interspill AMSTERDAM 2015

Overview of the American Petroleum Institute (API) Joint Industry Task Force Subsea Dispersant Injection Project

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ABSTRACT

The American Petroleum Institute is sponsoring research to study the use of subsea dispersant injection (SSDI) as a response to a deep water oil release. Findings from the study will help industry develop and communicate acceptable methods for implementing this technology to ensure its availablity both within the U.S. and internationally. The study is evaluating all aspects of SSDI including its effectiveness, fate and effects, subsea plume monitoring, and numerical modeling. As a result of this research, the body of knowledge regarding SSDI has grown. Laboratory studies have demonstrated the utility of directly injecting dispersants at the source of a blowout. Work has begun to understand the biodegradation potential and the potential for toxicity of a subsea plume to deepwater organisms, and progress has been made on enhancing numerical models to predict the fate of oil dispersed subsea. This research has been presented at other oil spill conferences since the project started in 2011. This paper will summarize this work and focus on findings developed in 2014.

INTRODUCTION

The American Petroleum Institute (API) established a Joint Industry Task Force (JITF) on Oil Spill Preparedness and Response (OSPR) in 2010. The goal of the JITF was to evaluate the response to the 2010 Macondo incident. It released the Industry Recommendations to Improve Oil Spill Preparedness and Response Report (OSPR JITF, 2010) on September 3, 2010. The report recommended areas of additional study or enhanced communication for all areas of oil spill response. The API used the recommendations from the report to define, fund, and coordinate multiple projects to evaluate oil spill response technology, including the Subsea Dispersant Injection Program (see Figure 1). A project team to study subsea dispersant injection (SSDI) was formed and research began in 2011.

Subsea dispersant application had not been used prior to 2010. Figure 2 shows a very simplified drawing that illustrates the concept. SSDI has goals of protecting the health and safety of responders in vessels near a well site and to minimize environmental impacts as much as possible.

More time is needed to fully assess the environmental impacts of the 2010 Gulf of Mexico (GOM) incident to fully determine if SSDI reduced environmental impacts. We can, however, make some observations about the technique and how it protected the health and safety of response workers. Aerial photos collected over the well site during the incident provide strong evidence that SSDI significantly reduced the volume of oil that reached the surface directly above the well.

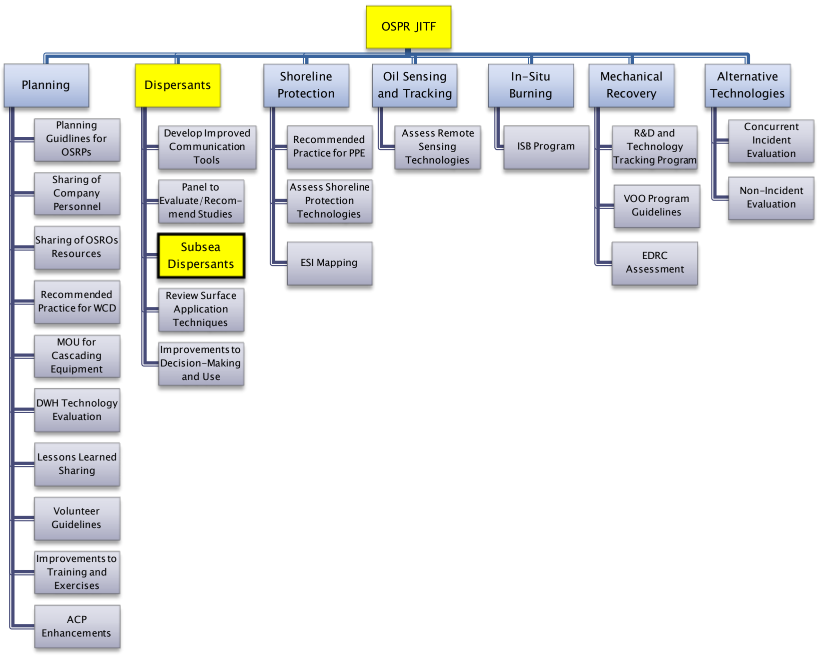

Figure 1. Organizational chart showing the various projects that the API is conducting within the OSPR JITF.

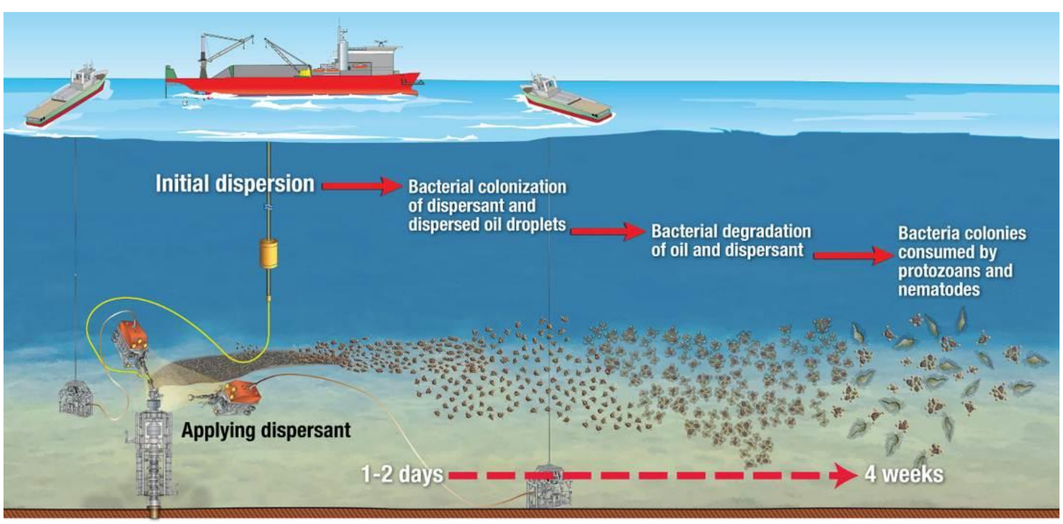

Figure 2. Diagram illustrating SSDI and the subsequent biodegradation process that begins when dispersants are applied to a deepwater release.

The photos in Figure 3 were taken on May 9, 10, and 11 of 2010. The images provide an aerial view of the scene immediately over the well site including vessels used for well-control operations. May 9 was 1 day before SSDI was initiated. This allowed the subsea oil release to rise to the surface and form a significant slick directly over the subsea well site. SSDI was initiated at 5:30 AM on May 10. The sea surface over the well site was estimated to have 90% less oil 11 hours later. The metocean conditions (currents and winds) do not account for the reduced surface expression of the oil while dispersants were used. SSDI was stopped on the morning of May 11 and a new slick appeared at the surface 5 hours later. These photos provide strong evidence that SSDI can significantly alter the fate of oil release during a deep water well-control event to reduce the amount of fresh, volatile oil surfacing near a location of well response operations. This could limit exposure of response workers to fresh volatile oil.

Figure 3. Aerial photos taken over the Macondo well site before SSDI started (upper left image; May 9, 2010), after 11 Hours of injection (upper right image; May 10, 2010), and 5 hours after injection ceased (bottom image; May 11, 2010).

SSDI has the following additional advantages over applying dispersants at the surface and other response options:

- Efficiency – subsea injection requires much less dispersant because the oil is fresh and concentrated. Testing has shown that fresh oils with high API gravity may readily disperse at dispersant to oil ratios below 1:100 and possibly even lower when the dispersant is mixed well with the oil (Belore, 2011).
- Precision – subsurface application allows for the dispersant to be mixed with oil in one manageable location before it spreads widely at the surface.

- Proceeds 24/7 – subsea injection would proceed day and night without interruption by weather, except extreme events such as strong tropical storms or hurricanes. Other response techniques have both weather and visibility limitations. Visibility limitations makes night time operations for other response techniques very challenging.
- More oil may be treated – an efficient subsea dispersant delivery system could potentially treat all oil escaping from a single release point.

These advantages have led the oil industry to incorporate SSDI into contingency plans and stockpile equipment to implement this tool during an emergency in strategic locations worldwide. To further support the inclusion of SSDI in contingency plans, industry has developed a large-scale, multiple-year project to conduct controlled testing of the method. The project is divided into five work areas: Effectiveness, Fate & Effects, Modeling, Monitoring, and Communications. Studies supporting each of these project areas are in progress.

This paper summarizes the API Subsea Dispersant Project and provides some of the preliminary results.

EFFECTIVENESS TEAM PROJECT

The goals of the Effectiveness team are to (1) provide evidence supporting the use of SSDI, (2) recommend dispersant injection methods, and (3) provide data that can be used to construct numerical models that simulate blowouts. Scaled testing of SSDI using a tower tank has been completed. The initial goal of the research was to simply determine if SSDI reduced the size of droplets of a jet of oil emanating from an orifice. The tower tank was then used to evaluate varying dispersant-to-oil ratios and injection methods. More recently, studies have been conducted to evaluate individual droplet behavior as they rise through the water column at their terminal velocity.

The tower tank is a circular tower that is 6 m tall by 3 m diameter (see Figure 4). The tank is filled with 42 m^3 of seawater to run an experiment and configured (as shown in Figure 5) to allow releases of crude oil from an orifice at the base of the tank with injection of dispersant at various locations – either prior to oil release or within the energetic jet of released oil. Measurement of the droplet size of released oil is used to assess the effectiveness of dispersants. Smaller droplets indicate a better dispersion because they rise through the water column more slowly than larger droplets. Particle-size measurements are accomplished using a laser particle size analyzer placed 3 m above the discharge point.

Figure 4. Photo of the 6 m tall by 3 m diameter tower tank used to conduct scaled experiments of SSDI.

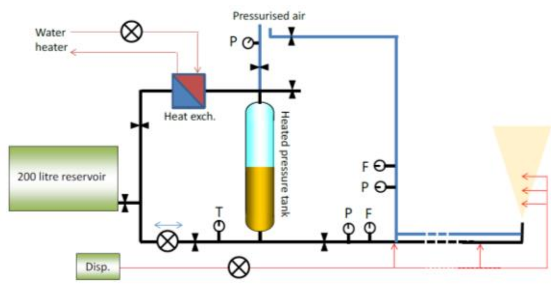

Figure 5. Drawing showing the set-up for the tower tank to allow study of SSDI.

Initial subsea dispersant injection testing was completed in the tower tank to both provide evidence that SSDI significantly reduced the size of oil droplets emanating from a point source and evaluate the effect of different dispersant-to-oil ratios on droplet-size.

In these experiments, oil was released at 1.2 L/min from an orifice 1.5 mm in diameter. The oil temperature was 11°C and dispersant was injected into the oil six pipe diameters (9 mm) before the dispersant-oil combination was released into the tank. This injection method was designed to simulate an insertion tool injection method that might be developed for full-scale systems. Figure 6 shows particle-size data plotted as relative droplet abundance on the y-axis versus droplet diameter on the x-axis. The data shows that a dispersant-to-oil ratio (DOR) as low as 1:100 significantly shifted the droplet size distribution to smaller droplets compared to the same conditions without dispersant added. The average droplet size was reduced from approximately 250 microns for the control test without dispersant to about 75 microns using 1:100 DOR. Higher DORs, 1:50 and 1:25 DORs, reduced droplet sizes even further. These test results indicate that even a low DOR can significantly reduce oil droplet sizes, which is the goal of SSDI (1:20 is the standard DOR used for surface application of dispersants).

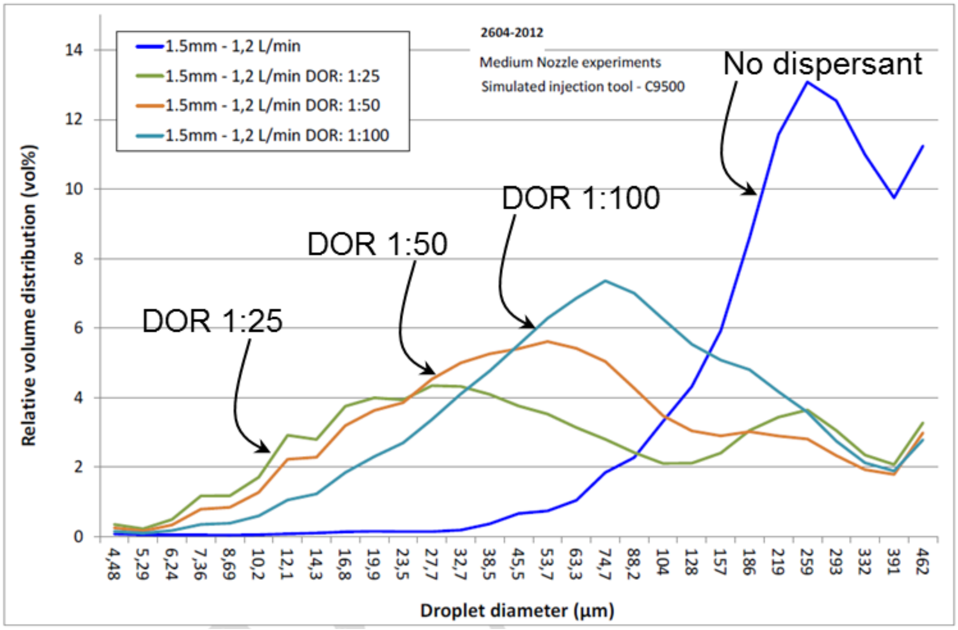

Figure 6. Droplet size distribution (volume %) formed for different DORs. Release conditions were a 1.5 mm diameter discharge port and an oil flow rate of 1.2 L/min.

Note that the scaling required to conduct these tests was significant. The tests used a 1.5 mm discharge whereas a full-scale discharge could be 40 cm in diameter. The small discharge orifice limited the size of droplets that could be released and biased both the treated and untreated droplets to sizes that might be less than would be expected at full scale. A small discharge orifice was required to limit the mass loading of oil into the column. Larger orifices required larger oil flow rates to generate the desired turbulent regimes for the discharge. The plume of oil generated by these larger flow rates quickly dispersed throughout the tank to contaminate the laser analyzer readings.

For certain discharge conditions, droplets for a full-scale release are expected to be several millimeters in size when dispersants aren't used. The discharge orifice used in these tests likely biased the droplets to smaller sizes because of the 1.5 mm orifice. This may not allow results for the tower-tank testing to directly estimate the size of droplets produced during a full-scale release. Scaling algorithms have been developed as described below. The data does show that addition of dispersant does significantly reduce the size of droplets emanating from point-source discharges.

After the initial tests, tower tank testing was completed to evaluate the best location to inject dispersants. The injection locations studied included 2000 pipe diameters before the oil jetted into the water (Premix), 6 pipe diameters before release (Insertion tool), three pipe diameters above the release point (3Φ), and 3 pipe diameters above and three pipe diameters to the side (3.3Φ). Test results (Figure 7) indicated that the location of the injection point did not significantly alter the droplet size distributions produced. Further testing (not shown in Figure 7) found that moving the injection point more than six pipe diameters above the discharge point resulted in larger droplet distributions. This is likely because an injection point this far away from the release is at a location where much of the energy of the turbulent jet has dissipated. These results indicate that the dispersant and the oil do not need long periods of contact before the oil is ejected to the environment.

In addition to the tower-tank testing, recent testing has focused on studying the behavior of droplets as they rise through the water column at their terminal velocity outside the turbulent jet. These tests were completed using an inverted cone water tunnel (Figure 8). The water tunnel suspends individual droplets of oil in it using a continuous downward flow of seawater at a constant rate. The cone shape of the water tunnel combined with the constant volumetric flow rate of seawater causes the velocity of water to decrease from the top to the bottom as the cross-sectional area of the cone increases. The terminal velocities of the droplet determine where they will orient within the cone. Droplets can remain suspended in the cone indefinitely to simulate rise of individual droplets to the surface outside the energetic discharge jet.

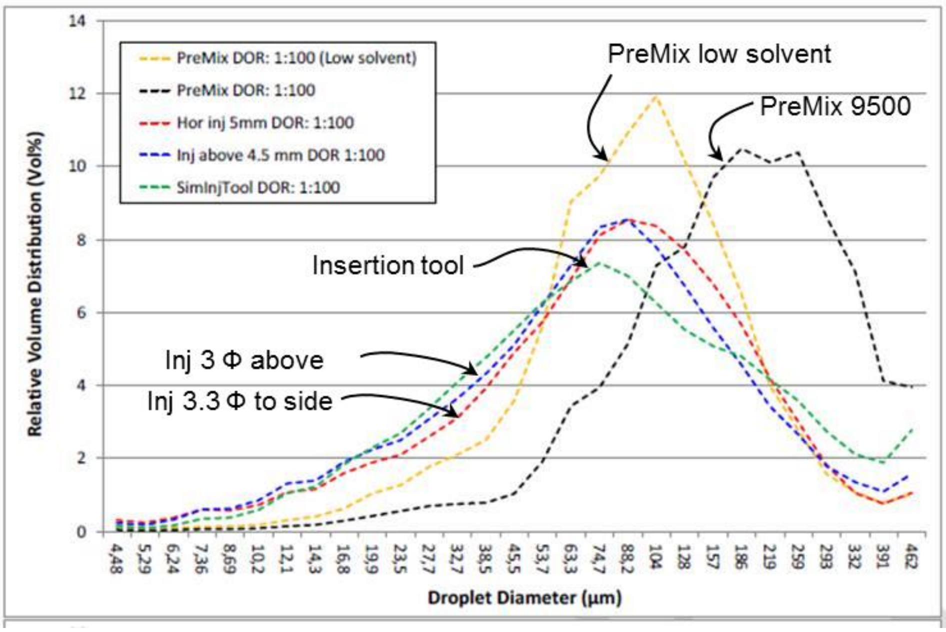

Figure 7. Droplet size distribution (volume %) formed when injecting dispersant at different locations at a 1:100 DOR. The premix tests injected dispersant into the oil 2000 discharge orifice diameters before discharge, the insertion tool simulated injecting dispersant into the oil six diameters before discharge, 3Φ indicates injecting dispersant 3 diameters above the release point, and 3.3Φ indicates injecting dispersant 3 diameters above and 3 diameters to the side (outside the jet of oil). Release conditions were a 1.5 mm diameter discharge port and an oil flow rate of 1.2 L/min.

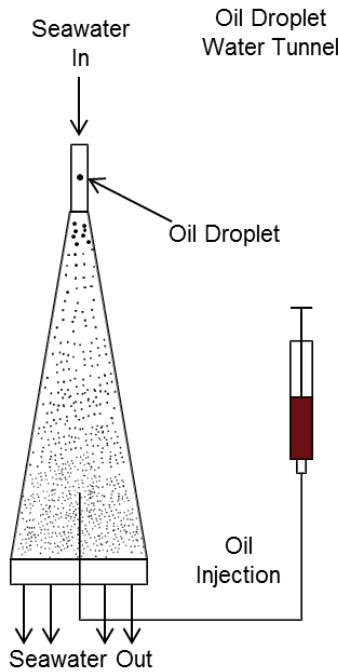

Figure 8. Conceptual drawing of the inverted-cone water tunnel used to study the far-field behavior of droplets.

The photos in Figure 9 show two large droplets suspended in the water tunnel. The left photo shows a droplet not treated with dispersants. This droplet remained relatively round as expected for an oil droplet in water for the multi hour observation period.

The right photo shows a large (approximately 1 mm diameter) dispersant-treated droplet in the water tunnel (DOR of 1:50). The droplets treated with dispersant behaved very differently in the water tunnel. Instead of a round-ball these droplets formed an umbrella shape. The treated droplets were not stable in the water tunnel and underwent “tip streaming.” Tip streaming is when very small droplets “stream” off the edge of the umbrella. These initial tests were conducted at a water temperature of 25°C, significantly higher than the 4°C expected in most deep water marine locations. At 25°C, shedding continued until the original droplet was too small to remain in the water tunnel, which took less than 30 minutes. The minimum size droplet that could remain in the water tunnel was approximately 250 microns based on the water velocity in the tunnel and Stoke’s Law.

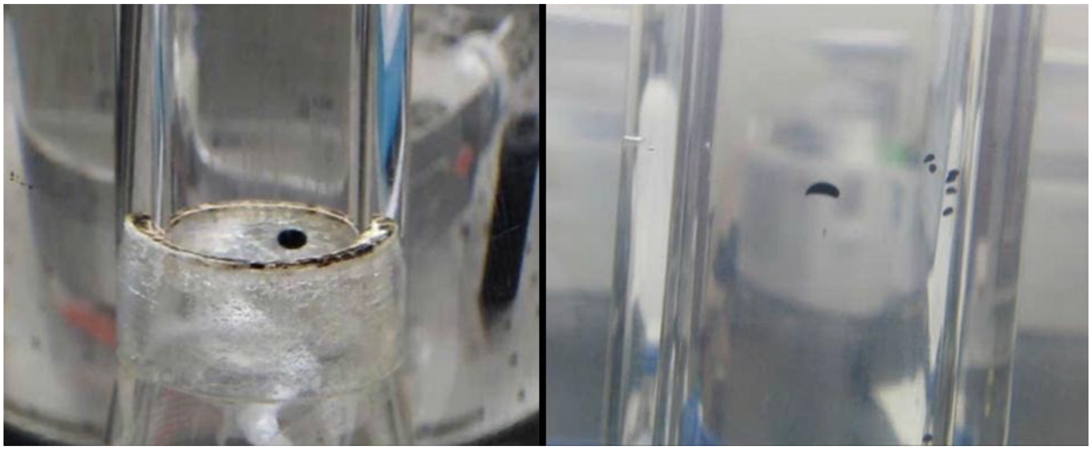

Figure 9. Images of droplets suspended in the inverted-cone water tunnel. The image on the left shows a typical ball-shaped untreated oil droplet and the image on the right shows the inverted-bowl shape seen when a droplet was treated with dispersant (DOR was 1:50).

Tip streaming is likely the result of reduced surface tension of a droplet and the movement of surfactant molecules around the surface of a droplet because of the induced current it experiences as it rises through the water at its terminal velocity. The surfactant molecules likely congregate at the base of the umbrella like droplet shape. At these tips the interfacial tension would be lower than the bulk interfacial tension allowing smaller droplets to stream off the large droplet even with turbulence the droplets experience as they quiescently rise at their terminal velocity. Figure 10 illustrates the movement of surfactants in a droplet as tip streaming occurs. As daughter droplets are produced from the surfactant rich base of the umbrella shape, they carry surfactant away from the parent droplet. As the process proceeds, the parent droplet loses more and more surfactant until it becomes stable and streaming ceases.

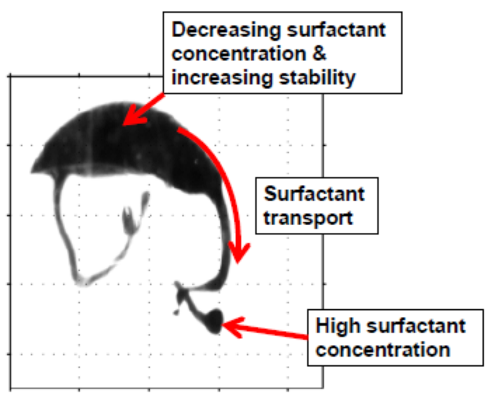

Figure 10. Drawing illustrating the movement of surfactants in an oil droplet during "tip streaming."

Figure 11 are digitized images taken of droplets in the inverted water tunnel. The images show droplets treated with and without dispersant. The untreated droplets initially were large – 5 – 10 millimeters in diameter. When these droplets were allowed to remain in the turbulent water tunnel for 60 minutes, the turbulence of the tunnel caused the droplets to break into smaller droplets as shown in image (B). This shear-induced breakup of the larger droplets may be caused by the unnatural flow patterns in the water tunnel because of wall effects and the low currents at the wall. Video of the water tunnel shows unexpected movement of these droplets if they were just rising at their terminal velocity. What occurs in the water tunnel is that smaller droplets can locate near the walls of the tunnel where they experience lower downward water velocity and rapidly rise above the larger droplets then move away from the walls and rapidly fall back down. This cycling may have caused the droplets to shear into the droplet distribution seen in image (B) after 60 minutes. More research is needed to determine if this breakup will occur in a real system.

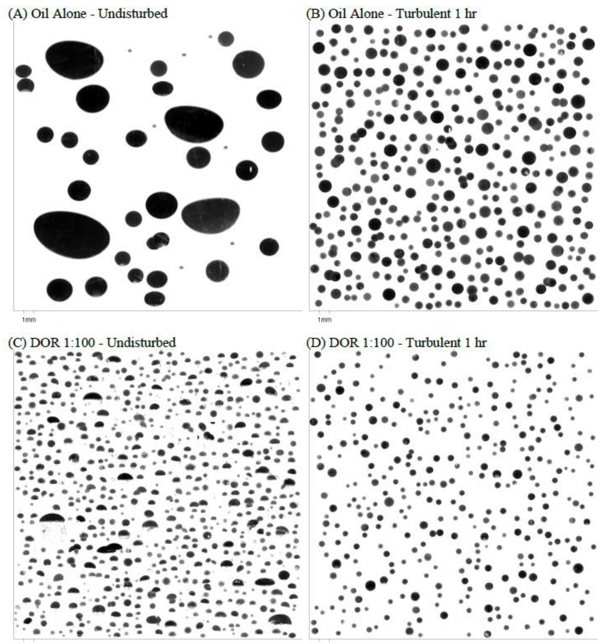

Figure 11. Digitized images of droplets in the inverted-cone water tunnel showing (A) untreated droplets immediately after they are injected into the tunnel, (B) untreated droplets after experiencing 60 minutes of continuous water down flow in the tunnel, (C) treated droplets (1:100 DOR) immediately after injection into the water tunnel, and (D) treated droplets after 60 minutes of continuous water down flow in the tunnel.

Images (C) and (D) in Figure 11 show the dispersant-treated droplets immediately after placement in the water tunnel and then 60 minutes after experiencing water down flow. Two things to note in these images are the shapes and incidents of tip streaming seen in image (C). Many of the droplets have the umbrella shape and tip streaming is visible. In image (D) (after 60 minutes of tip streaming), the droplets are very round and no tip streaming is evident. The droplets at this point have average diameters well below 1 mm. More experiments are needed to quantify these observations.

Testing was also completed in the tower tank to evaluate a wide range of oils, three dispersant types, the effects of oil temperature of droplet size distributions, and the effects of gas. The results indicated that the three most widely stockpiled dispersants (Corexit® 9500, Finasol® OSR 52, and Dasic Slickgone™ NS) were similar in their ability to reduce the droplet size distribution of oil emanating continuously from a point source release point. Testing was performed on five different oil types with differing density and chemistry. The droplet size and dispersant efficacy were strongly dependent on oil type, although in all cases dispersant-treated oil formed significantly smaller droplets than untreated oil.

The simultaneous release of gas (air was used as a substitute for safety reasons) with oil did not appear to substantially alter the size of oil droplets formed from dispersed or non-dispersed oils. However, these are preliminary findings since the tests did not use methane or high pressure. In addition, the laser analyzer used to measure droplets/bubbles could not differentiate between gas and oil so some assumptions had to be made when interpreting the droplet/bubble sizes.

The most interesting results were from experiments to evaluate the effects of oil release temperature on droplet size distributions. The initial studies done in the tower tank for this research used relatively cool oil (10 - 20°C). Oil from a well-control event would likely be entering the marine environment at close to reservoir temperatures, which could be 100°C or warmer. Tests were done in the tower tank where the oil was heated from 13°C to 100°C. As the oil was heated to 100°C at a DOR of 1:100 the average droplet unexpectedly increased in diameter until at 100°C droplets approached the size of the untreated droplets. As the untreated oil was heated, the decrease in viscosity caused the oil droplets to decrease in size (see Figure 12). The increase in droplets size for the treated oil with temperature and the decrease in droplet size for the untreated oil with temperature resulted in droplets that were approximately the same size at 100°C. Droplet size was not as sensitive to temperature at a higher dosage (1:50) and the treated oil had significantly smaller droplets than the untreated oil.

Although these results might be seen as indicating that dispersant may not be needed for a turbulent release of higher temperature oils, this is likely not the case for several reasons. First, the scaling factors used to estimate droplets from a full-scale discharge are a function of both oil viscosity and interfacial tension. The interfacial tension of the treated oil is much less than the untreated oil so full-scale droplets would be smaller. Also, these results indicate the droplet size tested is just outside the energetic jet of the oil. Untreated oil is likely more subject to coalescence than the treated oil and the treated oil droplets are likely further subject to breakup by tip streaming as they rise through the water column. Finally, if monitoring during a real event indicates that 1:100 DOR doesn't significantly alter the fate of oil and slicks are forming near the well site, increasing the DOR to 1:50 could reduce droplets further and reduce surfacing.

In addition to the tests described above, tests are planned to repeat some of the work performed in the tower tank using a pressurized tower tank. These tests will be conducted with live oil (oil containing dissolved gases) and gas. The initial tower tank cannot be pressurized and it cannot use live oil (oil that contains dissolved gases as it would when initially discharged from a well) or natural gas for safety reasons.

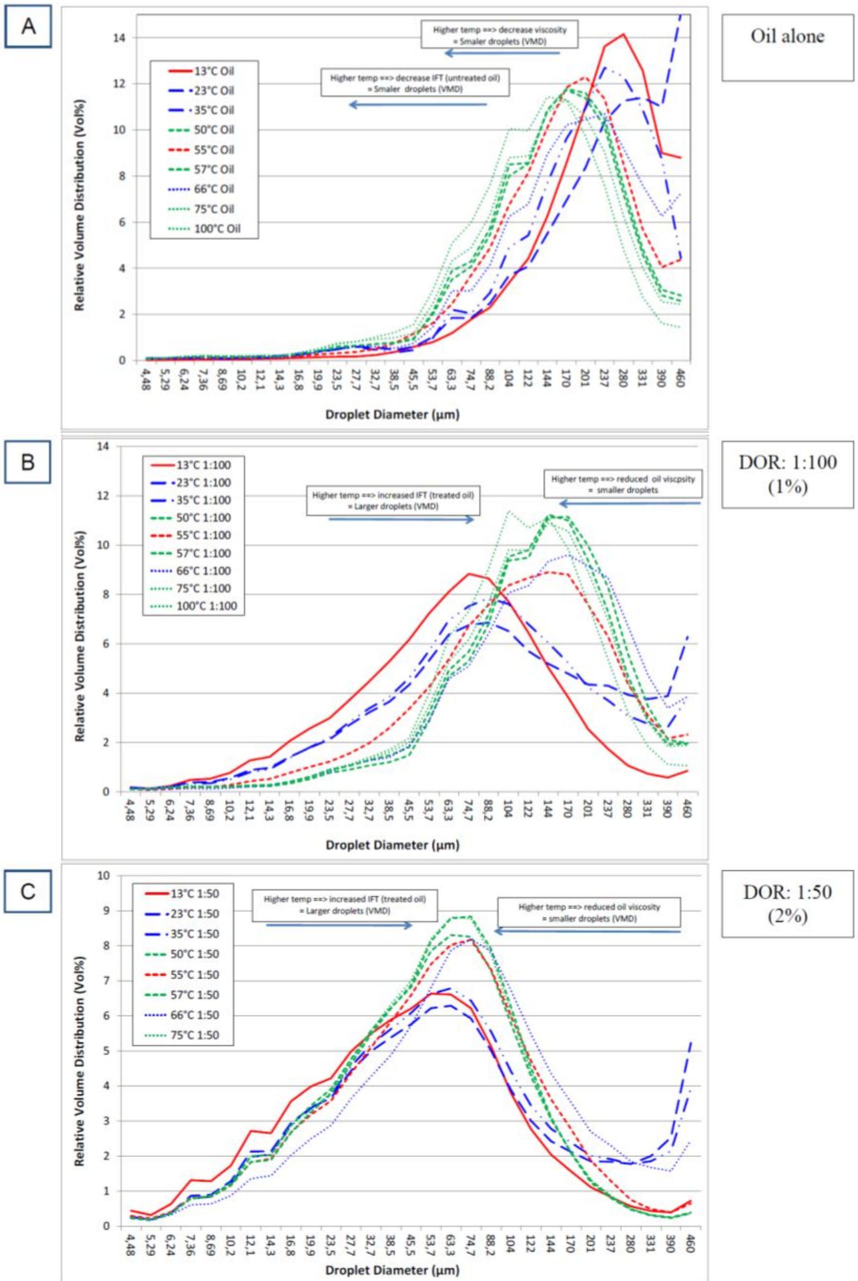

Figure 12. Combined results from the three different tower tank experiments as a function of temperature (13-100ºC). A: oil alone, B: DOR: 1:100 and C: DOR: 1:50.

FATE AND EFFECTS TEAM PROJECT

In addition to the work studying efficacy, the project includes a significant effort to study the fate and effects of dispersed oil in a deep water environment by evaluating the biodegradation and toxicity of dispersants and dispersed oil on deepwater communities. Prior to initiating studies, the project team held a workshop in October 2012 to develop a framework for protocols to be used during the biodegradation and toxicity testing. The workshop was attended by subject matter experts in chemistry, deepwater ecology, microbiology, and toxicity from academia, government, and industry. Recommendations from the workshop were used to develop requests for proposals (RFP) to conduct biodegradation and toxicity testing.

The objective of the initial biodegradation research project was to review the most recent literature on deepwater petroleum biodegradation to determine what additional work may be needed. This work has completed and a final report is under review.

The toxicity research was organized into three inter-related phases. Phase I consists primarily of literature and toxicity model reviews; Phase II includes toxicity testing at 1 atmosphere pressure; and Phase III includes toxicity testing under pressure representative of the deep sea environment.

Phase I was further divided into two project areas. The first project is designed to evaluate the potential for dissolved gases to influence the toxicity of a deepwater release and to determine if pressure changes the toxicity of other dissolved hydrocarbon components. One way that a surface oil spill differs from a subsea well incident is that a surface spill is typically oil that has had all the reservoir gases removed. For a release directly from a well, both free and dissolved gases may be present, and these gases may affect the toxicity.

Before conducting any experiments, available toxicity models will be run to predict the toxicity of C_1 to C_4 gases. These results will be compared to measured toxicity data (if available) and field measurements of concentrations of dissolved gases (if available) to assess the model performance. The model predictions and available field data will be used to assess the relative contribution of dissolved phase gases on the aquatic toxicity of all the crude oil components. This information will help determine if empirical data on the toxicity of dissolved phase gases and if a predictive toxicity model that takes into account the effects of pressure may be of interest. In addition, empirical information and models will be used to determine if pressure may play a role on the toxicity of larger dissolved hydrocarbons.

The scope of the second project of the Phase I toxicity study is to develop information on the behavior of crude oil components under deepwater marine conditions. The goal is to first use models to understand the potential exposure concentrations of dissolved hydrocarbon components under deep sea conditions. The dissolved hydrocarbon concentrations estimated by the exposure model will then be used in a model to predict the toxicity to organisms under deep sea conditions.

The scope of the Phase II toxicity study will be to conduct acute, lethal toxicity tests at ambient laboratory pressure (i.e., 1 atmosphere) using constant single test chemicals with at least three deep sea species to allow comparison with existing Species Sensitivity Distributions (SSDs) for shallow water organisms. The goal is to determine if deepwater organisms are more or less sensitive. SSDs is a tool developed three decades ago to support ecological risk assessments (Klapow and Lewis, 1979, Mount, 1982, Blanck, 1984, Posthuma et al., 2001). SSD is a statistical distribution describing the variation in toxicity of a set of species to a single compound or a mixture. SSDs exist for species that reside in surface marine waters but there is limited data on the toxicity of species that reside in deepwater. The Phase II tests will use barotolerant or Diel Vertical Migration (DVM) species from a potential list of copepods, amphipods, fish, and corals. These tests will focus on species that are known to have been caught and maintained in the past. Test compounds will include individual high purity aromatic compounds (e.g., toluene, naphthalene, 2-methyl naphthalene, phenanthrene).

In addition, Phase II testing will include toxicity tests at 1 atm using a reference crude oil that already has an SSD associated with it. Test organisms will be the same barotolerant or DVM species used in the single chemical component tests. The toxicity test results for the reference oil and the barotolerant / DVM species will be compared to the existing SSD to determine if the tested deepwater organisms are more or less sensitive than shallow-water species.

The expectation is that Phase I and II of this program will take more than 1 year to complete. In that time, a determination will be made if Phase III testing is warranted. Phase III testing will focus on repeating much of the Phase II testing at high pressure. If this research is adequately conducted by others, then the API program may not pursue this work.

MODELING TEAM PROJECT

The goal of the Subsea Injection Program's Modeling Project is to enhance existing numerical tools to estimate the fate of dispersed oil plumes resulting from subsea injection. Models that predict the fate of deepwater oil discharges have been available to more than 10 years. These models, however, were not designed to include the change in droplet sizes caused by injection of dispersants.

The research has been divided into three components: the first will focus on evaluation of existing oil droplet size models, the second will include an inter-comparison of integrated plume models, and the third will develop a new theoretical model to predict oil droplet and gas bubble sizes.

Work to identify and evaluate existing droplet size models is complete. This work included identification of oil droplet size data sets from lab and field tests. This data will be used to validate existing oil droplet models. A peer-reviewed publication describing the model intercomparison study is in preparation.

The third step in the modeling research will be to develop a theoretical dynamic (population based) droplet model. The subsea discharge models evaluated so far have all been static in that they predict a droplet size distribution formed at the end of the energetic jet phase that doesn't change. The modeling project team intends to develop a dynamic model that simulates the time-varying changes in droplets as they break up and coalesce within and outside the energetic jet. In addition, the team will develop integral and analytical models of properties (dissipation rate, holdup, velocity, width) of multiphase plumes for input to the droplet model. Lastly, the team will extend the droplet model to further distances from the energetic jet. As described, recent studies in the inverted-cone water tunnel have shown that large oil droplets, containing dispersant, undergo further break up by tip streaming. The dynamic model, once fully developed, will be validated against the data sets generated by the Effectiveness project and other data.

MONITORING TEAM PROJECT

The Monitoring Team's focus is to evaluate, develop and recommend plans and technologies for SSDI monitoring. In May 2013, the U.S. National Response Team (NRT) published a document titled: "Environmental Monitoring for Atypical Dispersant Operations: Including Guidance for Subsea Application and Prolonged Surface Application (NRT

Guidance)". During the development of the NRT Guidance, the Subsea Dispersant Monitoring project team continued development of an Industry Recommended Subsea Dispersant Monitoring Plan. Both the Industry and the NRT plans have a similar goal of providing response teams with information on the effectiveness of dispersant operations. The Industry plan only describes monitoring tools for SSDI and does not describe surface dispersant monitoring protocol. Further, the Industry plan is focused on collecting information about the effectiveness of SSDI and the fate of subsea dispersed oil that can provide information for operational decision making. Monitoring protocols that require days for processing and evaluation are not a focus of the Industry plan because this information won't be as useful for supporting daily operational decision making. Another key aspect of the Industry plan is to stage the monitoring requirements to allow rapid implementation of easily-deployable tools followed by placement of more complex monitoring tools as the event proceeds. Further, the Industry monitoring plan does not recommend "shut down" criteria in the event that a defined performance parameter (e.g., reduction in dissolved oxygen concentration) may be exceeded. Instead the Industry plan recommends that exceeding a performance criteria triggers re-evaluation of the benefits of subsea injection when compared to other response options before recommending shut down or altering operations. In October 2013, the Industry plan was completed and was made available online at http://www.spillprevention.org/documents/API%201152-Industry-Recommended-Subsea-Dispersant-Monitoring-Plan.pdf.

COMMUNICATIONS TEAM PROJECT

One of the most important components of the SSDI project is communications. This is to both inform external groups of findings and to receive input from experts to guide research plans. A communications plan was developed that includes formation of external technical advisory committees that are staffed by appropriate experts, holding workshops to develop research plans, developing fact sheets that describe the various project objectives, ongoing efforts, and accomplishments-to-date, and writing project newsletters as important research data is generated. Newsletters can be read online at http://www.api.org/environment-health-and-safety/clean-water/oil-spill-prevention-and-response/api-jitf-subsea-dispersant-injection-newsletter.aspx.

Additionally, the Subsea Dispersants team continues to engage in outreach efforts with broader OSPR and research communities. Specifically, team members have given presentations at multiple conferences and provide yearly updates to the U.S. Interagency Coordinating Committee for Oil Pollution Research. These presentations describe preliminary research findings and future plans.

SUMMARY

The American Petroleum Institute (API) is conducting multiple areas of research to better understand SSDI operations and the potential effects of dispersed oil on deepwater environments. These tasks include performing scaled tests of subsea dispersant injection to determine effectiveness under various conditions and to identify optimal injection methods. Results thus far indicate that dispersants significantly reduce the oil droplet size generated when oil is discharged from a single point and that wands injecting oil either a few pipe diameters inside the discharge point or a few pipe diameters outside the discharge point may be adequate. Project teams are beginning to study the effects of subsea dispersed oil on deepwater water environments and projects have been scoped to study both the biodegradation and toxicity of dispersed oil under conditions representative of a deepwater environment. Most of the work on these projects will begin in early 2015. Work has begun to evaluate subsea oil discharge models to assess their accuracy and, if warranted, develop improvements. Finally, the API has developed an Industry Recommended Subsea Dispersant Monitoring Plan that can be used in contingency plans that incorporate SSDI. This monitoring plan is designed to provide information that can assist with operational decision making related to the use of dispersants.

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