COMPONENT PART NOTICE

THIS PAPER IS A COMPONENT PART OF THE FOLLOWING COMPILATION REPORT:

TITLE: United States - The Netherlands Meeting on Dredging and Related Technology (3rd) Held in Charleston, South Carolina on 10-14 September 1984.

TO ORDER THE COMPLETE COMPILATION REPORT, USE AD-A182 670.

THE COMPONENT PART IS PROVIDED HERE TO ALLOW USERS ACCESS TO INDIVIDUALLY AUTHORED SECTIONS OF PROCEEDING, ANNALS, SYMPOSIA, ETC. HOWEVER, THE COMPONENT SHOULD BE CONSIDERED WITHIN THE CONTEXT OF THE OVERALL COMPILATION REPORT AND NOT AS A STAND-ALONE TECHNICAL REPORT.

THE FOLLOWING COMPONENT PART NUMBERS COMPRISE THE COMPILATION REPORT:

AD#: AD-P005 474 - AD-P005 505 AD#: ________

AD#: ________ AD#: ________

AD#: ________ AD#: ________

IMPROVED TECHNIQUES FOR REMOVAL OF SEDIMENTS CONTAMINATED WITH HAZARDOUS MATERIALS

Roger S. Wetzel,* Anthony N. Tafuri,**
John R. Sinclair†

INTRODUCTION

Removal of contaminated sediments by dredging poses numerous technical and economic problems. These problems include the availability of dredging equipment suited for removing contaminated sediments in an environmentally sound manner, the ability to accurately delineate the extent and depth of the contaminated sediments, the availability of techniques for managing contaminated dredged material (e.g., dewatering, transporting, disposal), and the need to improve efficiency and cost-effectiveness of the dredging operations. Actual "hands-on" type data relating to these problems are minimal because there have been only a limited number of documented contaminated sediment dredging operations in the United States.

Realizing the need to improve the capabilities of response personnel in dealing with cleanup operations involving contaminated sediments, the US Coast Guard and the US Environmental Protection Agency (EPA) have jointly funded a research project to: (a) identify, characterize, and classify chemicals that sink in watercourses and are amenable to recovery by dredging and/or other techniques such as in-situ treatment; (b) review the state of the art of contaminated sediment management technology to document and identify improved methodologies for handling and disposing of contaminated sediments; (c) implement pilot-scale studies on recommended modified approaches identified under the state-of-the-art work; and (d) perform field demonstrations of methods and equipment developed.

The first two activities under this program have been completed and are the subject of this paper. The work was performed by JRB Associates under EPA Contract No. 68-03-3113, Task No. 14, and was jointly funded by EPA and the Coast Guard under an interagency agreement.

Under the Federal Water Pollution Control Act (Public Law 92-500) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund"), the Coast Guard and the EPA are mandated to ensure safe cleanup of hazardous chemical discharges in waters in the United States,

---

* JRB Associates (A Company of Science Applications, Inc.), 8400 Westpark Drive, McLean, Virginia.

** US Environmental Protection Agency, Municipal Environmental Research Laboratory, Oil and Hazardous Materials Spills Branch, Edison, New Jersey.

† US Coast Guard, Office of Research and Development, Environmental Technology Branch, Washington, D.C.

including bottom sediments which underlie the waters. In addition, the US Army Corps of Engineers is charged with maintaining the navigability of commercial waterways by dredging sediments to maintain adequate channel depths. The Coast Guard and EPA are concerned primarily with removal of contaminants (which may be in contact with sediments), while the Corps is concerned primarily with removal of sediments (which may be in contact with contaminants).

There are essentially three possible courses of action that can be taken to deal with sediments contaminated with hazardous materials:

a. Take no action and allow the contaminated material to remain in place.

b. Remove contaminants and sediments and treat, recover, and/or dispose.

c. Isolate or treat contaminated sediments in situ using physical or chemical means.

The first option is often unacceptable because of the environmental and health threats posed. Removal of contaminated sediment from the watercourse is most frequently accomplished by dredging and has been implemented at several sites in the United States and more extensively abroad. The third option, in-situ treatment, has received little attention in the United States, and is not considered to be an established technique.

The following are discussions of the activities that have been completed under this program.

IDENTIFICATION, CHARACTERIZATION, AND CLASSIFICATION OF HAZARDOUS CHEMICALS THAT SINK

Sinking chemicals, which are chemicals that are denser than water and relatively insoluble in water, present a serious potential threat to sediments underlying surface water bodies. If a sinking chemical is spilled and enters a surface water body, it tends to fall or flow to the bottom and, if liquid, tends to permeate the sediments. Once there, the properties of the spilled chemical determine its fate and potential hazards to people and to the environment. If a spilled chemical remains at the bottom of a watercourse, it can permeate the sediments and enter the food chain, producing toxic effects in aquatic and terrestrial flora and fauna, and in humans who drink the water, eat the plants or animals, or come in contact with the water.

The tendency of a chemical to sink in water can be predicted from its specific gravity and from its water solubility. In addition, important properties for predicting environmental transport, fate, and impact include physical state, reactivity, toxicity, bioaccumulation potential, and aquatic persistence. Knowledge of the chemicals and their properties is essential in deciding what remedial action is necessary and most likely to be effective.

In this regard, a database was developed using chemicals from the Chemical Hazards Response Information System (CHRIS) list and chemicals regulated under CERCLA. This database expands on the 1978 report, "A Feasibility Study of Response Techniques for Discharges of Hazardous Chemicals that Sink," performed for the Coast Guard by the US Army Engineer Waterways Experiment Station, by providing additional data on a larger number of chemicals. The resulting Hazardous Sinkers List contains 468 chemicals and the following information for each chemical (within the limitation of the availability of data):

- CHRIS code
- Physical state
- Specific gravity
- Water solubility
- Toxicity
- Ignitibility
- Reactivity
- Bioaccumulation potential
- Aquatic persistence
- Recovery and handling hazards
- Recommended response actions

REVIEW OF CONTAMINATED SEDIMENTS MANAGEMENT TECHNOLOGY

This review was accomplished through an information search (literature, manufacturers, vendors, associations, interviews) and through case studies involving contaminated sediments management with emphasis on remedial measures. It revealed that many existing technologies, such as those from the construction, dredging, mining, wastewater treatment, spill response, and hazardous waste management industries, are applicable to contaminated sediments management. The review also includes case studies in which various unconventional techniques were implemented. All of this information is summarized in table format.

In addition to the technologies employed in the cleanup incidents, the information search further revealed a wide variety of other technologies that have potential applicability to cleanup of contaminated sediments. The equipment and techniques associated with these technologies were investigated. Those having high potential for wide application were identified and needs for further research, development, and/or demonstration were described. The subject of contaminated sediments management was divided into the following functional categories for the purpose of technology review:

a. Characterization and location of sediment contamination.

b. Equipment and techniques for removing sediments.

c. Dredged material management.

d. In-situ treatment methods.

OTHER FINDINGS

This research has identified other areas of concern which have potential for advancing the state of the art. In an effort to avoid duplication of ongoing research programs, and also considering time and resource limitations of this project, three activities were selected to fulfill the remaining objectives of the project. These activities are as follows:

Investigation of improved methods for selectively separating dredged solids by level of contamination

Since a major portion of the contaminated dredged material management problem is associated with the volume of material that must be handled, costs can be minimized by isolating contaminated material and handling and disposing only that portion of the dredged material classified as "hazardous." The separation of solids by level of contamination appears to be possible by the tendency of contaminants to adsorb onto fine-grained sediments such as clays and organic material. Off-the-shelf equipment is limited in applications involving separation of contaminated sediments. The examination of cases where existing solids separation equipment has been employed indicates that development of equipment designed specifically for separation of dredged sediments by grain size would contribute significantly to the state of the art.

Investigation of ground freezing technology for sampling and removing contaminated sediments

Ground freezing has been used successfully to provide a temporary barrier to ground-water movement and temporary structural stability in the construction of dams and tunnels. It has recently come into consideration as a potential technique for containing and facilitating the removal of contaminants in sediments and ground water. The process would involve placing refrigeration probes in the sediments at close intervals and cooling them from a portable refrigeration unit. Ice crystals would spread and form a wall of frozen sediment. The frozen contaminated sediment could then be lifted out with little disturbance to the remaining uncontaminated sediment, or it could be maintained in a frozen state until dredging or in-situ treatment methods could be implemented. Current ground freezing methods are very slow and costly. They can freeze only a small zone about 1.5 ft in diameter and have high energy requirements. These limitations may make the use of ground freezing cost-effective only for removing small volumes of contaminated sediments or for collecting sediment samples. However, ground freezing technology has sufficient promise to merit further research to determine its feasibility and cost-effectiveness.

Preparation of a manual of practice for responding to contaminated sediments problems

A variety of approaches have been employed in selecting sediment cleanup methods, ranging from consideration of relatively few conventional alternatives to exhaustive examination of numerous proven and unproven technologies. Further, in only a few cases investigated in this study was "no action" considered as an alternative on par with "action" alternatives. It is clear that parties that may be responding to contaminated sediments problems have not had ready access to the full body of information that is available. A collection of existing information, geared toward a practical decisionmaker's approach to screening and selecting the most appropriate rapid response actions, would help ensure that available alternatives are not overlooked and that appropriate alternatives are evaluated in a logical framework.