A new multidisciplinary approach to dredged sediment management: Venice industrial Channels and other tests

Antonino Rapisardi[1], Edoardo Slavik[1], Daniele Vanni[2], **Giovanni Preda[2]** and Sabine E. Apitz[3]

[1]3V Green Eagle S.p.A., Bergamo, Italy
Phone: +39 035 0761306
E-mail: antonino.rapisardi@3vgreeneagle.it

[2]Trevi S.p.A., Cesena, Italy
Phone: +39 0547 319579
E-mail: gpreda@trevispa.com;

[3]SEA Environmental Decisions Ltd., 1 South Cottages, The Ford, Little Hadham, Hertfordshire SG11 2AT, UK
Phone: +44-(0)-1279-771890
E-mail: drsea@cvrl.org

Introduction and Background: In spite of significant reductions in chemical emissions in recent decades, ports, harbors and waterways throughout the world must contend with a legacy of contaminated sediments that continue to complicate the objectives of navigation, development and ecosystem restoration. While containment and disposal of contaminated dredged material (CDM) remains an option, limited capacity, public opposition, waste hierarchy issues and concerns over long-term risk, monitoring and liability can all be barriers. On the other hand, many treatment approaches raise concerns about energy use, emissions, waste streams and fate of treated materials. The ideal approach for any project depends on a site-specific balancing of these competing decision drivers, but most regions will require a flexible mixture of approaches tailored to region-specific drivers and the characteristics of various sediment management units within a project. This paper will describe the demonstration of a flexible, innovative, very low emission treatment, reuse and recycling process for lightly to extremely contaminated (metals, PAHs, PCBs, dioxins) sediments in industrial ports in Italy (Porto Marghera, Venice Lagoon and other sites).

Approach/Activities: Referring tot he Venice Lagoon, a full-scale (150 m^3) demonstration treated sediments from three different regions of the Port. The treatment train was customized to sediments at each sub-site. The weakly contaminated sediment was treated by size separation and re-use of cleaner coarse materials; the remaining slurry of fines was subjected to centrifugation and process consolidation with stabilizers continuously customized to feed stream characteristics; this results in a remarkably homogeneous stabilized material. The cement grout, the recipe of which is adapted to optimize the addition of water, is introduced directly at the entrance of the centrifuge. The binders' quantity in kilos per tons of dry solid in the solid discharge that is produced by the decanter is calculated on the basis of the features required from the material and to its final use. There is thus a thorough mixing of the binder with the solid matrix; the resulting material begins to harden immediately after emerging. The resulting consolidated material is suitable for disposal or re-use. Extremely contaminated slurries, on the other hand, were subjected to a patented high temperature and pressure wet oxidation treatment. This process, used extensively in Italy for a range of wastes, breaks down complex organic compounds, including contaminants, to CO2 and water, as well as trace amounts of biodegradable compounds. Outputs for treated DM are thus traces of CO2, water which can be subjected to biodegradation and re-use, and an inorganic inert product that can be recycled in the manufacture of highly resistant and shape controlled expanded materials. These low density, high compressive strength materials, with inorganic constituents such as metal contaminants tightly locked up in stable crystals, can be used in several applications such as mortars, plasters, glues, light concrete and industrial laundries. Heat generated during the exothermic treatment process is recycled in the drying of solids before recycling.

Results and Discussion: A frequent cause of failure when treatments are scaled up from bench to field is the highly variable nature of DM as a feed stream. An adaptable system and experience in treating a range of wastes were critical to the success of this demonstration. Experimentation goals were to develop several technologies and assess the advantages that the cycle offers: a) Production of reusable material; b) Elasticity of the process; c) Integration with validated processes; d) Reduction of contamination. Experimentation with process consolidation produced a material meeting these objectives with a single process, reflux-consolidation, reducing handling and allowing the harbor authorities to save money. The wet oxidation treatment was efficient on highly contaminated sediments. Detailed results of the demonstration will be presented, but organic contaminants (hydrocarbons, dioxins, PAHs and PCBs) were reduced by 80-95%, with metals oxidized to stable mineral forms. Sustainability and feasibility of the treatment train has been evaluated and scored in terms of waste hierarchy, cost, energy use and short-term and long-term human health and ecological risk. Considering these parameters, scores based demonstration results will be compared to a range of other common CDM management strategies.