Maritime Resources

New Jersey/New York Harbor

Sediment Decontamination Technology Demonstration Program

New Jersey Department of Transportation's Office of Maritime Resources (NJDOT/OMR) worked closely with the United States Environmental Protection Agency (USEPA) to evaluate new sediment decontamination technologies for their potential to provide new management opportunities for navigational dredged material. NJDOT/OMR initiated the Sediment Decontamination Technology Demonstration Program to evaluate technologies and foster the startup of commercial scale dredged material decontamination facilities that produce value added products from harbor sediments.

While the investigation of decontamination technologies has a long history, including over ten years at USEPA, NJDOT/OMR selected five firms representing the technologies most likely to be economically viable in the navigational dredging market to perform pilot scale projects on sediments from northern Newark Bay. These sediments are known to be among the most contaminated in the harbor's navigation channel system.

The technologies selected were:

- thermal destruction to manufacture lightweight aggregate (Upcycle Associates, LLC),
- thermal destruction to manufacture blended cement (ENDESCO/Clean Harbors, LLC),
- sediment washing and chemical destruction (BGW. LLC and NUI Environmental Group), and
- enhanced mineralization/chemical destruction (BEM Systems, Inc.).

Technologies considered promising were given the opportunity to propose demonstration level projects.

You will need Adobe Acrobat Reader to view the PDF files which is available at our state Adobe Acrobat Access page.

Technology summaries:

BEM Systems, Inc.

BEM of Chatham, NJ evaluated the use of Georemediation technology to transform dredged materials into a material suitable for fill, cover or

capping projects. Georemediation technology is a proprietary admixture process that reportedly decontaminates sediment in two ways. The additives are mixed with sediments and are allowed to incubate for a period of several weeks. During this time, metals are incorporated into the mineral matrix and organic contaminants are oxidized. The resulting soil-like material can then be used as a stabilized fill for remediation or construction. More information is available from the project update sheet (pdf 111k).

BGW, LLC

BioGenesis Enterprises was the only decontamination technology vendor to complete their pilot project under the USEPA/ WRDA decon program. For more information on the pilot study, visit the BioGenesis web site. BioGenesis Enterprises (operating as BGW, LLC) performed a demonstration scale test of their sediment washing technology at the Bayshore Recycling facility in Keasbey, NJ between December of 2005 and May of 2006. The Biogenesis technique involves slurrying dredged material with surfactants, mixing them violently, and extracting the mineral from the water/organic fraction of the sediment. Strong oxidizers are used in the process to destroy the organics, and metals are treated through conventional water treatment technologies. The minerals are separated from the water using centrifugation and belt filter presses. The resulting clean aggregate is then used as a base for topsoil manufacture. Over the course of the project, BioGenesis treated over 14,000 cyd of sediment from the Raritan River, Arthur Kill and Passaic River. While the overall program was plagued with logistical problems resulting from the use of an innovative handling and storage facility at Bayshore Recycling, the decontamination portion of the program was successful at showing the potential for this technology to process more dredged material than any of the other technologies tested. Some limitations with regard to litter and refractory organic detritus were illustrated during the project; however the team was able to overcome these difficulties with time. A full scale facility can be designed from the lessons learned and may be competitive with current market prices for dredged material processing. The resulting aggregate was used in the remediation of a nearby brownfield site under an Acceptable Use Determination. A portion of that material was shipped to Connecticut for use in a beneficial use project. Another smaller portion was used to manufacture topsoil which was used to build a demonstration garden at Montclair University. While the treated aggregate was typically not suitable for unrestricted beneficial use due to high concentrations of either Arsenic or PAHs or both, once blended into topsoil it met the standards for Residential use in New Jersey. Details of the treatment program and beneficial use can be found in the full project report (pdf, 34.9Mb). It is important to note that the use of BioGenesis technology on material more contaminated than that seen in this study would require careful benchscale evaluation.

ENDESCO/Clean Harbors

ENDESCO Services of Des Plaines, IL, used the resources of the Gas Technology Institute to bring a rotary kiln to the harbor for the manufacture of blended cement from dredged material. Sediments were dewatered using a filter press, mixed with geotechnical modifiers and then fed into a rotary kiln at temperatures in excess of 2500 degrees Fahrenheit (or over twice as hot as an incinerator). In the kiln, the sediments actually melt, or vitrify, and come out the other side looking like chocolate jimmies. The EcoMelt is then pulverized and mixed with

other materials to provide a blended, cement product. Blended cement is found in products like Sacrete. As with other kiln technolgies, the organic contaminents are completely destroyed in the extremely high temperatures. Any by-products, such as mercury vapor, are removed using state-of-the-art pollution control equipment. Metals are incorporated into the glass-like product and are unleachable. A pilot plant was constructed at the IMTT site in Bayonne, NJ in 2002/03 and tested during 2004/05 on approximately 100 cyd of Newark Bay sediment. The pilot report (pdf 4.8m) clearly shows that thermal destruction is a viable method for cleaning contaminated sediments without compromising air quality. Unfortunately, the design of the kiln feed and discharge systems proved inadequate for sustained production of Eco Melt and additional design work (pdf 5.3m) was required. Despite the fact that sustained operations were still hampered by poor outlet design, additional testing was performed using sediment from Newark Bay and the Passaic River. This demonstration report (pdf 5.5m) shows that the Cement Lock technology is potentially viable for small scale operations on both highly and moderately contaminated sediments at a reasonable price. Prices can be even lower if mixed waste streams are utilized, but this comes at a reduced throughput rate for sediment. Energy can be generated from the operations if the kiln is fitted with cogeneration equipment (steam turbine). The team evaluated the potential for Cement Lock technology to be used as a remedial technique for the Passaic River cleanup (pdf, 3.61m), which was subsequently amended (pdf, 281k). A report (pdf 2.9m) on beneficial use of the EcoMelt product is also available. Appendices listed in the report are available on request.

Harbor Resource Environmental Group

Harbor Resource Environmental Group, Inc. of Red Bank, NJ (formerly NUI Environmental Group of Elizabeth, NJ) and their partners Parsons Brinkerhoff, Tetra Tech EC, Inc., LITT Consulting, and Lefco Environmental Services evaluated a technique to reduce organic contamination through the direct addition of a strong oxidizing agent (Potassium Permanganate). The resulting cleaner sediment was then dewatered using a belt filter press and blended with Portland cement to create an amended dredged material typical of that used in other projects. The benefit of this technology is its potential to provide a "low tech/low cost" way to bring down the concentration of certain contaminants in dredged materials, thereby making it suitable for a broader range of beneficial uses. A pilot study (pdf 2.8m) on 650 gallons of upper Newark Bay dredged material was completed in 2001 on this approach. A larger scale demonstration was conducted in 2005 at the Bayshore Recycling facility in Keasbey, NJ . The demonstration project (pdf 5.9m) on the decontamination of 300 cubic yards of upper Newark Bay dredged material yielded mixed results.

Upcycle Associates, LLC

Jay Cashman, Inc. of Boston and Upcycle Aggregates of New Jersey have teamed up to utilize dredged material as feedstock for the manufacture lightweight aggregate. Sediments are first dewatered using a belt filter press, then mixed with shale fines and extruded into pellets. The pellets are fed into a rotary kiln at temperatures of 2100 degrees Fahrenheit (about twice as hot as a solid waste incinerator). In the kiln, the pellets begin to melt then "puff" as the organic matter inside explodes. The pellets are then cooled and come out looking like brown cheese puffs. The pellets are completely inert and can be used in place of stone in lightweight concrete manufacture or as fill material where weight is an issue. All volatile contaminents are destroyed by the hot

gases or collected in state-of-the-art pollution control equipment (including particulates, mercury and dioxins). Metals are incorporated into the mineral matrix of the product and are unleachable. A 4 cubic yard (cy) pilot project, Sediment Decontamination and Beneficial Use Pilot Project - Final Summary Report (pdf 6.2m), was completed in 2001 and a demonstration project is currently being planned. More information is available from the project update sheet (pdf 52k).

The following are NJDOT/OMR presentations on the program:

- The Use of Sediment Decontamination Technologies for the Management of Navigational Dredged Materials (November 2002) (pdf 1.9m)
- The Use of Sediment Decontamination Technologies for the Management of Navigational Dredged Materials (November 2001) (pdf 1.8m)

In situ Stabilization

One of the biggest concerns that we have in the decontamination program is removal and handling of moderate to highly contaminated sediments. Because the sediments are fine grained and highly unconsolidated, resuspension during dredging and loss of sediment during handling is a big concern. NJDOT/OMR contracted with the Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers to research the feasibility of using deep soil mixing technology to partially solidify contaminated harbor sediments *in situ*.

CAIT, working with Raito, Inc., utilized a strategy that has been proven successful in California and in Asia to stabilize sediment for waterfront construction (pdf 180k). The concept involves using a triple auger system to penetrate into unconsolidated sediments. When the desired depth is reached, the augers are reversed while a grout mixture is injected down the auger shafts into the sediment. The augers agitate the sediment grout mixture as they are withdrawn from the sediment.

The team hypothesized that once the mixture cured, the sediment particles would be held in place, preventing resuspension and effectively entombing the contaminants they may contain. The sediment can either be left in place without fear of contaminant loss, or it can be removed without the particle suspension that typically occurs during dredging. It also would make the handling of contaminanted sediments much easier and safer.

As can be seen in the pilot report (pdf 887k) and in these photos (pdf 1.3m) the technology was highly effective at stabilizing unconsolidated sediments in Newark Bay. The stabilized sediment was allowed to cure for several months, and was easily removed with conventional dredging technology. Additional investigation is needed to evaluate the efficacy of the technology at larger scales and to quantify the potential for contaminant release during stabilization and removal.

Last Updated: March 17, 2010