ORC TECHNICAL BULLETIN #2.2.2.1

Oxygen Release Compound, ORC®

Uses in Chlorinated Co-Metabolism

One of the most promising applications for ORC is in the support of various co-metabolic processes In co-metabolism, certain enzymes produced and exuded by microorganisms, degrade chlorinated hydrocarbons. Unfortunately, some of the chlorinated hydrocarbon degradation products, such as epoxides, are toxic to the microorganisms and they must be constantly "stoked" with substrates to maintain co-metabolic activity.

Step 1.

MMO (enzyme)

Methane ----------> Methanol CH_3OH ----------> CO_2

Oxygen, NADH

Step 2.

MMO (enzyme)

TCE ----------> Ep**ox**ide (toxic to MMO bacteria) ----------> CO_2

Oxygen, NADH

Oxygen is Required in the Degradation of Methane to CO_2 (Step 1), a reaction mediated by the enzyme Methane Monooxygenase (MMO). This same enzyme can also independently degrade chlorinated hydrocarbons in a process that also requires oxygen (Step 2). The aerobic degradation of phenol and toluene also produces enzymes (toluene mono and dioxygenase) which independently degrade chlorinated hydrocarbons.

Recent advances in microbial selection and strain development have opened up the possibilities for bioremediation via these more rapid and efficient co-metabolic processes. Among these are the development of microorganisms that elicit the degratory enzymes more easily and in greater quantity. Also, more importantly, there is promise that epoxide resistant forms may be able to thrive rather than succumb in the presence of these toxic by-products.

Co-metabolism may be the reason reductions in PCE and TCE were observed with ORC in laboratory experiments carried out by Retec. The objective of the experiment was to see if ORC could inhibit vinyl chloride formation. *In the course of this study the levels of TCE and PCE introduced into the culture environment were both reduced by two thirds in two months - relative to the control.* Furthermore, the authors of the study did not rule out *direct chemical oxidation* as a full or partial mechanism for the observed results.

In addition to the use of ORC in chlorinated co-metabolism, ORC can be used in the oxygen-dependent steps in the dual phase remediation of chlorinated hydrocarbons. This is discussed in detail in technical bulletin 2.2.2.2.

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