

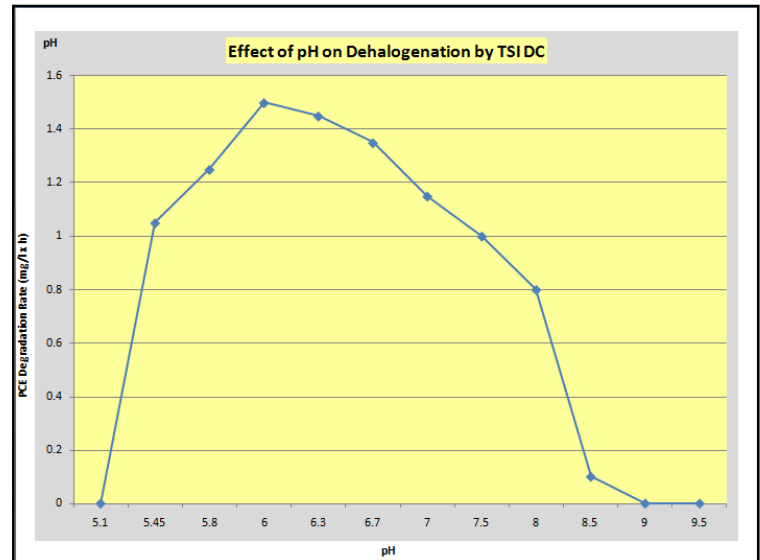


Terra Systems pH Buff-Up™ a Proprietary Buffering Package for Aquifer Remediation and Conditioning

Emulsified Vegetable Oil Substrates, lactate and other carbon substrates are added to the groundwater to rapidly generate reducing conditions and provide the necessary carbon and hydrogen to support native or introduced microorganisms (*Dehalococcoides*) for the biodegradation of chlorinated solvents such as tetrachloroethene (PCE) and trichloroethene (TCE) to innocuous end products including ethene and ethane. Often pH at a site is below optimal levels of 6.5 to 8.5 and a buffer needs to be added to the aquifer for complete dechlorination to occur.

Key Communication Points

1. A combination of laboratory and field studies has indicated that the optimal pH range for anaerobic bioremediation of chlorinated solvents is between 6.5 and 8.5.
2. Based upon laboratories at TSI, between 76.4 to 99.1% of the buffer demands (average 93.3%) are associated with the soil phase rather than the groundwater phase.
3. Because the buffer demands are so variable between sites and between locations within a single site, it does not make sense to use a substrate formulation with only one concentration of buffer. It is better to add the correct dosage of buffer for that location to the chase water and be able to achieve better distribution of the buffer than if it is only included with the substrate.
4. pH Buff-Up™ can be added to other carbon substrates like lactate, molasses, and emulsified vegetable oil substrates to increase the pH to the optimal range:
 - To counter the natural drop in pH due to the acids produced during the reductive dechlorination process.
 - To optimize pH conditions at the site.





pH Buff-Up™ uses 50% calcium carbonate in water combined with a proprietary thickener to optimize the pH at a site. Combined with a pH buffer test, it allows the PM to adjust the pH at multiple locations at the site by controlling the amount of pH Buff-Up that is injected.

Table I: pH Buff-Up™ Specifications

Ingredient	Percent	Benefit
Calcium Carbonate	50	Slightly soluble compound that will provide a long lasting buffer
Water	48-50	Required to form a suspension of the calcium carbonate
Thickener	0-2	Keeps the buffer in suspension
Total		

Technical References for the benefits of optimizing pH for in-situ bioremediation.

Alexander, M. L., R. Cronce, and T. Battenhouse. 2011. Differential Adjustment of pH for Optimal Reductive Dechlorination Conditions. A-65, in: H.V. Rectanus and R. Sirabian (Chairs), *Bioremediation and Sustainable Environmental Technologies—2011*. International Symposium on Bioremediation and Sustainable Environmental Technologies (Reno, NV; June 27–30, 2011). ISBN 978-0-9819730-4-3, Battelle Memorial Institute, Columbus, OH.

Lee, M. D., E. Hauptmann, R. L. Raymond, D. Ochs, R. Lake, and M. Selover. 2010. Buffering Acidic Aquifers with Soluble Buffer to Promote Reductive Dechlorination. F-031, in K.A. Fields and G.B. Wickramanayake (Chairs), *Remediation of Chlorinated and Recalcitrant Compounds—2010*. Seventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2010). ISBN 978-0-9819730-2-9, Battelle Memorial Institute, Columbus, OH, www.battelle.org/chlorcon.