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The Integration of Science and Technology in Oil Spill Response Decision-Making

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For over 30 years, researchers have focused on identifying the relationships of physical and chemical properties of oils as they weather and form emulsions following a spill. In 1995, Nordvik and Champ working at the Marine Spill Response Corporation, were able to bring the data and information together to identify the relationships between weathering and the windows of technology effectiveness. The concept was published in late 1995 (Nordvik, 1995; Nordvik et al., 1995, and Champ et al., 1997), see Figure 1.

The Windows approach is intended for use by local, state, federal agencies, response planners, clean up organizations (responders), insurance companies, tanker owners, and transporters. The data bases represent the state of the art for response technologies and research in oil spill response. The major contribution of the "windows" concept is significant environmental and cost benefits in oil spill response. It provides policy and decision-makers with a scientifically based and documented "tool" in oil spill contingency planning, response, education and training using performance effectiveness data for oil spill response technologies derived from laboratory, mesoscale, and experimental field studies that has not been available before. These performance effectiveness data have been correlated to a wide range of viscosities of different weathering stages of tanker transported oils into a dynamic oil weathering data base to identify and estimate time periods, called "technology windows-of-opportunity."

Oil spill response is an extremely complex and challenging cross-disciplinary experience. In the operational decision-making process, it combines a wide range of issues and activities under emergency response conditions that include: the nature of the material spilled, which undergoes changes in physical and chemical properties (weathering) over time, local environmental conditions, sensitivity of impacted natural resources, and selection and effectiveness of response/clean up technologies. This also encompasses emergency mobilization, marine operations and effectiveness of operations, air surveillance, remote sensing, on site and regional spill trajectory, human protection, safety assessments, oily waste minimization, handling and disposal; and education and training.

Integrating Data And Information Into a Spill Response Management System

Effective oil spill planning and response today also requires a large amount of available data and information and the ability to rapidly process and manage this information. Planning and decision-making in oil spill response requires an understanding of oil weathering processes and the subsequent changes in an oils characteristics and the effect of these changes on response technologies over time. These changes have an important influence on the usefulness and effectiveness of response methods and technologies. Four major categories of response (clean-up) technologies are available: chemical treatment (dispersants, emulsion breakers), in-situ burning, mechanical recovery (booms, skimmers, oil-waster separators, adsorbents), and bioremediation (including chemical).

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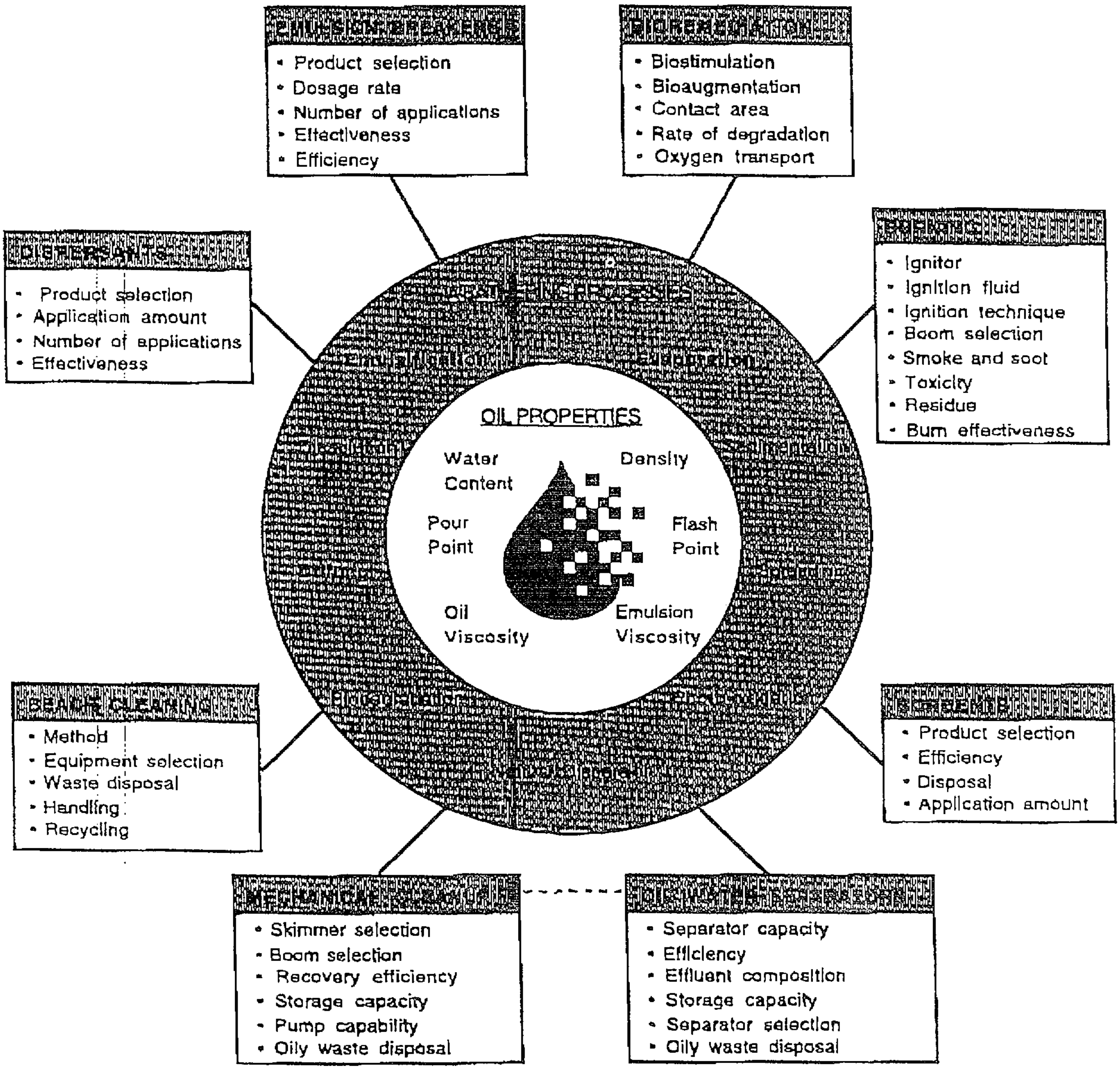
Methods and technologies in each of these categories are limited by environmental conditions both operationally and as a result of the changes in oil characteristics over time. Effective use of dispersants, in-situ-burning and some mechanical technologies is limited in time and governed by changes in oil properties. The most efficient, environmentally preferred, and cost effective spill response is dependant on the following factors are: chemistry of the spilled product, quantity, location, response time, environmental conditions, and effectiveness of available response technologies.



Utilization of multiple response technologies require a rapid and scientifically based decision-making tool and an integrated system of response capabilities. Rapid oil spill response decisions are of vital importance to mitigate and reduce environmental damage. For dispersant and in-situ burning, decisions needs to be made immediately in order to respond within the first 2-24 hours after a marine oil spill has occurred.

Highly effective spill response requires the integration of data from many different sources: Existing spill contingency response plans, (strategies and tactics), multiple spill remote sensing images, from single sensors and systems, environmental databases (distribution of environmental sensitive and recreational areas), historical weather analysis (general planning purposes), weather forecast (for operational planning and response), physical oceanographic conditions (tides, currents, winds), local current, wind and temperature (for input to regional and local spill trajectory predictions), spill trajectory predictions, dynamic oil weathering model (prediction of changes of oil properties), oil weathering rates and physical properties, available and equipment and technologies, shipping traffic lanes (location of response capabilities), timing for delivery of response technologies, and windows response method and technology selections, emergency offloading equipment, and temporary Storage Capabilities

Oil spill response management in the past decade has evolved advanced remote and mobile systems to collect data and information and to transmit it directly from the spill to response policy and decision makers. Advances have been made in developing a series of new tools for contingency planning, response and training. These new scientifically based tools, can integrate several data sources, to bring together the impact of weather, sea state, wind, current and water temperature, the physical and chemical properties and characteristics and trajectory of the spill oil for identification of the time periods that specific response methods and technologies are most effective.

Oil spill response decisions (or lack of) made immediately (and in the first 48 hrs) can be the single largest factor that will influence the total cost of oil spill response and the degree of environmental impact. The total costs (including environmental, social and economic) could be greatly reduced if the Technology Windows-of-Opportunity SYSTEM were utilized. The System integrates data and information and can assume total responsibility for decision making, direct employment of equipment, direct the response as in a national disaster.

The data and information that need to be integrated are: remote sensing system to identify and monitor Coastal Waters (Satellite and Low Altitude Aircraft), remote sensing data and information about the location, distribution and thickness of the spilled oil will maximize the efficiency of the mechanical clean up operations, identification And Characterization Of Oils Transported In coastal waters, determine physical, chemical properties and weathering properties for the major oils transported in coastal waters, establish data on effectiveness of available oil spill response technologies stock piled in ports under normal range of environmental conditions for coastal waters, determine the technology windows-of-opportunity for predominate oils transported in coastal waters under a normal range of environmental conditions (waves, winds, and seawater temperatures) from the IKU model, create a certification protocol for oil weathering data and technology effectiveness data, and develop an at sea visible - color code for calibrated and verified effectiveness for technologies, develop a windows based education and training curriculum and program, revise contingency plans to incorporate technology windows-of-opportunity.

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