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Contaminated Sediments

Sustainable Management and Remediation

JAI Guest Editors

Mark Dyer
Rosa Galvez

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Foreword

THIS COMPILATION OF THE *JOURNAL OF ASTM INTERNATIONAL (JAI)*, STP1518, on *Contaminated Sediments: Sustainable Management and Remediation*, contains only the papers published in JAI that were presented at a symposium in Dublin, Ireland from June 30 to July 3, 2009 and sponsored by ASTM Committee D18 on Soil and Rock.

The JAI Guest Editors are Mark Dyer, Trinity College, Dublin, Ireland and Rosa Galvez, Laval Univeristy, Quebec, Canada.

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Innovative Remediation Technologies and Processes

Overview

Water bodies and seaways like the Mekong River in Asia and the Saint Lawrence River in Canada or heavy ship traffic ports in service worldwide, like those in cities such as Taranto (Italy), Istanbul (Turkey), Tokyo (Japan), or New York (USA), are omnipresent in the history of human development.

Retrospectively, there was an ancient belief that water bodies carried an unlimited self-purifying power and thus toxic substances have been discharged into waters since the beginning of the Industrial Revolution, causing contaminated water and sediments. It has been estimated that almost half of the industries active in the areas of agriculture, industrial production, manufacturing, and extraction or treatment of natural resources are located near the shores of ports on rivers or seas. Today entire river, lake, and ocean-shores ecosystems are threatened with exposure to the accumulated toxic substances.

Observations on the decline of fish, bird, and mammal populations, an increase in algae blooms on water bodies, the need to manage contaminated sediments to keep waterways in service, or re-give water bodies their recreational role, have aroused public concern about contaminant accumulation within bottom sediments. The global awareness of the limits to human growth has, fortunately, turned the concepts of sustainable development into a social priority. The application of these concepts is becoming reality in the forms of protection, restoration, and environmental planning and actions.

As ASTM-STP1518 will show, the last several years have witnessed an increase in government policies and bills that have provided funds to conduct research and characterization/restoration projects all over the world. STP1518 includes a fine compilation of interesting case studies for important projects being conducted in Ireland, Scotland, Malaysia, Turkey, Japan, Canada, and the USA. These projects provide examples of detailed geochemical characterization, contaminant cause–effect links with health, natural attenuation, and proposals of environmentally sound solutions to the SUSTAINABLE MANAGEMENT AND REMEDIATION OF CONTAMINATED SEDIMENTS. From this point of view, the organizing committee of the 4th ASTM International Symposium of Contaminated Sediments (ISCS) is proud to have achieved its main objective.

Indeed, papers presented at the 4th ASTM ISCS showed that sediments constitute a concentrated reservoir of metals, heavy metals, organic contaminants (HAPs, PCBs, TBT) in concentrations ranging from trace levels to several orders of magnitude higher than those found in the overlaying or in the interstitial water. Ecotoxicological data shows that contaminated sediments can threaten an ecosystems health by increasing the mortality rates and/or by decreasing the growth or reproductive rates of susceptible aquatic populations where these effects can be transferred throughout the ecosystem via food chain pathways.

Data on dredged sediments from Istanbul, Tokyo, or Taranto ports showed contamination of various degrees. In the past, when not discharged into open water or along the water banks, the dredged material was used as filling material for dam construction, as a source of sand and clay for construction, and for building artificial islands. Today these reuse activities are limited due to an increased awareness of the toxicity of the sediments.

The environmentally safe handling of contaminated sediments is a new area of concern for geo-environmental engineers. The options to frequently consider are: (a) coverage of contaminated sediments by structural features or by adding fixing agents; (b) the neutralization of contaminants by dredging, treating, and re-deposition of the sediments in place; (c) the dredging of the contaminated sediments followed by off-site encapsulation; and (d) the encapsulation of the sediments along the shore by dredging, accumulating, and covering.

Due to the potential threat to human/ecosystem health, projects are frequently subject to the approval of environmental evaluations and public hearings. Involving the majority of stakeholders from the beginning of any remediation project, from coneption through the decision-making process, is judged to be greatly beneficial. Aspects such as stakeholder preoccupations, building integrated remediation scenarios, aid decision approaches, and public communication will be included in the program of the 5th ASTM ISCS scheduled to take place in Montreal in 2012.

Some aspects and points of discussion that could be added to the technical program of the 5th ASTM ISCS include the following:

Most remediation scenarios include dredging, probably because dredging appears to be the only solution to recuperate the contaminants within the sediments. The problem of what to do with the extracted sediments still remains to be carefully considered (technically, economically, and environmentally). The sediments may be considered as hazardous waste and must be detoxified to one's best ability as stipulated by local government regulations.

The main constraint against dredging is the potential hazard of re-suspending the contaminants in the water column. The factors controlling this hazard were reviewed during keynote lectures. The potential hazard associated with re-suspension is a valid concern when dealing with open water bodies such lakes, rivers, or ocean sites (as opposed to canals) in which the protection of micro- and macro-habitats is a priority. However, modifications and upgrading of dredging equipment may assist in the minimization of this difficulty. Several specialized bodies (i.e., the U.S. Army Corps of Engineers) have elaborated procedures to minimize the ecological impact and accentuated the need for building better dredging equipment. In that sense, Japan, USA, Belgium, and The Netherlands have also marketed dredging equipment with special features specifically for the dredging of contaminated sediments.

The installation of a low permeability cover membrane or the use of fixing features (e.g., grids, sand/gravel) as possible solutions may be limited by a

self-consolidation and overloading phenomenon that may result in the extrusion of pore water containing some of the contaminants.

There is no universal cover material, and the choice and installation techniques for such a membrane on-site are complex. At present, this technique is used frequently for emergency situations and serves to control the escape of contaminants (e.g., during hazardous waste spills). For long-term utilization of these membranes, exhaustive compatibility studies between sediments and membranes must be investigated. It must be recognized, however, that the in situ encapsulation and/or mechanical fixation of contaminants is definitely a non- permanent solution from the viewpoint that contaminants will remain in their actual state, protected by a liner for which lifetime and membrane integrity assurance are the subjects of great controversy.

The treatment option, either in situ or ex situ, seem to be in harmony with public environmental concerns since contaminants will be either removed or fixed.

Remedial techniques are presently chosen and applied based mainly on a cost analysis linked to an incomplete risk evaluation of the hazard posed by contaminated sediments, both facts being reflected in an absence of remediation criteria. If better knowledge of how contaminants are retained within the sediments is available, efficiencies of contaminant removal or fixation—or the actual real need for decontamination (the no action option)—would be quantifiable, the incertitude of risk levels will be minimized, and rational, realistic remediation goals will ultimately be applied in technically sound decontamination projects.

The editors wish to thank all the members of the international and local organizing committee for all efforts and collaboration. Thanks are extended to the editorial and symposia ASTM teams, in particular to Dorothy Fitzpatrick, for her patience and always positive input.

We also wish success to the organizing committee of the 5th ASTM ISCS to be held in Montreal in 2012, and would like you to consider this publication as an invitation and the promise of a grand event. In the meantime you are invited to continue the exchange of views and knowledge that took place at the 4th ASTM ISCS by visiting www.astm4iscs.blogspot.com.

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