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Hazardous Waste Engineering
Research Laboratory
Cincinnati OH 45268

Research and Development

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Project Summary

Evaluation of Thirteen Spill Response Technologies

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The primary goal of this project was to inform potential users and manufacturers of the existence, stage of development, mode of operation, and intended use of 13 spill response devices, concepts, or prototypes. These 13 technologies were developed under previous contracts to the U.S. Environmental Protection Agency (EPA) for detection, containment, and cleanup of hazardous chemicals. The 13 technologies were: two models of a cholinesterase antagonist monitor for pesticides (CAM-1 and CAM-4); a hazardous materials identification kit (HMIDK); two insoluble sinkers detectors; a lactate dehydrogenase (LDH) test method for chlorocarbons; an oxidation/reduction field test kit; a particle size analyzer for oil/water mixtures; a foamed concrete dike system; a leak plugger system; vapor control coolants; vapor control foams; a capture and containment bag; an emergency collection system; and a sorbent oil recovery system.

Potential users and manufacturers were informed about the devices by presentations, mailings, exhibits at conferences, and publications in trade magazines. In addition, value engineering analyses were performed on two prototypes.

After examining either the device or the available technical literature on the devices, potential users or manufacturers were invited to offer comments and suggestions on the item. These responses were then analyzed to assess the potential for practical application for each technology. The study generated a high level of interest for several of the prototypes. Analysis of the responses indicated that five of the prototypes were ready for development and four others could be commercialized if certain improvements were made.

This Project Summary was developed by EPA's Hazardous Waste Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The full report describes efforts to elicit interest in and to analyze the practical potential for 13 spill response prototypes, concepts, or devices that had been developed under various EPA Office of Research and Development (ORD) contracts over the preceeding ten-year period but that had not been commercialized. New environmental laws such as the Resource Conservation and Recovery Act (RCRA) of 1976 and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 justified reassessment of the utility of the outputs of initiatives taken by EPA's ORD under the Clean Water Act (PL 92-500) to develop technologies for the detection, containment, and cleanup of hazardous chemicals in the environment.

Assessment Activities

Users and manufacturers were informed about the technologies by mailing one-page descriptions, presentations to trade groups, publications in trade magazines, exhibits at conferences, USEPA technical reports and Project Summaries, and exchanges

of information by telephone. Information was provided to organizations that showed interest in the technologies or that, based on Science Applications International Corporation's (SAIC) knowledge of manufacturers, research and development staffs, experts, and special interest groups, had a potential need to learn about the items.

Special activities were performed to assess the practical applicability of specific prototypes, including:

- Value engineering analyses for the cholinesterase antagonist monitors (CAMs) and the emergency collection system;
- Development of a USEPA manual on the use of foams by first responders to control spills;
- Fabrication, testing, and market analysis of the capture and containment bag;
- Field and laboratory testing of several prototypes by users and manufacturers to identify needed improvements.

Assessment of Spill Response Systems

The authors of the report then solicited comments from potential users and manufacturers. The advantages cited by the respondents were evaluated to assess the potential for practical application of each technology and to identify improvements that were considered necessary for successful implementation. A brief description of each of the 13 technologies and a summary of the respondent's comments are presented in the following paragraphs.

Cholinesterase Antagonist Monitors (CAM-1 and CAM-4)

Pesticide detection devices for laboratory (CAM-1) or field detection (CAM-4) of organophosphate and carbamate pesticides in water by the inhibition of cholinesterase enzyme activity. The consensus of opinions after review and testing was that the sensitivity of the monitor needed to be increased significantly. While the CAM-1 used outmoded circuitry, the value engineering analysis indicated that the CAM-4 was a well-made unit that would be in demand if sensitivity could be increased.

Hazardous Materials Identification Kit (HMIDK)

A hand-carried test kit capable of analyzing wastes for 36 common hazardous organic and inorganic substances. Potential users and manufacturers commented that the kit was complex and required a relatively high level of skill and training. Nevertheless, the kit could meet the need to identify hazardous materials in soil and water if cost and complexity could be reduced.

Insoluble Sinkers Detectors

Two separate devices to detect and locate denser-than-water organic pollutants that settle to the bottom of rivers, ponds, lakes, and streams. The first device, using changes in conductivity, was judged to have inadequate sensitivity for use in monitoring drinking water intakes. The opinion of the respondents was that the second device, based on acoustic echoing, would not be used frequently enough to justify its cost. In addition, a less costly, more efficient device operating on the same principle had become available.

Lactate Dehydrogenase (LDH) Test Method

A field screening test for detecting chlorinated hydrocarbons in water by the inhibition of lactate dehydrogenase enzyme activity. Inadequate sensitivity and expected interference by other chemicals commonly present in wastewater were the primary objections expressed by the reviewers of the technology. It was also noted that alternate methods for detection are available.

Oxidation/Reduction Field Test Kit

device that can distinguish incompatible wastes in the field by their redox potentials. Several reviewers noted that they were using this kit successfully to assure proper segregation of wastes at cleanup sites. Based on his experience, one respondent expressed some concern that an inexperienced operator could misclassify flammable liquids as oxidants. Units are being produced commercially.

Particle Size Analyzer

A device that uses stop-action photography to measure the size of oil droplets in oil/brine mixtures. The reviewers agreed that this unit would be very useful in determining when to take oil/water separators out of service, particularly at field sites such as drilling platforms. Recommendations were made that the photographic process be replaced by a less complex techniq that would make it possible for a l highly trained operator to use. At le two manufacturers are pursuing improved system that takes th comment into consideration.

Foamed Concrete

Quick-setting, rigid concrete to used by first responders to build s supporting temporary dikes around spi Very little interest was exhibited for t technology; the unit's weight and lack portability were the major objections. addition, reviewers noted that available urethane dike pack was m practical.

Leak Plugger System

A rifle-like device that plugs leaks tanks, drums, pipes, and other vessels injecting polyurethane foam. While c and relatively short shelf-like for t urethane precursor chemicals we expected to reduce the utility of t device, specific areas where it could valuable were noted. The U.S. Co Guard is currently using a modifi system to plug leaks below the waterl of damaged vessels.

Vapor Control Coolants

The use of Dry Ice to inhibit release the atmosphere of toxic and/or flammal fumes from spilled volatile chemica The ready availability of large quantit of this coolant near spills of vola organic liquids was not expected to common. A representative of t Cryogenic Gas Association noted that existing device for the conversion liquid carbon dioxide to snow might modified to meet the objective of t concept.

Vapor Control Foams

The application of surface foams inhibit the release to the atmosphere toxic and/or flammable fumes fr spilled volatile chemicals. Considera interest was noted on this topic. There evidence that it is being widely used firefighters and other emergen response personnel. The consensus w that wide distribution of information wo be helpful.

Capture and Containment Bag

A large, polyethylene bag designed be attached to leaking tanks, drun pipes, and other vessels so that liqu can be collected. Sufficient posit reaction was expressed for this prototy that additional prototype bags we designed, fabricated, and subjected

further testing. The fabricator, B.F. Goodrich, (as well as the majority of other reviewers) concluded that the bags were "extremely viable." Respondents indicated that a cost of $200-$400 per unit would be acceptable.

Emergency Collection System

A segmented 7,000-gal. polyurethane-coated bag equipped with a suction hose and a pumping unit to collect and retain liquid chemical spills. Only minimal interest was expressed in this system; high cost was the major deterrent. The use of pillow bags and portable pumps and hoses was noted as a more economical alternative.

Sorbent Oil Recovery System

A mobile system to collect oil from the surface of lakes, streams, and rivers in open-celled polyurethane foam cubes that can be retrieved and recycled. Inefficient recovery of the oil-saturated cubes was noted as the major drawback of the system. In addition, other equipment is available and is believed to be superior.

Conclusions

Based on the assessment activities carried out in this study, five of the studied technologies are considered suitable and ready for practical application in the immediate future. These are: oxidation/reduction field test kit, particle size analyzer, leak plugger, vapor control foams, and capture and containment bag.

Four systems that may be suitable for implementation if modifications can be made are the cholinesterase antagonist monitor (CAM-4), which requires increased sensitivity; the hazardous materials identification kit (HMIDK), which must be simplified and reduced in cost; vapor control coolants, which will be practical only if a system can be devised for conversion of liquid carbon dioxide into a deliverable solid form for blanketing a spill; and the emergency collection system, which requires changes in design and materials to reduce its cost.

The remaining four technologies were deemed to be unsuitable for practical application at this time. Competition from existing technology was a major factor, while cost and complexity were other factors.

Recommendations

Specific recommendations for seven of the devices studied follow:

- *CAMs* - Modify the devices to respond to a lower detection limit.
- *HMIDK* - Simplify the kit so that it may be used with minimal training. Also, reduce the cost and make replacement parts and reagents available from a single manufacturer.
- *Particle Size Analyzer* - Continue work to replace manual photographic analysis with computerized analysis of photo-images.
- *Foamed Concrete* - Modify the prototype to make it less expensive and more portable.
- *Vapor Control Foams* - Publish and distribute the new handbook on the use of foams to spill responders.
- *Capture and Containment Bag* - Make the results of this study available to those small and medium firms who may manufacture the units as specialty items.
- *Emergency Collection System* - Modify the collection bag to reduce cost significantly and/or make its reuse practical.

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***Mary K. Stinson** is the EPA Project Officer (see below).*
The complete report, entitled "Evaluation of Thirteen Spill Response Technologies," (Order No. PB 87-165 619/AS; Cost: $13.95, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

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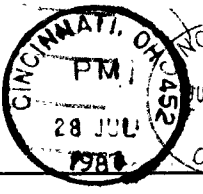

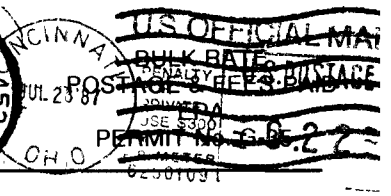

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