Solar Operated Oil Seperator From Water

Parab Ashwini Mohan[1], Mungekar Pooja Sudhir[2], Mr. Pawar Shivprasad Suresh[3], Mr. Ravi Kumar Pandey[4], Prof.Siddharth Suman[5]

[1, 2, 3, 4] Dept of Mechanical Engineering

[5]Assistant Professor, Dept of Mechanical Engineering

[1, 2, 3, 4, 5] Dr. DY Patil College of Engineering & Innovation

Abstract- *Oil skimming is basically sticking of oil to some material which is inserted in it. This action can be effectively used as oil can stick to the material but not the other impurities in it. Hence by this principle, Oil can be separated from its containments as well as it can be separated when it is containment. Oil skimmers are effectively used in various industries for the sake of separation of the coolants especially from water. Although designs vary, all oil skimmers rely on specific gravity, surface tension and a moving medium to remove floating oil from a fluid's surface. Floating or sinking oil and grease cling to skimming media more readily than water, and water has little affinity for the media. This allows skimming media in the shape of a belt, disk, drum, etc. to pass through a fluid surface to pick up oil and grease with very little water. This oily material is subsequently removed from the media with wiper blades or pinch rollers. Oil skimmers are simple, dependable and effective tools for removing oil, grease and other hydrocarbons from water. Often, a skimmer by itself can achieve the desired level of water purity. In more demanding situations, skimming is a cost-effective means of removing most of the oil before using more complicated and costly treatments such as coalesces, membrane filters and chemical processes.*

Keywords- Oil, Oil skimming, grease, filters

I. INTRODUCTION

Solar based; disc type oil spill recovery system is derived from the same mechanism. The concept of using this disc type oil recovery system to tackle the crisis of oil spill is a very efficient and effective possibility. It has numerous advantages over Chemical or Sponge suction techniques which are used now days for cleaning the oil from water surface.

Also, by using solar energy to drive the system makes it very effective, economical and environ friendly. This practically allows us to cross the boundaries of limited-service area and to reach the long distances for the purpose of cleaning and recovery. Also, the system can be fully automated which can guide itself or can be guided by remote control. Means, a single person can operate and control 100s of such system at a time. This saves lots of human efforts and hence reducing the cost of operation. The simple disc skimmer mechanism is hence could be converted in to such an effective weapon against the global crisis of the oil spill. The following paper explains the need, brief background knowledge needed for the understanding of the concept, and the modifications in the concept. The solar based; disc type oil spill recovery systems can be proved vital in future to tackle the oil spill crisis all over the world. Oil pollution occurs in harbor basins when leaks from shore facilities for the supply of diesel fuel to fishing vessels find their way into the harbor water; when vessels pump out oily bilge water in port; when used engine oil is dumped overboard and when an accident results in leakage of fuel oil. A fishery harbor which is contiguous with the main harbor also faces the risk of major oil spills if the main port is a transfer point for crude oil or refined products from oil tankers. To mitigate oil pollution, the fishery harbor manager should take necessary action to:

1. Provide shore-based reception facilities for oily wastes (bilge water and spent oil) from vessels and
2. Minimize leaks while bunkering.

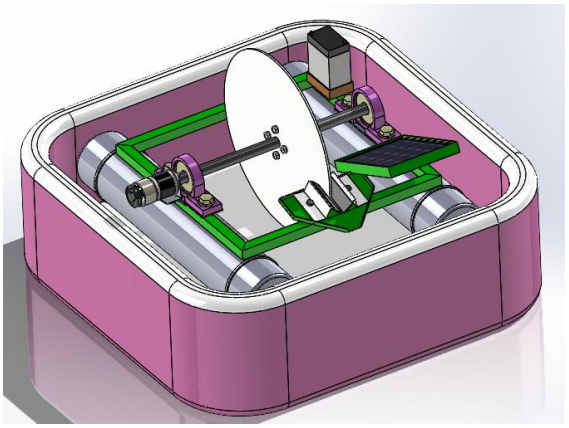

Figure 1 Solar Operated Oil Separator from Water

Oil spills affect small organisms living in the sea, such as plankton, and larval fish, as well as bottom-dwelling organisms like oysters, seaweed, mussels. When these organisms die due to the oil, this affects the food chain, Fish who prey on these animals will have difficulty finding food, and may die. This will in turn affect their predators and so on. Studies have shown that the environmental damage of oil

spills is far greater than originally thought. The hydrocarbons in petroleum-based oil are able to negatively impact marine life at concentrations as low as one part per billion. The heavier components of crude oil such as polycyclic aromatic hydrocarbons cause the most damage. Although being less toxic than lighter components such as benzene and toluene, unlike these components they are not volatile and do not evaporate easily. The oil mixes deeply into pebbles or sandy beaches, and remains there for months or years.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

Oil skimming is basically sticking of oil to some material which is inserted in it. This action can be effectively used as oil can stick to the material but not the other impurities in it. Hence by this principle, Oil can be separated from its containments as well as it can be separated when it is containment. Oil skimmers are effectively used in various industries for the sake of separation of the coolants especially from water. Although designs vary, all oil skimmers rely on specific gravity, surface tension and a moving medium to remove floating oil from a fluid's surface. Floating or sinking oil and grease cling to skimming media more readily than water, and water has little affinity for the media. This allows skimming media in the shape of a belt, disk, drum, etc. to pass through a fluid surface to pick up oil and grease with very little water. This oily material is subsequently removed from the media with wiper blades or pinch rollers. Oil skimmers are simple, dependable and effective tools for removing oil, grease and other hydrocarbons from water. Often, a skimmer by itself can achieve the desired level of water purity. In more demanding situations, skimming is a cost-effective means of removing most of the oil before using more complicated and costly treatments such as coalesces, membrane filters and chemical processes.

III. STUDIES AND FINDINGS

Investigation of a novel parameter that considerably enhances the performance of disk oil skimmers is introduced. This is of a great significance for the contingency plans of removing oil spills from aquatic environments and deciding their scenarios. Efficiency of a conventional disk oil skimmer could be nearly doubled by careful optimization of the angle between the plane of the disk and the vertical plane. Therefore, this parameter is particularly significant as it requires only a minimum effort to modify existing disk skimmers. Results revealed the presence of a minimum immersed area required for the offset angle to be effective. An optimum rotational speed of around 80 rpm was found, regardless of the design or operating parameters applied. For each disk diameter studied, an optimum offset angle was found. These optimum values were independent of the oil film thickness and oil type. A maximum improvement of 204% in oil recovery rate was obtained for the largest disk diameter studied and oil film thickness of 20 mm. The type of oil spilled matters because different types of oil behave differently in the environment, and animals and birds are affected differently by different types of oil. However, it's not so easy to say which kind is worst.

There is an inverse correlation between the mass of recovered oil and angle oil forms with the test surface. For a given oil, the lower the contact angle the higher the recovered mass. Contact angle measurements can be performed along with traditional mass recovery (dip and withdraw) tests. Surface roughness and oil composition have a significant effect on the results of the tests. Higher roughness results in larger recovered mass and lower contact angle, for the same oil-polymer pair. More viscous oils form a thicker film on the test surface allowing larger mass to be recovered, although their affinity (contact angle) to the test surface may be similar to less viscous oils.

The laboratory experiments provide important insights into the key physicochemical properties that control the behaviour of oil and oil/ice mixtures under these conditions.

Although it is well known that viscosity is a strong function of temperature, it was clear that under these conditions, every degree that the temperature decreases can have a significant effect on viscosity, since the relationship is semi-logarithmic for all oils tested. The evaluation of different materials served to determine which surfaces would perform better under different conditions, and extended our previous work at higher temperatures (Broje and Keller, 2007b). Under cold climate conditions in the laboratory, Neoprene and other elastomers (Hypalon and SBR) had higher oil mass recovery from an oil film, compared to hard polymers (LDPE) and metals (aluminium). Thus, Neoprene and Hypalon coated drums were considered in the CRREL field tests. Although a lower contact angle in indicative of better wetting, the correlation between contact angle and oil recovery was not very clear. It is recommended that mass recovery be used as the parameter that can best determine whether a material will be better than others for oil recovery.

IV. CALCULATIONS

1. Design of motor:

Power of Shaft P = 10 watt

Power transmitted by shaft,

$$P = \frac{2\pi NT}{60}$$

Where, N→ Rpm of motor shaft = 30
T →Torque transmitted

$$10 = \frac{2\pi 30T}{60}$$

T = 3182.6 N-mm

2. Design of shaft

Now, T_1 is the maximum torque among all shafts, so we will check shaft for failure here.

$$T = \frac{\pi\, \sigma s\, d^3}{16}$$

$3182.6 = \pi /16 \times 135 \times d^3$

D= 4.9 mm

Motor shaft is 6mm and main shaft is 20mm, so our design is safe.

3. Selection of bearing

For 20mm Shaft diameter we take standard breaking no. P204.
P=pedestal bearing
2=spherical ball or deep groove ball bearing
=04=5 × 4 = 20mm
Bore diameter of bearing.

4. Force generated by motor on disc

T = Force × Radius of disc

3182.6 = F × 175

$$F = \frac{18.18\ N}{9.81}$$

$$F = 18.18\ N$$

F = 1.85 Kg

5. Battery calculations

Charging Time:
Battery - 6V/5 Amp = 30 watts
Solar Panel – 2.5 watts
Current (I) = P/V
I = 2.5/6
I = 0.41 Amp
Charging Time = (Battery Watt/Panel Watt)
= (30/2.5)
= 12 Hrs.
Discharge Time = (Battery watt/Total watt Consumed)
= 30/10
≈ 3 Hrs
= 180 min

6. Calculation for buoyancy

Force exerted by weight of body
Fg = mass x g
= 7.6 x 9.81
= 74.59 N
Volume of cylinder
Volume $= \pi r^2 h = \pi \times 0.050^2 \times 0.550 = 0.001075\pi = 0.0043$ meters^3
For 2 pipes = 0.0086 meters^3
The buoyant force can be found using the formula.
The buoyant force is:
$F_b = \rho g V$
$F_b = (1000\ kg/m^3)\ (9.80\ m/s^2)\ (0.\ 0086\ m^3)$
$F_b = 84.28\ kg{\cdot}m/s^2$
$F_b = 84.28\ N$
The buoyant force acting on the vessel is 84.28 N.
We see that,
Fb > Fg
84.28 > 74.59 N
Hence, the model would float.

V. REVIEWED

Recently in Mumbai, there occurred 2 cases of sever oil spill near sea shore affecting most of the aquatic life of the area. Also fishing and tourism were affected by this spillage. The environmental effects of such oil spills are not negligible as this is a global problem now days. Every year, there is 100 million US gallons of oil spill. This is equal to 100 large size gymnasium halls. The numbers though could not tell the actual harm caused to the environment by such oil spill as it is in numerous. So, there is need of an effective way to clean this oil from the surface without actually wasting it. Such oil spills are considered forms of pollution. Oil spills also have highly adverse effects on the environment. These oil spills greatly affect animals, which may in turn sometimes lead to animals getting endangered. Animals may be affected because oil spills may cause hypothermia, inducing low body temperatures. Oil may also enter the lungs or livers of animals, in turn poisoning the animals. Oil may also kill animals by blinding them, affecting their natural predator prey instincts, resulting in which they will be unaware of their predators, and will eventually be preyed on.

Increasing oil exploration, production and transport in Arctic waters will increase the risk of an oil spill occurring in cold and ice-infested waters. The mechanical oil spill recovery equipment currently used in warmer waters was not designed to collect much more viscous oils, or oil-ice mixtures. The presence of ice crystals in oil emulsions affects the adhesion processes between an oil slick and the surface of an oleophilic skimmer and prevents oil from being efficiently recovered. Novel drum skimmer surface geometry and materials, tailored to the conditions present under cold climates, are expected to significantly increase the rate of oil recovery, reducing cost and risk. The objective of this project was to perform a comprehensive analysis of the adhesion between oil or ice-in-oil mixtures and various surface patterns and materials, under cold climate conditions. This knowledge was then applied to improve existing mechanical response equipment so that it can be applied efficiently under these conditions. The novel recovery surfaces that proved to increase the recovery efficiency of a drum skimmer up to two times in warm waters were also successful in cold climate conditions.

VI. IMPROVEMENT

In our project single disc is mounted on the shaft so the oil collection capacity is very less. If our project requires to be installed in sea, Concept of multiple discs in grid form has to be done. In this concept an empty container ship will be used. Instead of single disc multiple discs will be installed on single shaft behind the ship and equal number of scrappers will be installed and collected oil will be stored in container and will be properly disposed of. By using this technique, we can increase the oil collection capacity up-to 1000 time. The ship can be controlled by GPS and will be sent to accidental location automatically for collecting oil. The power required to run the ship will be replaced by diesel engine for increasing its speed and power.

VII. CONCLUSION

Solar Based, Disc Type, Oil Spill Recovery System is easy, effective, economical and environ friendly system to tackle the global crisis of the oil spill. It has many advantages over present day technologies to clean spilled water. It can effectively clean the water surface recovering most of the oil back in usable form. The system can be automated and run-on solar system making it greatly capable to survive on its own. Hence lots of human efforts are eliminated and hence oil spill can get faster and efficient response. The hazardous effects of oil spill are thus effectively reduced. Hence, Solar Based, Disc Type, Oil Spill Recovery System promises to be an important tool against global crisis of oil spill.

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