HRC TECHNICAL BULLETIN #4.1.2

Hydrogen Release Compound HRC™

HRC and Iron Wall Technology (ZVI)

HRC technology is a passive approach for the accelerated bioremediation of chlorinated hydrocarbons such as perchloroethene (PCE), trichloroethene (TCE) and other compounds. How then do these methods contrast with passive mechanical operations that are currently in use such as iron walls (zero valent iron)?

Zero Valent Iron

Passive mechanical systems are essentially a reference to zero valent iron technology (ZVI), more commonly known as the "Iron Wall". ZVI technology is a patented technology that carries significant royalty payments on the order of 15% of the cost of the project. The technology has received significant attention in recent years as people search for effective ways treat chlorinated solvent plumes. However, the conclusion often reached by those who have researched the topic is that ZVI technology is often viewed as an "expensive Band-Aid" insofar as it is expensive to install and simply cuts off the plume and does not address the source of contamination nor the upgradient plume area.

ZVI/HRC Barrier Cost Comparison

In comparison to the use of a line of HRC application points (in for form of an "HRC Barrier") to achieve the same plume cut-off as an iron wall, the HRC option is usually a fraction of the cost (e.g. 1/30th the cost) of a comparable "iron wall" application. For example, the plume treatment accomplished by an iron wall installation costing $800,000 could very well be accomplished by an HRC application costing $26,000.

Performance Problems with Iron Walls

To give credit where credit is due, ZVI technology is a valid technology for specific instances however, it must be properly designed. While iron wall applications have been successful at reducing target contaminant concentrations moving through the iron wall on several sites, these designs are susceptible to failure in every dimension – length, depth, and thickness.

With respect to depth the issue is simply as follows. Depending on the specific design water can in fact breach the barrier and can flow underneath the iron wall. With respect to length it is the same issue – if improperly designed water will flow around. In either case, the costly iron wall installation is deemed a failure by allowing untreated water to circumvent the treatment zone.

Hybrid Iron Wall with HRC Application

In terms of iron wall failure, thickness is the least worrisome dimension of failure. The track record has been good in terms of limiting the breakthrough of parent or daughter compounds. However, the thicker the wall the

more costly it is as tremendous volumes of iron are required and excavation/disposal costs increase dramatically with thickness . An interesting feature related to thickness also emerges in that the extinction of the contaminant is governed by a logarithmic function such that a full 90% of the thickness is required to remediate the last 10% of the contamination. This raises an intriguing option – a hybrid ZVI and HRC system. The key to making this work is to have a very low cost trenching installation of the iron wall – on the order of six inches rather than six feet. This would then allow a limited breakthrough such that a very low cost HRC injection down gradient can do the polishing. In very general terms a $500,000 wall that is several feet thick can be scaled back to $100,000 and supplemented with a down gradient HRC barrier that would typically run less than $20,000.

In summary, there are various limitations to ZVI technology for *in situ* remediation, the most obvious is the tremendous cost and inflexibility of the constructed installation, not to mention their unproven long-term viability. Given that bioremediation is a viable option for the accelerated natural attenuation of contaminated sites, the following are some advantages of using an HRC slow release hydrogen strategy.

1. Low Capital, Design, and O&M Costs:

HRC is a passive, in situ approach and avoids substantial design, capital, and operations/maintenance (O&M) costs. These features are not a given for iron walls which is technically passive – but involves substantial design and capital costs for these large-scale construction projects. Sometimes even the design costs alone of a ZVI system will approach or exceed the costs of an HRC treatment.

2. Minimal Site Disturbance:

HRC offers the potential for in situ treatment without the requirement for aboveground equipment after initial injection, thereby allowing remediation without disrupting normal business or commercial activities. Applying these slow-releasing substrates to the subsurface is fast and easy. An iron wall operates invisibly but the installation is a major undertaking.

3. Applicability at Deeply Contaminated Silts

Iron walls have depth limitations as a function of trenching. However, HRC can be easily placed at depth through the use of injection or auger backfilling. Because HRC releases lactic acid and hydrogen out into the contaminated aquifer, an in situ treatment area is formed. Thus, treatment occurs over a large area, without rely on capturing and funneling all of the contaminated groundwater through a small trench to contact immobile iron particles as in the iron wall technology.