PRACTICAL DESIGN CONSIDERATIONS FOR BIOREMEDIATION OF 1,1,1 TCA

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Bioremediation of 1,1,1 TCA (TCA) is significantly more challenging than bioremediation of tetrachloroethene (PCE) and trichloroethene (TCE) series compounds. Work has been conducted by us and others to indicate that dehalobacter species are required to conduct the dechlorination. Our experience over the past eleven years, at over 20 enhanced bioremediation TCA impacted sites indicates that TCA degradation will generally occur after PCE and TCE series compound degradation has generally been completed (or mostly completed). One can generally dechlorinate PCE and TCE with almost any electron donor (lactate, molasses, vegetable oil etc.), but our work has clearly indicated there is a *real* electron donor preference with TCA degradation. In many instances, these same electron donors will work for TCA dechlorination, however we have observed several project sites where whey is the only electron donor that will stimulate TCA dechlorination. These have tended to be mixed solvent and high TCA concentration sites. We have speculated that whey contains vitamin B12 and magnesium, both cofactors that we have observed to speed up dechlorination in our laboratory studies with other electron donors (such as lactate). The breakdown of whey (which contains proteins and other complex compounds) also generates more electrons (generating more reducing conditions) than the break down of simple organic acids such as lactate which may be a critical factor.

On the bright side, TCA is much more unstable that PCE and TCE and will often abiotically break down to 1,1 dichloroethene (1,1 DCE; which is more easily biodegradable to vinyl chloride) under reducing conditions.

Our experience also indicates that TCA degradation is very concentration sensitive with inhibition starting as low as 35-70 mg/L. It is possible that the high TCA concentration inhibition of methanogens is largely responsible for this observation. A strategy that we have employed for high TCA concentration sites has been enhance abiotic dechlorination until the concentration drops below 70 ppm and/or to employ groundwater mixing/pretreatment to bring the TCA into the biodegradable range. This approach often requires an interim above ground treatment process, and we have had great success using a submerged, fixed-film bioreactor with activated carbon as media to decrease VOC concentrations and provide a continuous inoculation during bioenhancement. Our NJ-14 bioaugmentation mixed culture, which contains TCA degraders, has been used at most of our sites and is a key component to our success with TCA dechlorination.

A compilation of our laboratory and field experience with TCA dechlorination will be presented in the paper.