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Development of Oil Skimmer by Flat Belt Type Technique for Separating Oil from Mixture of Oil and H₂O

Amit Jitender Gupta¹, Enoch Andrandes², Muazzam Jummal³, Nakib Shaikh⁴, Akhtarhusen Momin⁵

^{1, 2, 3, 4}Student, ⁵Assistant Professor, Department of Mechanical Engineering, Theem College of Engineering, Boisar

Abstract: Marine life and environment were affected by oil spill. The effects of such oil spills on nature are not negligible as demand of oil is increasing day by day. So we need to find some other ways to reduce the effect of oil spill. It is important to clean or collect this oil from the surface without actually wasting it as we know it is a nonrenewable resource. In the past years the world has faced number of oil spill accidents which have caused harm to marine life as well as humans. Oil spill forms layer on surface of water which prevents sunlight from passing through it and also reduces dissolved oxygen level in water. To minimize the effect of oil spill many oil skimmer techniques are used. Belt type, Pipe type, Rope type, Drum type etc. In this project we are working on Belt type oil skimmer to separate the machine oil from coolant and oil from water. Our aim of this project is development and fabrication of a compact mechanism for collect oil from coolant and water with the help of belt in minimum period of time. Our goal is collect maximum amount of oil from coolant and water for this we are going to select different materials of belts like polymer belt nylon-fibre belt. The collected oil can be reused in machining or for other purposes in industries. This set up uses the DC motor, polymer belt, nylon-fibre belt, pulley, supporting frame, polyurethane blade. The objective of project is reducing or control pollution. In industries, to separate oil from coolant and water, we mostly use belt type oil skimmers.

Keywords: Oil Skimmer, Water Pollution, Belt Type, Oleophilic Skimmer.

I. INTRODUCTION

Now a day for achieving rapidness, various machines and the equipment are being manufactured. In such a contemporary era of liberalization, small scale industries are contributing during a big way to the growth of our country. New machines and techniques are being developed continuously to manufacture various products at cheaper rates and top quality. Taking into account the above contribution we have tried to manufacture such an equipment which is the accessory of machine tool to have the cutting fluid coolant is used for treating. Due to the changes in properties of coolant while mixed with lubricating oil when it is used continuously. Hence it is required to remove oil from the coolant. The oil skimming is that the operation of removing or separating the oil from the oil polluted coolant. Containers has the mixed coolant and oil.

A. Various Methods are Used to Separate oil From Coolant

- 1) By separating the oil from the coolant by violently pouring the upper layer of mixture within the another container.
- 2) By removing oil layer by using a separation device.
- 3) By skimming oil using at belt arrangement. The primary two methods aren't accurate also these are time consuming and it requires kind of skill for its execution. The later one is straight forward and the oil are often separated with none fatigue and therefore the process is accurate. The oil glues to the belt. The belt with oil is shipped against the separating device which directs the oil to a container. In precision machine tools, there's a cooling system which is that the main requirement of a machine while doing operations operation on the materials which are comparatively harder. When operation goes on, at that point there's generation of warmth thanks due to friction between tool and work material. This heat causes wear and tear of tool and there's also un-wanted deformations in the material. There's also an opportunity of change in properties. Insufficient heat dissipation reduces the standard of product and decreased tool life. To avoid this machine cooling is completed due to help of coolant. The iron particles from it, may create problems like damage of coolant supply (pipe line) system, damage of pump, better machine accuracy can't be obtained, during a grinding machine, where it's required to take care of accuracy also finishing of the work piece.

“OIL SKIMMER” removes the oil from coolant. As name suggests, the belt does main roll, belt with oil is pulled towards drum and provides filtered coolant.

II. METHODOLOGY

The consideration and planning for developing the machine are as follow: -

- A. Selection of gathering of component for the craving moment. Components like motor, pulleys, bearing etc.
- B. Calculation of vitality machine parts. Calculation of motor rpm, load of motor, torque of motor, voltage required to run motor, pulleys dimensions, bearings dimensions etc.
- C. The most important thing in oil skimmer is to select material of the parts because many chemicals and hydrocarbons are present in the mixture which can effect on the life of machine parts so according to that we have to select the material for the machine components.
- D. Determining the extent of segment drawing and sending for the manufacturing of the machine parts.
- E. Preparation of part drawing with all the details and sending for manufacture to achieve product with maximum precision.
- F. And at last manufacturing or assembling and collecting machine.

Selection Of Materials

SR NO	COMPONENT	MATERIAL	STEEL CODE
1	Angle for stand	Mild steel	C-45
2	Roller shaft	Bright steel	C-45
3	Frame	Mild steel	C-25
4	Shaft	Bright steel	C-45
5	Rests	mild steel	C-25
6	Holding block	Mild steel	C-25
7	Container sheet	Mild steel	C-25
8	Sheet	Mild steel	C-40
9	Nut bolt & washer	Mild steel	C-45
10	Belt	PVC	Polyurethane
11	Plummer block	Cast iron	Cast iron
12	Nut bolts and washer	M.S	C45
13	Single row ball bearing	Chromium steel	6204

III. DESIGN OBJECTIVE

The basic objectives of the projects are: -

- 1) To separate the oil from the coolant solution.
- 2) To increase the life of coolant.
- 3) To increase the tool life.

To avoid change in properties of material. A sincere attempt is made to accomplish almost all objectives as mentioned above and make it practically feasible.

IV. COMPONENT FUNCTIONAND SPECIFICATION

- 1) *DC Motor:* Motor used in our project is half hp centre shaft economy series DC motor. It is high quality motor with low RPM and high torque. The shaft of motor is made of steel and it has steel gears and pinion which ensure longer life and good wear and tear properties. This motor is maintenance free. The shaft rotates in plastic bushing. The whole assembly is covered with plastic ring. The gearbox is sealed & lubricated with grease for smooth working of motor and it makes it maintenance free.



Fig.4 DC Motor

- 2) *Polymer Belt*: The belt is used is made of polymer material. It has width of 150- 200mm. It is endless type of belt. The material is selected according to oil to stick on the belt. It is mounted on pulley. Length of the belt is 1060mm. The belt is immersed in liquid up to 100mm. The belt can withstand temperature up to 82 degrees Celsius and it has very good oil removal rate. Tension is given to the belt by lower pulley with dead weight.



Fig.5 Polymer Belt

- 3) *Pulley*: It is made of cast iron. It is coated with aluminium coating. The bearing is used in pulleys for smooth working. The main function of pulley is to hold and support the belt and give rotary motion. At the bottom dead weight is supporter to give tension on belt.



Fig. 6 Pulley

- 4) *Supporting Frame*: The frame of oil skimmer is made up of mild steel. It is supported to the pulley and belt assemblies and also motor is fixed on the frame. The frame must be lighter in weight so that it will be easy to transfer. It is the body of oil skimmer.

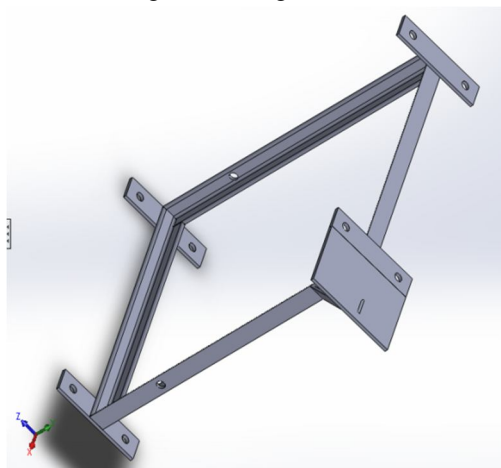


Fig. 7 Frame

- 5) *Polyurethane Blade*: It is mounted on the assembly over oil receiver tank to remove oil from the belt. The length of the blade depends on the width of the belt. The blade is fixed on the assembly with the help of clamp. The blade has sharp edge to remove oil from the belt. When the belt rotates oil stick on the belt and removes by blade and collected in collecting tank.



Fig.8 Polyurethane Blade

V. WORKING PRINCIPLE

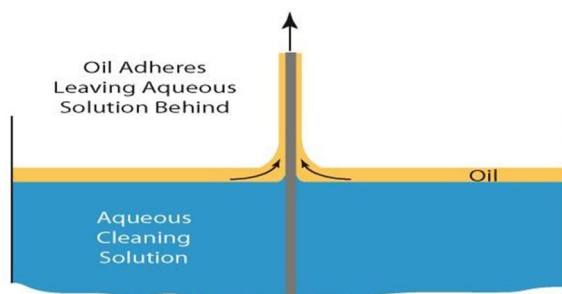


Fig.9 Working Principle of Oil Skimmer

The oil and coolant mixture is collected in the container from machine such as Lathe machine, milling machine etc. Oil being lighter in weight will float over the coolant. As the belt is driven by motor through pair of rollers, oil sticks onto the belt and is separated using scrapper on the other end. Separated oil is transfer to the container which we can reuse for machine. The after completion of the process coolant can be reuse effectively. Due to low density of oil. Oil float on the surface of water and form the thick layer on the surface. As we know that water is polar and oil is non-polar according to this we have selected belt material which is non-polar due to which when belt dipped in water tank or coolant then oil sticks on the belt and it is separated with the help of scrapper.

A. Advantages

- 1) To separate the oil from the coolant mixture.
- 2) To increase the life of coolant.
- 3) To increase the tool life.
- 4) To avoid change in properties of material.
- 5) Low maintenance cost.

B. Limitations

- 1) Only adhesive oil fluid particles can be separated in oil Skimmer.
- 2) It can separate the oil which can float on the coolant (low viscosity).

C. Applications

- 1) Wastewater Sumps
- 2) Coolants and Cutting Fluids
- 3) Parts Washers
- 4) Cylindrical Grinding machine
- 5) Centre less grinding machine
- 6) Milling Machine & where coolant separation is necessary

VI. RESULT

A. Analytical Calculation

Let us assume,

T=Thickness of film on belt in m=1mm

W=Width of belt in m.

D=Diameter of shaft in m.

N=Speed of rotation of shaft in rpm

$$V = T \times W \times \pi \times D \times N$$

$$= 0.001 \times 0.055 \times \pi \times 0.018 \times 7.2$$

$$= 22.39 \text{ ml/min}$$

B. Observation Table

Table -1

Recovery rate ml/min	Belt speed RPM	Thickness mm
22.39	7.2	1

Table -2

Sr. no.	Belt speed RPM	Oil spilled in ml	Collection of spilled oil in ml	Time Min	Recovery rate ml/min	Average recovery rate
1.	7.2	18	15	1.00	15	13.995
2.	7.2	22	23	1.35	17.04	
3.	7.2	32	27	2.14	12.61	
4.	7.2	35	34	3.00	11.33	

C. Result & Discussion

- 1) At 7.2 rpm the amount of oil Recover = 91.90%
- 2) At 7.2 rpm the average time taken to recover oil = 1.87 min.
- 3) High viscosity oil have high recover rate.



Oil skimmer

VII. CONCLUSION

In this project we have found numerous point which need to be booked into while designing the oil skimmer. The changes in the design of skimmer results in huge difference in the oil recovery. The part of the machine where recently placed and arrange in order to obtain maximum efficiency of work. Polyurethane belt give better edge in oil recovery all design aspects lead to improvement of oil skimmer. The oil from coolant was easily separated with this machine. This machine overcame many design hurdle to reach the final stage.

The objective of oil project oil skimmer is: -

- 1) Successfully fabricated oil skimmer.
- 2) Better oil removal rate and less cost.

Our oil skimmer machine is much durable comparing to other methods. Machine is simple we can depend on our oil skimmer for its effective result we can depend on our oil skimmer for its effective result. Further testing and modification will significantly improve oil recovery process. We consider the experience we got with designing and the machine could help in the industries.

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IX. CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this article.

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