API JITF Subsea Dispersant Injection Newsletter

September 2014

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UPCOMING EVENTS OF INTEREST

Clean Gulf 2014
San Antonio, TX
December 2–4, 2014

2015 Oil Spill and Ecosystem Science Conference
Houston, TX
February 16–19, 2015

Learn more at API.org

Welcome

Since our last newsletter, the API Subsea Dispersants Injection Joint Industry Task Force has many significant accomplishments to share. First, the Effectiveness team completed its second phase of research in the 6-meter tank at SINTEF's facilities in Trondheim, Norway. The report from this phase is in its second revision and should be released later this year. Additionally, the Effectiveness team completed its third phase of testing at the high pressure tanks located at the Southwest Research Institute (SwRI) in San Antonio, TX. This joint project between SwRI and SINTEF explored the effect of pressure on droplet size distribution of oil and dispersed oil. As of this writing, a fourth phase of testing, being conducted by a team composed of SINTEF and the University of Hawaii, will characterize the break up of oil droplets outside the energetic jet phase. It is in its final preparatory phases before testing. Findings from the first three phases of this work indicates that understanding oil-droplet behavior outside the energetic jet phase is critical to a better understanding of the fate of oil released subsea.

The Fate & Effects team, using the consensus input developed during their 2012 workshop in Houston, TX, commissioned several projects related to the biodegradation and toxicity of oil and dispersed oil at depth. The initial efforts of this research will be forthcoming and the next round of efforts should be contracted sometime in the latter half of 2014.

The Modeling project team concluded their initial round of research with a workshop held at the end of January. Prominent modelers from around the world were afforded the opportunity to simulate a variety of standardized, initial conditions, the results of which were collated, compared, and discussed.

During 2013, the Monitoring team developed an industry-recommended plan for monitoring deep water dispersed oil plumes for use in contingency plans and drafted a white paper reviewing potential monitoring technologies. The team continues to engage with Federal, state, and local stakeholders on ways to improve efforts to use subsea dispersant injection as a potential spill response method.

The group plans to conduct significantly more work in the latter half of 2014 and into 2015. The teams will continue scaled testing to evaluate the effectiveness of subsea dispersant using live oil, gas, high pressure and higher flow rates. In addition, they will study the behavior of dispersant-treated oil droplets outside the energetic jet phase to observe and quantify the so-called "tip streaming" behavior. Fate and effects toxicity testing will begin in 2014 as the group hopes to generate initial data on the toxicity of dispersed oil to organisms representative of deep water environments. The modeling work will continue with the initial development of a time-varying droplet prediction algorithm that will track droplet size distribution from the initial jet phase through the entire water column. The monitoring work will focus on continuing efforts to work with external groups to develop monitoring plans that operationalize subsea dispersant injection.

Effectiveness Team Project

SINTEF has produced a final report, titled Subsurface Oil Releases – Experimental Study of Droplet Distributions and Different Dispersant Injection Techniques-version 2, which describes the Phase I effectiveness testing performed in their 6-meter tower tank. This document is available for review on API's website, http://www.oilspillprevention.org/ and will form the basis for two articles to be published in peer-reviewed journals.

SINTEF has also completed the first draft of a report describing the results and conclusions from the Phase II testing performed in their 6-meter tower tank. The purpose of this work was to study the influence temperature may have on droplet size distribution of oil and dispersed oil; the influence of gas on droplet size distribution of oil and dispersed oil; and how dispersant effectiveness (measured by shift in droplet size distribution) varies as a function of oil properties (four different oil types), dispersant type (six different products) and dispersant dosage (six different dosages). The team hopes to complete the review and release the final report detailing the results and conclusions from this work later this year.

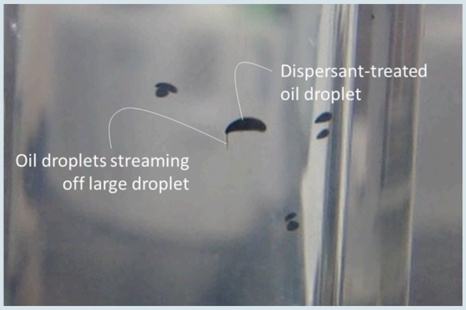


Photo from the University of Hawaii's water tunnel that shows a large (~4 mm) droplet of oil undergoing tip streaming. The droplet was treated with 1 part dispersant to 100 parts oil prior to placement in the water tunnel. Droplets treated with dispersant don't form round balls. Instead they take the shape of an umbrella. Tip streaming is similar to the observation of water dropping off the edge of an umbrella. However, instead of water the droplets are small droplets of oil.

As reported in the third newsletter, SINTEF and Southwest Research Institute (SwRI) have completed the Phase III research efforts that explored potential pressure effects on dispersant efficacy. This project replicated the Phase I efforts, which were conducted at low pressure, at pressures representative of deep sea conditions. The two groups are currently documenting their results and expect to deliver the draft report to API in July 2014.

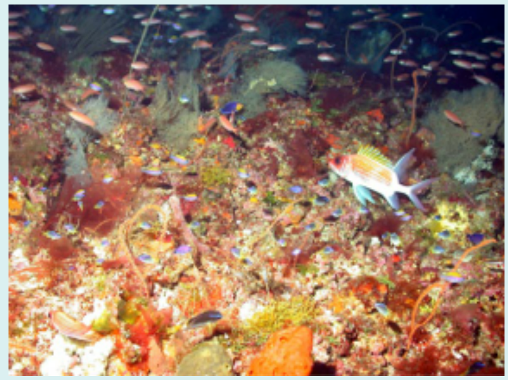
A Phase IV project has also been initiated. A team composed of SINTEF and researchers at the **University of Hawaii** (UH) will investigate the behavior of both oil and dispersed oil droplets as they rise in the water column after exiting the turbulent jet phase that might result from a subsea discharge. UH has developed a water tunnel system that uses continuous down flow of water to suspend oil droplets at specific locations for long-term observation. This system allows droplets to remain in the water column at their terminal rise velocity for extended periods. In this way, observations can be made of droplet behavior in a way that is representative of droplets floating to the surface. The team will evaluate the maximum stable size, deformation/splitting, and tip-streaming. Previous work done at UH indicates that tip streaming may be an important process that causes large dispersant-treated oil droplets to disintegrate into very small droplets as they rise at their terminal velocities in the water column. The figure below shows a photo of a droplet treated with 1 part dispersant to 100 parts oil undergoing tip streaming in the UH water tunnel. The UH observations are that tip streaming continues until the large droplet disintegrates into smaller droplets that are no large than 100 microns in diameter.

Fate and Effects

The Fate & Effects project team, using the consensus input developed during their 2012 workshop in Houston, TX, commissioned several projects related to the biodegradation and toxicity of oil and dispersed oil at depth. Recently, the findings from this conference were presented at the 2014 International Oil Spill Conference in Savannah, GA. The accompanying peer-reviewed paper from this presentation will be available for review when the 2014 conference proceedings are published.

The first phase of the biodegradation research was awarded to the University of Tennessee. Led by Dr. Terry Hazen, the University of Tennessee is performing a thorough literature review to characterize the current state of the knowledge of hydrocarbon biodegradation in deep water. Additionally, his team will also identify areas for further inquiry as they relate to this area of investigation. The results of these reviews will inform future phases of research.

In addition, workshop participants defined areas for future toxicity research. The first phase of research is being conducted by two different organizations – HDR, Inc. and DHI. One uncertainty on the effects of a subsea release of hydrocarbons (oil and gas) is the toxicity caused by the released gas. Another uncertainty is how pressure influences the toxicity of hydrocarbons in general. HDR is performing a literature review and modeling to understand how pressure influences aquatic toxicity of gas molecules as well as the role of pressure on hydrocarbon aquatic toxicity. Another uncertainty with a deep water release of oil and gas is how the various components of the oil will partition between the hydrocarbon phase and a dissolved phase. Acute toxicity to hydrocarbons is primarily driven by the dissolved constituents. A team from DHI is conducting a literature review and modeling to understand how oil and gas components partition at depth. The results of these efforts will be used to develop protocols for conducting toxicity testing on deep water organisms at conditions representative of deep water environments. The second phase of research, which will examine the toxicity of single and compound chemicals at 1 atmosphere pressure on species representative of those found in the deep ocean, is anticipated to commence in the fourth quarter of 2014.



Deep reef fish in Gulf of Mexico. (Source: NOAA)

Modeling

The Modeling project team has several coordination efforts in place. In conjunction with the Effectiveness project team, a workshop was held on the 6th and 7th of June, 2013 in Tampa, FL. Attendees included API, SINTEF Massachusetts Institute of Technology, Texas A&M University, University of South Florida, C-IMAGE, and several other Gulf of Mexico Research Initiative (GoMRI) consortia. This workshop included presentations of ongoing research efforts being conducted or sponsored by these organizations. Members of the API team participated in the GoMRI Modeling ListServ group that meets periodically to discuss modeling research initiatives.

GNOME model, one of the models being evaluated, output depicting relative distribution of oil. (Source: NOAA)

The Modeling team held another workshop at the end of January 2014. This effort allowed modelers the opportunity to evaluate the predictions of integrated oil spill models for simulated, accidental oil well blowouts with and without the subsea application of dispersants. A number of test cases were prepared by the team to support this effort and covered a wide range of potential scenarios. The modeling results were collated, presented, and discussed at the workshop and provided the model developers with the opportunity to discuss model development needs.

Monitoring

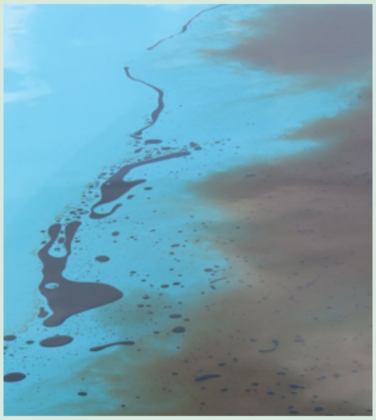
In 2013, API completed its subsea dispersant injection monitoring plan, appropriately titled Industry Recommended Subsea Dispersant Monitoring Plan Version 1.0, and submitted it to the NRT for review and consideration. On August 27, 2013, members of the Monitoring Team presented elements of this plan to members of Regional Response Teams (RRTs) IV and VI during their recent joint meeting in North Carolina. API recognizes the importance of engaging the U.S.

Autonomous Benthic Explorer ROV (Source: NOAA)

National Response Team, RRTs, and other local, state, and Federal stakeholders on the topic of oil spill preparedness and response. To reflect this belief, API has proposed a meeting with the NRT to discuss various aspects of the industry plan in the context of the NRT's guidelines established in Environmental Monitoring for Atypical Dispersant Operations.

Communications and Outreach

The American Petroleum Institute (API) hosted its second annual oil spill dispersant workshop at the Bureau of Safety and Environmental Enforcement's (BSEE) oil spill response and research facility (Ohmsett) from July 22nd to July 24th, 2014. To facilitate API's ongoing outreach efforts to provide a full spectrum understanding of dispersant use and the associated net environmental benefits, the workshop provided an introduction to dispersants, an overview of biodegradation of oil, and a policy and research forum focused on the subsea dispersant program and related dispersant research projects.

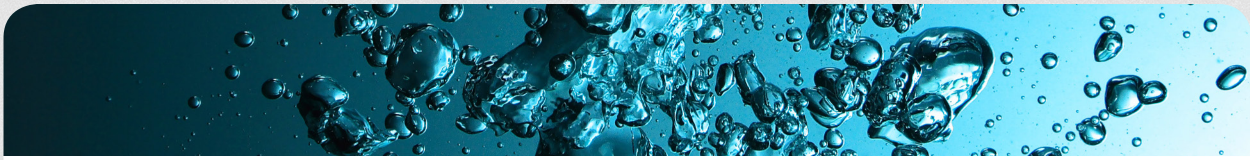


During a demonstration during the open house at the Ohmsett Facility in July 2014, the effect of dispersants on an oil slick is illustrated by the change in color from black to brown due to the formation of tiny dispersed oil droplets entrained in the watecolumn. (top) API's Subsea Dispersants Injection Program Chair Tim Nedwed and Robyn Conmy of the EPA discuss dispersants chemical behavior while watching on-water demonstrations of dispersants on oil.(bottom)

A diverse contingent of dispersant researchers, policy advisors, and experts attended the forum from academia, industry, non-governmental organizations (NGOs), federal agencies, and state/regional based oil spill response organizations.

The event included a demonstration of the Ohmsett's surface and subsurface oil spill simulation capabilities. Randy Belore from SL Ross conducted several surface oil spill simulations in the facility's 2.6-meterillion gallon saltwater tank, with and without dispersant application. Attendees were able to note the difference in oil slick progression over time and how dispersant use caused the oil to rapidly break up into small droplets that became suspended in the water column The demonstrations also highlighted the variations of dispersant effectiveness given different types of crude and environmental conditions. Workshop participants also observed various skimmer models and techniques and measurement tools such as LISST particle size analyzer and high resolution digital imaging techniques.

Overall the workshop was a success as it provided an opportunity for academic researchers, government responders, and industry to communicate about the specifics of dispersants use and its practical applications, while gaining a broad understanding of the extent of research and development of dispersant effectiveness.



Dispersant Factsheets

API has developed ten factsheets to provide educational information on dispersants. Please find them on API's oilspillprevention.org site here:

SpillPrevention.org

INTRODUCTION TO **DISPERSANTS**

Things You Should Know

- Mechanical recovery will always be the most widely used response option, because most spills are small and nearshore.
- Dispersants remove oil from the water surface thereby protecting birds, mammals, and sensitive shorelines.
- Dispersants can be used under a broad range of environmental conditions. For large offshore spills, the limitations of other response options may make dispersants the most effective response tool.
- Modern dispersants are biodegradable and contain ingredients which are similar to, and in some cases less toxic than those found in many common household soaps, cosmetics, shampoos and even food (Fact Sheet 2).
- All environments contain naturally occurring microbes that feed on and break down crude oil.
- Dispersants are designed to break a slick up into tiny oil droplets, which enhances the rate of microbial degradation and ultimately removes the oil from the environment.
- Dispersant use is always based on a net environmental benefit analysis (Fact Sheet 6).
- Scientists have been studying the effects of dispersants on the marine environment for over 30 years, and are still actively engaged in dispersant research, development and innovation.

Overview

Dispersants are products used in oil spill response to enhance natural microbial degradation, a naturally occurring process where microorganisms remove oil from the environment. All environments contain naturally occurring microbes that feed on and break down crude oil. Dispersants aid the microbial degradation by forming tiny oil droplets, typically less than the size of a period on this page (<100 microns), making them more available for microbial degradation. Wind, current, wave action, or other forms of turbulence help both this process and the rapid dilution of the dispersed oil. The increased surface area of these tiny oil droplets in relation to their volume makes the oil much easier for the petroleum-degrading microorganisms to consume (**Figure 3**).

Dispersants can be used under a wide variety of conditions since they are generally not subject to the same operational and sea state limitations as the other two main response tools — mechanical recovery and burning in place (also known as in-situ burning). While mechanical recovery may be the best option for small, near-shore spills, which are by far the majority, it has only recovered a small fraction of large offshore spills in the past and requires calm sea state conditions that are not needed for dispersant application. When used appropriately, dispersants have low environmental and human health risk and contain ingredients that are used safely in a variety of consumer products, such as skin creams, cosmetics, and mouthwash (Fingas et al., 1991; 1995).

This fact sheet summarizes what dispersants are, how they work, when their use is considered, and any associated environmental trade-offs and potential human health effects.

Fact Sheet Series

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FACTSHEETS: