

PETROLEUM OIL SPILL MANAGEMENT IN OFFSHORE

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ABSTRACT

Oil spills are disasters occurring because of human activities. Due to harmful effects of oil spill to environment similarly as marine life, it becomes essential to search out suitable solution both for oil spill prevention and oil spill response. However, preventing oil spill is certainly better option. Nevertheless, when a spill occurs, the simplest approach for controlling the spill is to require action quickly and in a very well-organized and efficient manner. This paper discusses about oil spill and related factors. It will also present potential solutions for prevention of oil spill.

Keywords: Oil spill, Oil slicks, Emulsion, dispersant, Best Available Techniques (BATs).

INTRODUCTION

Oceanic oil spills became a serious environmental issue thanks to intensified petroleum exploration and production on continental shelves, and thanks to transportation of a lot of fossil oil. Oil spill causes adverse effect on aquatic organisms. The impact of an oil spill depends on a spread of things, including oil characteristics, atmospheric condition, rate of oil spill and nature of aquatic organisms.

Causes of Oil Spills

From 1970 to 2019, majority of oil spills have occurred thanks to collision with another vessel on sea-water or under water. During loading and discharging of oil, hull failure, equipment failure, fire or explosions, or weather-related damage also are liable for minor oil spills. Despite decrease within the overall number of spills, the quantity of oil spills caused by collisions has been growing. Since 2010, oil spills events are higher than previous decades. Factors like physical phenomenon, relative density, and viscosity significantly affect the flexibility of an oil spill to spread.

Fate of Oil Spills

Natural actions including weathering, evaporation, oxidation, biodegradation, and emulsification reduces the severity of an oil spill and accelerate the recovery of an affected area.

- Weathering may be a series of chemical and physical changes that cause spilled oil to interrupt down and become heavier than water which ends in natural dispersion.

- Evaporation occurs when the lighter or more volatile substances within the oil mixture vaporises within some hours and leave the surface of the water whereas heavier components are less likely to evaporate and that they undergo weathering or may go upto the seabed.
- Oxidation occurs when oil contacts the water and oxygen combines with the oil hydrocarbons to supply water-soluble compounds. Slicks round the edges are greatly affected.
- Biodegradation occurs when microorganisms, like bacteria, go after oil hydrocarbons. A good range of micro-organisms biodegrade different components of oil and protect environment from hazardous effect of oil spill. Warm water environments favours biodegradation.
- Emulsification is that the process that forms emulsions, which are mixtures of small droplets of oil and water. Emulsions are formed by wave action. Water-in-oil (known as “chocolate mousse” and oil-in-water are kinds of emulsions formed. Water-in-oil emulsions are formed as a results of strong wave action because of which water is trapped inside viscous oil. Oil can interact with the sediment at the underside of the freshwater bodies.

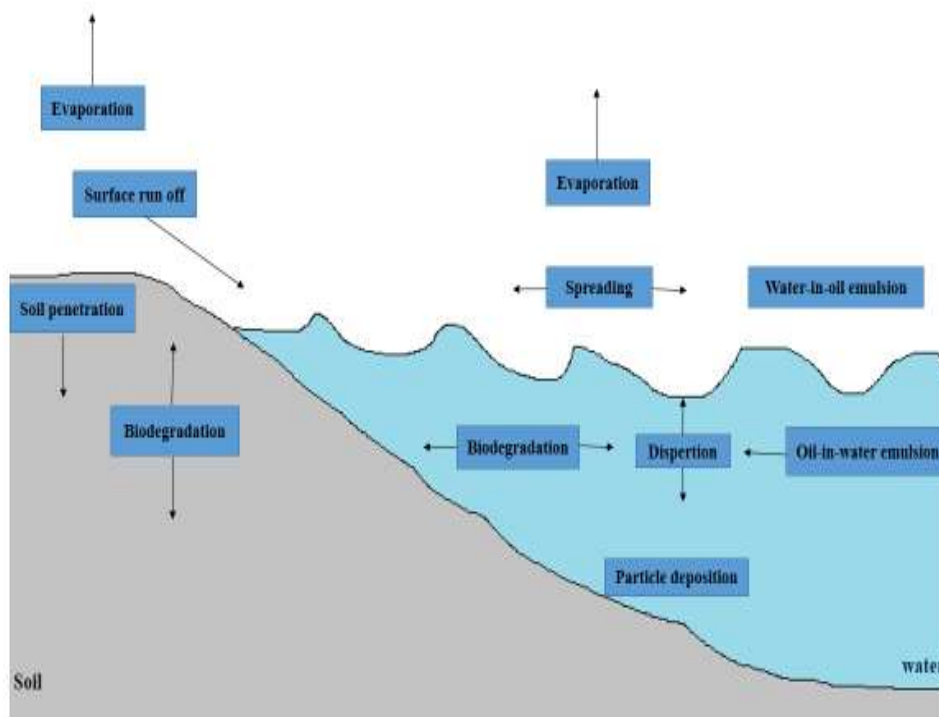


Figure 1: Fate of oil spill

Effects of oil Spill on Plants and Animals

Petroleum contains toxic substances together with metals like nickel, vanadium, and iron. Aquatic organisms are seriously injured or maybe killed because of contact with toxic substances in oil. Environment is plagued by petroleum additionally as non-petroleum oil. Non-petroleum oil spills can significantly damage environment than petroleum oil spills. Aquatic species like whales can swim far from a spill or go deeper within the water to travel far from oil spill. However, aquatic animals living near the shore experiences greater risk of contamination. Additionally, sea grasses and kelp beds which are used for food, shelter, and nesting sites by many alternative species are full of oil spill. Birds and mammals are significantly facing problems like destruction of food sources and habitats and fauna with toxic elements in oil.

Preventive Measures for Oil Spill

Oil spill is controlled by using equipment which restrict the spread of oil and to permit for its recovery, removal, or dispersal.

- Floating barriers called Booms, skimmers, and sorbents are commonly used for recovery of oil from the surface. Containment booms are used to control the spread of oil to avoid the chance of pollution near shores. They also concentrate oil in thicker surface layers for a easy recovery. Additionally, booms divert oil slicks for a easy removal from the surface of the water. Fence booms, Round or Curtain booms and Non-rigid inflatable booms are commonly used equipment for oil spill control.
- Skimmers is also self-propelled, used from shore or operated from vessels and their effectiveness depends on climatic conditions. Weir, oleophilic, and suction are different skimmers used for oil spill prevention.
- Sorbents are materials used to recover oil by soaking oil from water. They will be both oleophilic or hydrophobic (water-repellent). Sorbents are usually natural organic, natural inorganic or synthetic materials that are accustomed to remove final traces of oil, or in areas that can't be reached by skimmers. After oil recovery, sorbent must be far from the water and properly disposed of or cleaned for re-use. Factors like rate of absorption, oil retention and easy application should be considered for sorbent selection. An important solution to combat oil spill is suitable selection and proper use of the equipment and materials consistent with form of oil.



Figure 2: Oil damages on Wild life, marine ecosystems, and coastal environments

Alternative treatment typically involves dispersing agents, biological agents and in-situ burning that may be employed in place of mechanical methods, especially in areas where untreated oil may affect sensitive habitats the foremost and where a clean-up becomes difficult and environmentally damaging.

- Dispersing agents are surfactants that break oil into small droplets and help to clear oil from the water surface, making it less likely that the slick will reach the shoreline. The effectiveness of a dispersant is decided by factors including the composition and sort of the oil to treat, the tactic and rate at which the dispersant is applied, water salinity, temperature, and conditions confused.
- Bioremediation is another solution for oil spill which are nutrients, enzymes, or microorganisms that increase the speed at which natural biodegradation occurs. Bioremediation could be an action which is preferred after application of all mechanical oil recovery methods. It acts slowly, over the course of weeks, months, or years; removes oil from the environment. However, Bioremediation increases the speed of biodegradation of spilled oil from shorelines and minimizes potential environmental damage.
- Another method to mitigate oil spill is In-situ burning of oil which involves the ignition and controlled combustion of oil. The National Oil and Hazardous Substances Contingency Plan (NOHSCP) authorizes in-situ burning as a clean-up method but requires approval from the Regional Response Team (RRT) before it can be used. In-situ burning is usually utilized in open-water together with mechanical recovery methods.

Factors like water temperature, wind direction and speed, wave amplitude, slick thickness, oil type, and also the amount of oil weathering and emulsification that have occurred affect the performance of insitu burning. The factors liable for in-situ burning of inland spills are soil type, human proximity, erosion potential and presence of wild life species.

Chemical and biological methods are generally used with mechanical methods for prevention of oil spills.



Figure 3: Oil spill response tactics (BSEE)

Some Important Marine Time Oil Spills Registered

- In 1969, a blowout on an offshore platform off the coast of Santa Barbara, California, spilled over four million gallons of oil.
- In 1989, the Exxon Valdez cargo vessel ran aground within the Prince William Sound in Alaska, spilling over 11 million gallons of oil.
- In 1991, Iraqi forces invading Kuwait deliberately released eight million barrels of oil into the Gulf in a very bid to foil a US-led attack.
- The largest marine oil spill altogether of U.S. history was the Deepwater Horizon spill. On April 20th, 2010, an explosion occurred on the Deepwater Horizon oil rig within the Gulf of Mexico, killing 11 people. Before it had been capped three months later, approximately 134 million gallons of oil had spilled into the ocean. An \$8.8 billion settlement for restoration was reached in 2016, and restoration remains continuing today.
- The recent (on 25th July 2020) oil spill off the island of Mauritius: The Japanese-operated MV Wakashio ran aground off the Ocean Island, and is assumed to possess leaked over tonnes of oil in an environment.



Figure 4: Wreck of the MV Wakashio pictured on August 17, 2020

“It is interesting to watch that the number of oil spill in barely some years in earlier decades was greater than the full of all the oil spilt this decade”, says the ITOPF. In last decade, there have been quite 60 accidents leading to 164,000 tonnes of oil being lost.

CONCLUSIONS

- Oceanic oil spill is serious environmental issue which affects millions aquatic species.
- The severity of environmental damage caused by an oil spill depends on many factors, including the quantity of oil spilled, type and weight of oil, location of the spill, breeding cycles, species, seasonal migrations, and weather conditions.
- Nevertheless, remedial methods have been developed within the course of years in sight to resolve problems generated by this disaster that is oil spill supported by two principle, the containment and therefore the oil recovery.

REFERENCES

- 1) Adam Augustyn, Adam Zeidan, Alicja Zelazko et al (May 3, 2021); “Oil spill” Britannica.
- 2) Bureau of Ocean Energy Management; “Catastrophic Spill Event Analysis: High-Volume, Extended-Duration Oil Spill Resulting from Loss of Well Control on the Gulf of Mexico Outer Continental Shelf.” U.S. Department of the Interior.
- 3) Larry West (November 11, 2020); “5 Environmental Consequences of Oil Spills”.
- 4) National Oceanic and Atmospheric Administration (August 2020); “Oil spills”; U.S Department of commerce.
- 5) Peter Mwai (14 August 2020); “Mauritius oil spill: Are major incidents less frequent?”; BBC.
- 6) U.S. Environmental Protection Agency (December 1999); “Understanding Oil Spills and Oil Spill Response”.
- 7) Wikipedia (May, 2021); “MV Wakashio oil spill”.