

**Study a novel on oil spill and its modelling in KG Basin area**¹Chinta N Siva Prasad, ² Dr. Nihal Anwar Siddiqui¹Student of M.Tech-HSE, University Of Petroleum & Energy Studies, Dehradun.²Sr. Associate Professor & HOD of HSE Engineering, University of Petroleum & Energy Studies
(UPES) Dehradun, Uttarakhand

Abstract - Offshore oil spills are of tremendous concern due to their potential impact on economic and ecological systems. A number of major oil spills triggered worldwide consciousness of oil spill preparedness and response. Challenges remain in diverse aspects such as oil spill monitoring, analysis, assessment, contingency planning, response, cleanup, and decision support. This article provides a comprehensive review of the current situations and impacts of offshore oil spills in KG basin, as well as the policies and technologies in offshore oil spill response and countermeasures. Correspondingly, new strategies and a decision support framework are recommended for improving the capacities and effectiveness of oil spill response and countermeasures. In addition, the emerging challenges in cold and harsh environments are reviewed with recommendations due to increasing risk of oil spills in the kg basin areas from the expansion of the Arctic Passage

Key Words: KG Basin- Krishna & Godavari Basin

Introduction:

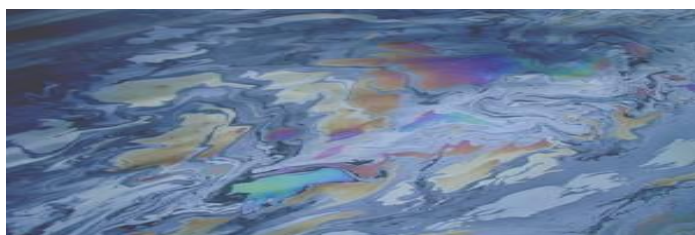
Oil pollution in the marine and coastal environments is a common feature in our days, on account of the wide use of this product, its production and transport. The impact of an oil spill depends on the type and amount of oil, on climatic factors, on abiotic site characteristics and on the sensitivity of local species. Damages caused to marine organism Oil as a stressor affects all the environment and marine water. However, due to the importance of the vascular plants as energetic sources, its effects related to this compartment have received more attention. Also, damage is somehow easier to visualize in trees than in small animals when assessing field impact. Oil spill means release of a liquid petroleum hydrocarbon in to the environment due to human activity, and is form of pollution .It is mostly observed in marine areas. There are so many incidents of marine oil spills it can also happen on land. Oil spilt in water is more dangerous than oil spilt on the land. Oil spill modelling provides useful information in risk assessment and the contingency planning process. Following identification of the worst case spill scenarios, oil spill modelling can assist in the identification of resources most at risk. The identification of these resources can assist in the appropriate prioritisation of sensitivities.

Physical & Chemical Properties of Oil

When oil is spilled at sea, it normally spreads out and moves on the sea surface with wind and current while undergoing a number of chemical and physical changes. Not all the oil spilled becomes persistent in the marine environment sometimes through natural dispersion of the oil into the water, lead to the removal of the oil from the sea surface, and facilitate its natural breakdown in the marine environment. But the oil that forms emulsions with sea water becomes very persistent and remain at sea or on the shoreline for prolonged period of time.

Crude oil is made up of a wide range of hydrocarbons ranging from very volatile, light materials such as propane and benzene to more complex heavy compounds such as Bitumen's, asphaltenes, resins and waxes refined products such as gasoline or diesel are composed of smaller and more specific ranges of these hydrocarbons. Under the guidelines of International Oil Pollution Compensation Funds (IOPCF), an oil is classified into persistent and non-persistent when tested in accordance with the American Society for Testing and Materials (ASTM) Method D86/78 or any subsequent revision thereof- at the time of shipment. If at the time of shipment at least 50% of the hydrocarbon fractions, by volume, distil at a temperature of 340°C (645°F) and at least 95% of the hydrocarbon fractions, by volume, distil at a temperature of 370°C (700°F), the oil is considered to be Non-persistent. In all the other cases it is considered persistent. Non-persistent oils tend to disappear rapidly from the sea surface whereas persistent oils dissipate more slowly and usually require a clean-up response if spilled or threatening coastal waters.

Examples of persistent and non-persistent oils are listed below.



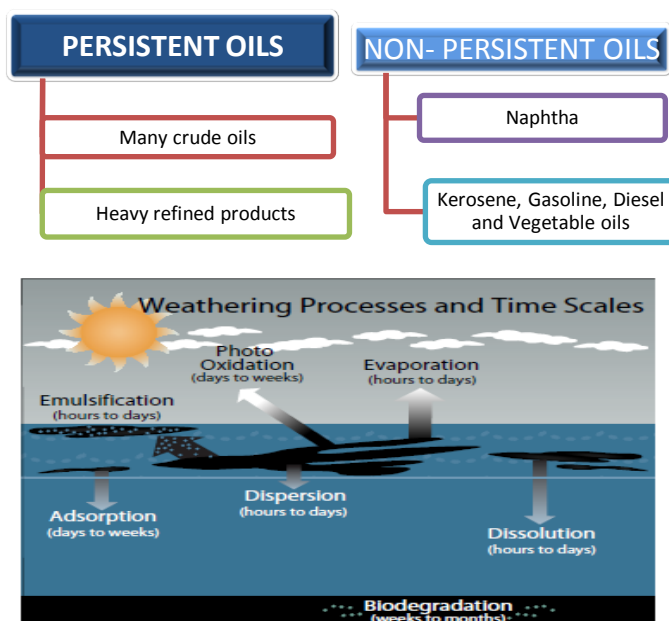
Non-persistent oil



Persistent Oil.

Oil has two important physical properties which both change during an oil spill: Density (specific gravity/buoyancy) - oil's ability to float. Viscosity - how much it flows - how thick it is?

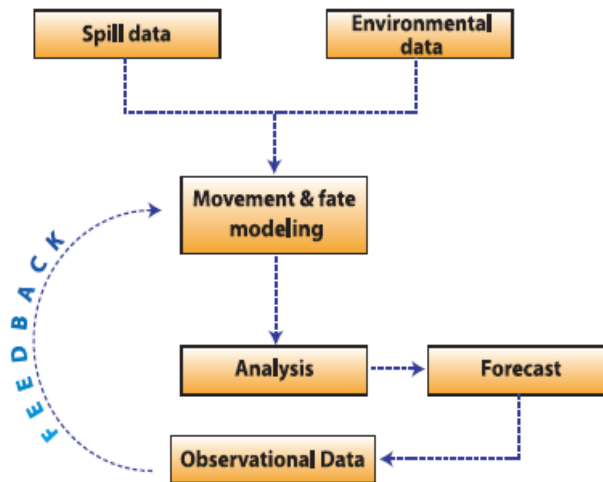
As the light ends of the spill evaporate, the oil becomes heavier (more dense) and may then sink below the surface (Bunker C oil is about same density as water and therefore sinks below the surface). Due to this evaporation the viscosity of the oil increases and it becomes difficult to pump. its movement will also be very slow. But under warm condition the viscosity decreases and the oil spreads more quickly. Time is one of the factor that causes a change in the characteristics of oil spilled. The oil spill undergoes weathering process according to time



TRAJECTORY OF OIL SPILL

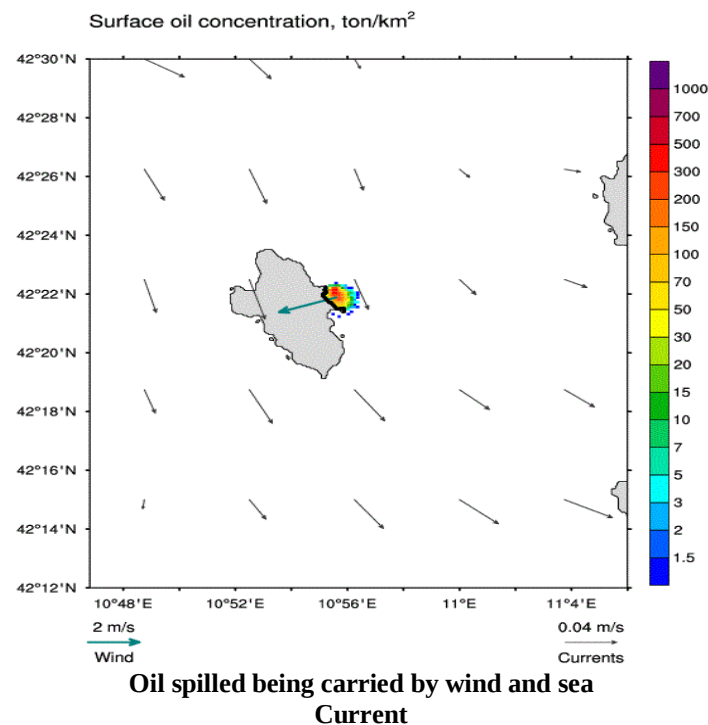
Literally trajectory means- "The path followed by an object moving through space".In the case of oil spill modeling it means- the path that the spilled oil travels and for a oil spill modeler it is very important to have the knowledge of the trajectory of oil spilled.Forecasting the movement of an oil spill is often hampered by insufficient input data, particularly in the first few

hours of the release. Detailed spill data (location, volume lost, product type) are often sketchy and environmental data (wind and current observations and forecasts) are often sparse or unavailable nonetheless, the modeller must examine the data and attempt to understand the physics and chemistry that will likely affect the oil movement and fate of the particular spill



OIL Spill Trajectory Analysis

The spreading process occurs quickly and, for most spills, mostly within the first hour. in the open ocean, winds, currents, and turbulence will quickly move the oil. Spreading will occur quicker for lighter and for less viscous oils in warm water temperatures and for warm oils the slick does not spread uniformly but will often have a thick part surrounded by a larger, but thinner sheen. the figure in the below slide shows a colour-enhanced image of an experimental spill .the orange portion is the thick part of the slick and the pink area, sheen note that about 90% of the oil is found in 10% of the slick area (the orange portion of the figure).





Colour-enhanced image of a test spill (<50 barrels)

SOURCES OF OIL SPILL

There are various sources of oil spill depending upon what is taking place off shores, within the territorial regions, in the EEZ, and beyond.

The sources for oil spill are:



SOURCES OF OIL SPILL CONDITION:

Natural seepage from bed:

Seepage can occur either through a fault zone extending to the seabed, or the absence of a impervious cap rock



Upstream exploration and production:

This covers a wide range of activities in the offshore region. Even though so many measure are taken oil exploration there are chances for blowouts of the drillers. Most of the off shore drilled crude oil consists of more percentage of persistent oil.



Transfer from downstream:

Once the oil is explored at the off shore facility, it is transferred to shore terminals and refineries. Different means are used for this purpose. For example, direct transfer by trunk pipeline to shore after aggregation from a group of wells. During this transfer there are chances for blowouts and as result- oil spill.



Ports and terminals:

Minor spills may take place during the course of port operations; in most cases, these are due to contraventions of the regulations. Accidents such as collisions between ships or groundings in ports or navigation channels may lead to major spills.



Recent collision of ships at ports

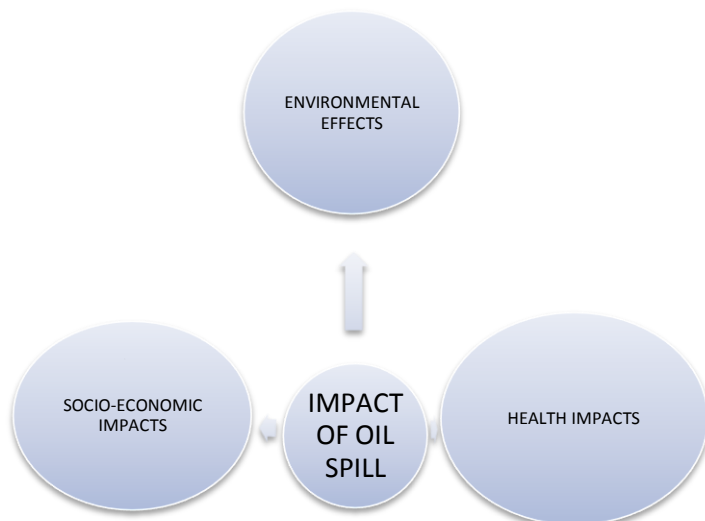
Near coast refineries and processing plants:

This will include all industries located on the Indian coast such as refineries, chemical and petrochemical plants dealing with a wide range of hydrocarbons and other derivative chemicals. The risk of oil leakages is very little at these areas.



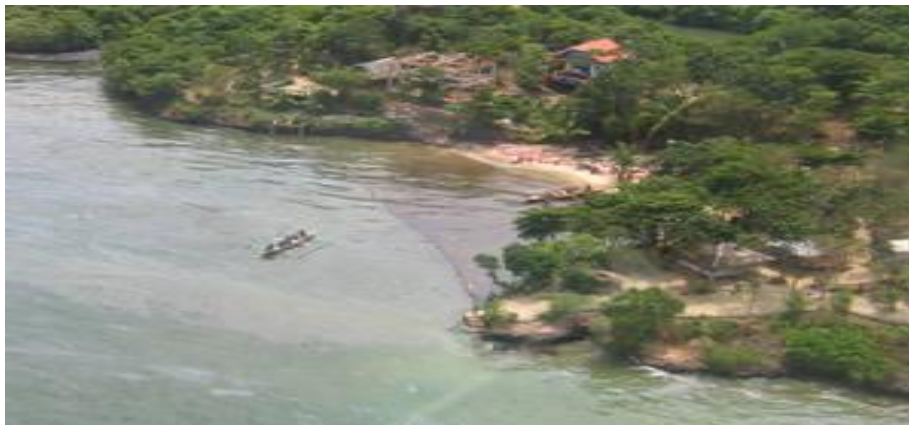
**Blow out caused at processing plant
Resulted in oil spill**

IMPACTS OF OIL SPILL



ENVIRONMENTAL EFFECTS

The effects of oil spills can have wide ranging impacts that are often portrayed as long lasting environmental disasters. It is true that an oil spill can have severe short term effects, especially when organisms are considered on an individual basis. However, environmental impacts should always be measured in a scientific context and should be appraised at an ecosystem rather than individual level.



Oil stranded on the shoreline adjacent to a fishing farm.
ENVIRONMENTAL EFFECTS CONDITONS

In other words, it is important (or more representative of long term environmental effects) to base the extent of environmental damage on the effects to ecosystems. For example, has the ecosystem retained its normal functions or how quickly will they resume following an oil spill under normal conditions many of the ecosystems most frequently affected by marine oil spills are accustomed to natural disturbances. Best examples are coral reefs.



The effects of an oil spill will depend on a variety of factors including, the quantity and type of oil spilled, and how it interacts with the marine environment. Wide variety of off shore and on shore (including birds near coastal areas) living animals face severe damage due to these oil spills. The effects of an oil spill will depend on a variety of factors including, the quantity and type of oil spilled, and how it interacts with the marine environment. It is important to remember that the clean-up techniques selected will also have a bearing on the environmental effects of a spill.





Effects of BP oil spill

ENVIRONMENTAL EFFECTS CONDITION:

Extensive research and detailed post-spill studies have shown that even major oil spills will rarely cause permanent effects. Marine ecosystems have high natural variability and are subject to ever-changing environmental phenomena such as storms, climatic anomalies as well as anthropogenic pressures. Furthermore, marine organisms have varying degrees of natural resilience to these pressures on their habitats. This natural variability means it is unlikely that exact pre-spill conditions will be reached. It makes determining the point of recovery following an oil spill, and the time it will take, difficult to accurately predict. It is generally accepted that recovery is reached when a community of plants and animals characteristic of that habitat are established and functioning normally.



GULF OF MEXICO OIL SPILL AND ITS EFFECT ON ENVIRONMENT: AN EXAMPLE.



Contaminated mangrove in August 2010



Natural recovery of the same mangrove in November 2010



Oiled Pelican before cleaning

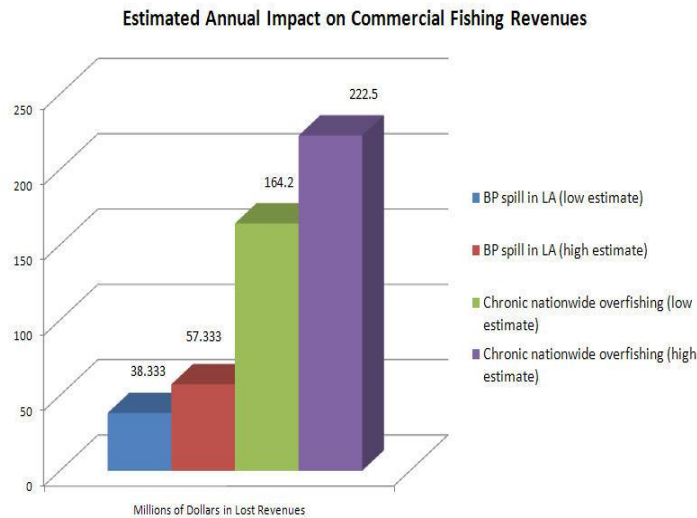


Oiled Pelican after cleaning

SOCIO-ECONOMICS IMPACTS EFFECTS:

Social impact assessment is an approach that used to examine social and cultural consequences of oil spills. These consequences can be found throughout the micro-macro continuum from individuals to communities to society. The social impacts resulting from an oil spill event are felt throughout the affected communities – from the fisherman who is unable to work, to the community suffering from the loss of recreational resources, to the general public left wondering when their lives will ever return to “normal.” In addition to the costs incurred in cleaning up oil spills, serious financial losses are sometimes experienced by economic sectors that rely on clean sea water and clean coastal areas. Typically, the greatest economic impacts are felt in commercial fisheries and tourism. Although a great number of other sectors can be affected, such as power plants, shipping, salt production or seawater desalination. The production of salt can be severely affected if an oil spill occurs when water is let into the pans.

SOCIO-ECONOMICS IMPACTS EFFECTS CONDITIONS:



Beach before spill



Beach After spill



Pink coloration in salt pans



A shut down power plant

HEALTH IMPACTS:

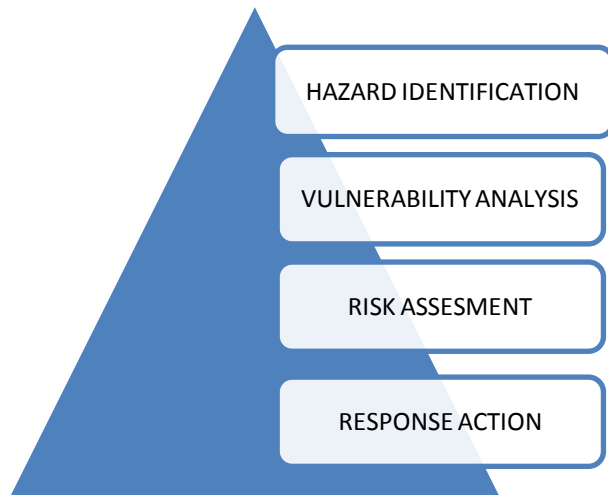
Oil has a direct effect on people through direct contact or inhalation of oil fumes. Short term adverse effects can include nausea, headaches and dermatological problems in fishermen, residents living close to the affected areas and beach visitors. Long term adverse effects of oil contact include cancer, pulmonary disease, skin diseases and hormonal disruptions. Fish, plant crops and animal products from coastal farms close to the oil spill sites need to be tested for hydrocarbon content and other oil impurities before being declared safe for consumption.



OIL SPILL CONTINGENCY PLAN:

Oil spills are, unfortunately, common events in many parts of the world. Most of them are accidental, so no one can know when, where, or how they will occur. Preventing oil spills is the best strategy for avoiding potential damage to human health and the environment. However, once a spill occurs, the best approach for containing and controlling the spill is to respond quickly and in a well-organized manner. A response will be quick and organized if response measures have been planned ahead of time. A contingency plan is like a “game plan,” or a set of instructions that outlines the steps that should be taken before, during, and after an emergency. A contingency plan looks at all the possibilities of what could go wrong and, “contingent” upon actual events, has the contacts, resource lists, and strategies to assist in the response to the spill.

OIL SPILL CONTINGENCY PLAN CONDITION:



HAZARD IDENTIFICATION:

- Types of oils frequently stored in or transported through that area.
- Extreme weather conditions that might occur in that area.
- The location of response equipment and personnel trained to use the equipment and respond to the spill.

VULNARABILITY ANALYSIS:

- Lists of public safety officials in the community
- Lists of facilities such as schools, nursing homes, hospitals, and prisons.
- Identification of parts of the environment that are particularly susceptible to oil or water pollution

RISK ASSESMENT:

Contingency planners compare the hazard and the vulnerability in a particular location to see the kind of risk that is posed to a community.

RESPONSE ACTION:

Notifying all private companies or government agencies that are responsible for the cleanup effort.

- Stopping the flow of oil from the ship, truck, or storage facility, if possible, and preventing ignition.
- Containing the spill to a limited area.
- Removing the oil.
- Disposing of the oil once it has been removed from the water or land.

After the plan is developed, it is very important to test it as to see if it works as anticipated. Testing usually takes the form of an exercise or drill to practice responding to a spill. Once the test results are proved to be positive then the plan is exercised. The private companies and government agencies should have an assessment of the plan that is exercised when a spill occurs. This is very important for improving the contingency plan for the next possible spill. Based on the type of spill different types of contingency plans are prepared. These plans can range from general to very specific plans.

ILLUSTRATION OF TYPES OF CONTINGENCY PLANS

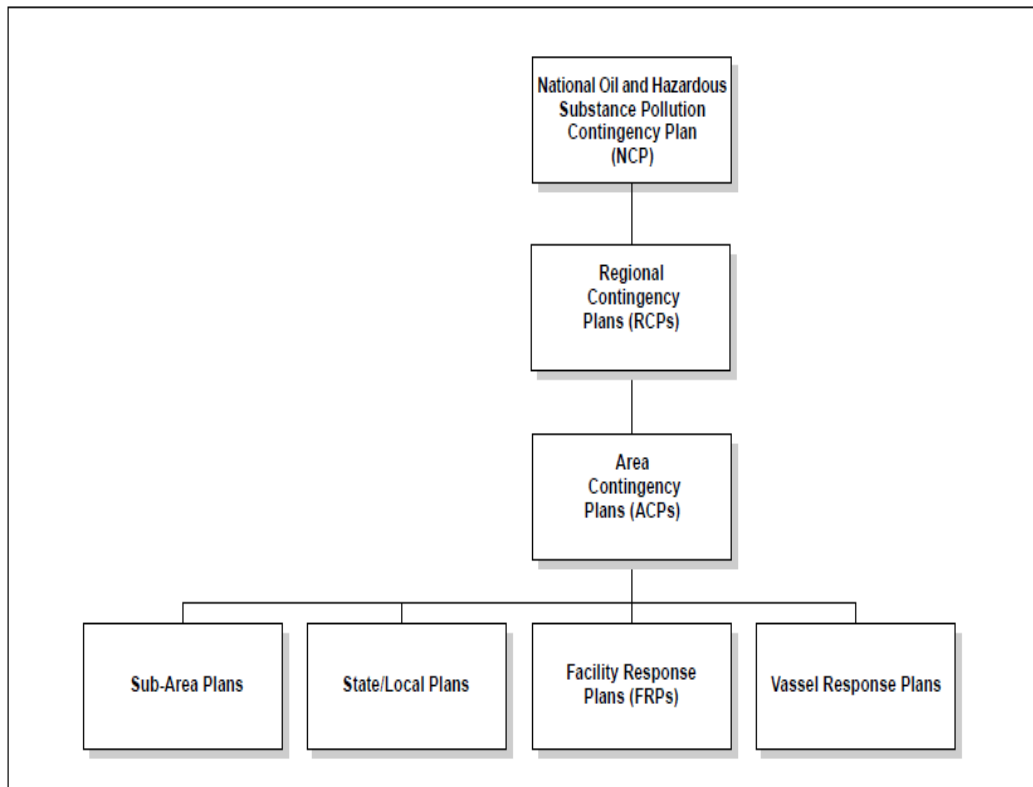
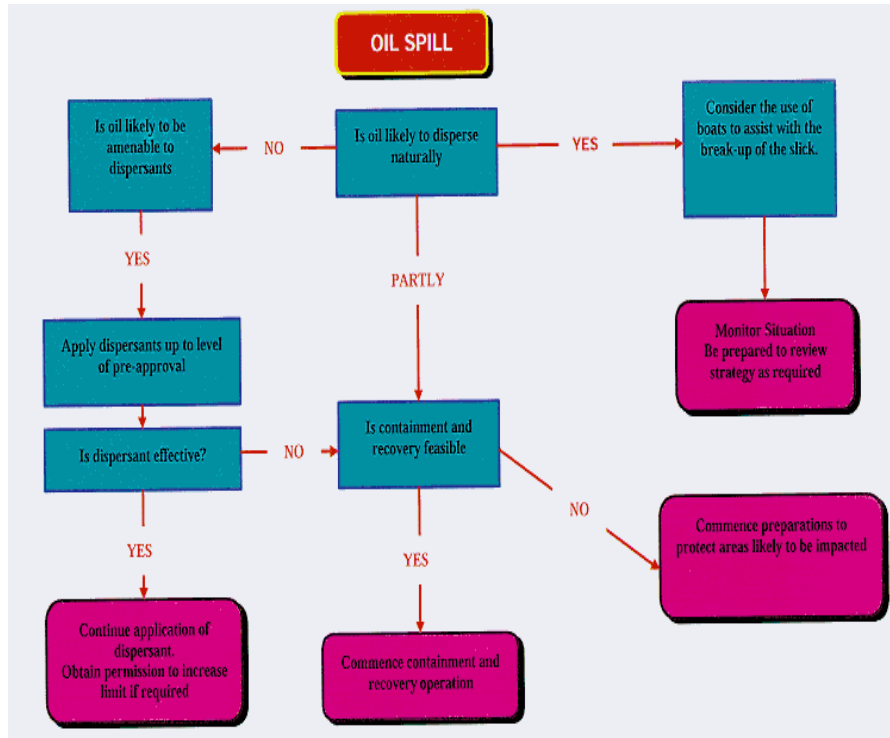


ILLUSTRATION OF A CONTINGENCY PLAN WITH A FLOWCHART

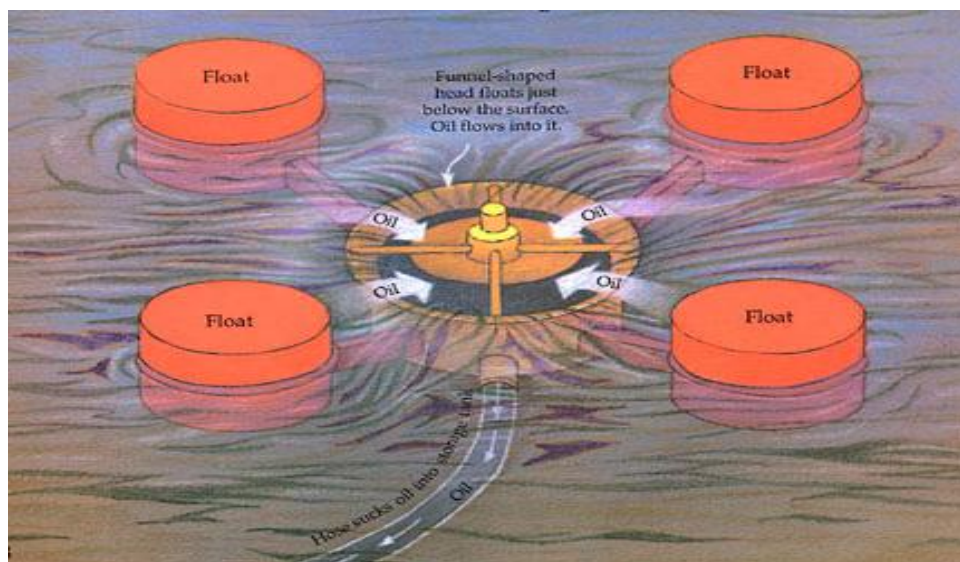


CLEANUP-METHODS:

Oil spill response teams are formed to immediately react to the incident of oil spill. Based on the type of oil and the place of the oil spill, different response measures are taken up. Both physical and biological methods of cleaning up oil spill are used. Also best economic way to clean up is selected, i.e., the costs for the cleanup activities are estimated and the best and cheapest method is implemented. Most oil spills reach the shoreline and cause visible pollution. The selection and correct application of clean-up techniques are therefore essential. When cleaning methods are being used extreme care should be taken in order to ensure the safety of the personnel working on it.

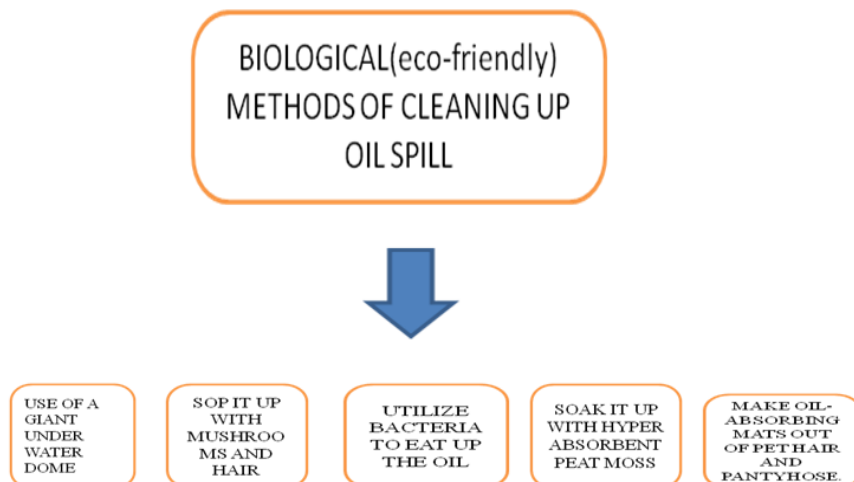
Some physical methods to cleanup oil spills





CLEANUP-METHODS CONDITION:

Biological or eco friendly methods of cleaning up the oil spilled are being used



USE OF A GIANT UNDER WATER DOME:

Desperate times call for desperate measures and BP engineers have begun working on an enormous dome that they propose could be lowered over the massive oil spill. They expect the dome to contain 1000 barrels of oil.

SOP IT UP WITH MUSHROOMS AND HAIR:

Mats made from the mixture offer a totally organic and effective way to sop up oil on water. The technique isn't just speculation either – it was actually utilized in the Cosco busn oil spill of 07

UTILIZE BACTERIA TO EAT UP THE OIL:

Bioremediation — using naturally present microorganisms to clean up oil spills — makes use of bacteria living in the ocean who actually “eat” the oil when it enters their natural habitat. Adding sulphate or nitrate fertilizers to the microorganism population causes them to multiply beyond their natural state and eat up the toxic metals invading their home at up to five times the rate that they would without assistance.

SOAK IT UP WITH HYPER ABSORBENT PEAT MOSS:

A Norwegian company has come up with a totally natural way to soak up nasty oil slicks – good old’ peat moss! The super absorbent moss they’ve developed can be scattered on the spill to absorb the oil, and then scooped right out of the water along with the oil.

MAKE OIL-ABSORBING MATS OUT OF PET HAIR AND PANTYHOSE:

Most pet owners have a LOT of animal hair and fur floating around their homes. San Francisco-based non-profit Matter Of Trust is asking dog and cat owners and groomers to donate their pets’ locks (as well as their own) to stuff inside of used pantyhose to create mats and booms that are perfect for soaking up oil.

REFERENCES

www.Boston.com
www.travelgrove.com
www.thetimes.co.uk
www.counterspill.org
www.oilandgasiq.com
www.offshore-technology.com
www.environmental-research.com
www.eoearth.org
www.amsa.gov.au
www.dnewsbd.com
www.coastalcare.org

www.ndtv.com
www.ibnlive.in.com
www.oilspillresponse.com
www.itopf.com
www.apasaresponse.com
www.marinergroup.com
www.elaw.org
www.paulmirocha.com
www.upct.es
www.oceansltd.com
www.bbc.co.uk
www.forestandbird.org.nz
www.groundtruthtrekking.org
www.oilprice.com
www.oilspillnews.net
www.ecowatch.com
www.indiancoastguard.nic.in
www.oilspillsolutions.org
www.bp.com
www.oils.gpa.unep.org
www.nola.com
www.environmentmagazine.org
www.theatlantic.com
www.ukmarinesac.org.uk