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Oil spill recovery techniques in petroleum industry: a review on treatment process

Vaibhav Sharma,[1] Anam Ramish,[1] Omprakash Sahu[2]

[1]Department Petroleum Engineering, UIE, Chandigarh University Mohali, India

[2]Department of Chemical Engineering, UIE, Chandigarh University Mohali, India

Correspondence: Omprakash Sahu, Department of Chemical Engineering, UIE, Chandigarh University Mohali, India, Tel +91-9752610957, Email ops0121@gmail.com

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Abstract

Oil spill are a significant natural worry in this day and age. With the expansion in human induced activity accidental or may be incidental spillage of oil has seriously influenced the climate, causing both biological and economic harm. Many methodologies have been used for this concerned. Mechanical, chemical and Biological methodologies have been used as remediation procedures for oil spill cleanup. Based on sort of oil spilled, climate conditions, and geology of the encompassing territory, cautious determination of medicinal strategies should be finished. Mechanical or Physical methodologies, for example, booms, skimmers, and sorbents are used related to each other for cleanup tasks and are one of the generally utilized essential reactions. Chemical methodologies or Synthetic dispersants when showered on oil spill quicken the pace of characteristic scattering of medium-and light-weight oils. Bio stimulation, bio augmentation, phytoremediation, and hereditarily changed creatures (GMOs) have all been attempted as healing systems for oil spills with fluctuating achievement. As Biological techniques are most secure, it need to update them with the assistance of various apparatuses such as with the study of various biological structures, functions and molecular tools should also be taken into consideration to make them more effective.

Keyword: oil spill, skimmers, bio stimulation, bio augmentation, booms, sorbents

Introduction

Oil Spills are the major cause of pollution which can be also termed as oil pollution due to leakage or accidental release of liquid petroleum into the environment. Oil spill is the greatest concerned in today's world.[1-3] The origin of oil spill is majorly in Oil platforms, refineries, or the oil tankers that met with the accidents. Oil spill causes loss in ecology as well as in economy the reason behind all these losses are that because ecology and environment and dependent on certain parameters governing oil.[4-6] It has a major impact in marine environment. The marine oil spill is characterized into thick oil with a thickness of more than 10mm and the thin oil with a thickness of under 10mm in the field of oil spill removal.[7-10] Further the thin oil having thickness under 1mm are characterized as oil film and can be ordered into different level as indicated by their appearance on the outside of ocean water.[11] Spill majorly occurs at sea or marine areas due to human activities then itself affect the life of living things which are entirely depended on marine environment. Even moderately little single spills may cause huge mortality among seabirds, for example, since quite a while ago followed duck, eiders, and penguins.[12] It is assessed that somewhere in the range of 100,000 and 500,000 seabirds are slaughtered due to oil slicks each colder time of year in the North and Baltic Seas. The oil isn't just a danger to seabirds while it is drifting at the surface or has tainted shorelines.[13] In the 2010 Deepwater Horizon oil spills set off overall awareness of marine spill reaction. The damage which can cause by the oil spill can vary in many ways such as the chemical composition of oil, the area which is affected due to spill, and which kind of cleaning activity is applied.[14-15]

In literature numbers of techniques were reported to short out the oil spill on sea. Generally physicochemical techniques skimming and booms, chemical treatment likes dispersant and solidifiers and biological techniques were shown good performances to control the oil spill.[16] Worldwide number of accident was occurred from last ten decades due to human mistake and other reasons. That has significant impact on human, plant, animals, eco-system and marine life.[17] To prevent the oil spill, it's necessary known the different methodology will play important role.[18] This review paper gives the insight of the properties, characteristics and all the methodologies which are used for remediation of oil spills. The methodologies such as Physical, Chemical, Thermal, in situ burning and biological methods which are being in order to tackle the problem of oil spill.

Properties of Oil Spills

The properties of oil can be classified on the basis of physical properties and chemical properties.

Physical properties: The important physical properties of oil are surface tension, viscosity, pour point, Density and solubility in water.[19] Among all these properties density is considered as the most important factor to determine the behavior of oil in water Lower thickness of oils brought about expanding the dissemination of lighter materials and substances and they have left the heavier materials, which sank in water area, worked together with water or of course others in seawater to outline the risky sedimentation on seawater body.[20-22] The rate spreading of oil is also be evaluated by viscosity of oil. It is tough to degrade or treat the oil having high viscosity.[23] Also, horizontal spreading ability of oil can be increased by increasing in

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temperature and hence reducing density and viscosity of the oil. The cleanup difficulty is also caused by the pour point of the oil which was also known as element of temperature converting oil spill into semi-solid at a temperature higher than the freezing point.[24] Also, the oil in water solubility recognized by the structure and moreover the contamination and bioremediation was very less and relies upon temperature and substance structure of hydrocarbon, solubility of oil in water was around 28-31 milligrams/liter.[25] Additionally, oil travel faster in in warmer water because of the reason that oil surface tension in inversely proportional to temperature.[26]

Chemical properties: Based on chemical properties oil is classifies into saturated and unsaturated hydrocarbons, fragrant or aromatic hydrocarbons, resin and asphalt, refined items. The Saturated hydrocarbons are additionally considered as alkanes with the easiest hydrocarbon structure that is just of carbon and immersed hydrogen molecules.[27] Alkanes are hard to solute in ocean water because of reason that they are little chemical reactive flammable and contain 1 to 40 carbon atoms in carbon chain and also they are non-polar compounds.[28] Aromatic Compounds sweet smell compounds consist of at least one aromatic ring. The aromatic compounds are considered as serious pollutants because they contain cancer causing agents. The aromatic hydrocarbons under aerobic condition have sharp degradation.[29] Normal crude oil contained about 30% of alkanes, half of cycloalkanes, alkenes, alkynes or dialkenes,15% of aromatics; 5% of nitrogen, sulfur and oxygen and others. Due to complex structure of asphaltenes and resin the biodegradation was difficult to analyze.[30] And, the refined items are the assortment of saturated and unsaturated hydrocarbon that is made by the interaction of synergist breaking subordinate upon the unrefined petroleum types and the treatment strategies.[31-33]

Methodologies to recover oil spill: Various techniques were introduced to recover the oil spills such as physical methods or mechanical methods, chemical methods, thermal methods called as in situ burning, biological methods or generally known as bio remediation.[34]

Physical Methods: Physical methods are generally used as barrier to control the spread of oil spill .In these method chemical and physical characteristics are not changing. The barriers which are used for the prevention and control of oil spill are booming, skimmers and absorbent.[35]

Booms: In boom method equipment were used to prevention the spreading of oil spill. They are mostly depending on the wind direction and current characteristics, the parameters other than wind direction and currents are velocity and wave height.[36] It is generally used to restrict the movement of oil. Generally, there are three types of boom that can be used like fence boom, curtain boom and fire boom.[37]

Fence Boom: In this type of method boom has fence like structure, which has been made as floating. Hence buoyancy and weight of base for holding fence under the water. The condition of water fence booms using should be calm and sheltered.[38] The fence boom arrangement is shown in Figure 1.

Curtain Boom: Curtain boom (Figure 2) are generally non-absorbent type of boom it consist of foam filled type of chamber above the water along with skirts which are weighted below the surface.[39]

Fire Boom: The fire booms are specially designed boom to control the spill by burning in controlled way. Therefore those are capable to protect the pollutant (spilled oil, shown in Figure 3) from the water.[40]

Figure 1 Fence Boom arrangement to control oil spill.

Figure 2 Curtain boom for oil spill control.

Figure 3 Fire boom oil spill control.

Skimmers: Skimmers are very common practices technology to control or prevent the oil spill. This methodology can be utilized to isolating oil from water. Mostly it classified in two way self-propelled and stationery, which shown in Figure 4. The self-propelled skimmer move with thrusters and it can be operated by mechanical liver.[41] This type of skimmer can be placed were the oil having high concentration. Stationery skimmers are movable to different location with help of ropes with the maximum concentration of oil.[42]

Adsorbent material: The applications of adsorbent materials are consider as final step to clean up oil spill after skimmer.[43] The primary reason for adsorbent material is to change fluid into semi strong all

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together over to eliminate the oil spill. The materials which are used as adsorbent material are basically of three types depending on its adsorption capabilities such as organic sorbent material, inorganic sorbent material and synthetic materials.[44] The organic adsorbent are extract from different biomass like wood, plants, animals and natural occurring materials. In organic adsorbent are chemical by product of different chemical industry. As well as synethic adsorbent are treated one that are chemical or physical modified from different sources.[45]

Figure 4 Application of stationary skimmer for oil spill control.

Chemical Methods: Unlike physical and chemical method has ability to change the oil spill chemical and physical property. In chemical control methods dispersants and solidifiers were employed to control oil spill.[46]

Dispersant: A range of various surfactants were bring in use as dispersant for oil spill control. The surfactants act as catalyst or agent and entrench themselves at interfaces tension between oil and water. Dispersants can minimize the coating of oil, which help to reduce the oil from marines.[47]

Solidifiers: Solidifiers are the material, which formed physical bond with the oil droplet. It's chemical process in which solidifier convert the oil into viscous mass. The process is convenient to recover the oil by applying the boom technology. Mostly this methods are using for small accident or little oil spill (Shown in Figure 5).[48]

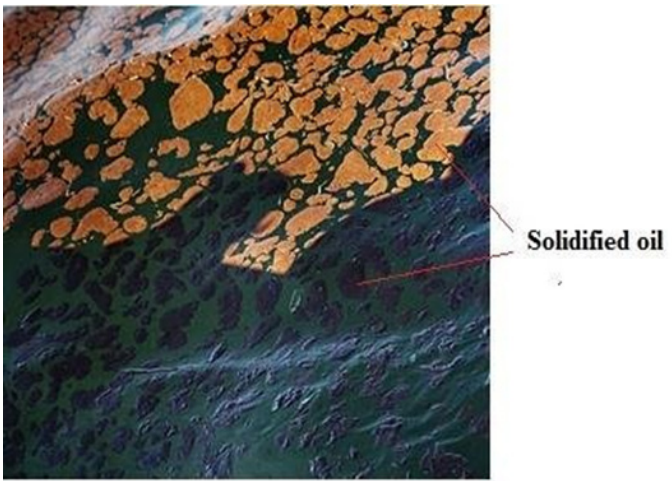

Figure 5 Solidifiers of oil spill.

Thermal Method (in situ burning): Thermal techniques were considering as quick response or last option for oil spill control,[49] which presented in Fig.6. Since the spilled oil were burnt with help of fire. The method depends on or limited to area far from sensitive zones and equipment; oil spill was sufficiently wide to consume with volume simultaneously and oil spill thickness should be enough to maintain the combustion. The safe distance of thermal method is calculated by z= 0.75d. Where z is the distance of safety and d is the area of burning.[50]

Figure 6 Thermal or in situ burning.

Biological Method: Biological techniques are slow process, in which microbes such as bacteria, fungi, yeasts involves to decompose the oil droplets.[51] In literature basically three types of microbes were reported to consume the oil. These microbes were classified in terms of condition like those consume sulfur called Sulfate Consumer; those work in presences of air called aerobic and those work in absence of air called anaerobic microbes. The process generally carried out the metabolism to break the complex compound into their food for overcoming environment quality. This method is suitable at all climatic conditions, therefore consider as economical and efficient. The byproducts after degradation are carbon dioxide and water.[52] In this techniques oil cannot be recovered but the residues was continuously degraded by different microorganism Different types of microorganism such as Gordonia, Brevibacterium, Aeromicrobium, Dietzia, Burkholderia, and Mycobacterium were reported in literature to decompose the hydrocarbon.[53-55]

Conclusion

The summarized techniques for recuperating and treating the oil spill from disaster were examined. Each procedure in like manner included pros and cons. Hence, it was imperative to do the measures to do measure to access focusing on picking the most reasonable oil spill recovery procedures. The standards ought to be unwavering quality, productivity, recovery and treatment time, charge, marine life impact, trouble level, capacity of oil recovery, level of relying upon climate conditions, level of impact on oil attributes of oil, level of additional treatment in the recovering. Some specialized after effects of oil spill, recuperation and remediation was finished up as dependent on this examination; Physical strategies were utilized as the initial ones to recover the oil spill as oil spill occurrences was discovered earlier with not huge region. Booms ought to be utilized to zone and self-contain the oil spill territory. From that point forward, skimmers were considered as the principle first gear for thick oil layer with enormous scope of oil recovery rate. The rest skimmers were valuable with thin oil layer. Also chemical method such as dispersants and solidifiers are equally beneficial as the chemical method dries not require large amount of man power and is quickest way to remove the oil spill. Biological method is most secure method although it is not able to recover the oil but spill can be degraded by multiple organisms.

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