

News Release

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ADVENTUS GROUP Outlines *In Situ* Chemical Reduction (ISCR) Advantages

Remediation biotechnology firm explains key differences between ISCR and Conventional Emulsified Oil technologies

Raleigh, NC (June 24, 2008) – Adventus Americas, Inc., an international remediation biotechnology firm, recently outlined topical decision-making criteria for remediation engineers and environmental professionals. “Few, if any, of us are experts in the myriad fields of science associated with applied environmental biotechnology. As such, technology end-users, and vendors alike, are often confused and frustrated with apparently conflicting messages offered by the providers of various remedial technologies,” commented Jim Mueller, Ph.D, President of Adventus Americas Inc. “As part of Adventus’ continued commitment to scientific excellence and technical support, we seek to provide direct, comparative analyses of our technologies with seemingly similar offerings in a factual manner. The many accolades we have received from our peers and colleagues encourages us to continue with these efforts. This summary compares and contrasts our EHC® ISCR technology with carbon-only substrates consisting of emulsified vegetable oils. While the latter can be effective, there exist a number of fundamental differences.”

The Potential Significance of ISCR

Many chlorinated hydrocarbon compounds (CHCs) can be degraded via oxidative or reductive processes (<http://umbbd.ahc.umn.edu>). Accordingly, various *in situ* chemical oxidation (ISCO) technologies using oxidizing agents such as Fenton’s chemistry, permanganate and persulfate have been developed to remediate impacted environments. Each of these oxidants and their activators offer seemingly unique features and they can be very effective on a varying range of CHCs. However, an equally or perhaps more effective remedial strategy, especially for plume treatment, entails *in situ* chemical reduction (ISCR) using EHC® or granular iron (zero-valent metal) as the reductant.

Top Ten Reasons to Use EHC ISCR Technology vs. Emulsified Oils

EHC is a patented combination of controlled-release, complex carbon plus zero valent iron (ZVI) that uniquely exhibits the recognized benefits of *in situ* chemical reduction (ISCR). Hence, EHC integrates chemical and microbiological degradation processes that conventional enhanced bioremediation technologies do not. When specifically compared to emulsified oils, EHC offers the following qualitative and implementation advantages:

- 1. Better Contaminant Removal in Head-to-Head Test:** Several independent comparisons of EHC and emulsified soybean oils have been conducted. The results consistently indicate that EHC provided greater removal efficiency for all contaminants tested, including TCE and metabolites, chlorinated ethanes, and TCFM. Some of the reports are available from Adventus, upon request.
- 2. EHC Will Not Migrate or Promote Transport of Contaminants in the Subsurface:** EHC contains a hydrophilic (water loving) fibrous carbon source. Thus, it will not significantly adsorb chlorinated solvents and other hydrocarbons or migrate vertically once emplaced in the subsurface. Conversely, oils are inherently lipophilic and hydrophobic, which can adsorb contaminants. Oil droplets will tend to

attract one another and may float to the water table, or sink, thus moving out of the intended remediation zone, potentially carrying contaminants with them.

3. Multiple Treatment Mechanisms with Minimal Production of Catabolites: ISCR reactions unique to EHC promote rapid and complete dechlorination of target compounds (see “Thermodynamics of Low Eh Reactions” for further scientific validation at: <http://www.adventusgroup.com/library/articles.shtml>). Emulsified oils depend on the presence of specific microorganisms, and support degradation reactions that proceed along conventional sequential reductive dechlorination pathways. As such, potentially problematic intermediates such as DCE and VC from PCE or TCE, and DCM from CT or CF, will often accumulate. Emulsified oils may also reduce the bioavailability of contaminants through their adsorption to the oil matrix whereas EHC does not.

4. Minimized Contaminant Displacement / Mobilization: EHC solids are injected as an aqueous slurry (30 to 40% solids/weight). The small amount of water used during the injection process therefore causes little displacement of groundwater. In contrast emulsified oil injections are performed at lower concentrations (3% to 12% oil in water) or with water chasers and can therefore cause substantial plume displacement. The Florida Department of Environmental Protection, for example, stated its concerns regarding contaminant migration through the injections of emulsified oils in its acceptance letter of an emulsified oil product.¹

5. Ease of Construction: EHC is available in solid and aqueous (EHC-A) formulations and is manufactured according to site-specific needs and conditions. Given the high solids contents of injected slurries, field times are kept to a minimum. Oils are viscous liquids delivered as concentrated emulsions which typically require extensive dilution in the field to yield a viscosity between 1.3 and 2.1 times that of water and/or water flooding to facilitate *in situ* distribution. This can translate into significantly increased project costs due to the need for extended field time.

6. Minimal Accumulation of Contaminants in Reactive Zone: Little information is available on how long emulsified oils stay emulsified. Initially, the emulsified oil has a large surface area and releases dissolved organic carbon efficiently. Over time, however, interfacial forces can coagulate the emulsion into larger oil globules and ultimately into an oil layer. If the coagulated oil has sorbed a substantial mass of contaminants, it may represent a NAPL. This will not happen with EHC.

7. pH Buffering and Nutrients: The alkalinity generated by the ZVI component of EHC offsets acidity generated by fermentation of the organic carbon portion. This results in a natural buffering of pH, which prevents acidification. In contrast, fermentation of emulsified oils frequently leads to acidification, which can slow the rate of microbial dechlorination. Further, EHC provides a complete spectrum of major, minor, and micro-nutrients, because it is manufactured from natural plant materials. In contrast, emulsified oils may be deficient in one or more essential nutrients.

8. Superior Technology for Permeable Reactive Barriers (PRBs): EHC is ideal for placement as a PRB because it is solid, remains where placed, and will not migrate with groundwater.

9. Adaptable Formulations for Heavy Metals: EHC is uniquely effective for environments co-impacted with organic and inorganic contaminants (*e.g.*, As, Hg, Ni, Pb, Zn). The presence of ZVI and other amendments unique to EHC-M™ formulations will yield rapid, irreversible, long-term immobilization of heavy metals - while simultaneously dechlorinating organic compounds. This is not an option with emulsified oils since they do not provide ZVI.

10. Full Patent Indemnification for You and Your Client: EHC ISCR technology is the subject of numerous Adventus patents. Adventus will provide full indemnification, backed by insurance coverage, to protect users and site owners from lawsuits purporting patent infringement.

1 Florida Department of Environmental Protection;
http://www.dep.state.fl.us/waste/quick_topics/publications/pss/pcp/innovative/letters/inn_094b.pdf;
accessed 12 April, 2006

About Adventus Group – Environmental Biotechnologies for the 21st Century

The Adventus Group provides a growing portfolio of leading environmental remediation technologies, including patented offerings from Adventus Americas Inc., and EnviroMetal Technologies Inc. Our business model supports site owners, environmental engineers, regulators, and diverse consulting professionals by providing unbiased design, and selection of the most cost-effective remediation strategies.

Adventus exclusively offers DARAMEND®, EHC® and related ZVI technologies for In Situ Chemical Reduction (ISCR) along with TERRAMEND®, AQUABLOK+™, EHC-O™, A-SOX™, O-SOX™, and mGCW™ systems to address myriad soil, sediment and groundwater impacts. Our world-class technical team is a clearly recognized industry leader. Since its inception in 2003, Adventus has successfully deployed field installations at hundreds of sites across North America, Europe, Asia, and Australia.

The Adventus family of companies is always seeking strategic partnerships with complementary remediation biotechnologies, and qualified international licensees in numerous countries. For more information contact Michael Mueller at mike.mueller@adventusgroup.com or visit us online at www.AdventusGroup.com or www.eti.ca.