

## Oil Separator Skimmer

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### Abstract

Oil skimmer is used to remove the floating oil from liquid medium. The oil floats on the water since it has less density than water. The water molecules are more attached to each other than water. The water molecules are more attached to each other than oil molecules since they don't mix each other. Here we use the skimming medium as Belt & Metal disk. The skimming medium runs over the surface of water in which oil brought out with little amount of water. The main purpose of this fabricated skimmer is to purify the water from various dirt oils. The skimmer is more cost efficient and simple in design in comparing to costly treatments like membrane filters and chemical treatments. The oil is removed from the metal disc and belt through wiping blades. The floating grease or oil has formed in to solid mats our apparatus can be used to break the mats and remove them. This will reduce water pollution.

**Keywords:** Oil, skimmer, belt & metal disc, wiping blade

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### I. INTRODUCTION

Oil skimmer are the cheapest and most efficient way to remove surface oil in ocean, washing machines and leakage oils from coolant machinery etc. A belt and disc skimmers are great in many ways. The capacity is high and oil collection rate is excellent oil skimmer is easy to install. Oil skimmer is effective tool for removing dirt oil from water. A oil skimmer achieve the desired level of water purity. In more demanding situation oil skimming is a cost reducing means of removing most of the oil before using costly treatments such as chemical process. The skimming principle, upon which the technique relies, is depend on three physical properties of oils, namely specific gravity, surface tension, and affinity. A number of factors are to be taken into account when selecting skimmers but the most important aspects to consider are the Viscosity and adhesive properties of the oil intended to be oil skimmed.

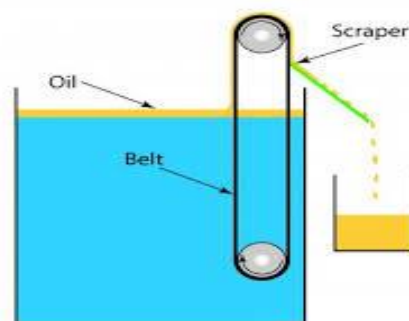


Figure1: Oil skimmer set-up

### 1. PARTS OF OIL SKIMMER

#### 1.1 Belt

Belt-type oil skimmers use an endless belt of corrosion resistant steel or synthetic medium, which is lowered into the tank or vessel to be skimmed. The belt passes through resilient wiper blades where the oil is removed from both sides of the medium. Belt machines provide a simple, dependable and cost effective method for removing oil, grease and other hydrocarbons from water.

### 1.1.1 Width and Length

Considering the width and length Removal capacity is not affected by length. Choose a length that assures submersion or contact with the liquid at its lowest level, allows easy mounting of the oil skimmer where oil discharge is convenient, and has good access for routine service.

### 1.1.2 Material

Belt performance and durability depend on the nature of the liquid, its chemical composition, temperature, etc. For instance, high temperature increases a belt's sensitivity to pH levels. To make sure the belt performs satisfactorily in the application.

### 1.2 Motor

DC Motor – 150RPM – 12Volts geared motors are generally a simple DC motor with a gearbox attached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly.

150 RPM 12V DC geared motors widely use for robotics applications. Very easy to use and available in standard size.

### 1.3 Scraper

Scraper is used to extract the oil from the surface of the belt. This is placed below the elevated roller. As the belt is dipped into the water with the help of the roller driven the motor the oil present on the surface of the water adheres to the belt. Scraper is attached providing least clearance which prevents the free motion of the belt. Due to the minimum clearance the oil on the surface of the belt is removed the scraper. This removed oil is collected in the collecting tank. Thus scraper which is considered to be an important element of the Oil Skimmer plays a key role in oil extraction.

### 1.4 Oil collector tank

Oil collector tank will be used to collect and store the oil collected by the oil skimmer during the operation. The separated oil is stored in the tank. Larger the tank, longer the operation can be performed without interruption.

## II. MODELING

### 2.1 Structure

The structure of oil skimmer is made out of Stainless Steel (SS).

Reasons for selecting stainless steel are

- The oil skimmer works in liquid medium
- Corrosion Resistance
- Cryogenic (Low Temperature) Resistance
- Work Hardening
- Hot Strength
- Ductility
- High Strength

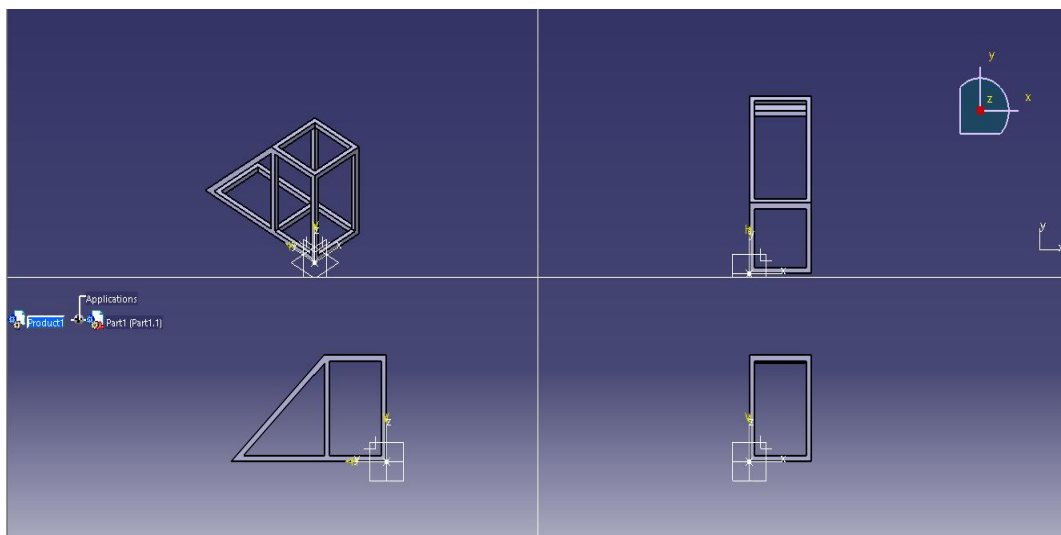


Figure2: Modeling Structure

### 2.1.2 Dimensions

- 4 Stainless steel square rods - 12 Inches
- 2 Stainless Steel Square rods - 18 Inches
- 2 Stainless steel Square rods - 22 Inches

### 2.1.3 Fabrication

#### 2.1.3.1 Welding

- Welding is a fabrication process whereby two or more parts are fused together by means of heat, pressure or both forming a joint as the parts cool. Welding is usually used on metals and thermoplastics but can also be used on wood
- The parts that are joined are known as a parent material. The material added to help form the joint is called filler or consumable. The form of these materials may see them referred to as parent plate or pipe, filler wire, consumable electrode (for arc welding), etc.
- As opposed to brazing and soldering, which do not melt the base metal, welding is a high heat process which melts the base material. Typically with the addition of a filler material.
- Heat at a high temperature causes a weld pool of molten material which cools to form the joint, which can be stronger than the parent metal. Pressure can also be used to produce a weld, either alongside the heat or by itself.
- It can also use a shielding gas to protect the melted and filler metals from becoming contaminated or oxidize.



**Figure3: Welding Structure**

### 2.2 Rollers



**Figure4: Rollers**

The conveyer belt is supported by the rollers. These rollers are mounted on a shaft of diameter 6mm through a hole drilled in to each of the two rollers and these shafts are inserted into the holes made on the frame which holds the rollers in required positions and there by letting the belt to roll over it. Commonly used materials for industrial rollers include steel, aluminum, PVC, rubber, polyurethane, or some combination thereof.

### 2.3 Gears

A gear is a rotating circular machine part having cut teeth or, in the case of a cogwheel or gearwheel, inserted teeth (called cogs), which mesh with another toothed part to transmit torque. A gear may also be known informally as a cog. Geared devices can change the speed, torque, and direction of a power source. Gears of different sizes produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The rotational speeds, and the torques, of two meshing gears differ in proportion to their diameters. The teeth on the two meshing gears all have the same shape.



Figure5: Gears

### III. ASSEMBLY

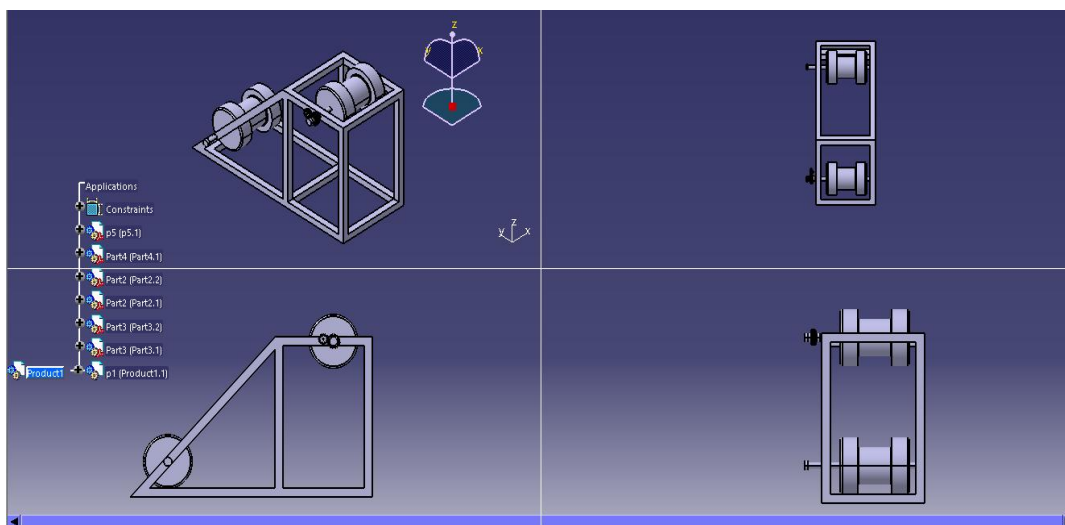


Figure6: Structure Assembly

Assembly of the oil skimmer begins with the Structure. The welded structure has holes for the shafts to be inserted on which rollers are mounted. Two rollers are placed one at the top and the second one in between the inclined structures. The roller on the top is driven by the Motor which has a RPM of 150. The conveyor belt made of poly isoprene is attached in between the rollers.

### IV. WORKING

The Oil skimmer has a motor driven by battery which is responsible for its working

The moving parts of the oil skimmer are belt and rollers, while the remaining parts remain in their location i.e., excluding the belt and rollers the remaining parts such as shaft, structure, scraper have only single degree and zero degrees of freedom.

The motor drives the shaft through the pinion which rotates the gear mounted on the shaft. This causes the rotatory motion of the shaft there by rotating the roller. The rotation of the roller causes motion in belt which is attached in between two rollers ensuring no slip or relative motion between the rollers and the belt.

The roller on the lower side or the second roller is dipped in the water. Along with the roller a part of belt is also dipped into the water and as the motor starts to rotate the conveyor belt starts moving between the two rollers extracting the oil from the lower side on the water surface. The extracted oil is removed from the surface of the belt through scraper.

The extracted oil is collected into the collection tank. Larger the size of collection tank longer the oil skimmer can be engaged without any interruptions provided there are no breakdowns.



Figure7: Oil skimmer working

## V. CALCULATIONS

### Frame specifications

- Height = 18 inch
- Width = 12 inch
- Inclined link length = 22 inch
- Inclination angle = 30 degree

### Gear and pinion parameters

- Gear Diameter = 15 mm
- Pinion Diameter = 40mm
- Gear teeth = 25
- Pinion teeth = 15

### Motor Specifications

- Type = DC
- Volts = 12
- Speed = 150 rpm

### Considering the schematic diagram

$$N_1 = 150 \text{ rpm}, N_2 = ?$$

$$d_1 = 20 \text{ mm}, d_2 = 80 \text{ mm}, T_1 = 15, T_2 = 25$$

### From formula:

$$\text{Gear velocity ratio} = N_2/N_1 = d_1/d_2 = T_1/T_2$$

$$N_2/N_1 = T_1$$

$$N_2 = 150 * (15)/25$$

$$N_2 = 90 \text{ rpm},$$

### From observation:

$$\begin{aligned} \text{Oil collecting per second} &= 2 \text{ ml} \\ \text{Oil collecting per minute} &= 120 \text{ ml} \\ \text{Oil collecting per day} &= 120 * 24 \\ &= 172,800 \text{ ml} \\ &= 172,800/1000 \\ &= 172.8 \text{ liters} \end{aligned}$$

The total oil collection per day is calculated = 172.8 liters

## VI. 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.

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