The History of Chemical Dispersants in the United States

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Background

Although dispersants were researched in the United States in the late 60's and 70's their use was not readily accepted due to concerns about their potential environmental impacts. This began to change in the mid-1980's. Their eventual acceptance as a viable countermeasure is due, in part, to the education of regulators and resource mangers to the pros and cons of dispersant use. SL Ross Environmental Research Limited (SL Ross) had a key part to play in this process.

SL Ross is a Canadian company that has been involved in the study of the use of chemical dispersants as an oil spill countermeasure since the company's formation in 1980. In the early 1980s SL Ross developed a dispersant-use decision-making tool for the Canadian Government's Department of the Environment (Trudel 1983). The methodology subsequently was applied to the Canadian Southern Beaufort Sea region. The results of the study were presented at the Arctic and Marine Oilspill Program Technical Seminar (Trudel et al. 1985) that was attended by representatives of US oil companies. At that time these US companies were looking for a way to promote informed dispersant-use decisions in the US Gulf of Mexico region and became interested in the approach.

An organization called the Marine Industry Research Group (MIRG) funded SL Ross to present dispersant-use workshops in the US Gulf of Mexico states of Florida, Louisiana and Texas. Amoco Transportation Co., Chevron Corporation, Conoco Shipping Co., Exxon Shipping Co., Mobil Oil Corporation, Petro-Canada Products Inc., Phillips 66 Co., Shell Oil Co. and Standard Oil Co. were active member companies of MIRG when this work was carried out.

The goals of the workshops were to demonstrate the dispersant-use decision-making process to natural resource managers and spill response regulatory representatives in each of these states (as well as Federal regulators) and to gauge their reactions to the use of the method in their regions. Both Federal and State agencies are responsible for the approval of the use of dispersants on oil spills in the United States. The Environmental Protection Agency (US EPA) has primary federal authority over dispersant use in US federal waters and various State agencies (Fish and Wildlife, Environmental Management, Departments of Environment etc.) have jurisdiction in State waters.

At the time of the workshops the US EPA and the State of Texas positions on dispersant use were not favorable. The State of Florida had already begun to establish rules for possible dispersant use and had some guidelines in place for making dispersant-use decisions for State waters and was open to new ideas to improve their understanding of the issues. The State of Louisiana had not formed a strong opinion or prepared any

guidelines on dispersant use and was very interested in learning more about the use of dispersants.

The usual reasons given by representatives of the doubting organizations for not using dispersants were that 1) another potentially toxic chemical should not be added to the water to clean up a spill, 2) the oil should be removed from the marine environment not dispersed into it, and 3) the presence of dispersed oil would cause extensive damage to marine resources. The strongest arguments against the use of dispersants have always been those related to potential environmental or economic damage that might be caused. These arguments are still used today by those who oppose dispersant use. The dispersant-use decision process described below provides quantitative data to assess whether these arguments against the use of dispersants have any merit in specific spill situations.

Workshop Demonstration of Dispersant-Use Decision-Making Method

The workshops completed in Florida, Louisiana and Texas demonstrated the dispersant-use decision-making process developed by SL Ross. Personnel from the State and Federal agencies responsible for dispersant-use decision-making were invited to participate in the workshop and to provide local knowledge of the critical resources that might be affected by marine oil spills.

The decision-making process relies on a quantitative assessment of the likely impact of oil on critical biological and economic resources using the approach outlined in the simplified flow-chart of Figure 1.

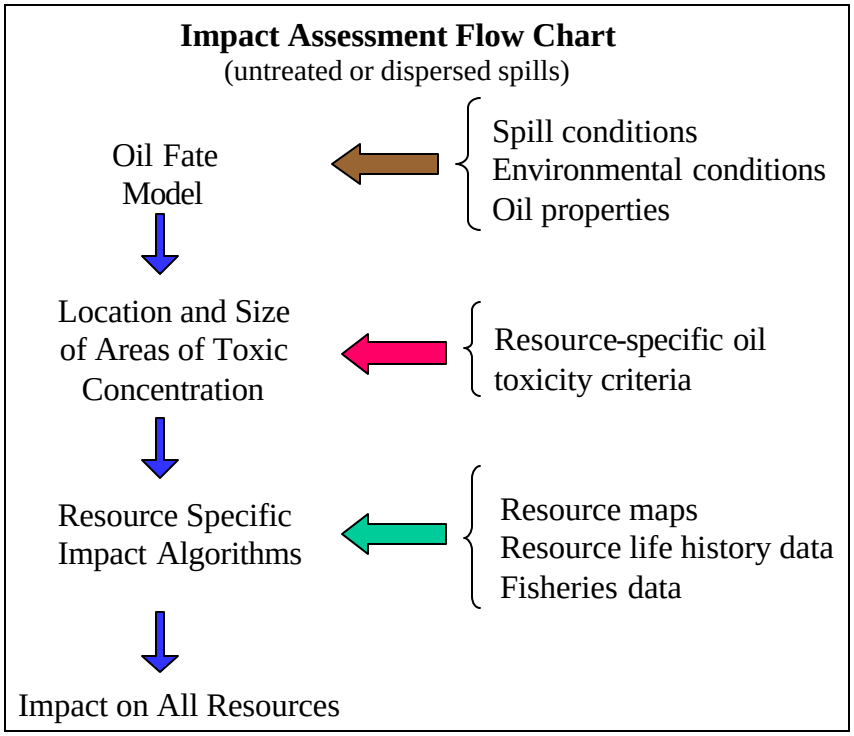

Figure 1. Dispersant-Use Decision Making Process Flow Chart

The basic process operates as follows.

- ?? First of all, the fate of oil from a hypothetical spill is determined both with and without the addition of chemical dispersants. Two maps are generated that identify the likely location of oil over time. One shows the spatial distribution and concentration variation of dispersed oil, the other shows the distribution and thickness variation of surface oil.
- ?? The important resources that could be affected by the surface or dispersed oil cases are identified.
- ?? The resources are ranked as to their relative importance. Habitats usually are highly ranked because they support a wide range of species. Man-made breakwaters would receive a low ranking.
- ?? A vulnerability profile for each resource is developed. This could include defining the life stage structure of the resource (e.g., eggs and larvae, juvenile, adult fish), the level of oiling (dispersed oil concentration or slick thickness) that will cause the impact of concern (mortality, tainting, fishery closure etc.) to each life stage, the geographic and vertical distribution of each resource life stage and the commercial value of the resource (if appropriate). Maps are again drawn up showing this spatially varying data.
- ?? The oil fate maps are then overlaid on top of the resource map distributions and the percent of the resource areas covered by oil at levels high enough to cause impact are calculated.
- ?? The process is repeated for each resource of interest using the oil fate mapping for both the chemically treated and untreated oil fate maps. The impact results are documented.
- ?? The impacts are then totaled for both the dispersed and untreated spill scenarios. Resources of higher importance are given a higher weighting in the final accounting of impacts.
- ?? A decision on whether dispersant application would be appropriate is then made based on these quantitative results. If a significantly smaller impact on the critical resources is demonstrated for the dispersed oil case, when compared to the impacts if the oil is left on the surface, then the use of dispersants can be recommended and documentation of why the decision was made is available.

The key local experts responsible for protecting the local environment, and ultimately making the final dispersant-use decision, were invited to participate in the three US workshops completed in 1986 and 1987. These experts provided distribution and vulnerability information for a number of critical local resources. The groups then analyzed a number of example oil spill scenarios and spill impact assessments for dispersed and untreated response scenarios. In many of the cases analyzed the use of dispersants was clearly justifiable due to the potential for reduced damage to shoreline habitats and bird populations.

By involving the local State and Federal personnel in the development of the spill scenarios and resource vulnerability profiles during the workshop they were given a sense of ownership in the product and thus had more confidence in the decisions that were made based on the outcome of the analyses.

At the end of the workshop sessions Florida and Louisiana were very enthusiastic about the method and its potential and Texas became a willing participant. However, it became apparent during the workshops that the resource agencies were interested in including a large number of resources in the assessment process to ensure that all possible impacts were assessed. To address this a meeting was held with key resource representatives from all of the states bordering the US Gulf of Mexico. Key indicator resources at risk were identified by representatives of each State during these discussions and at the end of the meeting 71 resources within the Gulf of Mexico were identified as being critical for dispersant-use assessment. These resources included 5 habitat types, 5 reptiles, 2 marine mammals, 10 invertebrates, 23 species of finfish, 23 birds, marinas, parks, and shorelines.

Development of Computerized Dispersant-Use Decision Aid

It was obvious that there were too many resources to consider using a manual mapping and overlay analysis, similar to that used in the workshops, to complete the analytical work needed for the dispersant-use decision. MIRG agreed to fund the computerization of the process using GIS technology and SL Ross's computerized oil spill fate and trajectory model. The intention was to have a system in place that could quantify and report the impact of an oil spill on all 71 resources within a reasonable time frame (within hours of a spill) so the information would be available for decision makers shortly after a spill event to assist in the dispersant-use decision process.

Resource maps and vulnerability profiles were assembled with the assistance of the resource management agencies of the states of Alabama, Florida, Louisiana, Mississippi and Texas and federal resource agencies such as the U.S. Fish and Wildlife Service, National Marine Fishery Service, Minerals Management Service, and NOAA. An automated, computerized system was constructed over a two-year period. The full system is described in detail in a 1989 International Oil Spill Conference paper (Trudel et al. 1989).

Sample resource maps developed for the system are shown in Figure 2. Over 400 such maps were generated for use by the system.

The computerized system was subsequently used to evaluate dispersant use tradeoffs in various regions with various spill types and locations. It became clear at which locations dispersants could be used to reduce environmental impacts (eg. protect important bird colonies or habitats) and where dispersed oil might cause more damage than good (eg. near commercial oyster beds).

The State and Federal regulatory agencies that participated in the process noticed these results and their opinions on dispersants and their potential value as a countermeasure

began to change. They realized that the potential benefits of dispersants outweighed their earlier concerns (adding another chemical, not removing the oil from the water, the likelihood of major damage to in-water species, etc.) in many situations.

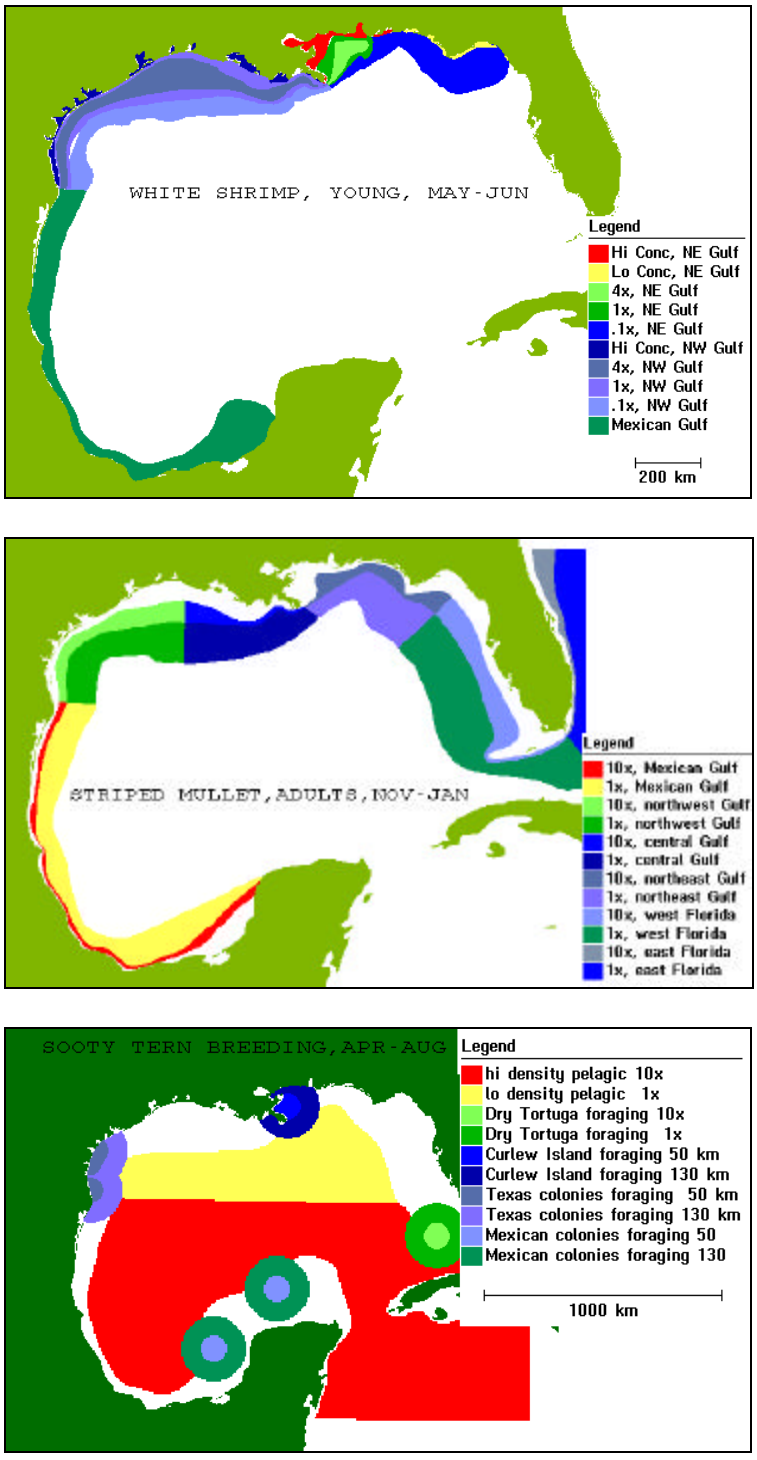

Figure 2. Example Resource Maps

Dispersant Use Pre-Approval Zones

In the late 1980's and early 1990's the State and Federal regulatory agencies became more eager to use dispersants and started questioning why they were not being considered in some response operations. The approval process was still somewhat cumbersome at this time and response agencies had not yet fully geared up for rapid dispersant response. Quick approval was seen as essential to responders investing in dispersant response equipment. Dispersant operations are more effective when the oil is fresh and not spread over too large an area.

Pre-approval for the use of dispersants in small areas such as the Louisiana Offshore Oil Platform (LOOP) and the lightering zone off Galveston Texas was established. In a paper given by the U.S. Coast Guard at the 1997 International Oil Spill Conference (IOSC) (Calhoun et. al. 1997), these pre-approvals were described as complicated, cumbersome and seldom used. The Regional Response Team (RRT) in Region VI recognized that an effective decision-making process incorporated into a pre-approval plan was needed if dispersants were to be an effective countermeasure. Having recognized this the RRT for Region VI gave On-Scene Commanders (OCSs) authority to use dispersants off the coasts of Louisiana and Texas under specific conditions in January of 1995. Details of this pre-approval process can be found in the aforementioned paper by Calhoun.

Similar dispersant pre-authorization zones have been established throughout the United States. A summary map of pre-authorization zones along US shores can be found at (http://www.uscg.mil/vrp/maps/dispmap.shtml). Presently only the states of Oregon and Washington do not have pre-authorization zones for the use of dispersants.

Accounts of dispersant use on actual spills in US Gulf of Mexico waters since the implementation of the pre-approval process can be found in the proceedings of the 2001 IOSC (Kaser et. al. 2001, Stoermer et. al. 2001).

Application of dispersants in these pre-authorized zones generally must be accompanied by programs to monitor both the effectiveness of the dispersant and effects of the dispersed oil on the local resources. A dispersant-effectiveness monitoring program called SMART has been developed by a number of US agencies and is implemented by the US Coast Guard during dispersant application programs to determine if the dispersants are working. Details of this monitoring program can be found at the following web address (http://response.restoration.noaa.gov/oilaids/SMART/SMART.pdf).

Effects monitoring plans are generally incorporated into a company's contingency plan if dispersant use is a proposed countermeasure operation. Each environmental monitoring plan is unique to the environment for which it is intended.

Changing Attitudes Concerning Dispersant Use vs Conventional Cleanup Techniques

After the Exxon Valdez spill the US Coast Guard implemented requirements for oil-spill removal equipment in vessel and marine-transportation-related facility response plans. These response plan equipment capability limits (CAPS) specify the amount of oil that must be recovered using available equipment (in-house or by contractor) that must be deployed within specific response times. The Caps guidelines put in place in the mid-90's allow for a reduction in mechanical recovery capability of up to 25% in areas where 1) dispersant pre-authorization is in place, 2) the spilled oil is chemically dispersible, and 3) a dispersant application capability is in place. Dispersant use is not mandated in any way under the existing guidelines but credit for their availability can be obtained. The CAPS guidelines are currently under review and the USCG is proposing that contingency plan holders be required to have pre-spill planning arrangements in place for the use of dispersants. Theses new rules would make having a dispersant capability mandatory and remove the 25% credit for their availability. This is evidence of further movement towards the acceptance of dispersants as a viable and vital spill countermeasures option.

Summary

Prior to the mid 1980's chemical dispersants were not seriously considered a legitimate spill response tool in the United States. The Marine Industry Research Group sponsored a series of dispersant-use decision-making workshops in the US Gulf of Mexico in 1986 and 1987. These workshops were attended by the state and federal agencies responsible for resource management and dispersant-use decisions in the region. This effort helped illustrate the potential benefits of dispersant use to those responsible for their regulation. A change of attitude towards the use of dispersants began and dispersants started to be considered as a viable oil spill countermeasure in appropriate circumstances. Pre-approval zone were established in the US Gulf of Mexico in the early and mid-1990's to facilitate the quick application of dispersants in the event of a spill. As examples of the successful use of dispersants grew so did their acceptance in other US Regions. At this time dispersant pre-authorization exists in some form in all coastal states except Oregon and Washington. There is currently a rule change being proposed by the US Coast Guard to require contingency plan holders to have pre-spill planning arrangements in place for the use of dispersants.

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