Upcycling Contaminated Soft Sediments

A CAIT demonstration project brought a new a technology from Japan for its debut in the United States. Pneumatic Flow Tube Mixing is a "one stop" approach to dredge processing and placement for beneficial reuse in construction and land reclamation projects.

About the project

Site: Clean Earth, Inc., dredge processing site in Kearny, New Jersey

Dredged material quantity: 4,500 yd^3

Material source: U.S. Army Corps of Engineers, Arthur Kill Site 4

Main contaminates: Polycyclic aromatic hydrocarbons, metals, and pesticides

Field operation duration: 2 months

Sponsor

New Jersey Department of Transportation
Program Manager: Scott Douglas

Research team

Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers
Principal Investigator: Ali Maher, Ph.D.

Tokyo Institute of Technology
Masaki Kitazume, Ph.D.

JAFEC-USA

Clean Earth Dredging Technologies, LLC

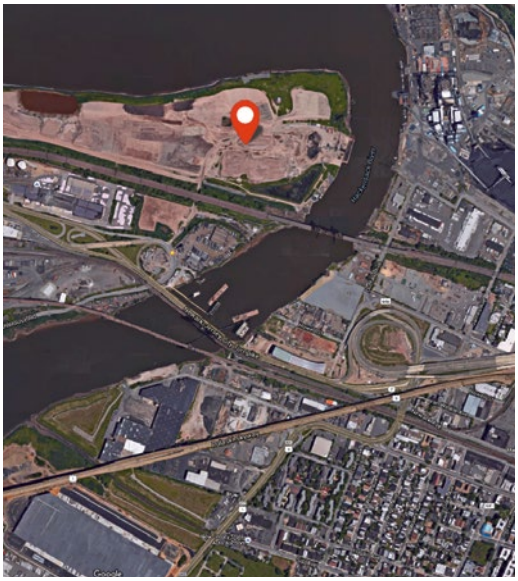
Sediment dredged from the world's harbors and ports can be used as fill for a range of land reclamation and construction projects, so engineers are always looking for more economical, ecological, and effective methods to use this plentiful material to their benefit.

The Port of New York/New Jersey is the largest shipping complex on the East Coast. To keep it operating, 5 to 6 million cubic yards of sediment—about half the volume of the Empire State Building—is dredged from the harbor annually. Due to the area's 100-plus-year industrial history, much of the dredged material is contaminated with PCBs, heavy metals, dioxins, and other pollutants. This material was dumped offshore or transported and stored in disposal facilities until the mid-'90s when New York and New Jersey jointly agreed that more efficient and environmentally sound solutions for dealing with dredged material were needed.

Muddy sediment from the New York/New Jersey harbor is generally too fine and soft to be used as construction fill without adding cement or another stabilizer, which also helps prevent contaminants in the material from leaching into the ground.

Usually, this material must first be taken to an onshore processing facility, and then transported to the location where it will be used.

The PTM system simultaneously processes and places material at the fill site, saving both time and transportation costs. For offshore and shoreline projects, PTM allows material to be dredged directly from the waterway, processed, and placed in a single operation.



Source: Google Maps

Top image: PTM operation at Clean Earth Technologies, Inc. ©Drew Noel Photography/Rutgers CAIT

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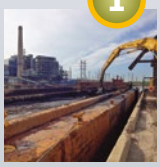
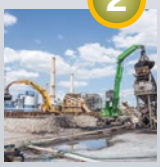
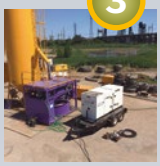
Upcycling using the Pneumatic Tube Mixing process



1 The dredged sediments are moved to the site on a barge or pumped directly from the waterway bed.

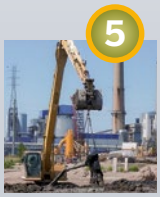


2 If there is debris in the dredged material, it is placed in a holding pit and then screened before entering the mixing system.



3 The screened material is pumped to a mixer and cement or a different stabilizer is added.

4 The sediment-cement mix agitates as it is piped to the pneumatic tube mixer, where blasts of compressed air break the "mud" into alternating air/mud plugs that are driven through the delivery pipe, mixing further.



5 The processed dredge material is then applied directly where fill is needed. It hardens into a stable surface in a few days.

PTM pilot project description and goals

Demonstration study goals

- Validate PTM as an efficient method of stabilizing contaminated fine sediments from New York/New Jersey harbor.
- Develop field specifications that are specific to the New Jersey/ New York region for using PTM in dredging operations.
- Make recommendations based on this small pilot project (4,500 yd^3) to scale up for operations of 10,000 to 15,000 yd^3/day or more.

The **field study** set up distinct areas for testing various concentrations of the Portland cement additive. Both shallow (1 foot) and deep (6 feet) test plots were filled with stabilized dredge materials. Cores from these plots are being evaluated to determine physical and chemical characteristics of the material. Additional in situ testing will assess suitability of the method.

The **laboratory study** consists of a comprehensive evaluation of raw and stabilized dredged materials' chemical and physical (geotechnical) characteristics for the purpose of designing further field experiments and developing QC specifications.

Binder Characteristics	
Type	Portland Cement
Quantity	4%, 8%, and 12%
Sediment Characteristics	
Physical, chemical and mineralogical properties of soil	Specific to CME location
Water content	In situ water content and that associated with 1.4 x LL for ease of flow during process
Curing Conditions	
Curing periods	7, 28, 90, 180, and 360 days
Curing conditions	Air dried and wet cured under both freshwater and seawater
Effect of disturbance	Included

PTM/06-18/e-only