ORC TECHNICAL BULLETIN #2.2.2.4

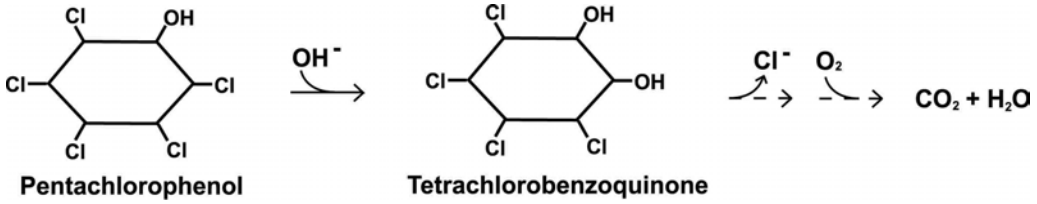
Oxygen Release Compound, ORC®

Remediation of Pentachlorophenol (PCP)

Pentachlorophenol (PCP) is a biocide used widely in the wood preservation industry. Laboratory results have successfully demonstrated bioremediation in soils and groundwater contaminated with pentachlorophenol. In fact, bioremediation has been recommended for implementation at numerous abandoned wood treatment sites (Dasappa, S.M. and R.C. Loehr, 1991). Oxygen Release Compound (ORC®) has been demonstrated to stimulate the rate of pentachlorophenol degradation and offers a unique alternative for PCP remediation.

Biodegradation of Pentachlorophenol

PCP degradation proceeds via a complex series of biochemical reactions beginning with an aerobic step that results in the formation of tetrachlorobenzoquinone (Spain, 1997). Subsequent dechlorination steps yield intermediate compounds susceptible to aerobic ring cleavage. The oxidative sequence ultimately ends in the formation of carbon dioxide.



Laboratory results indicate that PCP degradation occurs rapidly under aerobic conditions with half lives ($T_{1/2}$) less than 48 hours. (Maritinson et.al., 1984). Furthermore, field demonstrations in certain contaminated soils show half lives less than 15 days (Crawford and Hohn, 1985).

Pentachlorophenol Treatment with ORC

ORC provides a slow, steady supply of oxygen that can stimulate the aerobic degradation of pentachlorophenol. Results from a field study at a Region 9 USEPA wood treatment site show that soils amended with ORC achieved a PCP biodegradation half life ($T_{1/2}$) of 37 days compared to the aerobic control (contaminated soils not treated with ORC but exposed to air) which showed a PCP degradation half life of 210 days (Vernalia, et.al., 1997).

A pilot study in which ORC filter socks are being used to enhance the remediation of PCP-contaminated groundwater has produced promising results. The following data were collected after 2.5 months of treatment with ORC.

Well No.	Distance Downgradient	Initial Concentration (ppb)	Concentration after 2.5 Months (ppb)
1	30	400	7
2	5	7	0.3
3	30	54	1.7
4	30	16	1.2

Full scale implementation of enhanced in situ bioremediation with ORC is currently under consideration at several wood treatment facilities with PCP contaminated soils and groundwater. ORC presents a passive, cost effective approach to the remediation of PCP, without the costs associated with highly engineered systems.

ORC Installation Design Parameters

The theoretical mass ratio of oxygen to PCP required for the aerobic degradation of the contaminant is 0.54 to 1.0. Thus, 0.54 pounds of oxygen are required to degrade one pound of PCP.

The sorption coefficient (K_{oc}) for pentachlorophenol is 5.30E+4 ml/g, suggesting that the compound has a stronger tendency to sorb to the aquifer matrix relative to petroleum hydrocarbons (e.g., benzene K_{oc} = 8.30E+01 ml/g). Therefore, when designing groundwater treatment systems employing ORC it is recommended that the aquifer matrix is sampled for PCP concentration. Such considerations will allow for more accurate indications of the oxygen demand imparted by the sorbed fraction of contamination.

References

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