

Design and Fabrication of Sea Oil Separator

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ABSTRACT

Oil is one of the precious crude and being used in many routine applications of human life. During the operating of crude oil, the transportation of crude oil requires the adoption of safety measures in port terminals. At sea accidents are further serious cause of oil pouring and cause of pollution. It is not easy to determine the amount of oil spilled into sea every year but according to estimates, it is expected to be around 4 million tons in the whole planet and 600.000 tones only for Mediterranean. Research and technological advancements in enhanced oil recovery (EOR) had been growing at a high rate over the past 10 years due to growing concern that all the 'easy oil' has been exploited and result of high oil prices, which increased R&D appetite and investment into enhanced oil recovery (EOR). In this Project, we are designing a prototype of a device which can be used to recover this spilled oil.

Keywords: Sea oil, Oil Skimmer, CAD Design

I. INTRODUCTION

Oil can be defined as: "A viscous liquid derived from petroleum, especially for use as a fuel or lubricant" or "Any of various viscous liquids which are insoluble in water but soluble inorganic solvents and are obtained from animals or plants" (Oxford Dictionaries, 2012). Oils are, based on these definitions, divided into two categories with different chemical composition; mineral oils (also called crude oils) and organic oils (also called fats) in which essential oils are included.

During the recent decade, World has witnessed big oil spillage accidents into ocean and made huge impact to the environment. Apart this, sometimes Oil is getting spillage through being the results of chronic and careless habits in the use of oil industries and oil products. It is estimated that approximately 706 million gallons of waste oil enters the ocean every year; whereas more than half of that sourced from

land drainage and waste disposal. Offshore drilling & production operations and spills or leaks from ships or tankers are typically contributing less than 8% of the total whereas routine maintenance of ships (nearly 20%), onshore air pollution & hydrocarbon particles (about 13%) and natural seepage from the sea floor (over 8%). This has caused ever lasting damage to aquatic life.

Herewith, the objective of this project is to design and fabricate belt type oil skimmer. The belts absorb the oil from water which can be scooped out and collect into a vessel by providing piping arrangements. The collected oil can be reused for many purposes. To make the system very effective, economical and eco-friendly which practically allows us to cross the boundaries of limited service area and to reach the long distances for the purpose of cleaning and recovery? The system can be used to reduce oil pollution at higher rates with increased efficiency.

This saves lots of human efforts and hence reducing the cost of operation.

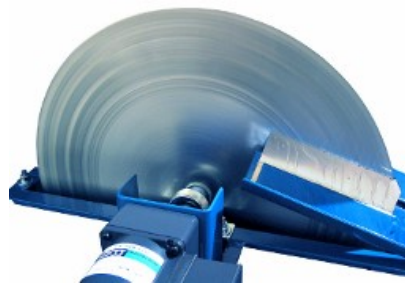


Figure 1. General Oil Skimmer

II. OVERVIEW OF TECHNOLOGY

A. Oil Skimming

Oil skimming is a low-tech but reliable and efficient technique. An oil skimmer is defined as “Any mechanical device specifically designed for the removal of oil (or oil-water mixture) from the surface of water without altering the water’s physical and/or chemical characteristics. The skimming principle, upon which the technique relies, is dependent on three physical properties of oils, namely specific gravity, surface tension and affinity. Most oils have a lower specific gravity than water, which allows it to separate from water and float to the surface unless agitated. These oils are possible to collect using an oil skimmer. Other oils do the opposite and, if not agitated, sink to the bottom of the water and must be collected by other means than skimming.

B. Skimming Technology

The mechanisms through which oil is removed from the water surface can be divided into oleophilic techniques, which rely on the adhesion of oil to a moving surface, and non-oleophilic techniques. Non-oleophilic techniques include weir skimmers relying on gravity, suction systems, and mechanical skimmers, which physically lift the oil with scoops, or grabs.

Oleophilic skimmers recover oil based on the properties of specific materials, which have greater affinity for oil than for water. There exist numerous types of oleophilic skimmers and they are therefore divided into subgroups such as disc skimmers, drum skimmers, rope mop skimmers, belt skimmers, and

brush skimmers. Regardless of the type of skimmer, the principle behind the technique used is the same for all oleophilic skimmers. The skimming head, i.e. the part with the oleophilic surface, is rotated or pulled through the oil slick and the oil is then scraped or squeezed off and the oil removed into assume to be pumped or sucked away. Oleophilic skimmer usually achieve the highest ratio of recovered oil in relation to entrained water, also referred to as the recovery efficiency, compared to other skimmer types. Oleophilic skimmers reach their highest efficiency when handling medium viscosity oils (between 100 – 2000 CST).

C. Working Principle of Oil Skimmer

The basic principle used in this method is that oil has greater affinity towards some materials rather than water. Hence, when came in to the contact with such material, oil sticks to its surface and hence can be removed off from the surface of water. Floating 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 floating oil and grease with very little water. This oily material is subsequently removed from the media with wiper blades or pinch rollers. Design of the proposed skimmer.

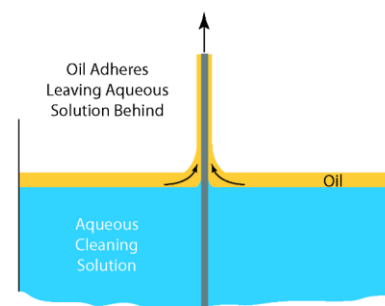


Figure 2. Working Principle of oil skimmer

D. Working Principle of Solar Panel

Conversion of light energy in electrical energy is based on a phenomenon called photovoltaic effect. When semiconductor materials are exposed to light, the some of the photons of light ray are absorbed by the semiconductor crystal which causes significant

number of free electrons in the crystal. This is the basic reason of producing electricity due to photovoltaic effect. Photovoltaic cell is the basic unit of the system where photovoltaic effect is utilized to produce electricity from light energy. Silicon is the most widely used semiconductor material for constructing photovoltaic cell. The silicon atom has four valence electrons. In a solid crystal, each silicon atom shares each of its four valence electrons with another nearest silicon atom hence creating covalent bond between them. In this way silicon crystal gets a tetrahedral lattice structure. While light ray strikes on any materials some portion of light is reflected, some portion is transmitted through the materials and rest is absorbed by the materials.

III. THERIOTICAL CALCULATIONS

Motor Selection

Torque is given by,

$$T = I * \alpha$$

Where, I = Mass moment of Inertia
 α = Angular acceleration

For a Disc,

$$I = m * R^2 / 2$$

$$= 0.5 * 2 * (0.1524)^2$$

considering overall mass of 2 kg

$$= 0.02322576 \text{ kgm}^2$$

Hence, I = 0.02322576 kgm²

Now, assume drum accelerate from 0 to 60 rpm in 2 seconds.

(Efficiency is maximum for speed limit

40-60 rpm)

Now,

$$w = w_0 + \alpha * t$$

$w_0 = 0$; (Since disc is stationary at

starting)

$$w = \alpha * t$$

$$2\pi * N = \alpha * 2$$

Therefore, $\alpha = 60\pi \text{ rad/sec}$

Now,

$$T = I * \alpha = 4.377 \text{ N-m}$$

Also

$$\text{Power, } P = 2\pi * N * T / 60$$

$$P = 27.507 \text{ Watts}$$

Take an application factor to take into account scrapper and water resistant, Taking $K_a = 1.5$

$$P = 1.5 * P = 41.263 \text{ W}$$

$$P \sim 50 \text{ W (approx.)}$$

IV. DESIGN & 3D CAD MODELING

A. Schematic Diagram of Oil Skimmer

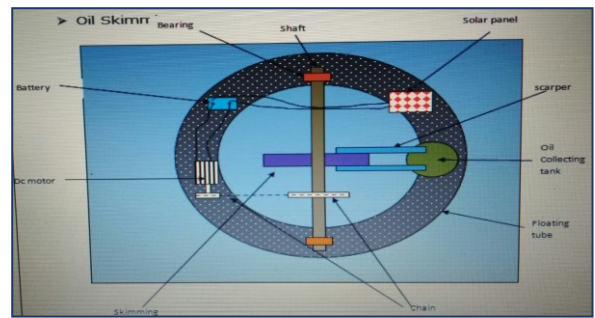


Figure 3. Schematic Diagram of oil skimmer

Solidworks CAD & CAE software are used to design various parts of the oil skimmer assembly. Solid works in addition to e-drawings, a collaboration tool and a draft sight a 2D CAD product. Building a model in Solid works usually starts with a 2D sketch. The sketch generally consists of 2D geometry. Feature Modelling used to generate 3D parts of oil skimmer. After completion of all parts of product using Solidworks advanced assembly features such as standard mating, Mechanical mates which allow to assemble oil skimmer parts to complete assembly.

B. Parts and Assembly of Oil Skimmer Assembly:

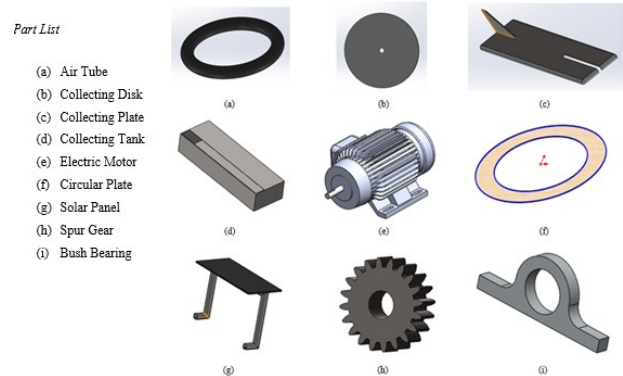


Figure 4. Parts of Oil Skimmer

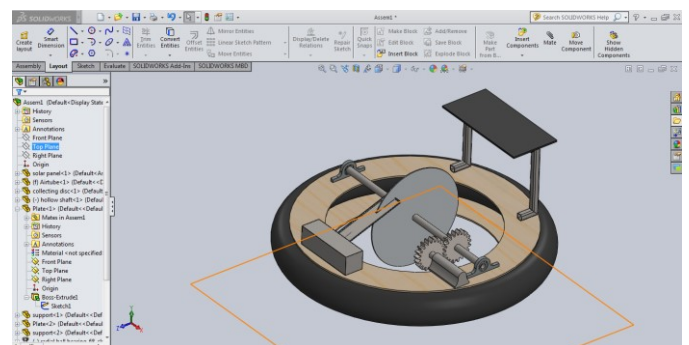


Figure 5. Assembly of Oil Skimmer

V. CONCLUSION

Herewith the objectives we design oil skimmer with following outcomes from this projects.

- Probable design modification can be included
- Designing dual disk model
- Integration of solar panel
- Automation of process using Sensors
- Useful in extracting wasted oil.
- Reducing damage to local ecosystem from oil spillage
- Can also be used in Industrial Application

VI. REFERENCES

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