

## IMPACT OF OIL SPILL IN THE MARINE ENVIRONMENT

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**Abstract** Petroleum contamination is a growing environmental concern that harms both terrestrial and aquatic ecosystems. However, the public and regulatory and scientific communities have given more attention to the contamination of marine habitats. This is because marine oil spills can have a serious economic impact on coastal activities, as well as on those who exploit the resources of the sea. Thus, communities that are at risk of oil disasters must anticipate the consequences and prepare for them. The deliberate release of around 6 million barrels of oil during the 1991 Gulf War in the marine environment is the largest oil spill in history. In the Gulf of Mexico, the BP Deepwater Horizon (DWH) oil spill on 20th April, 2010, which lasted over approximately three months, is the second largest in human history. When oil is spilled at sea it initially spreads out and moves on the water surface as a slick. It is a few millimetres thick and moves with the wind and current. At the same time, it undergoes a number of chemical and physical changes. The spreading of marine oil spills is affected by the action of winds, waves, water currents, oil type and temperature. The natural actions, which are always at work in aquatic environment, include weathering, evaporation, oxidation, biodegradation and emulsification. Generally, the effects of oil toxicity depend on a multitude of factors. These include the oil composition and characteristics (physical and chemical). If the levels exceed the threshold concentration, the additive toxic effect of hydrocarbons can lead to mortality. PAHs are the major contributors to toxicity. They have different metabolic pathways that produce metabolites. Inhaling hydrocarbons can cause respiratory tract irritations, as well as narcosis in mammals and birds. This is due to the volatile nature of hydrocarbons. Oil dispersants, which are a common tool used after oil spills, are also toxic and threaten pelagic and benthic organisms, as well as fish. In recent years, written studies have provided a considerable amount of information regarding the impact of oil spills and contamination of the seawater by hydrocarbons. The impact on marine life is impaired by the toxicity and tainting effects resulting from the chemical composition of oil, as well as by the diversity and variability of biological systems and their sensitivity to oil pollution. Marine life may also be affected by clean-up operations or,

indirectly, by the physical damage to the habitats in which plants and animals live. Communities that are threatened by marine oil spills have developed their own plans and policies to counteract the risk of marine oil contamination. These range from permitting or prohibiting increased oil transport volumes, to developing the capacity to respond to and recover from potential oil spill disasters. The multi-million dollar fish industry will be threatened, as well as the desalination of plants that supply most of the Gulf populations freshwater. Furthermore, people with careers in scuba diving will lose their jobs. As a result, the scuba diving tourism sector will also come under threat.

**Keywords:** Contamination, Crude, Hydrocarbon, Impact, Life, Marine, Oil, Petroleum, Spill, Toxicity, Water and threat

### **Introduction**

Our planet, Earth, has large reserves of oil and gas trapped deep beneath its surface. Occasionally, these reserves develop cracks and some of the oil or gas seep out. However, this is a part of nature and rarely causes any major damage. On the other hand, there are times when the same problem is caused because of human interference and it can cause a great deal of damage to marine ecosystems. In the last thirty odd years, the issue of oil spills and their effects has taken on much importance. This is because when an oil spill occurs, it causes a multitude of problems for the environment and us.

Oil spill can seriously affect the marine environment both as a result of physical smothering and toxic effects. Oil spill can seriously affect the marine environment both as a result of physical smothering and toxic effects. The severity of impact typically depends on the quantity and type of oil spill spilled, the ambient conditions and the sensitivity of organisms and their habitats to the oil.

Oil spill can cause a wide range of impacts in the marine environment and are often portrayed by the media as environmental disaster with dire consequences predicted for the survival of marine flora and fauna. In the major incident the short-term environmental impact can be severe, causing serious distress to ecosystems and to the people living near the contaminated coastline, affecting their livelihoods and impairing their quality of life.

The impact of spills have been studied and documented in the scientific and technical literature over several decades. Consequently, the effect of oil pollution is sufficiently well understood to allow for broad indication of the scale and duration of damage for a given

incident. Long-term damages have been recorded in a few instances. However in most cases even after the largest oil spills, the affected habitats and associated marine life can be expected to have broadly recovered within a few seasons.

### **What is an oil spill and how does it happens?**

An oil spill happens when liquid petroleum is released into the environment by vehicle, vessel or pipeline. It happens on a large scale and is mostly seen in water bodies. It happens due to human negligence and is a major form of pollution. The source of the spill is many. Tankers on land can release crude oil. In water bodies, the spill occurs due to drilling rigs, offshore oil platforms and well. Oil spills and their effects can also be experienced with refined petroleum or even waste oil from large-scale industries. What is common in all of them is that the damage caused by them is permanent and takes a long time to clean up.

When you hear oil spill, you probably think about all of the commercials that feature small animals covered in oil, but do you really know what causes the spill.

- People making mistakes or being careless.
- Equipment breaking down.
- Natural disasters such as hurricanes.
- Deliberate acts by terrorists, countries at war, vandals, or illegal dumpers.

When oil is spilled or dumped, it will float on the water. This layer of oil on top of the water is called an oil slick, as the water continues to spread the oil will become what is called a sheen which looks like a rainbow. When oil is spilled in the ocean, it is very hard to clean up. Most of Spilled oil the time; oil in the middle of the ocean is cleaned up naturally by waves. However if the oil drifts towards beaches it will cling to the sand and stones and clump together. This could potentially poison the beaches, and render them unusable. This ordinarily only happens when large amounts of oil are spilled into the ocean.



**SOURCE OF OIL SPILL**

## **Crude oil and its properties**

Crude oil is a complex mixture of organic compounds. These mainly consist of hydrocarbons, in addition to heterocyclic compounds and some heavy metals. The different hydrocarbons that make up crude oil come in a wide range of molecular weights and structure compounds. These compounds include methane gas, high molecular weight tars, asphaltenes, resins, waxes and bitumens. They also include straight and branched chains, single or condensed rings and aromatic rings such as the monocyclic (benzene, toluene, ethylbenzene and xylene). They additionally include polycyclic aromatic hydrocarbons (PAHs) such as naphthalene, anthracene and phenanthrene.

## **Toxicity of oil**

The general effects of oil toxicity depend on a multitude of factors. These include the oil composition and characteristics (physical and chemical), condition exposure routes and regimen, and the bioavailability of the oil. One major effect of oil is narcosis, a reversible anaesthetic effect caused by the oil partitioning into the cell membrane and nervous tissue. This causes dysfunctions of the central nervous system.

The additive toxic effect of hydrocarbons can lead to mortality, if the levels exceed the threshold concentration. When marine animals ingest oil hydrocarbons, they travel to the liver where enzymes activate PAHs to become more toxic and reactive products. The metabolites of polycyclic aromatic hydrocarbons (PAHs) and aliphatic hydrocarbons can be highly toxic and carcinogenic. In particular, PAHs are the major contributors to toxicity, with different metabolic pathways producing metabolites. These have oxidative and carcinogenic properties due to their ability to attack and bind to DNA and proteins. Hydrocarbons have a volatile nature and, therefore, inhalation of them results in respiratory tract irritation and narcosis of mammals and birds.

Oil spills can cause huge amounts of damage to the water and animals that live in the water. Depending on the circumstances, oil spills can be very harmful to marine birds and mammals and also can harm fish and shellfish. You may have seen dramatic pictures of oiled birds and sea otters that have been affected by oil spills. Oil destroys the insulating ability of fur-bearing mammals, such as sea otters, and the water-repelling abilities of a bird's feathers, thus exposing these creatures to the harsh elements. Many birds and animals also ingest (swallow) oil when they try to clean themselves, which can poison them. Depending on just where and

when a spill happens, from a few up to hundreds or thousands of birds and mammals can be killed or injured.

### **Effects of oil spill**

**Environmental Effects:** First of these is the environmental effect. The animal life that lives in the water or near the shore are the ones most affected by the spill. In most cases, the oil simply chokes the animals to death. Others that live face a number of other problems. The oil works its way into the fur and plumage of the animals. As a result, both birds and mammals find it harder to float in the water or regulate their body temperatures.

Many baby animals and birds starve to death, since their parents cannot detect their natural body scent. Birds that preen themselves to get rid of the oil accidentally swallow the oil and die due to the toxic effects. In many cases, the animals become blind due to repeated exposure to the oil. Dolphins, sea otters, fish, countless species of birds and many oceanic mammals face these consequences. Countering these effects and cleaning the oil can take anywhere between a few weeks to many years, depending on the damage caused.

**Effect on Economy:** The second major effect of the oil spill is seen on the economy. When precious crude oil or refined petroleum is lost, it affects the amount of petroleum and gas available for use. This means more barrels have to be imported from other countries. Then comes the process of cleaning the oil spill, which requires a lot of financing. Although the company responsible for the oil spills and their effect has to clean it up, there is a lot of government help required at this point.

**Effect on Tourism Industry:** The local tourism industry suffers a huge setback as most of the tourists stay away from such places. Dead birds, sticky oil and huge tar balls become common sight. Due to this, various activities such as sailing, swimming, rafting, fishing, parachute gliding cannot be performed. Industries that rely on seawater to carry on their day-to-day activities halt their operations till it gets cleaned.

While the long term issues cause by oil spills and their effects is yet to be fully observed, the daily problems are clear. However, most corporations still do not have a solid plan in place for when this emergency may strike.

One must understand that oil spill is not the only threat that marine life is facing. Increasing pollution contamination of industrial chemicals, exploitation of the resources they provide are also some of the serious threats.

### **Impact of oil spill on marine environment**

Oil destroys the insulating ability of fur-bearing mammals, such as sea otters, and the water repellence of a bird's feathers, thus exposing these creatures to the harsh elements. Without the ability to repel water and insulate from the cold water, birds and mammals will die from hypothermia.

Many birds and animals also ingest oil when they try to clean themselves, which can poison them. Fish and shellfish may not be exposed immediately, but can come into contact with oil if it is mixed into the water column. When exposed to oil, adult fish may experience reduced growth, enlarged livers, changes in heart and respiration rates, fin erosion, and reproduction impairment. Oil also adversely affects eggs and larval survival.

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### **Marine environment**

The following sections consider the different types of damage caused by ship source oil spills in various environments.

- offshore and coastal waters
- plankton
- fish and sea food, seabirds and marine mammals reptiles
- sea grass, corals reef,
- shorelines, rocky and, sandy shore, saltmarshes, mangroves



### **Oil spill incidents**

One of the biggest oil spills seen in history happened during Gulf war when approximate 240 to 336 million gallons of crude oil flowed into the Persian Gulf. It was considered one of the worst disasters, Oil spill in Mexico. Recent major oil spill happened when an oilrig, Deep-water Horizon sank in the Gulf of Mexico. The spill released somewhere between 172 to 180 million gallons of crude oil into the environment. In the year 2010 alone, six oil spills were seen in the USA. Outside of the United States, oil spills have happened in Canada, Nigeria, France, United Kingdom and in China. Hydrocarbons shot up the well at an uncontrollable rate and ignited, causing a series of explosions on the rig.

### **Major oil spills in Indian waters**

- Tanker: Trans Huron, 1974 (Laxadives), Sagar Vikas (blow out) year 1982 (Bombay High)
- Tanker: Maersk Navigator year1992 (Andaman Sea), Bombay High (Offshore) year 1993pipe line leakage
- MV SEA TRANSPORTER, 5 June 1994 - ore carrier grounded near Sinqerim, Goa.
- MARITIME WISDOM 23 March, 2005, iron-ore barge ‘Prapti’
- MSC Chitra Oil Spill off Mumbai August 7, 2010 (09.48 hrs ) - MSC Chitra collided ,with MV Khalijia – III about 10 Km off Mumbai coast ,2662 tonnes fuel oil BW Maple,January 28, 2017 (Chennai)

### **Clean up and recovery**

Clean-up and recovery from an oil spill is difficult and depends upon many factors, including the type of oil spilled, the temperature of the water (affecting evaporation and biodegradation), and the types of shorelines and beaches involved.

When oil spills, there is potential for huge amounts of damage. To prevent this damage, the oil has to be cleaned up. There are many ways to clean up the oil. According to this area they are:

**Containment and recovery:** Surround the oil with booms and recover the oil (for cleaning and reuse) with skimmers. Skimmers separate oil from the water by:

- **Sorbents:** Remove oil with absorbent sponges made from diaper-like substances. Some sorbents are made from natural materials -- straw, grasses, coconut husks, or wood chips.
- **Dispersants:** These are chemicals that act like detergents to break oil up into tiny droplets to dilute the oil's effect and to provide bite-sized bits for oil-eating bacteria that occur naturally, particularly in areas that have had a history of oil spillage Oil Spill.
- **Burning:** Burning is usually 95-98% efficient, but does cause black smoke. The smoke is not more toxic than if the oil were burned as intended in fuels. One gallon of oil burned this way creates the same pollutants as three logs in a fireplace or woodstove.
- **Bioremediation:** Enhancing natural biodegradation by natural oil-eating bacteria by providing them with needed fertilizers or oxygen. Oil on ocean floor
- **Shoreline clean up:** High-pressure hosing to rinse oil back into water to be skimmed up. This usually does more harm than good by driving the oil deeper into the beach and by killing every living thing on the beach. This was used extensively after the Exxon Valdez spill due to public and state pressure to make the beaches "look clean again," despite the known risks.

**Equipment used includes:**

- Booms: large floating barriers that round up oil and lift the oil off the water
- Skimmers: skim the oil
- Sorbents: large absorbents that absorb oil
- Chemical and biological agents: helps to break down the oil
- Vacuums: remove oil from beaches and water surface
- Shovels **and other road equipment:** typically used to clean up oil on beaches



## **Prevention**

Offshore oil spill prevention and response

Secondary containment methods to prevent releases of oil or hydrocarbons into environment.

Oil Spill Prevention Containment and Countermeasures (SPCC) program by the United States Environmental Protection Agency.

Double hulling - build double hulls into vessels, which reduces the risk and severity of a spill in case of a collision or grounding. Existing single-hull vessels can also be rebuilt to have a double hull. Thick-hulled railroad transport tanks. Appropriate evacuation zones and procedures, availability of fire suppression equipment. Disposal containers for spill clean up materials and the first aid procedures that might be required.

## **Conclusion**

Marine oil spills can have a serious impact on marine life, as well as on the economic coastal activities and the communities that exploit the resources of the sea. Generally, the effects of oil toxicity depend on a multitude of factors, including the oil composition and characteristics (physical and chemical), condition (i.e., weathered or not), exposure routes and regimen, and bioavailability of the oil. Oil dispersants, which are a common tool used after oil spills, are also toxic and threaten pelagic and benthic organisms, as well as fish. Marine life can also be affected by clean-up operations or indirectly through the physical damage to the habitats in which plants and animals live. Communities that are threatened by marine oil spills have realized the risk and have, therefore, developed their own plans and policy issues to counteract the risk of marine oil contamination. Due to the different anthropogenic activities relating to oil spills, in addition to the natural environmental stresses of the Gulf, a number of socio-economic impacts are predicted.

## **ACKNOWLEDGEMENT**

The author would like to express sincere appreciation to Dr K.C SAHOO, Head of Department (Marine Science Department) (Institute of minerals and metallurgy technology) for its laboratory support. Special thanks to **Liverpool John Moores University**.

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