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ABOUT THIS ISSUE

This issue highlights treatment trains used to decontaminate sediments containing a diverse range of hazardous compounds, and composting for large-scale remediation of soils containing polychlorinated biphenyls.

Sediment Decontamination Program for the Port of New York and New Jersey

by Eric Stern, EPA, Region 2

Efforts to commercialize dredged-material decontamination technologies for use in the New York/New Jersey Harbor are underway by a public/private partnership involving the U.S. EPA-Region 2, the U.S. Army Corps of Engineers-New York District, the U.S. Department of Energy's Brookhaven National Laboratory, Rensselaer Polytechnic Institute, and private industry. Through a step-wise, bench- and pilot-scale validation process, innovative and cost-effective technologies will progress to a production-scale facility capable of processing up to 500,000 cubic yards (yd^3) of dredged material per year. This project is conducted under the Water Resources Development Acts of 1992 and 1996.

Major contaminants of concern in the harbor include heavy metals, chlorinated pesticides, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls, and dioxins/furans. Levels of contamination vary widely, but range as high as 130,000 ppb for total PAHs; and 42, 631, and 4 ppm for arsenic, lead, and mercury, respectively.

In a sediment decontamination program such as this, the physical characteristics of the sediment are as important as contaminant concentrations because of the associated materials-handling problems and difficulty in dealing with fine-grained material. The physical characteristics of typical dredged material in the Port include fine-grained silts and clays (80-95%), a small fraction of larger grain sizes, and large-size debris. The as-dredged material is characterized as having a 30-40% solids content consisting of 3-8% total organic carbon.

A treatment train comprising materials handling, decontamination, and beneficial reuse of material is required to treat the variety of contaminants and wide range of concentrations found in dredged material in the Harbor. The project team determined that dredging/decontamination costs could be reduced significantly through the development and commercialization of a long-term, sustainable, profit-making enterprise for decontaminating sediments with a beneficial reuse. Twelve technologies initially were evaluated in bench-scale tests. Based on results of bench-scale testing, the following six completed pilot-scale testing on up to 25 yd^3 of contaminated sediments:

- *A thermochemical process using a gas-fired melter (rotary kiln) and modifiers.* Operating temperatures ranging between 1,200° and 1,500° C achieved destruction of all organic contaminants to below detection limits, without any secondary waste streams. The end product is a pozzolanic material that can be mixed with portland cement (which immobilizes the metals) to make a marketable blended-cement product for use in the concrete and construction industries;

Recycled/Recyclable

- *A solvent-extraction process followed by solidification/stabilization using portland cement as the binding agent.* Operating at temperatures of 38-60° C, this process resulted in a 90% average reduction in organic concentrations. Potential uses of the resulting soil-like material include construction fill, landfill cover, mine reclamation, and capping of brownfields and Superfund sites;
- *Stand-alone solidification/stabilization using portland cement.* This process serves to immobilize contaminants. Potential uses of the resulting soil-like material include construction fill, landfill cover, mine reclamation, and capping of brownfields and Superfund sites;
- *A thermal vitrification process using a plasma melter.* At temperatures of 1,316-1,371°C, the vitrification process resulted in a 99.9% reduction in organic and 63% reduction in metal concentrations. The end product is a glass-like material that contains the immobilized metals. This material could be used as construction aggregate or roadfill material, or could undergo further processing to make glass-fiber or glass-tile products;
- *Manufactured soil production followed by phytoremediation.* The U.S. Army Corps of Engineers, Waterways Experiment Station, has developed methods for producing manufactured soil from untreated sediment by mixing it with a cellulose material (such as wood chips, saw dust, or yard waste compost), cow manure, and lime and fertilizer, as needed. Commercial vendors are devising manufactured soil technologies using decontaminated material.

  Phytoremediation was used to reduce contaminant concentrations in both metals and organics. The suitability of the soil for growth of different plant species was tested for tomato, marigold, rye grass, and vinca, and it was found that the soil is most suitable for the growth of rye grass. The potential beneficial use is to serve as a topsoil layer supporting vegetative cover for landfill closure, mine reclamation, and capping of brownfields and Superfund sites;
- *A sediment washing process using biodegradable surfactants, chelating agents, and oxidation.* During tests, concentrations of metals and organics were reduced by approximately 90% in silts, clays, and sands. The treated material, which has the consistency and appearance of sediment, can be used to make a manufactured soil product to be used in agriculture, horticulture, forestry, parks and recreation areas, and habitat creation.

The testing program led to development of a treatment train that included both low- and high-temperature technologies capable of treating dredged material with different levels of contamination (Figure 1). Each process of the treatment train has a beneficial re-use component necessary to offset the cost of processing. Findings indicate that improved methods for removal efficiencies of inorganics are important for future technology improvements.

During 1998-1999, the Port program will involve a 15,000-yd³ demonstration of an advanced sediment washing process producing manufactured soil as a beneficial re-use, and a 10,000 yd³ demonstration of a thermochemical process using a portable rotary kiln to manufacture a blended cement. Additionally, the plasma torch technology will undergo a marketability study using 1,000 pounds of vitrified dredged material. This work will lead to full-scale operation of these technologies, each capable of decontaminating at least 100,000 yd³ per year, by the year 2000.

On a parallel effort, in 1998, the New Jersey Department of the Treasury and the Office of New Jersey Maritime Resources will demonstrate new and innovative decontamination technologies capable of producing a marketable end product at a full-scale (500,000 yd³/year) cost of no more than $35/yd³. For more information, contact Eric Stern (EPA-Region 2) at 212-637-3806 or e-mail stern.eric@epa.gov.
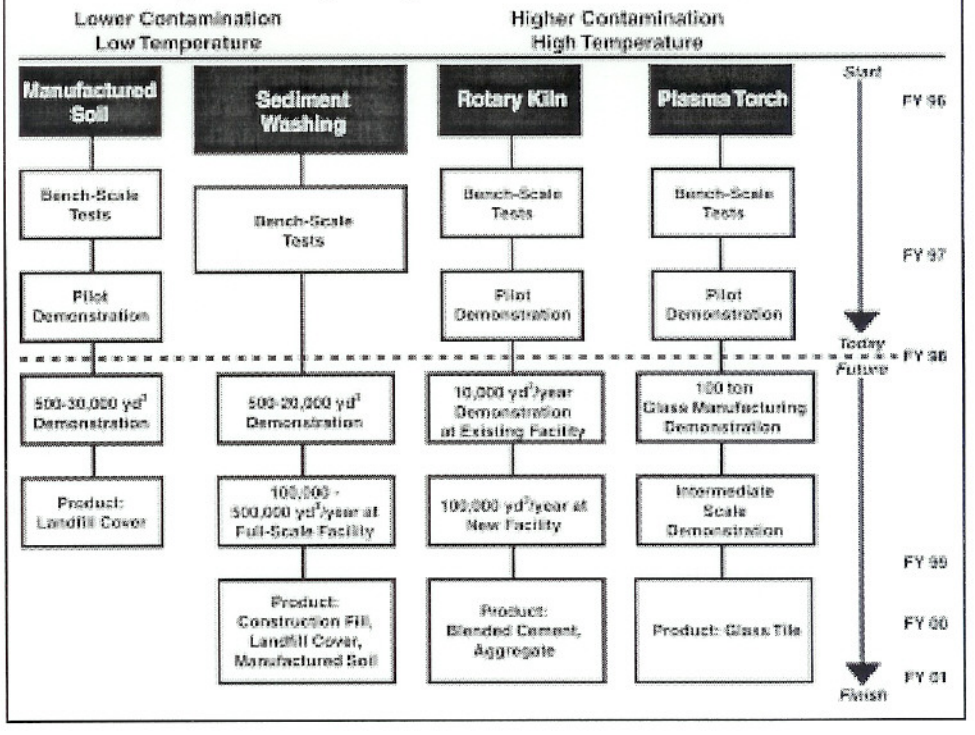
Figure 1. Plans for Large-Scale Decontamination Facilities