

# DESIGN AND FABRICATION OF OIL SKIMMER

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## ABSTRACT

These days, many oil accidents are happening in the sea, which greatly affects the environment. Ocean accidents can encourage cause oil pollution. So, oil separator systems are fundamental in such cases.

Various oil separator systems are available currently all over. In oil separator systems belt is one of the most important components. Different types of belts are being in use in these systems. The performance and efficiency of these systems mainly depend on the type of belt & belt material used in the system. So, it is necessary to study and analyze the performance of various types of belts in order to select the proper belt for better performance. In this paper, we are taking a review of various types of belt materials used, and research work done on oil skimmers and their belt materials.

Keywords - oil skimmer, motor, pollution, polyurethane belt, crude oil, etc.

## INTRODUCTION

Oil is one of the most precious crudes and is being used in many everyday applications of human life. Since most of the oils are poisonous so quite dangerous for alive when it comes to physical contact with them. Many countries have made strict safety norms for wastewater disposal containing oils, mainly from petrochemical and process industries, so such industries are equipped with oil skimmers to separate oil from disposal water.

The continuous removal of oil from process fluids increases the life of fluid resulting of:

- a) Reduction in the machine fluid refilling cost.
- b) Improves the disposal water quality.

What is an oil skimmer?

It is the process of removing or separating the oil from the oil-polluted coolant or oil from the oil & water mixture. The oil and the coolant in the mixed form are collected in the containers. And one of the following classified methods is adopted to separate the oil from the coolant.

- a) By separating the oil from the coolant by aggressively pouring the upper layer of mixture in another container
- b) By soaking the oil layer using the oil soaking element.
- c) By skimming oil using a flat belt arrangement.

The first two methods are not accurate also these are time-consuming and require sort of skill for their execution. The latter is simple, the oil can be separated without any fatigue, and the process is accurate.

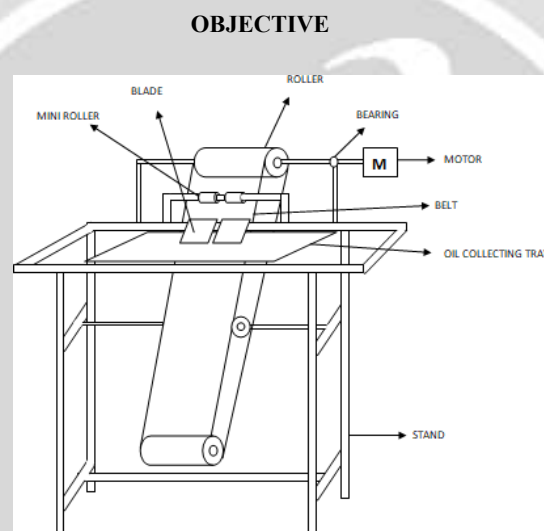
## LITERATURE SURVEY

UNITED STATES PATENT (April 28, 1981) of Ray R Ayers Methods and apparatus are provided for removing oil from the surface of the water using one or a multiplicity of discs which are provided with either or a combination of oil-absorbent

bristles and oil-absorbent materials disposed on the flat surfaces on the disc, the disc being disposed partially in the oil and partially in a vapor space there above, rotating the discs to cycle the bristles and or oil absorbent material alternately from the oil on the water to the vapor space there above, allowing the oil to adhere or absorb into the bristles or absorbent material and then removing the oil from the oil absorbent material while the oil absorbent material is in the vapour space.

Suraj Nair et al: Recently in Mumbai, there occurred 2 cases of severe oil spills near the seashore that affected most of the area's aquatic life. 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 nowadays. Every year, there are 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 an oil spill as it is numerous. So, an effective way to clean this oil from the surface is needed without wasting it. Now, in industries, we use oil skimmers to separate oil from other things like coolant and water. There are various methods for this, of which disk type oil skimmer is one of the majorly used.

A M Najar and et al: It is now common practice to use disc skimming systems to recover oil floating on the surface of the water. However, the performance of these devices is dependent on many parameters and is certainly not understood completely. This paper describes a fundamental study in which experimental techniques have been developed to enable the performance of model skimmers to be measured. This has enabled the importance of the various parameters to be examined in a more systematic and detailed way than ever before.



**Fig. 1 Schematic of oil skimmer**

The basic design objectives of this project work for carrying the waste oil from the marine area to remote places where the waste oil is dropped.

To separate the oil from the water. To increase the life of water. To increase the tool life. To avoid change in the properties of the material. A sincere attempt is made to accomplish almost all objectives as mentioned above and make it practically feasible. Oil Skimmer capacities range from 4 GPH (Gallon per hour) with our photo unit through 200 GPH (Gallon per hour) with our multi-belt models. Application users can expect less than 5% water in the discharge residue. Another objective of the project was learning how to work the different parts of the oil skimmer and achieve its optimum working.

### MOTIVATION

Nowadays an Oil spill is a release of oil into the environment, either leaked or discharged from a ship, lorry, truck, etc." or " an accidental release of oil into a body of water, as from a tanker, offshore drilling rig, or underwater pipeline, often presenting a hazard to marine life and the environment. The engineer is constantly confronted with the challenges of bringing ideas and design into reality. New machines and techniques are being developed continuously to manufacture various products at cheaper rates and high quality.

### PROBLEM STATEMENT

When oil spills occur in the ocean, the oil does not mix with the water and it spreads on the surface. The thick layer present in the ocean, also known as the slick expands, and the sunlight does not reach the ocean animals and plants. It affects



the food chain of the whole ecosystem. When oil spills occur, it will break down a moderate amount of oil and deposit on the bottom.

When oil spreads in the ocean, it breaks and sinks into the ocean which deteriorates the health of the ocean life. It contaminates the natural habitat of the ocean. Oil spills have harsh effects on the coastlines. The birds and the sea mammals are covered by the oil. Oil is so damaging to the whole ecosystem as it covers everything which is nearby the coastlines like sand, animals, grass and soil etc. It destroys everything near the coastline. The oil that spills into the ocean can greatly impact people's health who consume seafood. It can damage those marine animals that swim in the ocean and if they ingest oil, it will destroy them. In boats with inboard engines, the usage of oil absorbent pads on the bilges should be done so that any kind of leakage can be controlled by absorption.

### CONSTRUCTION

In the machine oil skimmer, the polyurethane belt plays a very important role to collect the oil from the water due to the low density of oil floating on the water's surface. The oil skimmer consists of a Motor, frame, polyurethane belt, bearings, reservoir, etc, the power is transmitted by the chain sprocket mechanism to the shaft and bearing. The belt and roller assembly rotate along the shaft the belt is power-driven using the gearbox and electric motor as the prime mover. The shaft is made up of mild steel and this shaft rotates with the help of a motor with the help of bearing support. When the belt is rotated, due adhesive property of oil sticks to the belt and collects in the tank by an oil scraper. An oil scraper is an arrangement in which oil is collected and passed to the container.

### WORKING

Oil and grease always float on the water's surface. They do not mix with water. Separation of it is based on surface tension, specific gravity, and viscosity of them. The "oil and grease skimmer unit has a special purpose belt, which is rotated by mechanical means such that it just touches the surface of the water the oil and grease particle stick to the belt material and travels with the belt up to scrapping arrangement where scrapping of oil and grease occurs and oil grease are collected. This unit mainly consists of a rectangular frame. In the first stage of the unit the top surface of the frame motor and gearbox of fitted. This arrangement is provided for the movement of the shaft as per the requirement. The belt is mounted on rollers with the help of pedestal bearings. On these rollers, the main oil-removing belt is placed. With the help of a tightening arrangement, the belt is sufficiently tightened so that it will not slip. And also, it gives an advantage for the adjustment of units as per the level of water flow.

On one side of the frame, a scrapping arrangement is attached which removes the oil and grease from the surface of the belt. The removed oil and grease are carried through the collector tray to the tank. When the unit is switched on, the motor starts, which is coupled to the inbuilt gearbox. The motion of the motor shaft is given to the roller by using a chain drive, which reduces the speed. This reduced speed is given to the driver shaft through a sprocket. The upper shaft is rotated, because the drum revolves at about a because of these drum revolves and the belt revolves at about 15 to 16 rpm. The belt is immersed in water oil and grease is stuck to the belt material. Which is carried with a belt up to the scrapping arrangement. Here scrapping of oil and grease occurs and oil and grease is collected in a barrel through a collector pipe. The belt after scrapping arrangement, here scrapping of oil and grease occurs and oil and grease are collected in the tank through collector tray scrapper. The belt after scrapping again goes the downward in water channel. This cycle is repeated continuously.

### CALCULATIONS

A] Design of motor:

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

T = Force × radius

B] Selection of bearing:

For 20mm Shaft diameter, we take standard breaking no. P204.

C] Design of bolt for sheer stress failure:

Stress = load/area

D] Design of transverse fillet welded joint:

Area of Weld = 0.707 x Weld Size x L

Stress-induced = Force Exerted / Area of Weld

E] Volume of tank:

Volume = L x B x H



Fig 2. 3D SolidWorks Model of Oil Skimmer

### APPLICATIONS

- This oil separator can be used in the navy to collect the oil in the sea if any oil spill occurs.
- This oil separator can be used in industries where oil is a major material used and leakage of oil occurs regularly.
- Marine applications: Offshore plants like ONGC.
- Oil collecting stations like Bombay High.

### ADVANTAGES

- To protect marine ecosystems.
- Protect From Global Warming.
- To minimize water pollution by oil skimmer.
- Minimize the possibility of Acid rain.

### LIMITATIONS

- Oil skimmer can separate only adhesive oil fluid particles.
- It can separate the oil which can float on the coolant.

### CONCLUSION

From the above observations, the polyurethane belt is having better oil skimming capacity. It removes almost 60 to 70 litter per day. A polyurethane belt is very helpful for skimming oil for operators. It is efficient and economical for removing the oil. It is more helpful to utilize where less noise operation is required. To Protect our marine ecosystem.

In this project, we enforced to highlight the function of the oil skimmer, its various design aspects, and its performance. All the results of experimental studies indicate that slight design improvements of typical oil skimmers towards including additional belt shall and use of belts with steel material instead of rope; significantly improve the oil recovery efficiency and also its structure became simpler.

#### REFERENCES

- Victoria Broje' and 'Arturo A. Keller', Improved recovery of oil spills from water surface using tailored surfaces in Oleophilic skimmers, Donald Bren School of Environmental Science & Management, University of California, Santa Barbara.
- 'ASTM. 2007.ASTM F726-06', "Standard test methods for sorbent performance of adsorbents", American society of testing and materials, West Conshohocken. P.A.
- R.S. Khurmi and J.K.Gupta. Machine Design-I. S Chand
- K Suhramanya. Fluid Mechanics and Hydraulic Machines. Tata McGraw Hill (2012)
- 'Sit. Schwartz', "Performance tests of four selected oil spill skimmers, in: Proceedings of the International Oil Spill conference", American Petroleum Institute. Vashington. DC, USA, 1979, pp. 493—496.
- 'S.D. (jill, W. Ryan', "Assessment of the ACW-40() oil skimmer by the Canadian Coast Guard for oil spill countermeasure operations. in: Proceedings of the International Oil Spill Conference", American Petroleum Institute, Washington. DC, USA, 1979, pp. 279—282.

