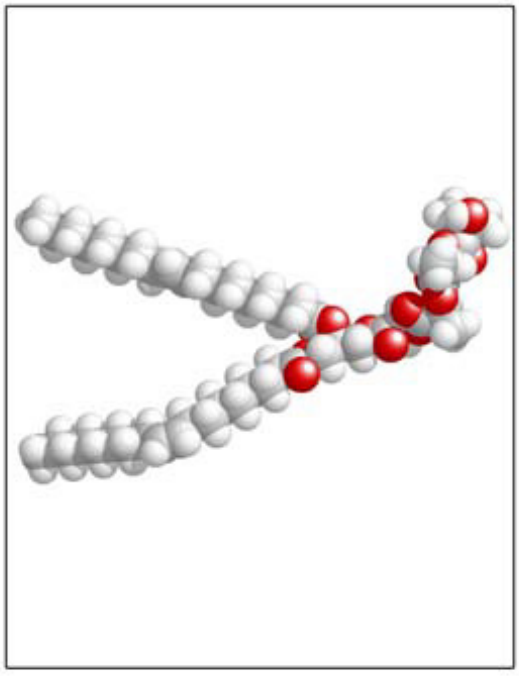
Introduction

3-D Microemulsion (3DMe)®, a form of HRC Advanced®, is the new paradigm in time-release electron donors for groundwater and soil remediation. 3DMe is based upon a new molecular structure (patent applied for) designed specifically to optimize anaerobic degradation of contaminants in subsurface environments and incorporates esterified lactic acid (technology used in HRC) and esterified long-chain fatty acids. The advantage of this structure is that it allows for the controlled release of lactic acid (which is among the most efficient electron donors) and the controlled release of fatty acids (a very cost-effective source of slow-release hydrogen). Upon injection, the controlled release of lactic acid is predominant, initiating and stimulating anaerobic dechlorination. Over time, the controlled release of fatty acids prevails, continuing microbial stimulation. The expected longevity of a single-injection application of the product is 1-2 years and may be in excess of 4 years under optimal conditions (e.g. in low-permeability, low-consumptive environments.)

3DMe is a slightly viscous liquid with a molecular structure composed of tetramers of lactic acid (polylactate) and fatty acids esterified to a molecule of glycerin which acts as a carbon backbone.



The image to the left illustrates a space-filling model of the glycerol ester in 3DMe. Oxygen atoms are shown in red, carbon atoms in grey, and hydrogen atoms in white. The long chains represent the fatty acid components of the molecule.

When 3DMe is placed in water, free lactic acid immediately begins to ferment which initiates reductive dechlorination to treat contaminants. Over time, the ester bonds will cleave, releasing dissolved-phase lactic acid and fatty acids. Thus, 3DMe provides the benefits of lactic acid, a rapidly fermented substrate and excellent hydrogen source, as well as fatty acids, which are slower to ferment, providing hydrogen to a contaminated site over an extended period of time. This combination of lactic acid and fatty acids provides a functional longevity of 1-2 years for most sites (>4 years under optimal conditions). 3DMe creates an anaerobic system in a redox range where bacteria known to be responsible for reductive dechlorination flourish. Maintaining these conditions ensures efficient utilization of the electron donor for reductive dechlorination, rather than simply providing excess carbon per unit time which can result in excess methane production, as simple soluble substrates often do.

3DMe Attributes

- Incorporates proven Hydrogen Release Compound (HRC®) base materials
- Provides a persistent and significant source of hydrogen
- Typical single-injection longevity of 1-2 years and over 4 years under optimal conditions
- Achieves wide subsurface distribution when applied as microemulsion
- Easily applied with readily-available direct injection equipment

Molecular Diagram

The following chemical structure shows the glycerol ester (patent applied for). The top “prong” is the tetramer of polylactate (look for 4 double-bonded O atoms). The middle and bottom “prongs” are fatty acids.