Environmental Solutions

EHC®
In Situ Chemical Reduction Reagent
Product Sheet

EHC® The Original ISCR Reagent

EHC® *in situ* chemical reduction (ISCR) reagent is the original patented combination of controlled-release organic carbon and zero valent iron (ZVI) used for the treatment of groundwater and saturated soil impacted by persistent halogenated compounds, including chlorinated solvents, pesticides and organic explosives. The EHC formula is the culmination of years of research and successful field use. EHC is comprised of a synergistic mixture of micro-scale ZVI and a solid organic carbon source, stimulating both abiotic and biotic dechlorination mechanisms.

Contaminants treated

- Chlorinated solvents including chlorinated ethenes, ethanes and methanes
- Energetic compounds such as TNT, DNT, HMX, RDX and perchlorate
- Most pesticides including DDT, DDE, dieldrin, 2,4-D and 2,4,5-T
- Chlorobenzenes including di- and tri-chlorobenzene
- Haloalkanes such as Freon 11, 12, and 113
- Nitrate compounds

Applications

EHC can address a wide range of contaminant concentrations and has successfully been applied to treat large dilute plume areas, groundwater hots-spots, and high concentration source areas:

- Permeable Reactive Barriers (PRBs) for Plume Control: EHC has an estimated lifetime > 5 years in the subsurface, which makes it ideal for placement into PRBs. The first full-scale EHC PRB has been operating since 2005, and has continuously supported >90% CVOC removal under flow-through conditions.
- Grid-Applications: EHC is also commonly used for source area/hot-spot treatment, and the product's longevity allows for continued treatment of contaminants as they slowly back diffuse from the solid matrix to groundwater at sites with high concentrations of sorbed mass / NAPL. EHC successfully treated a site with starting TCE concentrations >600 mg/L.
- Plume Treatment: Designs with multiple PRBs have been employed for cost effective treatment of large dilute plume areas.

Installation methods

- Injection of EHC Slurry via Direct Push Technology (DPT)
- Hydraulic or Pneumatic Fracturing (applied to fine-grain formations including weathered and fractured bedrock)
- Direct placement into open excavations or trench PRBs
- Deep soil mixing

SPECIFICATIONS

Composition:
- Micro-scale ZVI (~40%*)
- Controlled-release, food grade, complex organic carbon (~60%*)
- Major, minor, and micronutrients
- Food grade organic binding agent

Packaging:
Delivered as a dry powder, available in 50-lb / 25 kg bags and 1 ton super sacs.

Health and Safety:
Completely non-hazardous and safe to handle.

Longevity:
3 to 5+ years, depending on application

*Custom formulations available upon request

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The sound science of EHC

EHC will rapidly create strong reducing conditions via biotic and abiotic mechanisms as detailed below:

- The addition of organic carbon to the subsurface will support the growth of indigenous heterotrophic bacteria in the groundwater environment. As the bacteria feed on the organic carbon particles, the bacteria consume dissolved oxygen and other electron acceptors, thereby reducing the redox potential in groundwater.
- The ZVI particles will scavenge oxygen as it undergoes oxidation promoting an additional drop in the redox potential of groundwater.

EHC promotes both biotic and abiotic dechlorination reactions:

- As the bacteria ferment the organic portion of EHC, they release a variety of volatile fatty acids (VFAs) such as lactic, propionic and butyric acids, which diffuse from the site of fermentation into the groundwater plume and serve as electron donors for other bacteria, including dehalogenators.
- The small ZVI particles (i.e., <100 μm) provide substantial reactive surface area that stimulates direct chemical dechlorination. Furthermore, as the ZVI is corroding ferrous iron is released into the groundwater. As the dissolved iron travels into areas with higher redox potential, it will precipitate out as a number of ferrous and ferric precipitates, including, but not limited to iron oxide and sulfide. These ferrous iron precipitates have also been proven to be reactive with CVOCs and will stimulate abiotic dechlorination mechanisms in an extended area downgradient of the points of application.

EHC KEY ATTRIBUTES

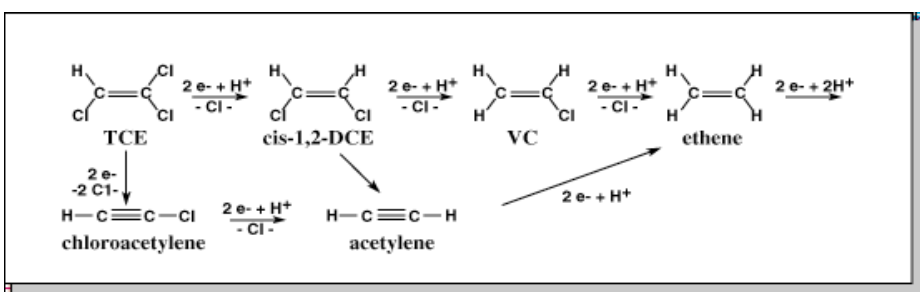
- Abiotic and Biotic Degradation
- pH Balanced
- Long-Lasting
- Field-Proven
- Quickly Generates Reducing Conditions
- Minimal Generation of Daughter Products
- Manufactured from Sustainable Recycled Materials

Synergistic benefits of combining organic carbon and ZVI

- Redox potentials as low as –500 mV have been observed in groundwater after EHC addition. These Eh values are significantly lower than those achieved when using either organic materials (e.g. lactate and molasses) or reduced metal alone. These low Eh potentials not only improve the kinetics of the dechlorination reactions but also support more complete decomposition of chlorinated solvents.
- Self-buffered – the alkalinity generated from ZVI corrosion (release of hydroxide) is off-set by the acidity from organic carbon fermentation (VFAs). Maintaining a near neutral pH is beneficial for microbial growth and also serves to prevent ZVI passivation from mineral coatings, hence extending the reactive life of the ZVI.

Multiple degradation pathways

The addition of organic carbon will promote conventional step-wise reductive dechlorination reactions, whereas the dominant abiotic pathway observed in contact with zero-valent iron and ferrous iron precipitates is beta-elimination; minimizing the generation of daughter products (specifically vinyl chloride).



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