



Discussion Paper

Use of specially formulated emulsions to stabilize soils affected with heavy metals, radionuclides and heavy organics

Tall oil pitch and asphalt-based emulsions have been used extensively in the commercial construction industry to stabilize soils for dust control, thereby minimizing their mechanical migration through wind or water erosion. These same emulsions have been modified (and the modifications patented) to chemically fixate heavy metals (such as lead, uranium, arsenic and chromium) rendering them resistant to leaching to groundwater, and creating a material that reduces infiltration and is resistant to wind and water erosive forces. Chemical theory indicates the technology would also work on heavy organics (PCBs, DDT, etc). Recent testing on PCB-contaminated soils at Camp Pendleton confirms that heavy organics will absorb into the pitch- or asphalt materials, providing significant reductions in their mobility.

In July 2000, the USEPA issued a determination that use of the Encapco technology qualifies as recycling for RCRA characteristic wastes, in that permanent chemical bonding is achieved in a commercially useable end-product. Treated soils exhibit increased soil strength and can be used as an asphalt base material. The technology is especially applicable for military ranges (lead and DU contamination), military base reuse sites (where treated soils can be used to construct new roads), and other applications. The emulsions can be mixed into the soil and/or applied topically.

This patented technology includes improvements over other stabilization technologies. Most previous stabilization technologies do not exhibit “permanent” treatment and are subject to loss of effectiveness under changing physical or chemical (pH) conditions. Recent testing by the Army Corps of Engineers on phosphate stabilization has confirmed that weathering can affect typical precipitation reactions. Additionally, most stabilization technologies do not work well on a range of inorganic and organic contaminants. Given the ability to treat metals, heavy organics and radionuclides, this appears to be one of the best technologies to stabilize a range of mixed wastes.

The use of specially-modified organic emulsions has now been proven effective as permanent treatment on lead-contaminated soils in full-scale implementation, and on depleted uranium, arsenic, PCBs and chromium in laboratory treatability tests. The technology has been used to improve road foundation soils at Ft. Hunter-Liggett, and to treat lead-affected soils for a CalTrans highway project in Richmond, CA. Once soil-specific emulsion design testing is completed, implementation of this technology in the field can be done with normal road construction equipment and crews.

Laboratory Experience with Depleted Uranium and Continued Testing

Laboratory testing of specially modified pitch emulsions in 2001 with the U.S. Army proved that depleted uranium could be stabilized in soils, reducing its solubility and leachability in water by over 99%. Although additional testing was required, the US Army provided an extremely favorable review of the Army-sponsored tests.

Based on this work, the US Navy awarded us a contract in mid 2002 to test the emulsions at Navy facilities around the country including bases in California, Indiana, Maine, and Pennsylvania, on a host of different and challenging chemical combinations. Laboratory testing has shown some interesting breakthroughs. In particular, the initial tests from Camp Pendleton CA successfully stabilized polychlorinated biphenyls (PCBs) in soils, testing from Mechanicsburg PA successfully treated lead and zinc at concentrations over 10,000 ppm, and testing from Crane IN successfully reduced the leachability of explosives (TNT) in soils. 1,000-ton field demonstrations are scheduled for Mechanicsburg, Crane and Portsmouth ME in the summer of 2003.

At the same time, the Navy Environmental Technology staff at Port Hueneme realized that an important role for these emulsions would be on sites with radioactive metals. There are a number of U.S. military and DOE sites where development and testing of nuclear and other weapons occurred historically, leaving large areas of surface soils contaminated with radioactive metals and other elements. The size of these affected areas (square miles in some cases) precludes excavation or use of typical remediation approaches, leaving no ready solution to manage risk. At these sites, soil particles with adsorbed radioactive elements and compounds are subject to migration through wind dispersal, water erosion, leaching, and biotic uptake.

As the patented pitch emulsion technology has been proven effective in reducing leachability of heavy metals, including uranium, and these emulsions have also been used commercially as effective topically applied dust palliatives, indications are that the technology could prove a uniquely effective risk-management solution for legacy contamination by low- to medium-level radioactivity at a range of U.S. facilities.

The Navy has now awarded a second contract to Encapco to test topically applied (sprayed) pitch emulsions at three federal facilities where residual radionuclides are present in soils. These projects include testing the emulsion technology on: (1) depleted uranium at the Army's Yuma Proving Ground (YPG), (2) thorium at Kirtland AFB in Albuquerque, NM, and (3) plutonium and americium at the Department of Energy's (DOE's) Nevada Test Site (NTS). These tests are now underway, with results expected by Fall, 2003.