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OIL SEPARATOR FROM INDUSTRIAL LIQUID WASTE

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ABSTRACT

This paper deals with the separation of oil from automobile factories, refinery industries, sugar factories and many small scale industries to find out the best solution for oil recovery from the water surface to produce oil free water.

Oil and water separator is mechanical equipment, which is used in the environment pollution control from oil spillage. Oil separator helps in removing the oil from the waste water. By removing the industrial liquid waste ofwater, it becomes free of oil pollution. This is mainly due to oleophilic material used in the oil separator. This oil separator can be used in the effluent treatment plant. The oil recovery rate and the oil recovery efficiency, the two most important parameters displayed the performance of the oil separator.The belt speed, oil recovery rate and oil recovery efficiency are the operating parameters of oil separator. This paper consists of construction, fabrication details, assembly, working and applications of oil and water separator.

Keywords: Oleophilic belt, U-Block bearing, Gear motor, Separator, Spur gear,

INTRODUCTION

The world is knocking the 21st century. Rapid industrialization has made our country as the 10th most industrialized country in the world. India is ranked 3rd in the world in respect of technological talent and the manpower. Rapid industrialization played a crucial role to improve our economy. There are lots of good outcomes, but it also created number of problems. “Pollution problem” a versatile one.

Pollution has a lot of problems in industries. Sugar factories, Automobile industries, are captured by pollution. Water pollution is a big problem which is unavoidable. The processed water at factory has created pollution. The factory requires huge amount of water daily and the processed water has to be wasted to the river.

The processed water contains low PH Value, which in turn makes the land salty. It can’t be used for agriculture. The oil and grease contents in water effect on the land as well as on human beings. Due to chemicals present in water, the water lives are on the edge of destroying.

Oil separator is mechanical equipment, which is used in the environment pollution control from oil spillage. Oil separator helps in removing the oil effluent from the waste water. By removing the oil from waste water, it becomes free of oil pollution. Oil separator can remove even a thin floating film of oil from the water. This is mainly due to oleophilic material used in the oil separator. These oil separators manufactured are required for the effluent treatment plant.

LITERATURE SURVEY

Oil and Water don't mix the relationship between oil and water in a mixture is well-known and Governed by two physical properties:

Specific Gravity: Most hydrocarbons have a lower specific gravity than water. Without agitation, the 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.

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.

IDENTIFICATION OF "PROBLEM DEFINITION"

Control of water pollution has become a major problem for the industries.

Water pollution is a big problem which is unavoidable in sugar factories, automobile industries & many other manufacturing industries.

The factory requires huge amount of water daily and the processed water has to be wasted to the river.

Further the water cannot be used for any other purpose.

It affects the marine life.

The oil and grease contents in water effect the land.

It affects human beings.

Oil spills kill birds, fish & it will destroy eco-system around the industries.

Pollution Problem In The Sugar Factory

In modern and advanced industrialization the world, the ecological balance of the nature is distributing and is passing a major alarm to the environment, thereby disturbance the living creature, natural sources like agriculture, water and air. The govt. of Indian ministry the environment and protection act (1986) has formulated the strict legislation and declared the sugar industry as "polluting industry." However the water pollution in the sugar factory is mainly due to oil emulsion, which is floating in the mill house gutter.

As all of we know, oil is not miscible with water. When the oil of oily waste enters into the water cannot be separated from oil. On the larger scale when huge amount of oil enters in to the steam of water, it gets heavily polluted. In such case, the recovery of oil is very important to get good quality of effluent. In the sugar factories ranging from 2500 to 5000 Tons of Cane per Day (TCD) there is always 200 to 300 li of oil spoilage into the gutter. When this huge quality of oil travels to Effluent Treatment Plant (E.T.P) with gutter effluent, it enters into the biological system of the ETP process. The current practices for the control of the oil spoilage a manual lifting of oil at the ETP is not efficient as oil comes as oil comes in huge amount so far that purpose oil collection gutter (oil traps) are associated with chocking of effluent lines with oil and bagasse, which in turn leads to problem in manual lifting. As this manual lifting of oily waste is dirty work and the problem of oil pollution contributes serious breakdown of the ETP process. It is therefore needed to introduce mechanical equipment to recover all oil and grease to control oil pollution.

CONSTRUCTION AND WORKING

Working Principle

Oil and grease always on the water surface. They do not mix with water. Separation of it is based on the surface tension, specific gravity and viscosity of them. The "oil and grease separator unit the special purpose belt, which is rotated by mechanical means such that it just touches the surface of the water the oil and grease

particles 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.

Construction and Working

This unit mainly consists a rectangular frame. In thefirst stage of unit at the top surface of frame motor and gears are fitted. The Quarter H.P gear motor is used having 30 rpm and the spur gear is used for reducing the motor speed almost 10 rpm. One small gear having 36 teeth & 60mm diameter is fitted with gear motor and another bigger gear having 55 teeth & 82mm diameter is fitted with pulley. The driver pulley is fitted suitable U- Block bearing arrangement for easily placed at the top of the frame. At the bottom of frame driven pulley is placed in the tightening arrangement. This arrangement is provides for the movement of the shaft as per the requirement.

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 is carried through the collector channel to the oil tray.

Initially half of the apparatus immersed in the water & oil mixture. When the unit is switched on, motor starts, which is coupled to the spur gear. The motion of motor shaft is given to spur gear, which reduce the speed. This reduced speed is given to the driver shaft. The upper shaft is rotated, because of the driven gear rotates at 18 to 20 rpm.

The belt rotates over the water surface, and then floating oil on water surface get stuck to the belt. After that stickled oil particle wiped out by wiper in collected an oil tray by the help of channel. The belt after scrapping again goes to the downward in water channel. This cycle is repeated continuously.

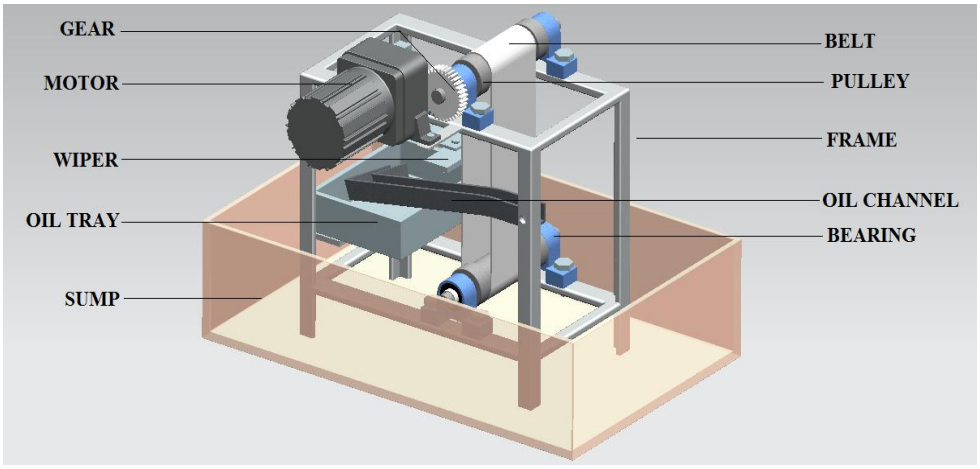

Fig. 1: Oil Separator

GEAR MOTOR

Quarter HP gear motor is used to rotate oleophilic belt by using spur gear & pulley. It takes 230 volts power supply. The rotations per minute (rpm) of gear motor is 30rpm, for our project we need 18 – 20 rpm hence by using spur gear the speed is reduced from 30 rpm to 20 rpm.

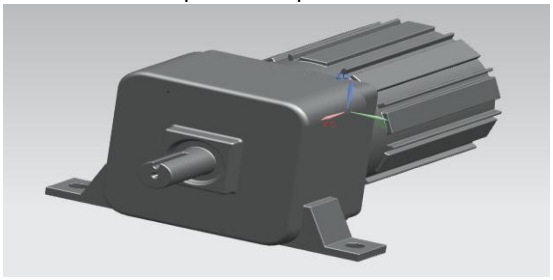

Fig. 2: Gear Motor

FLAT BELT

Oleophilic is a material which bonds to the oil, the belt is made by **Polyurethane**material that can be easily removed oil from the water.

Dimension: 1100*125mm

Fig. 3: Oleophilic Belt

RESULTS & DISCUSSION

The Oil Recovery Rate and the Oil Recovery Efficiency, the two most important parameters displayed the performance of the belt separator.

Oil Recovery Rate:

Oil recovery rate means how much of oil extracted from the oleophilic belt & collected in tray.

Oil Recovery Efficiency:

It is the ratio of extracted oil from the water to the oil mixed in the water.

$$Efficiency = \frac{Oil\ Extracted\ from\ the\ water}{Oil\ Mixed\ in\ the\ water} \times 100$$

Table1:

S. No.	Total quantity of water in tray(ml)	% Volume of oil contamination	Quantity of Oil added to water (ml)
1	100000	0.5%	500
2	100000	1%	1000
3	100000	1.5%	1500
4	100000	2%	2000

Quantity of Oil added to water

Table 2: 0.5% volume of oil contamination

Test	Time (min)	Amount of oil added(ml)	Amount of oil recovered (ml)	Efficiency
1	5	500	120	24%
2	10	500	245	49%
3	15	500	300	60%

1% volume of oil contamination

Test	Time (min)	Amount of oil added(ml)	Amount of oil recovered (ml)	Efficiency
1	5	1000	260	26%
2	10	1000	520	52%
3	15	1000	650	64%

1.5% volume of oil contamination				
Test	Time (min)	Amount of oil added(ml)	Amount of oil recovered (ml)	Efficiency
1	5	1500	410	27.33%
2	10	1500	850	56.66%
3	15	1500	1000	66.66%
2% volume of oil contamination				
Test	Time (min)	Amount of oil added(ml)	Amount of oil recovered (ml)	Efficiency
1	5	2000	580	30%
2	10	2000	1200	60%
3	15	2000	1400	70%

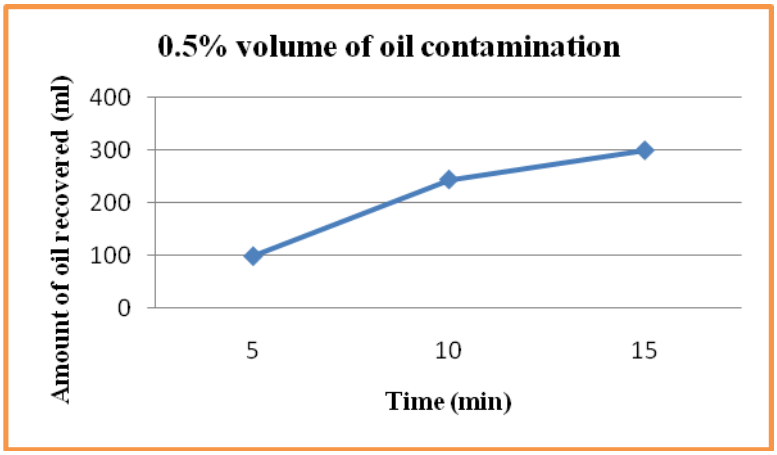

Fig. 4: Oil recovered V/s time graph

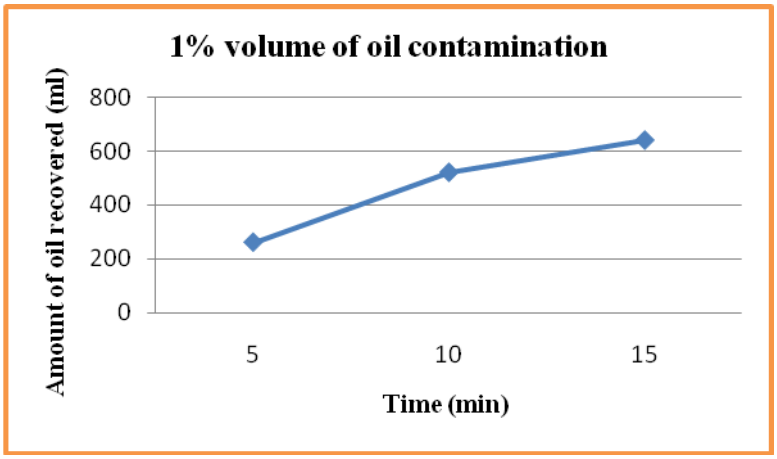

Fig. 5: Oil recovered V/s time graph

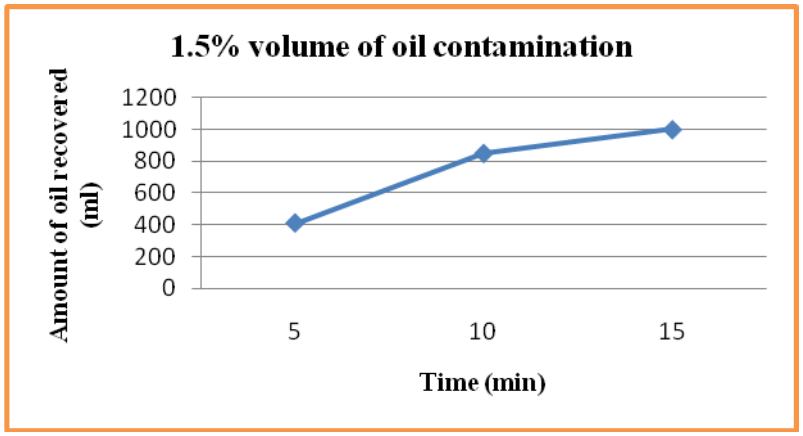

Fig. 6: Oil recovered V/s time graph

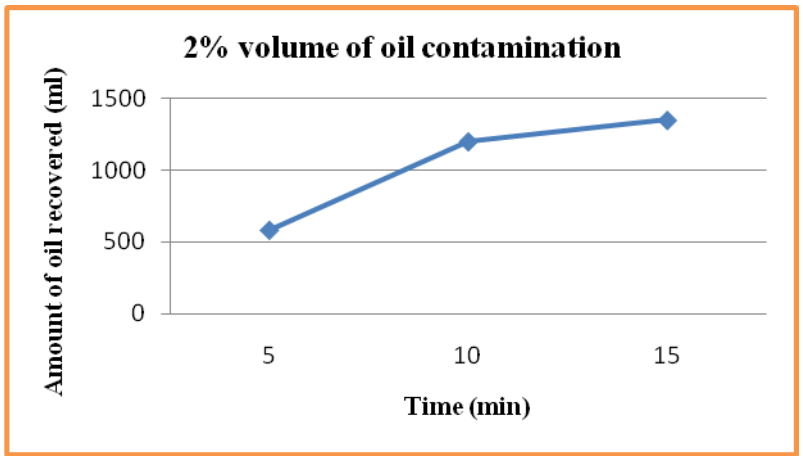

Fig. 7: Oil recovered V/s time graph

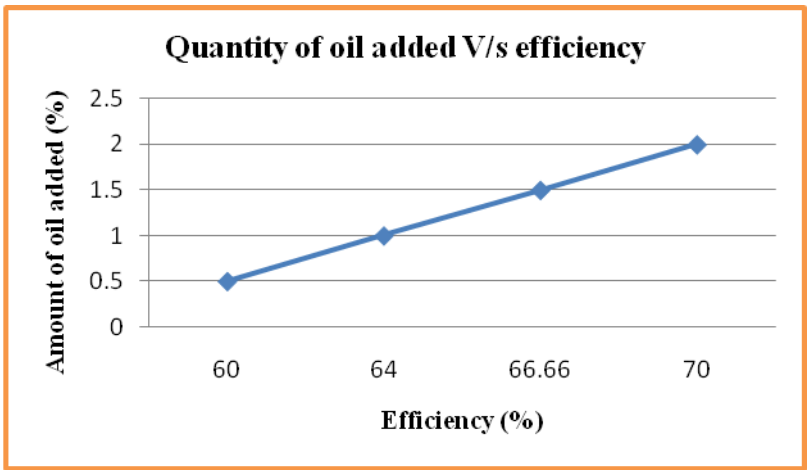

Fig. 8: Amount of oil added V/s efficiency graph

CONCLUSION

In this project after performing and analyzing the design considerations, modeling, fabrication details and testing of oil separator equipment following conclusions have been made. The oil separator equipment is easy to operate, i.e. only supervision is needed. Further smooth running of this equipment increases the life and reduces the maintenance. Cost of this project is comparatively lesser than the existing products so this equipment perfectly suit for small scale industries. After testing, efficiency has calculated at different quantities of oil and graphs have plotted for different experiments. Better efficiency is achieved.

This product is easily detachable and can comfortably carry to different work locations, thus it is versatile in working so this can be used in many industries. So this separation of oil from the water surface produces oil free water, thus effective means to pollution control. At lower cost this product is built up and satisfies the industrial needs.

REFERENCES:

[1]. Sadek. Z. Kassab-"Empirical correlations for the performance of belt separator operating under environmental dynamic conditions"-http://www.academicjournals.org/IJWREE, 18 June, 2010, page no- 121-129.

[2]. A m el-zahaby, a e kabeel, a i bakry and a m khaira-"Effect of adhering surface type of an oleophilic disk separator on the oil spills recovery from water"- Ninth International Congress of Fluid Dynamics & Propulsion,December 18-21, 2008, page no. 1-8.

[3]. V.B. Bhandari "Design of m/c elements" McGraw hill publication 2009.

[4]. R.S. Kulkarni & J.K. Gupta "Machine Design" Eurasia publishing house.

[5]. Kal Renganathan Sharma–"Power draw of the rotor during centrifugal high volume separation of oil and water" http://www.academicjournals.org/JMER, Vol. 4(1),January 2012, pp. 10-16.