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Dr. Hoag is an internationally recognized remediation engineer whose primary expertise is development of green technologies for environmental remediation. Dr. Hoag has more than 25 years experience in the field of subsurface remediation. He is a former University of Connecticut Professor with 4 patents and hundreds of publications. Dr. Hoag led VeruTEK®'s development work resulting in a family of cosolvent/surfactant formulations that greatly increase the efficiency and effectiveness of both oxidation and reduction processes to destroy Non Aqueous Phase Liquids (NAPLs). Dr. Hoag received his Ph.D. from the University of Connecticut in Environmental Engineering.

VeruTEK Technologies, Inc. is a green technology company that has developed green technology platforms for cleaning up organic contaminants such as coal tar, creosote, PCBs, dioxins, fuels, MTBE, chlorinated solvents and metals. Visit www.verutek.com to learn more.

TECHNICAL NOTE: THE NOVEL USE OF BROMOTHYMOL BLUE AS A MODEL COMPOUND TO COMPARE CATALYSTS USED TO GENERATE FREE RADICALS FROM HYDROGEN PEROXIDE.

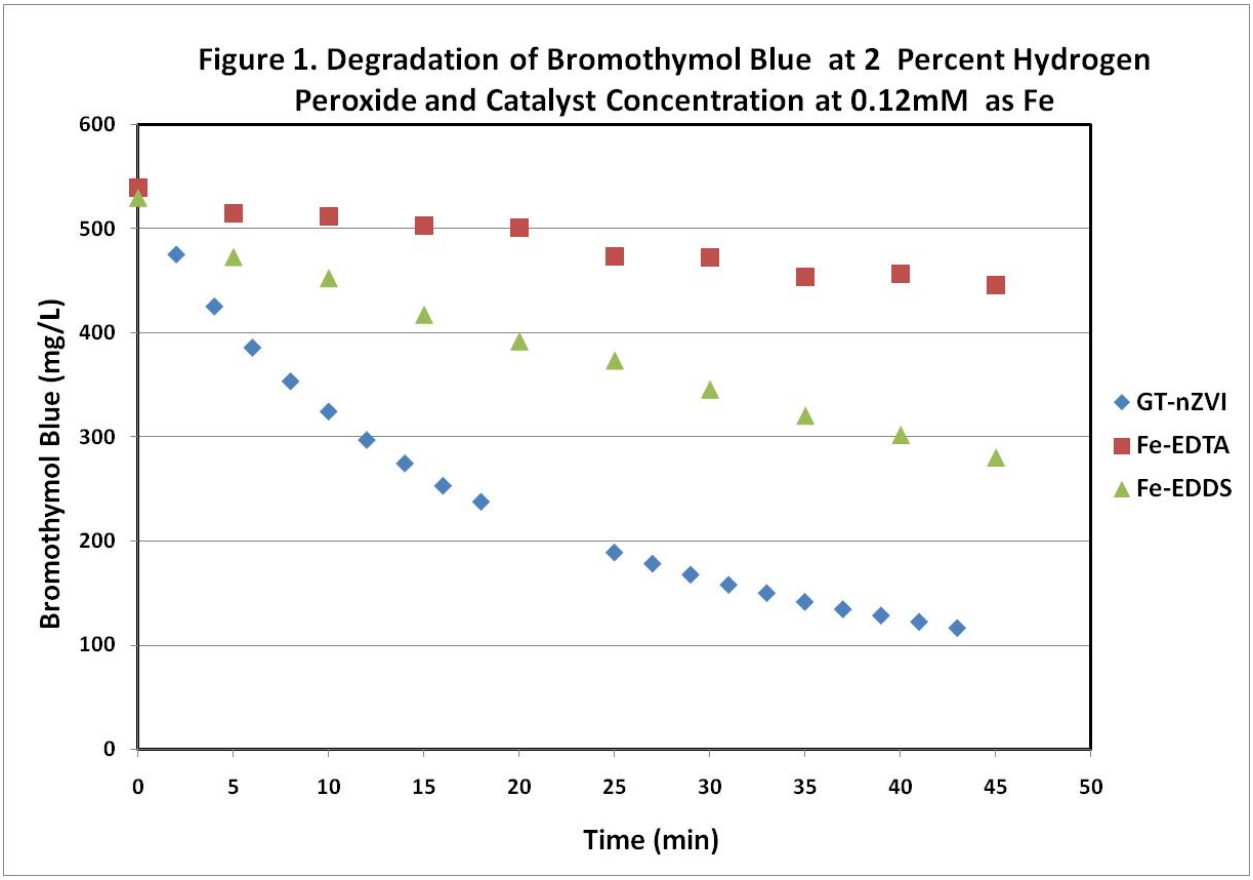
The development of green technologies for environmental remediation has now advanced to a stage where site-specific solutions are being developed based on contaminant chemistry, geologic particle-size distribution and stratigraphy, and costs. The theory and practice of plant surfactant-oxidant chemistry is being used to develop green technologies that compete cost-wise with excavation/landfilling while providing more complete remediation and safer remedies.

It is now possible to see costs for in-situ (in place) remediation of organic contamination and mixed organic/metal contamination decrease below $25 per ton of contaminated soil. VeruTEK® optimizes remediation by completing a ServicePAK before implementation of a remedy that provides the scientific basis for the remedy in addition to a schedule and cost estimate. To complete the ServicePAK, VeruTEK® now employs microcolumn methods to test the most effective green technology solutions for each contaminant matrix.

In this technical note, we report the use of Bromothymol Blue, a textile dye derivative also used a pH indicator, as a model compound to compare catalysts used to generated free radicals from hydrogen peroxide. Among others, a novel green synthesized nanoscale zero valent iron was used as a catalyst. This new plant extract and reduction/precipitation method takes place under ambient temperature and pressure, uses no hazardous materials, does not produce hazardous wastes, and this synthesis can take place on-site and in situ.

Similar to other dyes such as Methylene Blue, Methyl Organe, and Reactive Blue, Bromothymol Blue is not degraded by direct oxidation of hydrogen peroxide alone as peroxide must be catalyzed to form hydroxyl or other free radical species that are able to degrade these photostable dyes. The advantage of using Bromothymol Blue over Methylene Blue, however, is that Bromothymol Blue is not degraded by direct oxidation of persulfate while Methylene Blue is directly degraded by persulfate.

We used the rates of Bromothymol Blue degradation to compare the rate of free radical generation formed by a common iron chelate, Fe-EDTA, with a more environmentally friendly iron chelate, Fe-EDDS, to a new and novel green synthesized nanoscale zero valent iron (nZVI) catalyst. This new nZVI catalyst is made using plant polyphenols derived from green tea extract and a source of dissolved iron, in this case a 0.1M solution of ferric chloride. This synthesis pathway is patent pending jointly by USEPA and VeruTEK® and was developed under a Cooperative Research and Development Agreement with these two parties. While extensive work has been conducted regarding degradation reaction rates of Bromothymol Blue with these three catalysts over a wide range of peroxide concentrations and stabilizers, today we report an example using a 2 percent hydrogen peroxide concentration with each catalyst concentration normalized at 0.33M as Fe. Bromothymol Blue was measured real time in a cuvette using a Beckman Photodiode Array UV/VIS spectrophotometer. In Figure 1, we compare the degradation of Bromothymol Blue using Fe-EDTA, Fe-EDDS and green synthesized nZVI. It can be seen that Bromothymol Blue is degraded much more quickly using the green synthesized nZVI catalyst than either of the two Fe-chelates. Additionally, Fe-EDDS more effectively generated free radicals than Fe-EDTA.



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