

Portable Oil Filtration Unit

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Abstract Portable Oil Filtration Unit (POFU), is a portable oil filtrating device which can be used for filtration purpose in remote places and in the places where mid-level volume of oils are to be filtrated. In order to keep the system oil clean, periodic filtration is required to be carried out by using suitable equipment. In most cases, these equipments are too big or too heavy to be termed as portable. Also when it is necessary to carry out such filtration in remote applications where electric supply is not available easily, POFU can be a very handy and a useful device. The unit does not need electric supply and runs on a fuel powered engine which is coupled with pump.

Keywords- Mechanical Engineering, Fluid Mechanics, Oil Filtration, Portable Devices, Oil Conditioning, Maintainance.

1. INTRODUCTION

1.1 Objectives

To analyze characteristics of oil before and after the filtration process is carried out.

1.2 Thrust areas and market

Basically, noticing today's industrial scenario, we can state that there is a need of good filtration system to cope up with the tremendous increasing appliances and various applications in different industrial sectors. POFU is designed for filtering the oil required in remote areas. So POFU is an effective maintenance tool to address oil filtration applications such as

- Wind mills
- Mining equipments
- Construction equipments
- Railway track laying machines
- Farming equipments

1.3 Components used and sourcing

As we have selected to manufacture a PORTABLE UNIT, the basic requirement is of minimum and optimum used of available components. In order to make a precise setup of the equipment, the enlisted components are required.

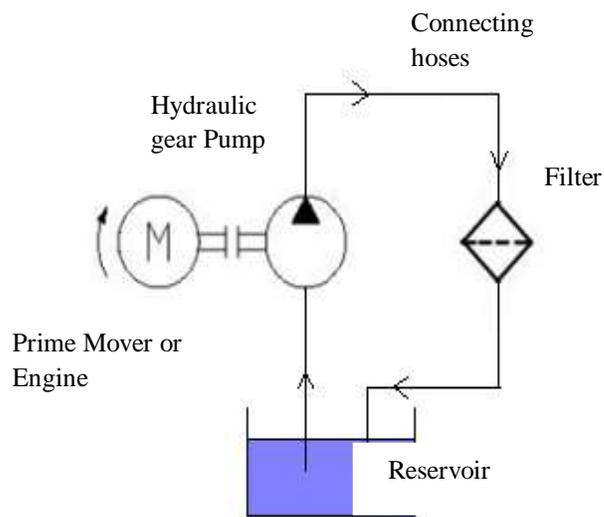
Following are the technical considerations of POFU:

- Prime Mover or Petrol Engine YAMAHA BIRLA ECOGEN 14E SERIES.
- Hydraulic Pump – Yuken India.
- Filter assembly (Paper Filter) – Hydroline Company.
- Fuel Tank (kerosene and petrol)
- Inter connecting Hoses of material Nylon – Swami Enterprises, Nana Peth, Pune
- Mounting frame made up of mild steel material.
- Anti-Vibration Pads – Parth Enterprises, Narayan Peth, Pune.

2. EXPERIMENTAL PROCEDURE

2.1 Designing process

In order to manufacture any component or equipment, the design is utmost important. Design is considered as the backbone of any product which is to be manufactured.



Circuit Diagram of Portable Unit

From the above fig. we can understand the working of portable oil filtration unit. The fig. states that first

of all, the oil which is to be filtered is stored in the oil reservoir.

Then we have to place the engine in such a manner that it will provide the rotation to the gears in the pump in order to pump the oil towards filter.

After the pump we have to provide the filter assembly which is used to filter the oil coming out from the outlet of pump. The oil is filtered in the filter and it will again drain to the reservoir through the connecting hoses.

2.2 Details of each component

Following are the main components we will use in the unit:

All the components are selected with trial and error method at present.

Prime mover or engine of 0.5 H.P. and 5000 R.P.M for functioning of the pump.

Hydraulic Pump which has a capacity of 10 L.P.M for pumping of the working fluid (hydraulic oil)

Filter assembly in which paper filter can be used for filtration process and remove particulates contamination. Paper filter can be of 10 microns.

Mounting frame made up of Mild Steel pipe will be the basic structure which constitutes the whole assembly.

Fuel Tank for the storage of fuel petrol and kerosene. The capacity of the tank is approximately 2 liters.

Inter connecting hoses made up of Nylon material for circulation of hydraulic oil.

Bell Housing made up of Mild Steel material duly designed and fabrication. Function is to hold pump with engine mounting.

Flexible coupling to connect engine shaft with pump shaft.

2.3 Fabrication and machining process

Mounting frame made up of mild steel pipes. Initially the basic designing will be carried out for its total size.

The frame will be designed in such a way that it should withstand the static and vibratory load of both the moving components namely engine and hydraulic pump.

After the surface finish the components would be painted.

Suitable bracket will be fabricated and attached to the main frame, considering the mounting holes of both engine outlet and pump mounting suitable bell housing will have to be designed and fabricated accordingly. Suitable size flanges will be machined and fixed to the bell housing (Engine and pump side).

3. PERFORMANCE ANALYSES

3.1 Operation

1. Fill adequate amount of Petrol in the petrol tank
2. Fill adequate amount of kerosene in the kerosene tank
3. We have to check whether the pipes are fitted properly i.e. one pipe should be attached to the inlet of the pump. The other end of the same pipe should be dipped in our fuel tank.

The second pipe should be fitted to the outlet of the filter. Other end of the second pipe should also be placed in our oil tank for continuous filtration of the oil.

4. Once all this is checked we have to turn on the engine with the help of a red colored knob provided at the extreme right corner of the engine.
5. Then we have to turn on the drain cock so as to drain the existing kerosene in the drain tube. Then there will be another knob situated at the left hand side which has three combinations
 - a) Stop
 - b) Start
 - c) Run
6. At first we have to put the engine at stop when we are draining the kerosene otherwise excess kerosene will be drained out.

7. Then we have to give choke to the engine.
8. After all this is done, we have to turn the knob to start.
9. To actually start the engine, we need to manually give rotary motion to the engine shaft. This can be done by winding a rope to the extension provided to the shaft. This wound rope has to be unwound by pulling it generating adequate torque to start the engine. (This may have to be done several times in order to generate adequate torque)

10. As the engine starts, the speed of the engine should be increased by pulling a lever provided near the shaft downwards. (It is necessary to carry out this step slowly)
11. As the engine speed increases, the pump starts sucking oil from oil tank. This oil travels to the filter where it is filtered. The filtered oil is again let go in the oil tank through delivery pipe. This process has to be continued a number of times to purify all the oil in the tank.

3.2 Oil auditing and various testing methods

Oil auditing includes various techniques and methods carried out for proper maintenance of oil parameters and related characteristics. The various Testing methods may include:

1. Microscopic Analysis
 - i. Optical particle counting by means of filtered sample under a microscope
 - ii. Visually identifies type of contamination
 - iii. Useful for static or dynamic sampling
2. On-line Particle Counting According to:
 - iv. NAS 1638
 - v. ISO 4406:1999
 - vi. Bottle-sampling & Particle Counting

4. RESULTS

1. We carried out a test on an online particle counter to find out the number of particles of contamination of the impure oil and when the oil was purified using the Portable Oil Filtration Unit.
2. The filter used in POFU was a 10 micron paper filter.
3. For test a sample of 1ml of oil was taken.
4. Thus following results were obtained before and after filtration of oil.

(Before Filtration) (After Filtration)

PARTICLE COUNT		PARTICLE COUNT	
SIZE (Micron)	No. Of Particles	SIZE (Micron)	No. Of Particles
4	1708	4	1752
6	625	6	517
10	237	10	144
14	104	14	55
20	657	20	25
50	546	50	1.3
75	215	75	0.27
100	57	100	0.08

5. Under ISO 4406:99 a sample is given fluid cleanliness rating using the table below for comparison.
6. To do this, the number of particles greater than three size ranges 4, 6 and 14 micron are determined in equivalent of 1ml sample of oil.
7. By comparing the table and the obtained results we can find out that,

Results we got	Range according to ISO 4406:99
1752 particles > 4 microns/ml	1300 to 2500
517 particles > 6 microns/ml	320 to 640
55 particles > 14 microns/ml	40 to 80

8. Thus we can say that the test carried out was a success as the obtained results are within the specified limits according to the ISO 4406:99 standards.

Above figure shows the ISO 4409:99 standards for

Number of Particles per ml		
More Than	Up to and including	Range Number (R)
90,000	160,000	24
40,000	90,000	23
20,000	40,000	22
10,000	20,000	21
5,000	10,000	20
2,500	5,000	19
1,300	2,500	18
640	1,300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2.5	5	9
1.3	2.5	8
0.64	1.3	7
0.32	0.64	6
0.16	0.32	5
0.08	0.16	4
0.04	0.08	3
0.02	0.04	2
0.01	0.02	1

Values We Used For Reference

oil testing and the values we referred

5. CONCLUSIONS

In order to keep system oil clean, the periodic filtration is required to be carried out by deploying suitable equipment. In order to carry out such filtration in applications located at remote places and also where electricity is not available easily, the portable oil filtration unit aka. POFU can be a very handy piece of equipment.

The use of such efficiently designed products can help in reducing the transportation costs, maintenance costs and also prove more efficient than the periodic maintenance carried out in the workshops. Conservation of energy in the form of electricity can be other criteria which will work in favor of the Portable Oil Filtration Unit.

5.1 6. FUTURE SCOPE

In order to keep system oil clean, periodic filtration is required to be carried out by deploying suitable equipment. In order to carry out such filtration for remote applications where electric supply is not available easily, POFU can be a good handy tool.

The use of such newly designed product can reduce the overall transportation costs, maintenance costs and prove more efficient than periodic maintenance carried out in workshops. Conservation of energy in the form of electricity can be another criteria mentioned for Portable Oil Filtration Unit.

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PHOTO GALLERY



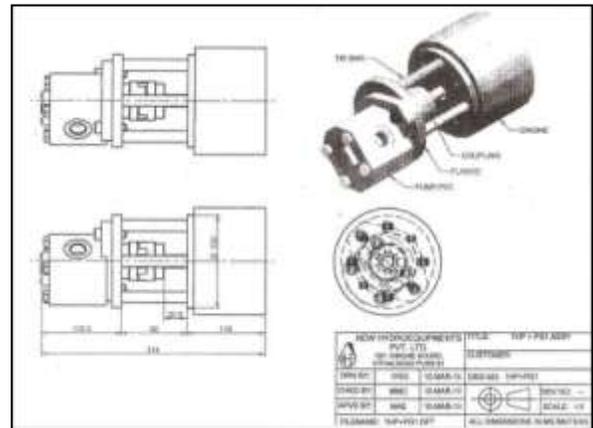
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Portable oil Filtration Unit (POFU) – A backpack design.



The above figure illustrates top view of the assembled product.



Bell Housing and other peripherals