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Case study on Experimental study of Oil Spill Clean-up Methods for More Effective Handling of Future Accidents

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Abstract: ***Petroleum (oil) is an essential natural resource for modern industrial society; it is used to produce energy and materials, which serve a variety of manufacturing, industrial and consumer needs. However, extensive oil extraction, transport and use have resulted in many accidental oil spills. USA Today reported in 2010 that the number of spills in the US has more than quadrupled over the previous decade. Oil spills pose hazards to both humans and wildlife, and adversely affect local ecosystems. It is therefore important for governments, industry and emergency managers to understand, appreciate, and hopefully improve strategies for oil cleanup. It is essential to review both the strategies that have worked and those that have not, so that optimal methods for handling such catastrophic events can be clearly identified. This report will serve as a case study analysis to assess best- and worst-case oil cleanup methods; by categorizing previous events based on gravity of the spill, cleanup success levels, length of time for remediation, and type of affected environment, more effective strategies can be developed for Evaluating and managing cleanup efforts. This includes more rapid oil spill cleanup with minimal impact on the local environment. The case studies reveal that human error is the single most important factor correlating with risk of oil spills; therefore, more effort should be spent towards prevention than on the development of new technologies for cleanup response. However, when the inevitable oil spill occurs, bioremediation and dispersant application are concluded to be the preferred methods.***

I. INTRODUCTION

Over the past century, oil spills have posed serious risks worldwide to land, air and aquatic environments (othumpangat and castranova, 2014). wherever extensive drilling takes place there is a possibility for a spill. therefore, drilling companies, emergency response teams, and national governments must be prepared for the timely and efficient management of this type of crisis. this presents a challenge worldwide, because despite great advances in technology, oil spills remain increasingly difficult to manage and control (othumpangat and castranova, 2014). no cleanup method has been shown to be 100% reliable and effective.

Numerous published studies have focused on oil spills and their effects on the environment. large-scale spills date to the 19th century; some have involved the release of over 500 million gallons with catastrophic results (spill prevention, 2014).

biota and local environments are greatly affected by oil spills. in addition, the fishing industry, recreational areas, and public water supplies all suffer following a spill. inadequate cleanup causes long-lasting health effects for populations living in areas surrounding oil spills. onwurah et al. (2007) explained that spills that are not cleaned up sufficiently could seep into the soil and contaminate strata surrounding potential drinking water supplies. on wurah et al. (2007) explained that too often cleanups do not eliminate the pollutants that contaminate air, water and soil after spills. cleanup efforts following oil spills have often proven ineffective, costly, and extremely difficult, and do not fully rehabilitate the affected areas. therefore, the prevention of oil spills is by far the most important means of handling oil pollution.

Previous studies have focused on case analysis of specific spills and their effects. solomon and janseen (2010) examined the long- and short-term effects of the deep water horizon oil spill and found that ecosystems will suffer for decades while recovering from a spill.

II. GOALS, OBJECTIVES AND SIGNIFICANCE

The primary goal of the reported research is to compare and contrast successful oil spill cleanups with unsuccessful methods in order to identify optimal methods for addressing future Cleanups. Past studies have focused on both effective and ineffective strategies; thus, it is important to examine the lessons learned from previous efforts and how to change response tactics to handle future events. The reported study will attempt to answer these questions throughcase analyses of major oil spills.

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III. CONVENTIONAL MANAGEMENT OF OIL SPILLSSPILL NOTIFICATION

In the event of an oil spill in United States waters, the first point of contact is the National Response Center, US Coast Guard in Washington D.C., followed by notification to the proper State authority (ITOPF, 2012). The recognized competent national authority on spills is the Office of Current Operation, US Coast Guard in Washington, DC.

A. Regional and Bilateral Agreements

The United States has bilateral agreements for collaboration on oil spill response with Bermuda, Canada, Japan, Mexico and the Russian Federation.

IV. SPILL RESPONSE MEASURES

The Oil Pollution Act of 1990 (OPA, 1990) controls spill response within the United States. OPA 1990 requires tankers within US waters to follow their own vessel response plan (VRP) (ITOPF, 2012). The plan must detail the resources available to handle oil spills under a variety of scenarios, including the loss of the entire cargo, and must identify the Qualified Individual that has been given full authority to implement the VRP with a spill management team.

Under OPA 1990, the size of the vessel responsible for an oil spill determines the extent of liability for the costs of removal and pollution damage.

However, OPA 1990 does not limit liability if the polluter does not manage the spill according to regulations, and some states do not recognize a cap on liability. OPA1990 requires that the vessel responsible for the release must coordinate its respond to the crisis with a designated Federal On-Scene Coordinator (FOSC). If the FOSC does not approve with the liable parties regarding how the spill is being managed, the FOSC has the right to take over management of the spill and hire contractors at the owner's expense (ITOPF, 2012).

The response to an oil spill depends on the type and gravity of spill. The FOSC, State On- Scene Coordinator (SOSC) and the vessel's Responsible Party (RP) respond to standard oil spills in coastal waters under joint command. In addition, a more comprehensive Incident Command System (ICS) is established to monitor cooperation between all parties concerned, including all relevant government agencies, private contractors and other parties of interest. The focus of the

ICS is on planning, operations, logistics and finance. The United States Coast Guard (USCG) is closely involved with response to spills in marine environments – the USCG selects the FOSC from the USCG Marine Safety Unit where the accident occurred.

A National Incident Task Force, under a National Incident Commander designated from the USCG, controls the management of the most severe spills.

The USCG National Strike Force Coordination Centre guides the cleanup in coordination with a multiagency local response team that includes a Scientific Support Coordinator from the National Oceanic and Atmospheric Administration (NOAA), the Department of the Interior and the US Army Corp. of Engineers, and the center of command is the Joint Operations Centre (JOC) (NOAA, n.d.). In addition, there is also National Response Team (NRT) involving 16 federal agencies with the EPA as chairman and the USCG as vice-chairman. Regional Response Teams (RRT) have been established for each federal region: Alaska, the Caribbean and the Pacific Basin. The roles of the NRT and RRT are to plan and coordinate the spill from a distance according to their own contingency plans (ITOPF, 2012).

A. Response Policy

The official international response to oil spills is to first mobilize the officially pre- approved mechanical equipment to contain and recover the oil and to use dispersants to break up the oil layer (ITOPF, 2012). FOSC is authorized to manage the spill through the use of pre- approved dispersants and in-situ burning if the area of the spill is located within three nautical miles from the US coastline and to depths greater than 10 meters (ITOPF, 2012).

B. Government Equipment

The USCG has at its command a vast arsenal of strategically placed equipment along US coastlines, as well as vessels designed to manage this equipment (ITOPF, 2012). The USCG and

National Guard have aircraft and helicopters for the transportation and monitoring of equipment and surveillance of the spill. USCG personnel are trained to use the equipment. These resources support those from private sectors. The US Navy also has an enormous cache of equipment at itsbases to manage their own spills that may be used if needed.

C. Private Equipment

The USCG has approved over 100 Oil Spill Removal Organizations (OSROs) to operate in designated areas within US waters. The main OSROs are the Marine Spill Response Corporation (MSRC) and National Response Corporation (NRC). The MSRC and NRC have specially equipped response vessels deployed along US coastlines (ITOPF, 2012).

The major oil companies established Clean Caribbean & Americas (CCA) to manage oil spills off the coast of Florida, mainly in the Caribbean region. CCA keeps equipment ready for immediate transport by air. Alyeska, the consortium which manages the Trans-Alaska Pipeline, possesses a great deal of equipment, including designated vessels, to manage spills along the coast of Alaska. Most oil handling facilities are equipped with spill response equipment (ITOPF,2012).

V. MAJOR OIL SPILLS IN THE GULF OF MEXICO AND OTHER U.S. WATERS

The Gulf of Mexico has been the scene of numerous cases of accidental oil spills by oil rigs and tankers. Most serious accidents in American waters have occurred in the Gulf of Mexico, and the risk of another such incident in this area is high. The Gulf of Mexico contains numerous oil rigs and pipelines and is used by tankers to transport oil. Figure 2 shows oil rigs or platforms and pipelines in the Gulf of Mexico.

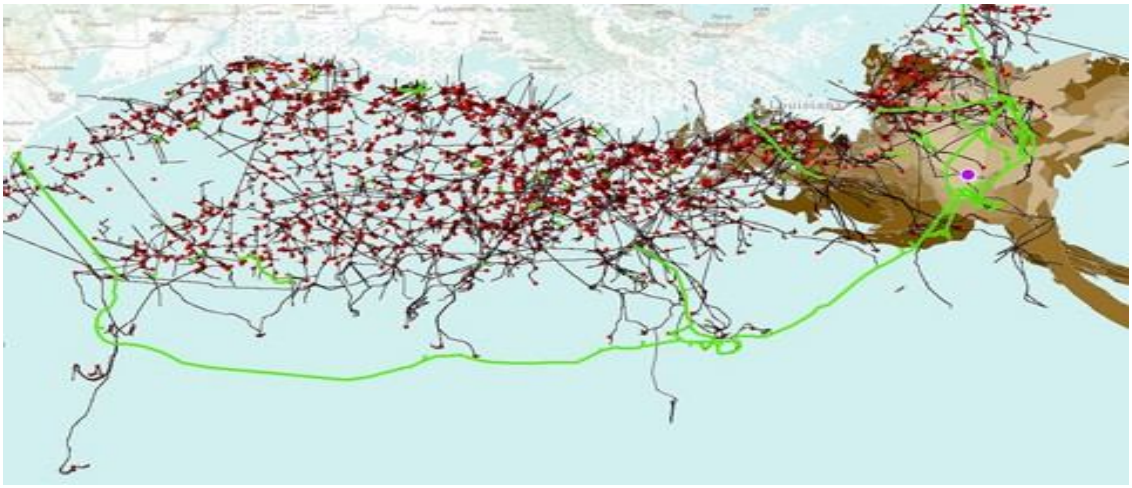


Fig. Oil rigs or platforms (in red) and pipelines (gray and green) in the Gulf of Mexico.
Source: green.blogs.nytimes.com

A. Impact of the Spill

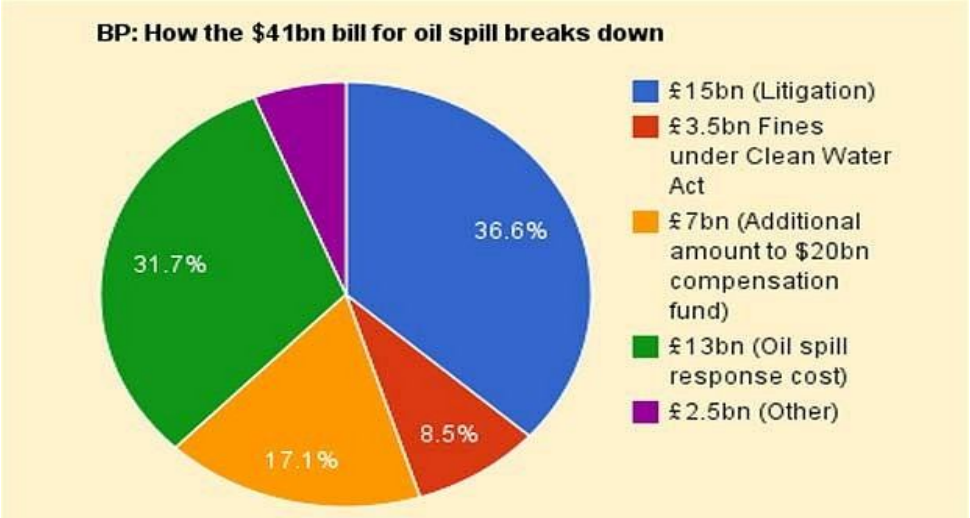


Figure . Breakdown of BP settlement.

B. Impacts on Human Health

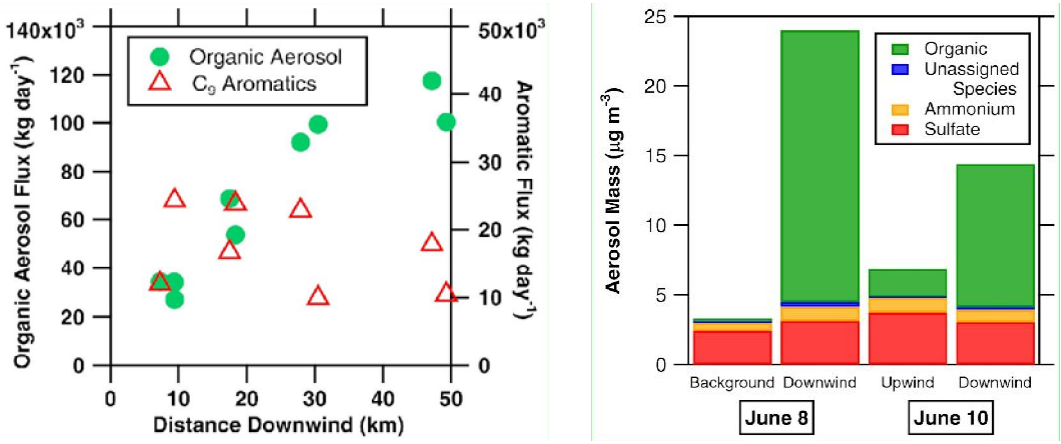


Figure . Dispersal patterns of aerosols and aromatic hydrocarbons.

VI. CONCLUSION

Since the time of the *Argo Merchant* incident, substantial progress has been achieved in the ability to prevent oil releases and mitigate the effects of oil spills. Progress has been greatest in the areas of prevention and shoreline cleanup; in contrast, however, cleanup efforts on water have experienced inconsistent results and remain a serious problem. In the analysis of five major case studies, it is suggested that future efforts continue to concentrate on prevention, because current efforts for limiting theadverse effect of pollution have failed to protect the environment.

One problem with management and prevention of oil spills is that although the overwhelming cause of spills has been attributed to human error, the focus of prevention has been on equipment. Scientists and engineers must find ways to deal with the human element in oil storage, transport, transfer, etc., if future spills are to be prevented. For example, the *Argo Merchant* incident stresses how once oil istransferred to a transport vessel it becomes much more difficult to control. Mega-tankers must adhere to the ITOPF guidelines for transportation and management of oil.

Improved responses are needed to limit the harm of an oil spill to the environment and promote faster restoration of damaged natural areas; oil has been found to permeate fine sediment in Prince William Sound 25 years after the *Exxon Valdez* accident. Improvements can be made through the use of alternate cleanup technologies, such as new bioremediation and dispersant methods and safer and more efficient ways of burning oil from the ocean surface. These improvements can help reduce the environmental damage of spills, and the products used during cleanup.

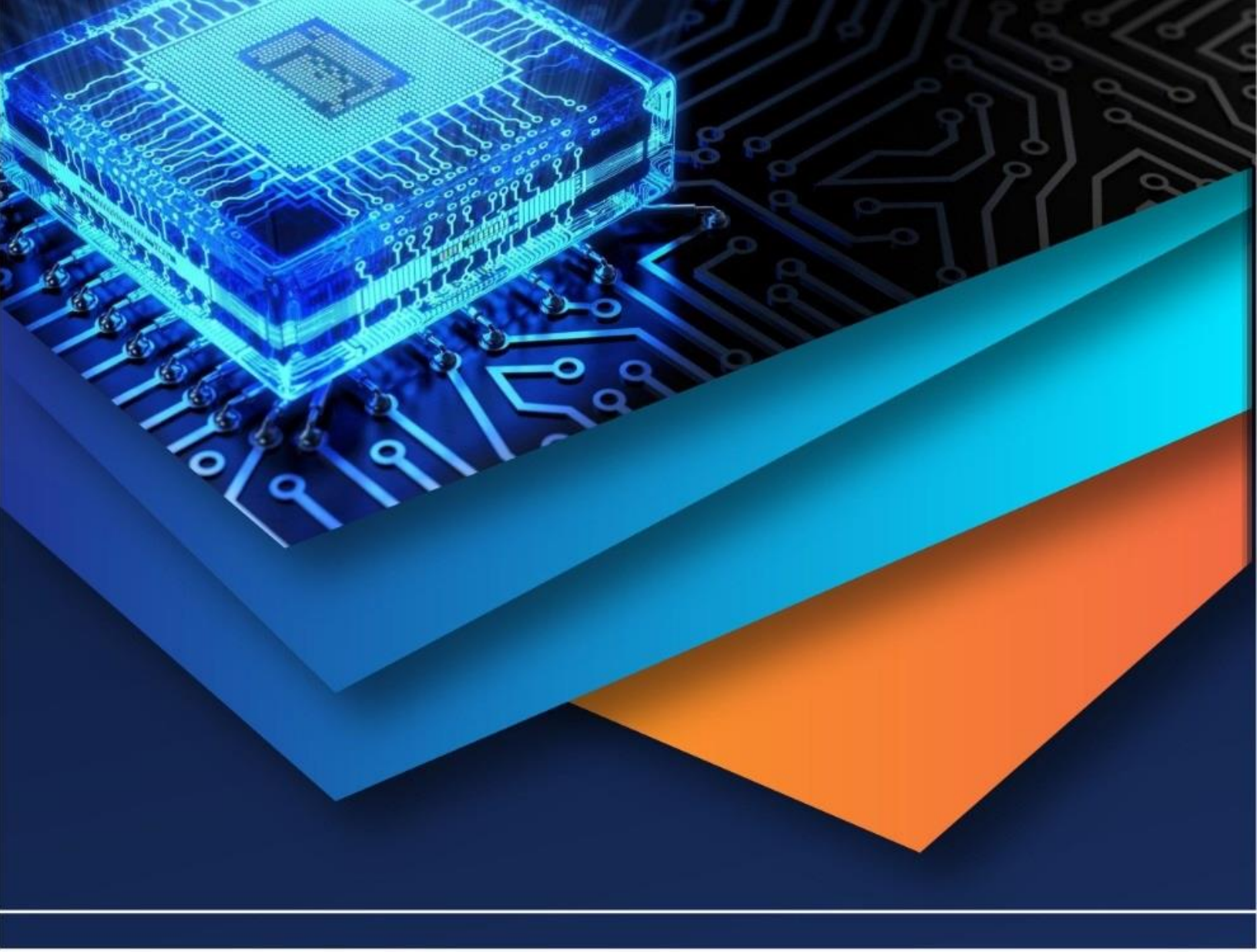
Oil spill response must be proactively addressed. For example, advances in prevention have, for the most part, improved primarily in response to major spill events. New technologies must be tested in preparation for future responses. There was a big leap forward in the prevention of oil spills and the efficiency of cleanup methods following the *Exxon Valdez* spill; nevertheless, the Deepwater Horizon release has taught an important lesson: technology has its limits, no matter how innovative, to prevent or successfully respond to spills. The *Mega Borg* and Hurricane Katrina incidents have shown us how weather, good or bad, can impact the ability to manage a major spill. Dispersants failed to work during the *Mega Borg* cleanup because the waters were too calm, and Hurricane Katrina limited access toaffected areas.

Nevertheless, the United States has had some success with mitigation efforts, including the prevention of spills, by establishment of laws and regulations to control the transportation of oil and that promote the development of more effective and efficient response protocols to a spill. The Oil Pollution Act of 1990 was instrumental in reducing oil spills of over 10,000 gallons in US waters from 178 in 1974 to 12 in 1996. The Act imposed stricter liability and requirements, including double-hull tankers in which the hulls are separated by ten feet. The Act also restricted single-hull tankers over 5,000 tons. The management of spills has become more efficient with improvements in equipment, resulting in more rapid and more complete recovery rates of oil. However, Hurricane Katrina highlights how recovery is still very much dependent on weather conditions at the spill site. The biggest improvement may be in the way these incidents are handled from an administrative/management standpoint. For example, the adoption of the Incident Command System and close collaboration between government agencies such as the US Coast Guard and EPA has led to more efficient cleanup of oil spills.

Ultimately of course, the key to good environmental policy as relates to oil is to focus on identifying ways to reduce the demand for oil by increasing the efficiency of energy use and by shifting to alternative energy sources. The costs of implementing these policies may be high, but the costs may be mitigated by the short-term and long-term benefits to industry, public health, and the environment. These policies must be implemented by close collaboration between government and industry leaders. Strong leadership can drive technology. So, the most important question remains as to how much society is willing to pay to prevent and manage oil spills. Public opinion is crucial.

REFERENCES

[1] Alaska Sea Grant College Program. (1995). Prevention, response and oversight five years after the Exxon Valdez oil spill. Proceedings of an international conference, 23-25 March 1994, Anchorage, Alaska. Report no. 95-02. University of Alaska, Fairbanks, USA
[2] Alkatib, M.A., Alam, M.D.Z., Muyibi, S.A., et al. (2010). An isolated bacterial consortium forcrude oil biodegradation. Afr J Biotechnol.,10, 18763–18767.
[3] Atlas, R., & Hazen, T.C. (2011). Oil biodegradation and bioremediation: a tale of the two worstspills in U. S. history. Environ. Sci. Technol. 45, 6709–6715.
[4] Atta, A.M., Al-Lohedan, H.A., Al-Hussain, S.A. (2015). Functionalization of magnetitenanoparticles as oil spill collector. Int J Mol Sci.,16(4), 6911-6931.
[5] Beazley, M.J., Martinez, R.J., Rajan S., Powell, J., Piceno, Y., Tom, L., et al. (2012). Microbial community analysis of a coastal salt marsh affected by the Deepwater Horizon oil spill.PLoS ONE, 7(11). doi: 10.1371/journal.pone.0041305.
[6] BBC News. (2010). Hair and fur used in Gulf of Mexico oil slick clean-up. Retrieved from:http://news.bbc.co.uk/2/hi/8672124.stm
[7] Brette, F., Machado, B., Cros, C., Incardona, J.P., Scholz, N.L., & Block, B.A. (2014). Crude oil impairs cardiac excitation-contraction coupling in fish. Science, 343(6172), 772-776.
[8] Bernabeu, A. M., Rey, D., & Rubio, B. (2009). Assessment of cleanup needs of oiled sandybeaches: Lessons from the Prestige oil spill. Environmental Science & Technology. 43(7), 2470.
[9] Bragg, J.R., Prince, R.C., Atlas, R.M., & Harner, E.J. (1994). Effectiveness of bioremediation for the Exxon Valdez oil spill. Nature, 368(6470), 413-418. doi:10.1038/368413a0
[10] Camilli, R., Reddy, C.M., Yoerger, D.R., Jakuba, B.A.S., Van Mooy, M.V., Kinsey, J.C., et al. (2010). Tracking hydrocarbon plume transport and biodegradation at Deepwater Horizon.Science, 330, 201–204.
[11] Cappello, S., & Yakimov, M.M. (2010). Alcanivorax. In: K.N. Timmis, T.J. McGenity, van der Meer, et al., (Eds.), Handbook of hydrocarbon and lipid microbiology. Berlin, Germany:Springer.
[12] Centers for Disease Control and Prevention (CDC). (2006). Health hazard evaluation of police officers and firefighters after Hurricane Katrina--New Orleans, Louisiana, October 17-28and November 30-December 5, 2005. MMWR Morb Mortal Wkly Rep., 55(2), 35-38.
[13] Center for Ocean Management Studies. (1978). Proceedings of a Symposium: In the wake of theArgo Merchant. University of Rhode Island, USA.
[14] Cheng, M., Gao, Y., Guo, X., Shi, Z., Chen, J., & Shi, F. (2011). A functionally integrateddevice for effective and facile oil spill cleanup. The ACS Journal of Surfaces and Colloids, 27(12), 7371-7375.
[15] Chiau, W. Y. (2005). Changes in the marine pollution management system in response to the Amorgos oil spill in Taiwan. Mar Pollut Bull., 51(8-12), 1041-1047.
[16] Choi, H. M., & Cloud, R. M. (1992). Natural sorbents in oil spill cleanup. EnvironmentalScience & Technology, 26(4), 772-776. doi:10.1021/es00028a016
[17] Craig, R. K. (2011). Legal remedies for deep marine oil spills and long-term ecological resilience: A match made in hell. Brigham Young University Law Review, 2011(6), 1863-1896.



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