

DARAMEND[®] and TERRAMEND[®] Bioremediation Technologies

Solid-phase Treatment of Soils and Sediments Impacted with Organics

DARAMEND[®] is an advanced biological treatment technology for soils, sediments and solid wastes contaminated with recalcitrant organic compounds. The DARAMEND technology has been successfully applied to more than 1,000,000 tons (909,000 tonnes) of soil, sediment and other wastes contaminated with polynuclear aromatic hydrocarbons (PAHs), phthalates, chlorinated herbicides and pesticides, organic explosive compounds and wood preservatives at a variety of industrial and Department of Defense (DoD) sites in the United States, Canada and Europe. An independent audit conducted by the U.S. EPA found DARAMEND to be effective in treatment of soils at a wood preserving site. Recently, DARAMEND has been successfully applied to soils containing organic explosive compounds at U.S. Navy and Army sites in Virginia, Iowa, New Jersey, Nevada and Illinois. The technology is uniquely advantageous because it can often be applied without excavation, generates no odors or leachate and does not result in bulking. The use of DARAMEND can result in substantial cost savings and shorter remediation schedules compared to traditional bioremediation processes.



DARAMEND[®] powder

DARAMEND can easily be applied to soil that has been excavated. For example, for a multi-year project at the U.S. Navy facility in Yorktown, Virginia, TNT-impacted sediment is excavated from a wetland in 1,200 ton (1,090 tonnes) batches, placed in a 1,200 ton (1,090 tonnes) capacity engineered bioremediation cell, and rapidly treated using DARAMEND technology. The TNT concentration has been consistently reduced from an average of over 10,000 mg/kg to less than 10 mg/kg for every one of the four successful batches treated to date.

In contrast to many other approaches, DARAMEND is adaptable to *in situ* treatment of surface soils, down to a depth of approximately 2 ft (0.6 m). When feasible, this method of treatment can be the most cost effective. Relative to *ex situ* treatment with excavation and construction of a treatment cell, cost savings of between US\$20 and US\$50/ton (US\$22 and US\$55/tonne) are possible. *In situ* treatment has been successfully used for treatment of phthalates, PAHs, chlorophenols (including PCP), pesticides and *in situ* treatment of explosive compounds was initiated this year at a military facility in the United States.

The cost of using DARAMEND bioremediation technology is dependent upon project-specific details such as project scale, type of contaminant, targeted cleanup concentrations, project timeline and excavation requirements. Typical turnkey costs for DARAMEND treatment range from US\$50 to US\$170/ton (US\$55 to US\$187/tonne) of soil.

Adventus' TERRAMEND[®] technology is a lower cost version of DARAMEND for application to more readily degradable organics such as petroleum hydrocarbons. Turnkey costs for TERRAMEND treatment range from US\$18 to US\$30/ton (US\$20 to US\$33/tonne) of soil.



TERRAMEND[®] pellets