USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2002MS6B

Title: A Single Technology for Remediating PNAs, Nitro/Nitrate Residues, PCBs, CAHs, Herbicides and Pesticides from Soils and Sludges with Na/NH3(l)

Project Type: Research

Focus Categories: Toxic Substances, Groundwater, Treatment

Keywords: water quality, groundwater treatment, hazardous wastes, toxic substances, chlorinated aliphatic hydrocarbons, polychlorinated biphenyls, dechlorination, pesticides, herbicides, soil decontamination, reductions, sludge, subsurface drainage, water treatment Primary PI: Pittman, Jr., Charles U.

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Abstract

Polynuclear aromatic hydrocarbons (PNAs) from creasote wood treatment plants and nitrated organic residues from munitions/explosives/propellant manufacturing contaminate soils at over 120 sites, many in the Southeastern US. Polychlorinated biphenyls (PCBs) and other chlorinated compounds are distributed in soils, sludges, estuaries, etc. at over 400 sites in the United States. Chlorinated aliphatic hydrocarbons (CAHs), widely used for degreasing/cleaning engines, auto parts, electronic components and dry cleaning, occur as serious contaminants at 358 major hazardous waste sites in the United States. This demonstrates a national need for a variety of rapid remediation methods. CAHs migrate vertically through soils to form dense nonaqueous phase liquids (DNAPLs) on aquifer bottoms. Ex-situ methods of CAH decontamination/destruction are needed for soils, sludges, bulk zones (DNAPLs in the valdose zone) and industrial process wastes. We propose a single reduction technology to destroy PNAs, nitrated organics PCBs, CAHs and other chlorinated pesticides and herbicides using solvated electron chemistry (Na/NH3) at room temperature applicable to ex-situ and some in-situ treatments. Since nitro and nitrate compounds are readily reduced, we think Na/NH3 reduction can decontaminate soils around ammunition and ordinance plants.

The goal of the proposal research is to develop a generalized technology to decontaminate soils (in-situ and ex-situ) and sludges contaminated with PNAs, Nitrated organics, PCBs, CAHs, chlorinated pesticides and herbicides. We have recently demonstrated that neat PCBs and PCB-contaminated soils and CAH-contaiminated soils (as received clay, loam, sandy soils containing up to 30% water) can be decontaminated in liquid ammonia slurries when treated with either Na/NH3 or Na/NH3. PCB-destruction efficiencies >99.9% were achieved in 30 sec. at room temperature. The products were biphenyl and NaCl. We determined water can be present yet acceptable PCB and CAH destruction occured at reasonable Na consumption. Can wet sludges be economically treated? This chemistry destroys carbon tetrachloride,

tetrachloroethylene, trichloroethylene, trichloroethane (major CAH-polutants) rapidly in soils in the presence of water. Will this scale up economically ? Demilitarization has emphasized nitro and nitrate compound contamination of nitration factory soils. Can these residues be reduced rapidly by Na/NH3 or Ca/NH3 in soils? Several nitroaromatics have been quantitively reduced using Na/NH3 Na/ethylenediamine in our labs. Polynuclear aromatic hydrocarbons, PNAs, are rapidly reduced in Na/NH3. Can this be extended to soils and sludges ? The major goal is to develop solvated electron chemistry (e.g. Na/NH3, Ca/NH3) as a single, multifunctional, portable technology applicable to both on site in-situ and on site ex-situ destruction of PCBs, PNAs, CAHs, and ammunition/explosive residues. The major focus is to demonstrate a new remediation technology.