

LIFE CYCLE COST COMPARISON HYDROGEN RELEASE COMPOUND (HRC®) VS. MOLASSES



Hydrogen Release Compound (HRC®) continues to be one of the most effective remedial options available for CAH remediation providing excellent long-term performance at the lowest overall project cost.

Introduction

It is important to periodically reevaluate product claims and performance in light of evolving marketplace and site remediation needs. In regard to HRC® performance, its application at over 3000 sites worldwide and a long list of third party peer-reviewed journal articles confirms the effectiveness of this unique product. Of equal significance in the marketplace is the relative cost effectiveness of the product.

During the development of HRC, RegenesiS recognized that the vast majority of enhanced reductive dechlorination (ERD) remediation project costs were related to construction, capital items, and operation/maintenance. Specifically we recognized that the use of high volume soluble substrates like molasses and lactate required complex engineering design, well networks, trenching, equipment, and expensive routine operation and maintenance. HRC was designed to eliminate much of these costs. By developing a material that is applied through a single direct push event and that releases lactate for over 12 months' time (and >36 months' time with HRC-X) we dramatically lowered the cost of applying electron donor material for successful enhanced reductive dechlorination. It is because of its controlled-release engineering and cost effectiveness that HRC has been so widely adapted across the globe for treating groundwater.

With this in mind, we would like to stress that **the only proper way to analyze actual remediation costs is to consider the total project life-cycle costs, not simply the cost of the electron donor substrate.** Life-cycle cost can be described as all costs of a remediation project from start to finish, including: design, permitting, well installation, work plan development, electron donor cost, operation/application, monitoring, reporting, and project management. Typically there is no positive correlation between electron donor cost and project cost. This is a common misconception that has been resurrected time and time again, generally by less progressive engineering firms seeking to drive up service billings. In order to illustrate this point, a cost comparison was developed comparing HRC to molasses as an electron donor for various ERD projects. A third party was contracted to perform design work on three prospective ERD projects, and to provide the relative life-cycle costs of the two electron donors. The engineer that performed this work was a Ph.D.- level bioremediation expert with 20+ years in the field of remediation and with experience using both HRC and molasses.

Site Analysis

The following includes an analysis of three diverse in-situ bioremediation sites. This comparison was undertaken to assess the total project cost associated with the use of HRC versus molasses at three variable sites. Detailed groundwater site remediation proposals were prepared for each site using HRC and molasses. The proposals were then compared to evaluate product-associated differences in total groundwater remediation project cost.

Site 1: Cookeville, TN (Manufacturing Site)

Contaminants: 120 mg/L Tetrachloroethylene (PCE), 200 mg/L Trichloroethylene (TCE), and 4.78 mg/L Cis-1,2-Dichloroethylene (cis-1,2-DCE); Signs of Dense Non-Aqueous Phase Liquids (DNAPL) were also detected at the site.

Site Dimensions: Source area is 2,500 ft²; Plume area is 20,000 ft²

Hydrogeologic Conditions: A silty sand and clayey sand aquifer beginning at 5 ft below ground surface (bgs) and vertically extending down to 15 ft bgs. Groundwater velocity at the site was measured at 0.68 ft/day flowing toward the northeast.



Natural Attenuation Parameters: 43 mg/L total iron, 2 mg/L dissolved iron, <1 mg/L nitrate, 45 mg/L sulfate, 0.13 mg/L methane, and <0.1 mg/L ethene

Third party evaluated costs associated with product specific remediation at the site are designated in Table 1.

Table 1. Cookeville, TN Remedial Project Costs								
Product	Cost							
	Well Installation	Work Plan and Permit	Product	Operation/ Application	Monitoring	Reporting	Project Management	Total
Molasses	\$27,000	\$20,000	\$12,000	\$48,000	\$15,500	\$29,500	\$19,000	\$171,000
HRC	\$0	\$20,000	\$20,880	\$7,000	\$15,500	\$29,500	\$19,000	\$111,880

Site 2: San Diego, CA (Department of Defense Site)

Contaminants: 13.6 µg/L PCE, 10.2 µg/L TCE, 8.5 µg/L cis-1,2-DCE, and 1.8 µg/L VC

Site Dimensions: Plume area is very large at 1,200,000 ft².

Hydrogeologic Conditions: Silty sand aquifer beginning at 20 ft bgs and vertically extending down to 40 ft bgs. Groundwater velocity at the site was measured at 0.04 ft/day flowing toward the north.

Natural Attenuation Parameters: 0.2 mg/L dissolved oxygen, 0.7 mg/L dissolved iron, 3 mg/L nitrate, and 180 mg/L sulfate

Third party evaluated costs associated with product specific remediation at the site are designated in Table 2.

Table 2. San Diego, CA Remedial Project Costs								
Product	Cost							
	Well Installation	Work Plan and Permit	Product	Operation/ Application	Monitoring	Reporting	Project Management	Total
Molasses	\$774,000	\$77,500	\$336,500	\$1,100,000	\$123,000	\$104,500	\$243,500	\$2,759,000
HRC	\$0	\$77,500	\$231,165	\$54,000	\$123,000	\$104,500	\$243,500	\$833,665

Site 3: Santa Clara, CA (Manufacturing Site)

Contaminants: 2.9 µg/L PCE, 340 µg/L TCE, 4,900 µg/L cis-1,2-DCE, and 4.4 µg/L VC

Site Dimensions: Plume area is 80,000 ft².

Hydrogeologic Conditions: Silty sand and clayey sand aquifer beginning at approximately 6 ft bgs and vertically extending down to approximately 21 ft bgs. The groundwater velocity at the site was measured at 0.2 ft/day flowing toward the northeast.

Natural Attenuation Parameters: 2 mg/L DO, 5 mg/L dissolved iron, 0.5 mg/L nitrate, 25 mg/L sulfate, and 1.6 mg/L methane

Third party evaluated costs associated with product specific remediation at the site are designated in Table 3.

Table 3. Santa Clara, CA Remedial Project Costs								
Product	Cost							
	Well Installation	Work Plan and Permit	Product	Operation/ Application	Monitoring	Reporting	Project Management	Total
Molasses	\$70,000	\$20,000	\$18,500	\$88,000	\$19,500	\$29,500	\$26,000	\$271,500
HRC	\$0	\$20,000	\$41,055	\$12,000	\$19,500	\$29,500	\$26,000	\$148,055

For the three given sites, HRC proved to have the lowest total remediation project cost. The significant factors in the differences of total project cost were well installation cost and frequent operation/application events required with molasses treatment. HRC, as a result of its controlled release profile, does not require well installation and/or frequent operation/application events. The only operation/application costs associated with HRC treatment are those associated with the product application event using direct push injection. For these sites, work plan, permitting, monitoring, reporting, and project management costs were considered equal. Although in some cases the HRC product costs were in excess of the molasses product cost, the entire project costs were still lowest for HRC.

In the interest of further validating project cost versus product cost Regensis encourages environmental professionals to utilize our free application and cost estimating service to draw their own conclusions. We are confident that these claims will be justified time and again at almost every type of site.

Please contact us at 949-366-8000 for a free application design and cost estimate.