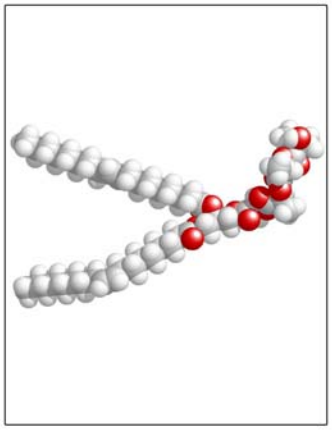
3-D Microemulsion (3DMe)™

TECHNICAL BULLETIN 1.0

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. This structure 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 dominates serving to initiate and stimulate anaerobic dechlorination. Over time the controlled-release of fatty acids will dominate, acting to continue microbial stimulation. The expected single-injection longevity of this product is 1-2 years and in excess of 4 years under optimal conditions, e.g. concentrated application in low permeability, low consumptive environments.

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



The image to the left illustrates a ball-and-stick version 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.

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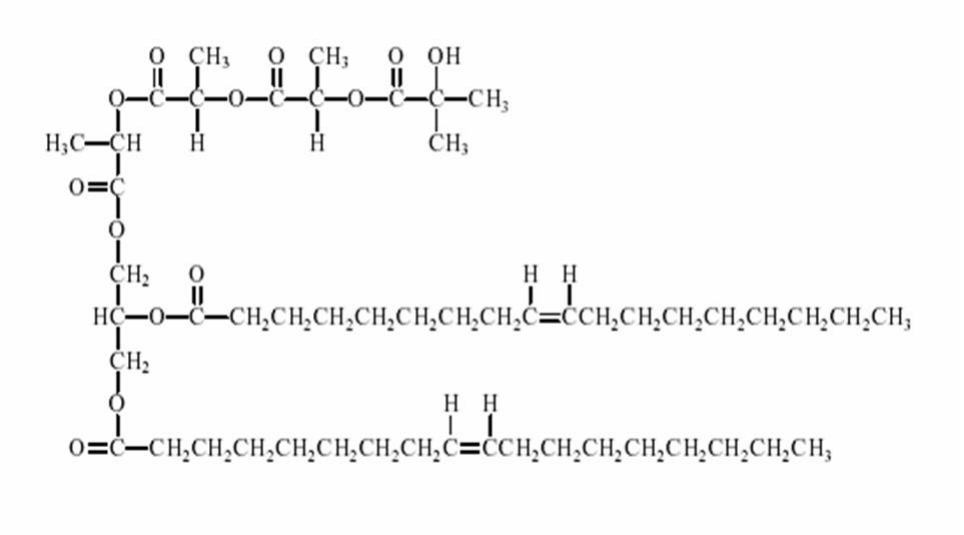
When 3DMe is placed in water, free lactic acid immediately begins to ferment which initiates reductive dechlorination and subsequent contaminant treatment. Over time the ester bonds begin to cleave, producing dissolved-phase lactic acid and fatty acids. 3DMe also contains free fatty acids for additional electron donating capacity. 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 and provide hydrogen to a contaminated site over extended time periods. 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 provides maximum 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
- Achieve 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.



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