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Endless Belt Type Oil Skimmer

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***Abstract*: Aim of this project is to remove the oily effluent from the waste water. Pollution has created lot of problems in industries. By removing the oil from waste water, it becomes free of oil pollutions. Oil skimmers are commonly found in three types: weir, oleophilic and non-oleophilic. Oleophilic skimmers are distinguished not by their operation but by the component used to collect the oil (rope, disk, belt or drum). It can remove even a thin floating film of oil from the water. This is mainly due to the "oleophilic material" used in the belt. A free floating endless belt oil skimmer was developed as means of recovering spilled oil from surface water. The skimmer utilizes a unique high efficiency belt which is driven by motor. By removing oil we can preprocess water for other use. This can avoid water wastage and control pollution due to oil spillage. In current world scenario most of the oil from the industries goes wasted into ponds, rivers and sea. So, national and international environmental norms are getting strict day by day. It is economical to manufacture a low cost machine to meet these norms.**

***Keywords:* Oil Recovery, Oil Pollution, Oleophilic Skimmer, Operational Planning.**

I. INTRODUCTION

Oil is one of the most important energy and raw material source for synthetic polymer and chemicals worldwide. As long as oil is explored, transportred , stored and used their will be the risk of a spillage. Oil pollution , particularly of sea and navigable water, has exited more public concerned than other water or spilt materials. Oil pollution of the sea has steadily increased with the increase in oil comsumption.The bulk this in flux is due to transportation related activities spill from tanker loading and unloading operations, pipeline rupture which may be due to industrial waste as leakage from engines, incorrect operations of valves and discharge of oily wastages. Oil pollution of the shore in addition to the reduction of amenity, also affects marine, shore life and vegetation. Crude oil consist of different hyadrocarbon that range from light gas to heavy solids. When oil is spilled on water, the physical and chemical properties of oil change progressively. Spilled oil has an undesirable taste and odour and causes sever environment damage on water fall, material life and affects tourism economy.

The pollution increasing various sectors of the world, eg.

i. The increasing industrial activities using petroleum as a primary source of energy.

ii. The high consumption in the western countries. ie- Europe and US

iii. The increase in marine transportation of oil and other hazardous materials.

Thus various processes have been developed to remove oil from contaminated area by use of booms, dispersants and skimmers, oil water separator or by use of different kinds of sorbent material. It is an efficient belt-skimmer which is handy and portable. It is useful for small oil waste tanks in which it catches the oil floating on the surface of the tank. It is a small machine which helps to solve the problem of oil pollution for small scale industries.

II. BACKGROUND OF THE INVENTION

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

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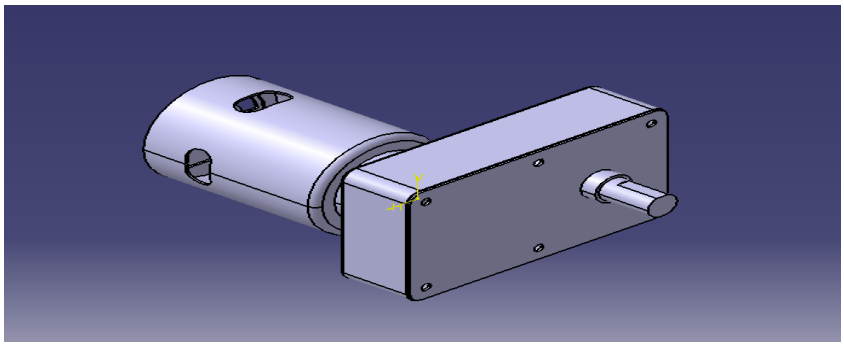
products. It is estimated that approximately 706 million gallons of waste oil enters the ocean every year; whereas more than half of that sourced from land drainage and waste disposal.

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. To separate the mixed oil from the water, industries wide various type of oil skimmers are getting used. Herewith, the objective of this project is to design and conduct efficiency studies of belt type oil skimmer by using various materialed belts. 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.

III. COMPONENTS

A. Motor:

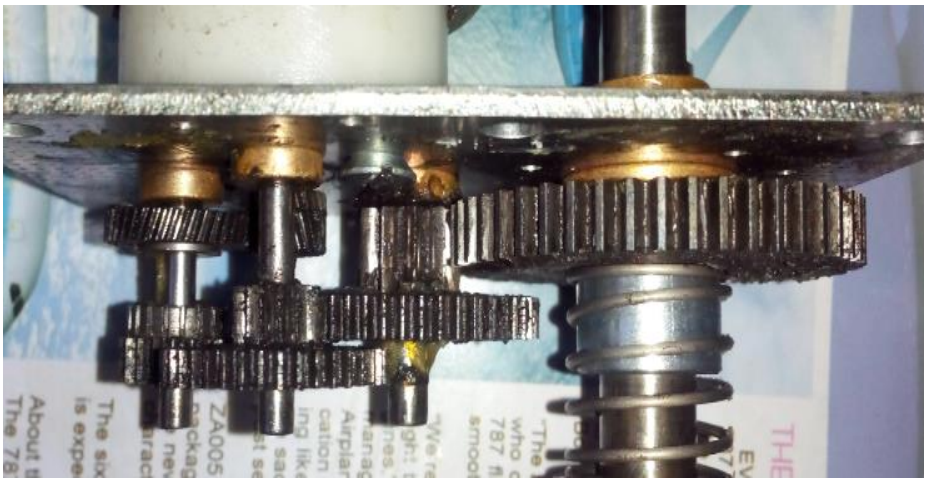
DC42 series motors are Dc motors (outsourced) that are used in combination with some Mechtex gearheads. Depending on the application, output speed, load applied etc the type of gear head can be selected. Case hardened steel gears are used due to the high torque generated by these motors. First pair of gears can be helical to damp the noise. All bearings arec permanently lubricated and therefore require no maintenance.



A) Motor

B. Gear Box:

Gear box is mounted on motor shaft for reduction in speed of motor. one end of gear box shaft is attached to motor shaft and other end is attached to the coupling. From all the calculation done it is seen that the required torque is 5.7324 N-m with weight of 1 Kg. The whole assembly of the motor with gear box is mounted in the molded box. It reduces speed from 2400 to 30 rpm by using four stage reduction gear box. In this four stage the first stage is helical gear because the speed reduction is maximum so compare to other gear it is effective. And other three stages are the spur gear.



B) Gear Box

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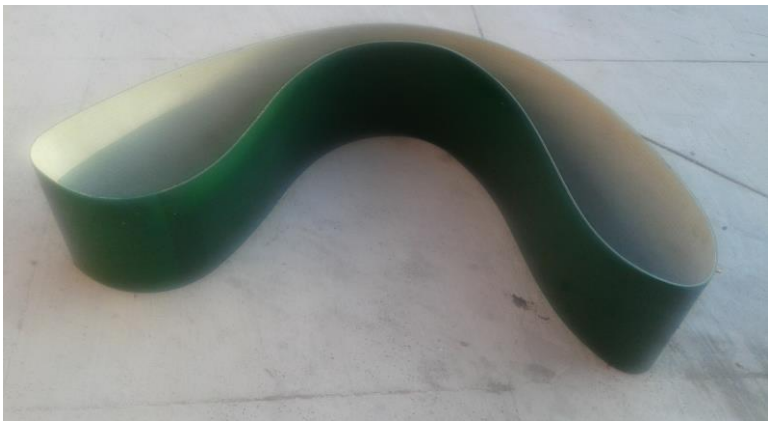
C. Belt:

It is made up of polymer material. It is endless type which has width of 154 mm. The material is so selected to stick oil to belt. It is mounted on the aluminum pulley. Length of open belt is 1800 mm. It is immersed in liquid up to 100 mm. Belt material has good oil removal rate and it can withstand high temperature up to 180 F hence we have selected polyurethane belt. Tension to the belt is given by lower pulley with dead weight.

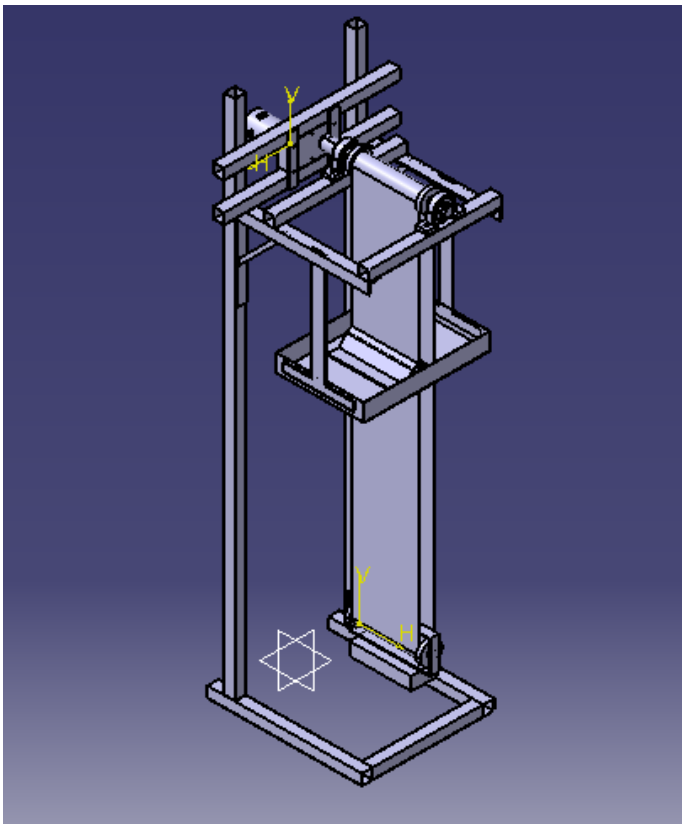


C) Belt

IV. WORKING PRINCIPAL

Specific gravity:

Most hydrocarbons have a lower specific gravity than water. Without agitation, oil separates from the water and floats to the surface. These oils are known as LNAPL's, Light Non-Aqueous Phase Liquid. Oils (and other compounds) that sink in water have a higher specific gravity and are known as DNAPL's, Dense Non-Aqueous Phase Liquid.



D) Cad diagram of actual working

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Surface tension and affinity:

Normally, oil bonds more tightly to itself and other materials than to water. This affinity and differences in surface tension between oil and water, cause oils to adhere to a skimming medium.

- The basic principle of oil skimmer is that when oil absorbing material is moved in the contaminated water then it will attract oil in water and it will be further removed with the help of suitable means.
- In belt type oil skimmer the belt of polymer material is used.
- As belt rotates at 30 rpm which is driven by motor through gear box in contaminated water, oil sticks to belt and moves up with belt.
- The oil is then removed with the help of thin scrapper which is made up of sheet metal of thickness 2 mm.
- Scrapper is mounted on tray at 45° angle in inclined position for smooth flow of oil over it.
- Removed oil is then collected in the container which is placed near to the setup.
- This oil is then used for further process.

Design Calculations:

Design of Gearbox [Final Stage]

G_4 [Gear Ratio] = 5

Assume Z_p [No. of teeth on pinion] = 10

b= 10 m, mm

Tooth system= 20^0 full depth involutes

G_4= Zg/Zp; Zg=50;

Np/Ng = Zg/Zp; 150/Ng = 50/10

Ng = 30 rpm.

d_p = 10m, mm

Levis form factor –

Yp = 0.1975 Yg = 0.4084

As material is same hence pinion is weaker than gear because Levis form factor is lesser for pinion

F_b = bending strength of tooth

$= \delta_b \times b \times m \times Y_p$

$F_b = 381.83\ m^2$, N

F_w =Wear strength of tooth

$= (d_p \times b \times Q \times K)$

$= 426.496 m^2$, N

As $F_w > F_b$ so, design the pinion on bending.

$$F_{eff} = \frac{K_a K_m F_t}{K_v}$$

$$= \frac{1 \times 1.2 \times (239.6/m)}{3/(3+0.0785m)}$$

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$F_b = FS \times F_{eff}$

$619.44m^2 = FS \times \frac{1 \times 1.2 \times (239.6/m)}{3/(3+0.0785m)}$

m [Module] = 1.051mm

Pulley Diameter = 50 mm

Belt Width = 154 mm

T_2 = 146.98 N ..(Tension at Slack side)

T_1 = 376.27 N …(Tension at tight side)

Design of Pulley Shaft

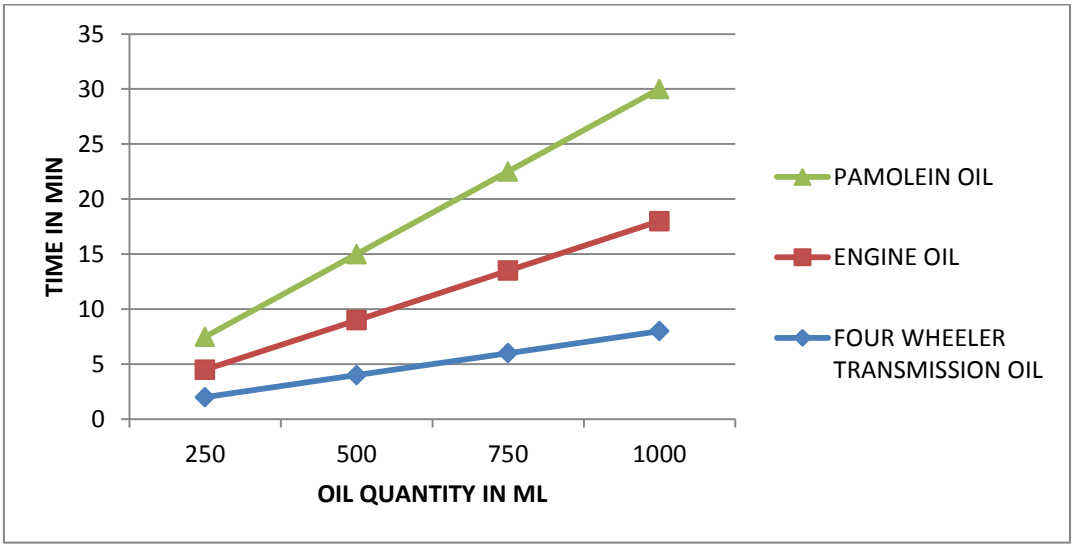
$M_e = (\pi/32) \times \sigma_{allo} \times d^3$

d = 13.58 mm

= 20 mm

Bearing selected 6204.

V. EXPERIMENTATION AND RESULTS



i. Four wheeler transmission oil has high viscosity of 90 Ns/m2 hence it requires less time for oil removal.

ii. Engine oil has viscosity of 30 Ns/m2 hence it requires more time than four wheeler transmission oil.

iii. Pamolein oil has less viscosity than others hence requires more time than others

As viscosity increases time for oil removal decreases.

VI. FUTURE SCOPE

Speed of the belt cannot vary so it is to be improved by providing multispeed arrangement.Scrapper plate arrangement may be improved. Oil resisting belt can be fitted to improve life and strength of belt. Solar panel can be attached to run the DC motor so improving the energy efficiency. The belt slips slightly on the drum due to the collection of the oil. Water drops are collected simultaneously with oil and this is to be reduced for better performance.Stirrer mechanism can be used to improve oil removal rate.

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