

## **Side-by-Side Comparison of Whey and Ethyl Lactate Substrates for Reductive Dechlorination**

**Michael R. Sieczkowski** (msieczkowski@jrwbioem.com)

Donovan Smith, P.E. (dsmith@jrwbioem.com)

(JRW Bioremediation, L.L.C., Lenexa, Kansas, USA)

Peter Guerra (peter.guerra@amec.com) (AMEC Earth & Environmental,  
Albuquerque, New Mexico, USA)

Jack Sheldon (jack.sheldon@amec.com) (AMEC Earth & Environmental,  
West Des Moines, Iowa, USA)

The successful use of purpose-designed high-cost carbon substrates over the past ten years for the reductive dechlorination of chlorinated solvents has led to the evaluation of lower cost common commodity chemicals for remedial purposes. As part of a larger field evaluation, two of these more common substrates were evaluated in the summer of 2007 in a side-by-side in situ pilot test at a site in New Mexico. Each pilot test cell included an injection well and a recovery well about 20 feet down gradient. The substrates evaluated were whey powder in the form of WilkeWhey™ and ethyl lactate in the form of SoluLac™. Both substrates were amended with a nutrient supplement in the form of Accelerite™ in order to accelerate the metabolic processes.

Ethyl lactate (lactic acid ethyl ester) is a highly soluble colorless liquid containing over 90% organic matter with a specific gravity of 1.03 and a flash point of 53° F. It is routinely used in the food and pharmaceutical industry and is readily biodegradable but has not been widely used in the chlorinated solvent remediation industry due to its relatively low flash point and corresponding health and safety considerations. The specific substrate used for this pilot test was selected due to its' lactate content and high purity. Whey powder has been used as a carbon substrate for a number of years but has not gained popularity due to the need to mix the powder with water and its' short "shelf life". Whey powder does present several benefits such as high lactate, protein, and vitamin content, and its' ability to be mixed in a wide variety of concentrations. The whey substrate used for this pilot test was in powder form and required on-site mixing with water prior to injection.

The pilot tests were conducted at a site contaminated with tetrachloroethene (PCE) and its daughter products including trichloroethene (TCE) and cis-1,2-dichloroethene (cis-DCE) at a total combined chlorinated solvent concentration of about 2,500 micrograms per liter (µg/L) with PCE representing about 1,700 µg/L of this total. Site geochemistry included nitrates at about 2 milligrams per liter (mg/L), dissolved iron and manganese at less than 0.5 mg/L each, and sulfate at about 225 mg/L. In addition to the geochemical parameters, phospholipid fatty acid (PLFA) and quantitative real-time polymerase chain reaction (qPCR) analyses were conducted at the baseline and after substrate injection to provide an overview of the changes in the microbial communities and to detect the presence genes specific to chlorinated-hydrocarbon degrading microbes and their enzymes. The PFLA and qPCR analyses were used to evaluate the relative

percentages of varying communities as found as firmicutes, anaerobic metal reducers, proteobacteria, sulfate reducing bacteria, eukaryotes, and general microbes.

This presentation reviews and compares the results of the geochemical, bacteriological, and contaminant profile for both the whey and ethyl lactate substrates.