



Comparison of four oxidation processes for the treatment of water contaminated with a mixture of chlorinated volatile organic compounds

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Chlorinated volatile organic compounds are some of the most prevalent contaminants in groundwater. In situ chemical oxidation (ISCO) is a frequently used remediation approach for the destruction of these compounds (Huling and Pivetz, 2006). In this work, a laboratory comparative study was performed to evaluate the feasibility of four chemical oxidation processes to remediate water polluted with a mixture of chlorinated solvents. The study site is a fractured rock aquifer contaminated by halogenated organic compounds (Palau, 2007). Two trenches were installed at the non saturated zone near the main contaminant release sources to intercept the contaminated recharge water before reaching the aquifer. The alkaline water of the trenches is periodically removed and the waters collected so far have had to be treated by incineration, with a high cost. Solutions are required for the remediation of these waters in order to achieve economic and energy savings.

Batch experiments were performed to evaluate the feasibility of chemical oxidation of chlorinated ethenes (c-DCE, TCE and PCE) and chlorinated methanes (CT and CF) present in the alkaline water collected from the trenches by permanganate, persulfate, hydrogen peroxide and Fenton. Different oxidant concentrations were considered and the most appropriate treatment for the contaminated water was selected taking into account the efficiency in contaminant removal, the final toxicity and AOX (absorbable organic halogens) values and the applicability of the carbon isotopic fractionation as an indicator of the effectiveness of the remediation.

The best results in terms of toxicity and AOX decrease were accomplished with permanganate. This treatment was more effective for the chlorinated ethenes than for the chlorinated methanes. With persulfate, unlike permanganate, all the contaminants were degraded, including chlorinated methanes. However, final toxicity values were higher than with permanganate. Fenton treatments, although did not increase the toxicity of the water, failed to sufficiently decrease the AOX until values low enough to manage the water in a treatment plant. Carbon isotopic fractionation, ϵ , during TCE and PCE oxidation by persulfate and Fenton ranged from -3.5‰ to -4.2‰ and from -2.8‰ to -5.4‰ respectively. Permanganate oxidation of TCE resulted in a significant isotopic fractionation ($\epsilon = -35.6 \pm 10.5\%$ 95% CI). This significant carbon isotopic fractionation implies a great potential for the use of $\delta^{13}\text{C}$ in monitoring in situ the efficiency of remediation technologies.

References:

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Palau, J. (2008) *Aplicación de la composición isotópica del carbono de compuestos orgánicos volátiles en acuíferos contaminados por disolventes clorados*. PhD Thesis, Universitat de Barcelona, Facultat de Geologia. Dept. de Cristal·lografia, Mineralogia i Dipòsits Minerals, 243 pp.