ISCR-Based Remediation of Herbicide/Pesticide-Impacted Soils in Canada, China, Colombia, Sweden, and the United States: 22 Years of Success and Surprises

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Background/Objectives.
Agricultural land is often converted to residential use as urban centers grow. An issue that may be encountered during these changes in land use is the presence of chlorinated pesticides and herbicides at concentrations above regulatory criteria. Over the past two decades, soil at many pesticide/herbicide-impacted sites has been successfully remediated using in situ chemical reduction (ISCR) treatments based on zero valent iron combined with organic carbon. A cycled, anaerobic/aerobic approach is used. This ISCR treatment has enabled attainment of industrial and residential remediation standards and provided an environmentally sustainable, greener alternative to excavation and off-site disposal. ISCR technology is now considered a proven alternative to excavation and off-site disposal.

Approach/Activities.
Large-scale in situ treatment is usually conducted only after completion of bench-scale testing on a representative soil sample(s) to determine if adequate removal efficiency can be attained. The bench work also provides estimates of the required soil amendment dosage and treatment time. In some cases, bench results indicate that remedial objectives cannot be attained. In cases where bench testing yields positive results, a variety of site-specific scale-up issues must be addressed and regulatory approval secured before treatment at a site can be initiated. After successful bench-scale testing, a pilot-scale demonstration may be prudent, to ensure successful scale-up under field conditions. Treatment at sites can be conducted in situ or on excavated soil using a variety of soil mixing techniques to incorporate the soil amendments. In most cases, irrigation is also required to achieve a soil water content conducive to reductive dechlorination.

Results/Lessons Learned.
A variety of soils containing chlorinated herbicides and pesticides, including 2,4-D, 2,4,5-T, Metolachlor, Chlordane, DDT, Dieldrin, Aldrin, Lindane, PCP, and Toxaphene, have been treated to applicable criteria. In some cases, treatment has been completed rapidly, without difficulty, within the predicted time, and on budget. In others, soil characteristics, weather, and unexpected site conditions (e.g., very high pesticide concentrations) have rendered treatment slower or ineffective due to the need for many treatment cycles. Case studies, both successful and unsuccessful, will be presented. Reasons for observed performance, both good and bad, will be proposed and discussed.