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). Gibson and Sewell (1) describe the effect upon the reductive dechlorination of tetrachloroethylene (PCE) when organic acids and alcohols are present. In this scenario, the acids and alcohols are metabolized by one group of organisms, yielding hydrogen, which is in turn used by another group of organisms which cause reductive dechlorination.

Once deposited into the subsurface, HRC slowly releases lactic acid which is metabolized by anaerobic bacteria as illustrated in Figure 1.

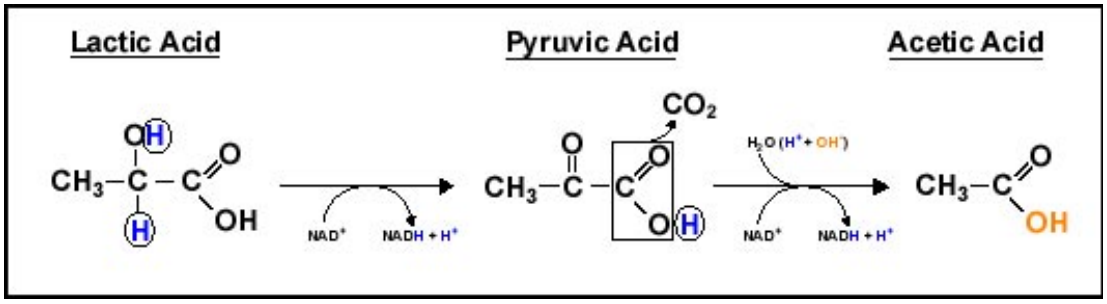

Figure 1

In the above process, lactic acid is first degraded into pyruvic acid, which is further degraded into acetic acid. The driving force for this fermentation reaction is the generation of ATP during glycolysis. Throughout this process, hydrogen atoms are taken up by the coenzyme NAD+ to form NADH. To further the reaction, the microbe must first regenerate NAD+ by releasing the hydrogen from NADH which is facilitated using an enzyme call 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 the 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.