

Biodegradation of Chlorinated Ethenes

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Chlorinated ethenes, such as tetrachloroethene (PCE) and trichloroethene (TCE), have been widely used as solvents for dry cleaning and degreasing and many other applications. Extensive use and inadequate disposal of chlorinated ethenes have led to prevalent groundwater contamination worldwide, especially in industrially developed countries, like Japan. The occurrence of the lesser chlorinated ethenes, such as cis-1,2-dichloroethene (cis-DCE) and vinyl chloride (VC) in groundwater is primarily a consequence of incomplete anaerobic reductive dechlorination of PCE and/or TCE.

VC is more toxic and is known to be a human carcinogen. It has recently been specified as a new substance for regulation by the Soil Contamination Countermeasures Act in Japan.

To obtain the information that facilitates better understanding of the origin and prediction of the fate of VC at contaminated sites, this presentation summarizes the biodegradation mechanisms, potential biodegradation pathways, degrading microorganisms, and biological degradation rates under natural and enhanced conditions based on extensive literature survey. In addition, theoretical solutions for analyzing up to four steps consecutive reactions are derived. The solutions can be used to simulate complete anaerobic biodegradation of PCE to non-toxic ethene (ETH) through TCE, cis-DCE and VC.

Keywords: Biodegradation, Chlorinated ethenes, Biodegradation pathway, Degradation rate