CALGON CARBON CORPORATION

Making Water and Air Safer and Cleaner

# SOIL AND SLUDGE STABILIZATION

**with Activated Carbon**

## Stabilization and Solidification Technology

Soil and sludge stabilization and solidification technology (also called chemical fixation or immobilization) is a demonstrated technology for hazardous waste treatment. Stabilization/solidification processes have been used for about 20 years to reduce the hazard potential of contaminated soils and sludges and allow for landfill disposal. These processes apply techniques such as adsorption, encapsulation, precipitation, and cementation to immobilize hazardous waste constituents and form stable solids. These solids exhibit reduced toxicity as determined by leach tests. This technology is almost universally applied in the U.S. for stabilization and containment of metals present in soils and sludges from CERCLA[1]/Superfund and RCRA[2] contaminated sites.

Only recently, this technology has been applied to the stabilization of organic chemicals found in contaminated soils and sludges. Market statistics indicate that there are over 10,000 hazardous waste sites in the U.S. with contaminated soil. Of these, at least 75 percent have either organic chemicals or organic chemicals plus metal constituents. The EPA's position on the stabilization of organic chemicals is that it can be an appropriate technology for the remediation of semi- and non-volatile organic chemicals in soils and sludges as long as containment of the stabilized material can be demonstrated through appropriate leachability testing.

Stabilization and solidification of organic chemicals is accomplished via a two-step process. In the stabilization step, organic chemicals are first contained using activated carbon. In the solidification step, the soil and activated carbon mix is immobilized with pozzolanic materials such as Portland cement, fly ash, limestone, and kiln dust.

1 CERCLA = Comprehensive Environmental Response, Compensation and Liability Act for abandoned or inactive hazardous waste sites.

2 RCRA = Resource Conservation and Recovery Act for identification and handling of hazardous wastes.

## Application of Activated Carbon

Activated carbon has been demonstrated to be cost-effective in the stabilization of organic chemicals. In one application, activated carbon was used by a private industrial company in the stabilization and solidification process to stabilize halogenated aromatic compounds found in 20,000 cubic yards of contaminated sludge. The solidified matrix exhibited a significant reduction in hazard potential as measured by leach testing and was approved at the state level for on-site landfilling. In a second application at a Superfund site, activated carbon was applied to soil contaminated with halogenated phenols and metals using the stabilization and solidification process. The EPA required Toxicity Characteristic Leaching Procedure (TCLP) testing, as well as an aggressive solvent leach test called Total Waste Analysis (TWA), to demonstrate containment. The solidified matrix successfully passed both tests and was approved by the EPA for on-site landfilling of 10,000 cubic yards of soil.

In both applications described above, the activated carbon was applied at a dosage of approximately 5 percent by weight of waste. This cost-effective solution to the problem (as compared to the use of multiple technologies to remediate mixtures of organic chemicals and metals) shows that using reactivated carbon (a recycled material) in stabilization mixes successfully immobilizes organic chemicals while keeping overall treatment costs low.

Information in the literature indicates that activated carbon is a superior adsorbent to clays, organophilic clays, and polymers in soil stabilization of chlorinated solvents, acidic petroleum compounds, and nonpolar semi- and non-volatile organic chemicals. In addition, activated carbon has been found to improve cement hydration and increase compressive strength of cement-based systems, as well as reduce the tendency of organics to volatilize during stabilization activities. The table on the reverse side of this bulletin describes stabilization and solidification applications using activated carbon.

Calgon Carbon's powdered and granular activated carbons are used by commercial treatability labs to conduct treatability studies which screen the stabilization and solidification technology for soil and sludge remediation. For further information on these treatability labs or for information on carbon supply and site handling options, please contact Calgon Carbon Corporation at 800-422-7266.

# SOIL AND SLUDGE STABILIZATION

## with Activated Carbon

### Stabilization of Organic Chemicals with Activated Carbon (full scale, field demonstration, and laboratory applications)

| Application | Waste | Volume | Contaminant Total Concentration | Stabilization Solidification Agents | Carbon Dosage Weight % | TCLP(1) Reduction | TWA(2) Reduction |
|---|---|---|---|---|---|---|---|
| Chemical plant (full scale remediation) | RCRA Sludge | 20,000 $yd^3$ | Dichlorobenzene @ 2,500 ppm | GAC* + Portland cement | 5 | >50% | N/A |
| Wood treating plant (full scale remediation) | CERCLA Soil | 10,000 $yd^3$ | Chlorophenols @ 4,000 ppm As, Cr, Cu @ 5,000 ppm | PAC** + proprietary solidification reagents | 5 | >99% | 91-97% |
| DOE field demonstration | RCRA Clay-like Soil | 3,500 $yd^3$ | Trichloroethylene @ 100 ppm | GAC + Portland cement + fly ash | 4 | Passed TCLP | 85% (using 60°C volatization measurements before & after stabilization) |
| Commercial treatability lab (screening study) | RCRA Soil | N/A | Organoarsenic @ 6,000 ppm | PAC + $FeCl_3$ + Portland cement | 15 | >93% | N/A |
| Private treatability lab (R&D study) | Spiked Silty Soil | N/A | Ethylacetate @ 250 ppm | PAC + Portland cement | 10 | >95% | >99% |
| | | | Chlordane @ 50 ppm | | | >99% | 90% |
| | | | Trichlorophenol @ 1,000 ppm | | | >97% | >99% |
| | | | Tetrachloroethylene @ 2,000 ppm | | | >95% | 73% |
| | | | Toluene @ 900ppm | | | >96% | 65% |

* GAC= Granular Activated Carbon
** PAC= Powdered Activated Carbon
(1) TCLP Reduction = before and after measurement of leachable constituents via TCLP method (EPA Toxicity Characteristic Leaching Procedure)
(2) TWA Reduction = before and after measurement of total constituents via chlorinated solvent extraction (EPA Test Method SW 846, Method 8270

## Limitations of Liability

The Supplier's liability and the Purchaser's exclusive remedy for any cause of action arising out of this transaction, including, but not limited to, breach of warranty, negligence and/or indemnification, is expressly limited to a maximum of the purchase price of spare parts or equipment sold hereunder. All claims of whatsoever nature shall be deemed waived unless made in writing within forty-five (45) days of the occurrence giving rise to the claim. In no event shall the Supplier, for any reason or pursuant to any provision of the warranty, be liable for incidental or consequential damages or damages in excess of the purchase price, nor shall the Supplier be liable for loss of profits or fines imposed by governmental agencies.

## Safety Message

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable Federal and State requirements.

Visit our website at **www.calgoncarbon.com**


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