Contaminated Sediments:
5th Volume
Restoration of Aquatic Environment

Co-Editors:
Catherine N. Mulligan
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Selected Technical Papers STP1554
Contaminated Sediments, 5th Volume:
Restoration of Aquatic Environment

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Foreword

THIS COMPILATION OF Selected Technical Papers, STP1554, on Contaminated Sediments, 5th Volume: Restoration of Aquatic Environment, contains 18 papers presented at a symposium with the same name held in Montreal, QC, Canada, May 23–25, 2012. The symposium was sponsored by the ASTM International Committee D18 on Soil and Rock.

The Symposium Co-Chairs and STP Editors are Catherine N. Mulligan and S. Samuel Li, both from Concordia University, Montreal, QC, Canada.
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Overview

Although part of the aquatic geoenvironment, sediments have received much less attention from researchers, policy-makers, and other professionals than other components. Sediments, however, are an essential and valuable resource in river basins and other aqueous environments. A large biodiversity lives in the sediments. It is thus a source of life and resources for humans as construction materials, sand for beaches, and farmland and wetland nutrients. Due to the close contact of sediments with the water environment, they are both a source and a sink for contaminants. There is a need to develop a better understanding of the sediment-water environment and better management practices due to their potential impact on human health and the environment. In particular, they need to be considered during efforts to meet sustainability requirements. Some of the major impacts due to increasing population pressures include:

- Loss of biodiversity and living resources
- Increased production of wastes and pollutants
- Depletion of non-renewable natural resources
- Decreased soil, water and air quality
- Increased discharges of greenhouse gases.

Sources of effluents containing the solids include urban, agricultural and industrial lands. Sediments have been removed for centuries by dredging for maintaining navigation and managing contaminated sediments. Alternative methods of sediment cleanup and management are needed and must be proven. The binding of the contaminants to the sediments, their bioavailability, mobility and degradability are all important aspects that must be addressed. Case studies are an important way to do so.

The major objectives of the symposium are to:

- Identify sources, types, and behavior of contaminants
- Discuss and share the state of art of sustainable options for the management of contaminated sediments in marine and freshwater environments for restoration of surface water
- Provide a forum to debate future directions and visions in terms of technical, environmental and economical perspectives
- Promote multilevel involvement and participation of stakeholders in restoration strategies.
The symposium aimed to attract a wide variety of papers and audiences from multidisciplinary backgrounds. Specific topics covered included the following:

- Source control, sustainability indicators, fate and transport of contaminants
- Ecotoxicology and bioavailability, port and harbor management, sediment quality assessment tools, beneficial re-use strategies for dredged materials, and combined treatments
- In situ and ex situ remediation technologies and natural recovery processes
- Sediment transport, risk assessment and decision making, sampling, monitoring and performance evaluation, habitat restoration, and biodiversity
- Sediment and site characterization, marine sediments, fresh water sediments, policies and regulations.

A compilation of interesting case studies for important projects being conducted in various countries including Japan, Canada, the USA and Ireland is included. These projects provide examples of the application of a variety of remediation techniques, risk assessment approaches and environmentally sound solutions to the restoration of the aquatic environment. The symposium audience included scientists, engineers, regulators, remediation site owners, and other environmental professionals from universities as well as students and consultants. Poster presentations and a panel discussion were also included in the symposium. From this point of view, the organizing committee of the 5th ISCS is proud to have achieved its main objectives.

Papers presented at the 5th ASTM International Symposium of Contaminated Sediments showed that sediments constitute a concentrated reservoir of dioxins, heavy metals, PAHs, and hydrocarbons in concentrations ranging from trace levels to several orders of magnitude higher than those found in the overlying or in the interstitial water. Ecotoxicological risk assessment was used to determine the link of macroinvertebrate traits and environmental conditions in addition to that of sediment quality guidelines with the trait combinations for management of dredging in the St. Lawrence River. A study in Japan on the effect of anoxic sediments on sand lance indicated that the modified sulphide could damage the aestivating sand lance. A public health impact assessment was incorporated into Ireland dredging license applications. The use of this approach was shown in an example of a port located in an urban environment close to residential areas. Another decision-making approach for sediment delineation is to use a quality assurance program as exhibited for coal ash release in the USA.

Two large-scale projects were highlighted in the Symposium. The proposal for the Randle Reef Remediation project, one of Canada’s most contaminated sites containing hydrocarbons and PAHs, involves dredging and the design of an engineered containment facility (ECF). The other was for the remediation of dioxin contaminated sediments in a large watershed in the USA. The exposure
studies, plant and animal assessment, and future remediation and restoration steps were reviewed.

The sustainable management of contaminated sediments is a new area of concern for geoenvironmental engineers. The options considered are: a) containment of contaminated sediments by engineered facilities or by adding fixing agents; and b) the removal of contaminated sediments by dredging, and treating, and off-site encapsulation.

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.

Various approaches to stabilization/solidification (S/S) have been used. One paper presented the results of leaching tests on a limestone cement stabilized chromium contaminated clay, while another examined the sorption of naphthalene to the cement treated soil and the effect of additives. Cementation to recycle wastes and improve the ground has been recently proposed. The possibility of using fly ash for the solidification/stabilization (S/S) of Ni and Zn was shown for contaminated sediment from the Krivaja river basin (Serbia). Cement-treated soil and air-foam treated lightweight soil were used as backfill from seawall structures. Air bubble treatment or addition of carbonized sewage sludge improved the properties of the soft clay soil. A flotation technique to remove copper from contaminated sediments was presented which would allow the treated sediment to be used at industrial or commercial sites.

In situ approaches are also considered. As organophilic clays can effectively adsorb NAPL and organic contaminants, they are useful as additives to a sediment cap, but the quantity used must be evaluated on a site-specific basis. The main constraint against dredging is the potential hazard of resuspending the contaminants in the water column. The potential hazard associated with resuspension is a valid concern when dealing with open water bodies such as lakes, rivers, or ocean sites (as opposed to canals) in which the protection of micro- and macro-habitats is a priority. However, a sediment resuspension technique was evaluated for enhancement of water quality for a phosphorus impacted lake. The phosphorus content could be substantially reduced in some preliminary tests.

Oil contamination was addressed both in the water and sediments. Aggregation of oil and suspended particulates was recently studied as it could potentially significantly impact oil transfer from the water to the sediments. As a remediation method for the oil in the water phase, peat has been shown to be an effective natural sorbent compared to other materials.

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 natural recovery option) would be quantifiable, the incertitude of risk levels would be minimized and rational, and realistic remediation goals would ultimately be applied in technically sound decontamination projects. Leaching tests remain an effective way to evaluate the transport of heavy metals (zinc and cadmium in particular) from sediments.

The editors wish to thank all the members of the international scientific committee and those within Concordia University for all their efforts and collaboration in organizing this symposium. Thanks are extended to the editorial and symposia ASTM teams and paper reviewers, in particular to Mary Mikolajewski, Manager, Symposia Operations. We would also like to express our condolences to the family and friends of one of the authors, Milena Dalmacija, Ph.D. who tragically lost her life.

We also wish success to the organizing committee of the 6th ASTM ISCS, at a location to be confirmed.

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