosphate pesticides but the chemical analysis also comprised additional 22 compounds including synthesis intermediates and degradation products of organophosphates. The ZVI treatment showed that all the contaminants were degraded with the exception of two diesters (phosphorothioates). The most rapid reduction was found for methyl parathion, ethyl parathion and malathion, which had first-order degradation rate constants on the order of 10−3 min−1. In the study, acute toxicity towards freshwater crustaceans (Daphnia magna) was included to evaluate the overall efficiency of ZVI treatment of the complex mixture. The acute toxicity tests with D. magna showed that the untreated groundwater was highly toxic. Thus, 50% of the daphnids were unable to swim upon 24h exposure to groundwater diluted 770 times. ZVI facilitated degradation resulted in a complete toxicity removal for the first four pore volumes, where after a three times dilution caused 50% inhibition of the mobility of the daphnids. The rapid degradation of the highly toxic organophosphates combined with the significant decrease in the ecotoxicological potential shows a promising potential for site remediation of organophosphates with ZVI technologies.

General information
Publication status: Published
Organisations: Water Resources Engineering, Department of Environmental Engineering, Environmental Chemistry, Residual Resource Engineering, Technical University of Denmark
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Pages: 627-633
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Chemosphere
Volume: 90
Issue number: 2
ISSN (Print): 0045-6535
Ratings:
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.92 SJR 1.721 SNIP 1.751
Web of Science (2013): Impact factor 3.499
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Original language: English
Keywords: Zero valent iron (ZVI), Organophosphate insecticides, Complex mixture, Groundwater remediation, Toxicity
DOIs:
10.1016/j.chemosphere.2012.08.058
Source: dtu
Source-ID: n:oai:DTIC-ART:elsevier/374350317::21697
Research output: Contribution to journal › Journal article – Annual report year: 2013 › Research › peer-review