HRC TECHNICAL BULLETIN # 1.1.3

Hydrogen Release Compound HRC®

Using Organic Substrates to Promote Biological Reductive Dechlorination of CAHs

The use of organic substrates has been proven to enhance the bioremediation of Chlorinated Aliphatic Hydrocarbons (CAHs). The effect of the addition of organic acids and alcohols on the reductive dechlorination of tetrachloroethylene (PCE) is described by Gibson and Sewell (1). In this process, the acids and alcohols are metabolized by one group of organisms to yield hydrogen which in turn is used by another group of organisms to effect reductive dechlorination.

HRC, once deposited into the subsurface, slowly releases lactic acid. The resulting lactic acid acts as a nutrient source for anaerobic bacteria which metabolize the lactic acid as illustrated in Figure 1.

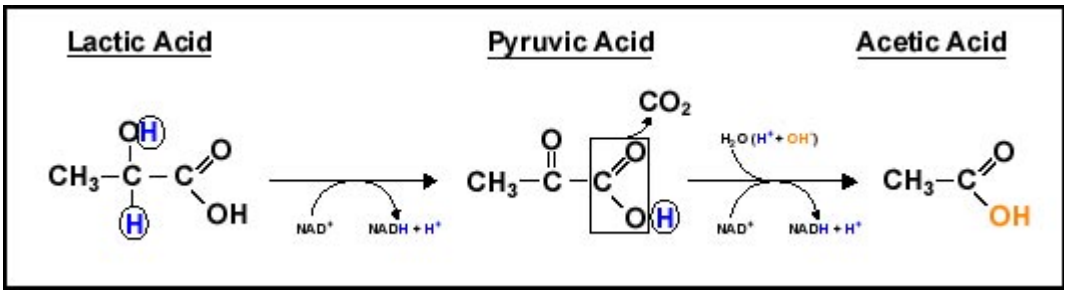

Figure 1

During the process, in which hydrogen atoms are taken up by NAD^+ to form NADH , lactic acid is first degraded to pyruvic acid, which is in turn degraded to acetic acid. The driving force for fermentation of lactic acid to acetic acid is the generation of ATP during glycolysis. To make this possible, the microbe must first regenerate NAD^+ by releasing the hydrogen from NADH. This is facilitated through the use of an enzyme called hydrogenase via the following reaction:

$$NADH + H^+ \xrightarrow[\text{Hydrogenase}]{} NAD^+ + H_2$$

Typically, in the conversion of lactic acid to acetic acid by acetogens, one mole of lactic acid produces two moles of hydrogen as H_2. The hydrogen is then available for conversion of CAHs to dechlorinated aliphatic hydrocarbons (see TB 1.1.2).

References:

1. Gibson, S.A. and G.W. Sewell. April 1992. Applied and Environmental Microbiology. 58(4): 1392-1393.

HRC Technical Bulletin Index||HRC Homepage