CLEANING UP PESTICIDE-CONTAMINATED SOIL WITH IRON METAL

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ABSTRACT

Spills at agricultural cooperatives and farmsteads can result in ground and surface water contamination by pesticide and fertilizer products. Finely ground iron metal (zerovalent iron, Fe\textsuperscript{0}) can be used to promote rapid degradation of many chlorinated and nitrogenated compounds, including common agrochemicals. When Fe\textsuperscript{0} is added to soil under anaerobic conditions, corrosion (oxidation) of the iron can be effectively coupled to reductive dechlorination and nitro group reduction. We conducted a field demonstration at a Nebraska farm cooperative on soil contaminated with metolachlor (>1400 mg kg\textsuperscript{-1}), atrazine (>250 mg kg\textsuperscript{-1}), alachlor (>90 mg kg\textsuperscript{-1}), pendimethalin (>90 mg kg\textsuperscript{-1}), chlorpyrifos (>15 mg kg\textsuperscript{-1}), and nitrate-N (>900 mg kg\textsuperscript{-1}) Contaminated soil was placed in windrows and mixed with a high-speed mixing and fractionation implement. Soil windrows were treated with Fe\textsuperscript{0}, Fe\textsuperscript{0}+ aluminum sulfate, and/or acetic acid and incubated under clear plastic at a soil water content >35%. Within 90 d, pesticide concentrations decreased by as much as 99% (metolachlor, adachlor, pendimethalin), 96% (atrazine), and 96% (chlorpyrifos), while nitrate-N concentration decreased by >90%. Laboratory experiments using radio-labeled metolachlor indicate that the Fe\textsuperscript{0} treatments can result in products that are more biodegradable. These results combined with the relatively low cost of Fe\textsuperscript{0} support its use for field-scale treatment of pesticide-contaminated soil, especially when land spreading or landfilling is prohibitive.

Key Words: remediation, zerovalent iron, chemical reduction, dechlorination, abiotic degradation