

“LITERATURE REVIEW ON OIL RECOVERING SKIMMER FROM THE SURFACE OF WATER”

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Abstract - These days there are so many import and export business are going on in the world. Because of expansion of business and shipping by sea in the cheapest mode it is used on large scale due to these huge cargo shipping these are so many cases of oil spill in the sea. World has witnessed big oil spill accidents into the oceans and made huge impact on the industries as well as the ecosystems. Due to these oil spills there were so many deaths of sea mammals and birds. After oil spill it creates a slick (A thick layer of oil) that ensures the sunlight and oxygen pass through water. It affects the life below the water due to lack of oxygen and sunlight. As some of the oils are dangerous and poisonous they are quite harmful for humans too when it comes to physical contact with them. As a remedy to these oil spills there are some types of oil skimmers are present. Belt type, Pipe type, Rope type, drum type etc. All of these are used in recovering the oil that has spilled. Nemours studies has been carried out in the field of oil spill recovery a detailed literature review study has carried out to understand the how oil skimmers are effectively works. This study is totally based on the how we recover the oil that has spilled.

Key Words: Oil, Functions Oil skimmers, oil pollution etc.

1. INTRODUCTION

1.1 Background

Pollution is the most significant danger which threatens the human nature. The most dangerous of these pollutants is oil pollution, because oil pollution threatens the environment as well as economy. It has been studied that recently with increasing use of oil. According to Environmental Protection Agency, almost 14000 oil spills are reported each year in the oceans alone. Many countries has made stringent safety norms for waste water disposal content with oils mainly typically from petrochemical and process industries so that such industries are equipped with such kind of oil skimmers to separate the oils from disposal water.

An oil skimmer is the device that is designed to remove oil floating on a liquid surface. Based on the specific design they are used for a various applications such as oil spill response, as a part of oily water treatment systems, removing oil from the coolant and aqueous part washers and collecting fats, mixed oil and grease oil in waste water treatment plant.

Consequences of oil spill disasters from waterway accidents, the oilrig, and the acts of wanton vandalism usually affected so seriously the environment, marine creatures, plants, life of other animals, and human in a long time. The ever-developing and advanced technologies should be used to meet treat and recover fast, efficiently oil spills and oil slicks. The overviews of as-using technologies such as physical, chemical, in-situ burning and bioremediation method were presented in this work.

A large efficiency of oil recovery from physical method was shown although it was only suitable for application before oil emulsified. Meanwhile, chemical method might be concordant with all oil types but the chemical residual caused perniciously to marine environment.

1.2 Physical characteristics

The oil physical properties such as surface tension, density, pour point, solubility in water and viscosity dramatically effected on the spreading speed of oil or oil slick. Density of most oils, that was an important factor in order to predict, determine the behavior in water, was lower and smaller than that of water so the oils floated and lied flat on water surface and tented to spread, expand horizontally. Lower density of oils resulted in increasing the evaporation of lighter materials and substances and they have left the heavier materials, which sank in water column, interacted with water or others in seawater to form the dangerous sedimentation on seawater body.

Oil viscosity was also an index of evaluating the rate of oil spreading. The information about the chocolate mousse was formed due to higher viscous oil and leads to the difficulty in degradation or treatment. Oil pour point was considered as a function of temperature, the oil spill becoming a semi-solid at temperature higher than that of freeze point caused the cleanup strategy difficultly and complicatedly. Solubility of oil in water related to form the pollutant and bioremediation was low and depends on temperature and chemical structure of hydrocarbon, solubility of oil in water was about 28-31 mg/l. On the other hand, oil surface tension was inversely proportional to temperature, hence oil spread more easily in warmer waters, this index effected directly, quickly on the ability of spreading even in case of disappearing the wind or water currents.

1.3 Chemical characteristics

The hydrocarbons with 50% to 98% of oil total components dominated complex chemical properties of oil. Furthermore, oil also included non- hydrocarbon compounds such as oxygen, nitrogen, sulphur and trace metals. Hydrocarbons listed in oil components and classified following nomenclature by The International Union of Pure and Applied Chemistry (IUPAC) Oils might be divided into saturated and unsaturated hydrocarbons, aromatic hydrocarbons, resins and asphaltenes, refined products.

2. LITERATURE

[1] **Thombare Babasaheb B.¹ (2018)**, has studies in their paper as named “**A Review on Analysis of Belt Type Skimmer**” that according to polar and non- polar properties of oil and water, water consist of H⁺ and OH⁻ having polar nature while oil acts as an non-polar substance. Therefore, they do not get mixed with each other and the oil floats on water instead of sinking in. They studied that the oil has lesser density than water so oil floats on water. The belt material they selected was a non-polar material due to which the oil gets attracted to the belt. They took the belt material like (cotton, rubber, steel, oleophilic, etc.) They took the material that had higher adhesive properties than water. Due to which the belt absorbs the oil more easily than the water. This is what they concluded in their paper.

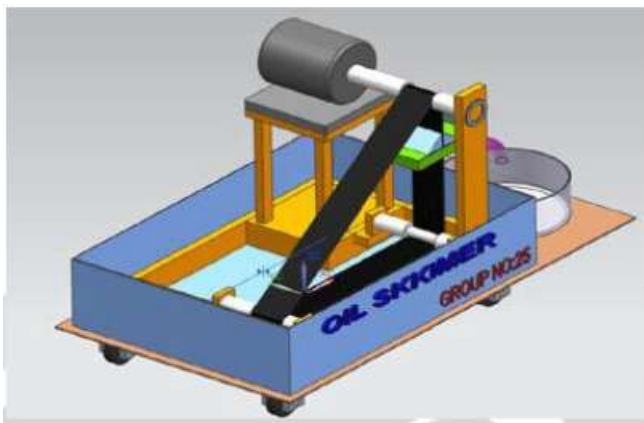


Fig-1 Model of oil skimmer conceptual model

[2] **Rakesh Pund¹ (2018)**, Studied in their paper as named “**Review on Analysis of Oil Skimmer**” that the polyurethane belt is having better oil skimming limit. They found out that the skimmer can evacuate around 60-70 liters of oil each day. They concluded that the polyurethane belt is effective and efficient for evacuating the oil. They even stated that the polyurethane belt is more advantageous to utilize where less clamor activity is required. They performed a practical in which they tried numerous belts (with different materials of belts) and concluded that the polyurethane belt has more oil recovering capacity

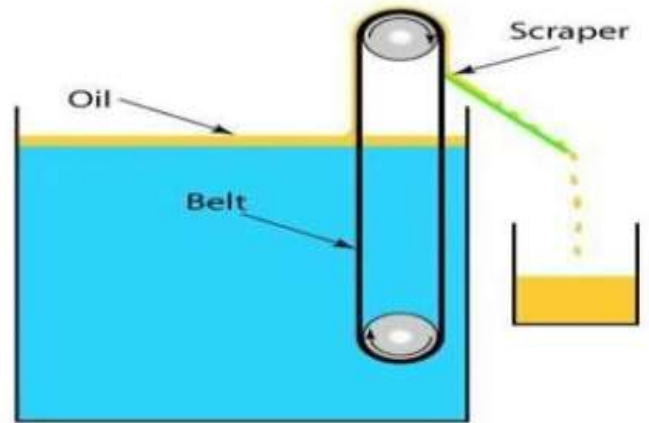


Fig-2 Construction of oil skimmer

[3] **Mamta Patel (2015)**, has studied in her paper as named “**Design and Efficiency Comparison of Various Belt Type Oil Skimmers**” that the slight difference in design and material can give a large impact on the oil recovery capacity of the skimmer. She concluded that the improvement of the oil skimmer towards to include additional belt shaft and use steel belt with steel material instead of rope significantly improves the oil recovery efficiency of the skimmer. Even by making the changes in the use of material as well as slight changes in the design (in short if the oil skimmer is modified a bit it can improve that efficiency of oil recovering capacity of the oil skimmer and even make the skimmer easy to use)



Fig-3 Actual snap of oil skimmer model

[4] **Sathiyamoorthi V¹ (2018)**, has studied in their paper named “**A review on mobile oil skimmer**” about the oil recovery capacity and the oil recovery efficiency. They found out that the belt speed, belt incline angle, thickness of the oil slick, and the speed of the belt are the important parameters among the others. They studied that the water drops are collected along with the oil. So for the skimmer to work efficiently it has to be reduced. Stirrer mechanism can be used to improve oil removal rate. Thus various process have been developed to remove oil from the contaminated area by use of booms, dispersants, and skimmers. It can also be separated by oil water separators or any sorbent materials. They resulted that the design improvement of the typical oil

skimmer towards the belt shaft and use of skimmer belt significantly improve the oil recovery efficiency and also assimilates simpler. In short they studied that the proper design of the skimmer and proper use of material can increase the oil recovery rate of the skimmer and can work efficiently. The angles of the belt and the speed of the belt plays an important role in the good efficiency of the skimmer.



Fig.4- Oil spill in the ocean

[5] Rafi Jamal Algawi¹ (2014), has studied in their paper named “study of operating conditions for oil skimmer apparatus from water” that the oil recovery rate increases with the increase in belt rotational speed. The oil recovery efficiency decreases with the increase in belt rotational speed. They even resulted that the oil recovery rate increases with the decrease in the oil temperature, but decrease in oil temperature decreases the oil efficiency rate. They studied that the oil viscosity plays an important role in oil recovery using a oil skimmer. A lower temperature increases the oil recovery rate and the oil recovery efficiency by increasing the viscosity. They even concluded that the PH of the water has a significant effect on the oil as its changes its physical properties of the oil making it difficult to be recovered. They even concluded that the material of the belt used on the skimmer has a significant role as its changes the oil recovery rate of the skimmer. In short they concluded that the factors like viscosity of the oil, belt material, surrounding atmosphere of the oil spill can change the oil recovery rate as well as the oil recovery efficiency of the skimmer affecting the recovery of the oil.

[6] Arturo A. Keller¹ (2008) Studied in their paper named “oil recovery with novel skimmer surfaces under cold climate conditions” that the temperature of the surrounding and oil plays a vital role in the recovery of the oil. They concluded that as the temperature of the oil increases it becomes difficult for the skimmer to skim it out of the water surface. Due to increasing temperature the skimmer belt is enable to adsorb it as it becomes hard. The decreasing temperature of the oil decreases the oil viscosity as a result decreasing the oil recovery rate of the skimmer. They concluded that as the temperature of the oil decreases it becomes less cohesive to the belt used for the skimming purpose. For the oil to be cohesive they studied and concluded to add the cohesive materials to the oil before

putting it through the skimming process. These cohesive material makes oil to stick to the surface of the belt and recover the oil from the surface of the water. In short they studied that the lower temperature atmospheres can make oil recovery difficult from the surface of the water. For the purpose to recover the oil it is necessary to add some cohesive admixtures to the oil spill for it to be recovered as it becomes non cohesive with the decreasing temperature of the atmosphere. In short the viscosity of the oil plays a vital role in the oil recovery rate as well the oil recovery efficiency.

[7] Vishal G. Naphade¹ (2018), has studied in their paper named “Design of Disc Type Oil Separator” that the material of the disc in the disc type oil skimmer can change the oil recovery capacity of the skimmer due to the weight of the material. They studied that the mild steel disc increases the weight of the skimmer making it harder to carry around. Due to heavy disc the oil recovery capacity changes drastically. Instead of the mild steel disc they used acrylic disc which is light in weight and does not soak oil. They resulted that the acrylic disc skimmer has the better oil recovery capacity than the mild steel disc skimmer. They even concluded that the acrylic disc gives better performance than the mild steel disc and is easy to handle and clean after the use.

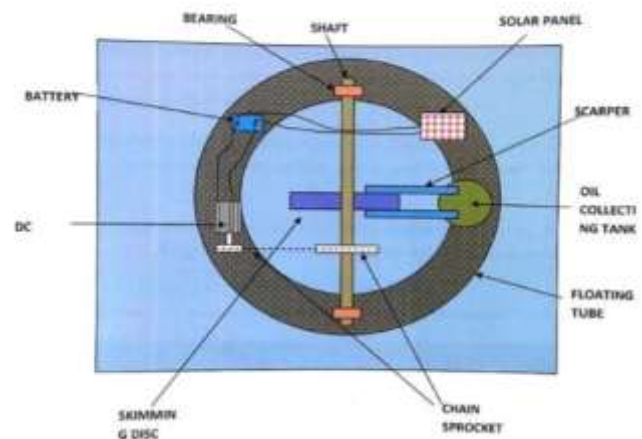


Fig.5- Oil Skimming disc

[8] N Widiaksan¹ (2017), has studied in the paper named “Analysis of effectiveness of oil spill recovery using disc-type oil skimmer at laboratory scale” the oil recovery capacity depends upon the speed of the disc of the skimmer.

Area (cm ²)	Rotation Speed (RPM)	Total Recovery Oil (ml)
31.5	20	157.6
	40	315
	55	433
89	20	444.2
	40	888.2
	50	1221

Table 1. Result of theoretical analysis

They tested the oil recovery capacity (oil recovered on the specific speed) at the medium speed, low speed and high speed. They even concluded that the larger area will produce higher amount of oil recovered. They concluded that at the higher speed of the disc it will recover some amount of water along with the oil. So the speed of the disc should be set according to the area of the spill and the depth of the oil spill. In short the disc speed is dependent on area of the spill and the depth of the oil that has been spilled on the surface of the water.



Fig.6- Disc Type Oil Skimmer

3. SUMMARY OF LITERATURE

There are number of papers published on use of oil skimmers for oil recovery from the surface of water. Many of them introduced a various new technique to design mechanical oil skimmers. But we think the most effective and economical oil skimmer is pipe type oil skimmer. This has a great impact on percentage of oil recovery from water surface, which has not been mentioned by earlier researchers.

4. CONCLUSION

As we learnt from all the researches work that there are some important aspects and points that are essential to consider while designing an oil skimmer. The very first thing is the design aspects of the skimmer and rotational speed of the belt is very important and also material which has been used. The slightest changes in the design aspect of the skimmer may cause a huge difference in the oil recovering efficiency of the skimmer. The belt must be of a polar material so that the oil that is a non-polar substance will stick to the surface of the belt. The other crucial thing is the placing of the component parts of the skimmer should be placed significantly. The working design of the skimmer should be accurate and significant for better performance of the skimmer. For the better efficiency it is studied that the polyurethane belt is most efficient for the skimmer to recover oil from the surface of the water. It is very crucial to keep the design aspects, the material of the component parts

and the rotational speed of the belt to get effective oil recovery efficiency from the skimmer.

5. FUTURE SCOPE

As we all know that there is still increasing demand for the oil and fuels. As a result there is more need to extract oil from the bottom of the ocean. Because of this there are going to be more spills and accidents resulting in more pollution. So as a remedy we are going to need the mechanical pipe type oil skimmer which is going to recover the oil efficiently from the surface of water. An efficient oil skimmer will a need of the hour in future, to recover the oil spilled on the surface of water. It will be necessary to recover the oil that has been spilled because the numbers of sea life deaths are high right now. The world cannot risk more deaths as it will affect the whole ecosystem, thus we conclude there will be an itching need for the efficient oil skimmer in future. Currently we are working on pipe type oil skimmer in our workshop photo (Fig. 7) as shown below and model is in under progress.



Fig.7- Pipe Type Oil Skimmer

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REFERENCES

- [1] Thombare Babasaheb B., Barse Babasaheb N., Barhate Ganesh B., Kolhe Sani M., & Jagtap Harshal B. (2018): "Analysis of belt type oil skimmer" IJARIE-ISSN(O)-2395-4396 Vol-4 Issue-2 2018.
- [2] Rakesh Pund, Roshan Mhaske, Shivam Rahane & Shubham Rajput (2018): "Review on analysis of oil skimmer" International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 10 | Oct 2018.
- [3] Mamta Patel (2013): "Design and Efficiency Comparison of Various Belt Type Oil Skimmers" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064.

- [4] Sathiyamoorthy V, Arumugam K, Arun Pragathish M, Barath B.N, Baskar M & Balamurugan S (2018): "A Review of Mobile Oil Skimmer", International Journal of Engineering & Technology 58-60.
- [5] Rafi Jamal Algawai & Maha adnan Dawood (2014): "Study of operating conditions for oil skimmer apparatus from water" ResearchGate Conference paper - 322303173, April 2017.
- [6] Arturo A. Keller & Kristin Clark (2008): "Oil recovery with novel skimmer surfaces under cold climate conditions " International Oil Spill Conference Proceedings: May 2008, Vol. 2008, No. 1, pp. 667-671.
- [7] Vishal G. Naphade, Atul M. Parande, Sunil N. Suryawanshi, Muqsid M. Inamdar & Vinayak Kale (2018): "Design of disc type oil separator", International Journal of Innovations in Engineering Research and Technology [IJIERT], ISSN: 2394-3696.
- [8] N Widiaksana, A A Yudiana and Y S Nugroh (2017): "Analysis of effectiveness of oil spill recovery using disc-type oil skimmer at laboratory scale" 2nd international Tropical Renewable Energy Conference (i-TREC) 2017 Earth and Environmental Science 105 (2017) 012086.