REVAMPING OF USED OIL USING FILTRATION PROCESS

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***Abstract*— In this study, a physical method was applied to revamp the used engine oil by the process of sedimentation in addition with the filtration process through the micron oil filter combined with the centrifugal separation and finally by heating the oil to the apt temperature to evaporate all the water content. During whole process of revamping the base property of the oil remains the same. After the usage oil get contaminated due to the factors like continuous friction between two rubbing parts. After the contamination of oil there is increase in the compounds of sulphur and barium also if the oil is used in the engine then there is increase in the carbon, ash and soot content in the oil which are highly toxic and may cause pollution to the zenith if not filtered. Also the dumping of used oil into the soil can lead to the degradation of the soil and that land may become barren and if the same oil is lead to the water ways via drainage then the contaminated oil is capable of polluting 10 million gallon of water per gallon of waste oil. Also the revamping aids benefit to the consumer by being able to use that same oil. Hence oil should be revamped as it adds benefits to both nature and consumers.**

Keywords— sedimentation, micron filtration, centrifugal separation, evaporative heating.

INTRODUCTION

The essential petroleum fragment generally used is the lubrication oil also referred as the engine oil [5]. Generally engine oil is used to reduce the reduce the friction between to rubbing surfaces[10] so that the useful energy is not wasted in the form of kinetic energy also engine oil is used for cooling and for cleaning purpose [11]. During its usage in the engine it get contaminated due to the overindulgence to the bearing material and due to this the percentage of the asphaltic compounds, aldehyde, acidic compound, gums, varnish, metals, additives and other phynolic compounds gradually increases [3]. Addition to these most of the important properties of the base oil from the used oil is not eliminated totally hence these properties can be again recalled by using certain form of filtration process. Due to the anthropogenic properties of these oil if it is directly dumped into the soil or to the dumping yards it will lead to increase in pollution and also the soil in which it is dumped get degraded [2] .hence in these case the revamping of the used oil is and effective and efficient solution to these problem hence decreasing the pollution and also the filtration leads to the green environment [4]. During filtration process the physical mechanical and chemical impurities are removed by directing the oil through the sedimentation, physical filtration, centrifugal separation followed by the evaporative heating process. Rashid abro [4] conducted test on the filtration of used oil using single solvent, composite solvent and acid treatment and resulted that composite solvent extraction leads to better efficiency among all and lead to the oil conform properties with the lube oil and acid method stands second in results but also carries drawback of environment hazard. R.k pandey[14] developed design and filtration of oil using centrifugal separation and concluded that the impurities ranging from (15-20) microns are also filtered using centrifugal separation. Mohammed ibrahim hassan [8] experimented the use of acetic acid and formic acids for filtration is used oil and concluded with the results that the acetic and formic acids do not results with the base oil and it reacts vigorously

with the used oil hence filtering it and making it ready for use. Afaf r. Taman [11] recycled engine oil using different solvents and resulted that sludge is removed at the rate of 4:1 and the condition of used oil is improved and stated is the method is feasible for dielectric oil .

CONSTRUCTION

A. CENTRIFUGAL SEPARATOR

As work is done motor to rotate in centrifugal direction

Power=P_2= 6 watt 6 J/s

Power=work/time

Work=power*time

=6*60……[for 1 minute]

Work=360 J

Q_2=W=work i/p to separator=360J=0.35 KJ

Heat transfer from surrounding to tank

Assume m=1Kg, Cp=1.8 KJ/KgK

Now, Q_1=m Cp (T_{in}-T_{out})

Q_1=1*1.8*(34-32)

Q_1=3.6 KJ

According to first law of thermodynamics,

U_1-Q+W=U_2…..(1)

The work enters into the tank in the form of energy

Only so this would be considered as heat input

Q=Q_1-Q_2

=3.6-0.36

Q=3.24 KJ

Since volume does not change (Taking volume = C)

i.e. we take oil at certain level & then do centrifugal action.

Work done (W)=0

Now Equation 1will be,

U_1-Q+W=U_2

U_1-Q+0=U_2

U_2-U_1=-3.24

Hence change in internal energy = KJ

[As it is positive then it becomes increase & it is negative then it becomes decrease.]

B. FLAT BELT

Power to be transmitted = 0.14193 Kw.

Input speed = 16rpm

Center dist. According to space available = 1250 mm

As per working condition we assume total slip = s=s1 + s2 = 10 %

Driver drum speed = 16 rpm

We assume diameter of drum = 112 mm
V = πDN / 60 x 1000
V = π x 112 x 16 /60 x 1000 = 0.1 m/s
B) Assume 5% slip between driving drum & belt
Velocity of belt = 0.1 – o.o5 x 0.1
= 0.0954 m/s
C) Assume 5% slip between driving drum & belt
Velocity Of driven drum dia. As same as driver drum dia. Is equal to 112mm
V driven drum = πDN / 60 x 1000
= π x 112 x N/ 60 x 1000

N = 60 x 1000 x 0.0963 / π x112
N = 15.25 rpm
Angle of contact = 180 degree

Length of belt:-

= π (D+ d) /2 + 2c + (D-d)^ 2 /4c

= (112 +112) /2 + 2 + 2 x 1250 + 112 -112) ^2/4x 1250

= 2878mm
As speed of belt is very low therefore neglecting centrifugal tension

So, Fc = mv^2 = 0
Coefficient of friction = 0.35

Power transmitted = 0.14193Kw

Velocity of belt = 0.0954 m/s

P= (F1 – F2) x V /1000
0.14193 = (F1 – F2) x 0.0954 /1000
So, (F1 – F2) = o.14193 x 1000 /0.0954
(F1 – F2) = 1477.08N……..1
&
(F1/F2) = e
= e0.35 x π
F1 = 3.00 F2…….2
Substitute equation 2 in 1
3 f2- f2 = 1477.08
F2 = 1477.08 /2
Slack side F2 = 738.54 N
F1 = 3F2
F1 = 3 x 738.54
Tight side (F1= 2215.62N)
Specification of belt:-
Special purpose belt
Material :- Nylon sandwich
Specification :- 2878 x 180 x 2mm

C. HEATER

Heat added in system=m Cp ΔT

= 1*1.8*(40-32)

Q=14.4 KJ

E. SHAFT

Now ,P_1 = VI =12* 0.5 = 6 watt

Now, $P_1 = 2\pi NT/60$

$T = P_1*60/2\pi N$

$T=6*60/2\pi*10$

T= 5.7295 Nm

T=5729.5780 N-mm

Now, calculated twisting moment & bending moment

a]Max bending moment = $M_b=wL/4$

Calculation of load (W)

As the weight of disc at the center of beam hence it becomes Simply supported beam with point load at center

Now, weight of disc = W 0.344gm = 344 Hg = 3374.64 N

Now, by equilibrium condition

$R_a=R_b$ =3374.64/2 = 1687.32 N

Now, $M_b=wL/ 4 =337.64*190.5/4 = 80.3586 *10^3$ N-mm

B] Calculation of twisting moment (M_t)

$M_t= 60* 10^6*$ power/$2\pi N$

$M_t= 60*10^6*6/2\pi* 10$

$M_t=5.7295 *10^6$ N-mm

Now, assume K_b= combined shock & fatigue factor applied to bending moment

$K_b=1.5$

K_t=Combined shock & fatigue factor applied to torsional moment

$K_t=1$

Now, σ_y =250 Mpa, S_{ut}= 841 Mpa

By shear stress theory,

0.30 $S_{yt}=0.30*250=75$ N/mm^2

0.18 $S_{ut}=0.18*841=151.38$ N/mm^2

Taking minimum

$T_{max}=0.75*75=56.25$ N/mm^2

Now,$\tau_{max}=(16/\pi*d^3)*(((K_bM_b)^2+(K_tM_t)^2)^{1/2})$

D= 18.03 mm

D~20 cm

D. SELCTION OF BEARING

1) Type of bearing = Self alignment ball bearing

2)Bore diameter=d_s=20 mm
20/5=4

3)Select SKF series from self aligning ball bearing

SKF series	C(Kgf)	N_{max}
2204	980	16000
2304	1400	10000

4) Assume life = L_{hrs}=12000hrs

5) $(L_{10})_{mr}=L_h*60*60/10^6$

$(L_{10})_{mr}$=43.2

6) Now $(L_{10})_{mr}=(C/P_e)^k$…..(1)

Now $P_e=[V*X*F_r+Y*Fa]\ S*K_t$…..(2)

As V=1 (inner race rotating)

X=1

F_a=0, S=1.4, K_t=1

Now, Radial load ($F_{r)}$=R_A or R_B/2

F_r=1687.32/2

F_r=843.66 N

Hence equation (2) will be

$P_e=[V*X*F_r+Y*Fa]\ S*K_t$

$P_e=[1*1*843.66+0]1.4*1$

P_e=1181.124 N

Equation (1) will be

$(L_{90})_{mr}=(C/P_e)^k$

$43.2=(C/1181.124)^3$

C=422.4617 Kgf

Hence we selecting bearing 2204

Fig.1. Oil Filter

Fig.2. Filtration process

Fig.3. Centrifugal separation process

WORKING

Initially water with oil to be revamped is poured in the tank assembly consisting of rotating disc. As the motor is started disc start rotating and oil in contact with it will collected in the pipe in contact with the disc. Near the mouth of oil collecting mechanism there is sponge which will initially hold the minute impurities and direct the oil the filter through the pipe assembly. Inside the filter due to small filter net clean oil free from all the foreign particles is directed to the centrifugal separator. Inside the centrifugal separator as the separator rotate due to the centrifugal force oil is splatter along the inner circumference and oil is again set free from all the dust particles of the impurities in it. Finally oil is heated in the heating tub up to 40-50 degree to set oil free from all the water particles. Hence the revamping of used oil is done.

CONCLUSION

The filtration process has thus resulted into the possibility of obtaining good quality revamped oils from used engine oils. The cost of revamping (of used engine oil) is relatively fictitious compared to its original production cost from crude oil. As the number of purification stages involved is reduced. From the testing conducted the flash point and the fire point of the lubricated oil and the used lubricated oil are comparable and the viscosity got decreased along with the increase in the temperature. The used lubricating oil can be recycled and can be used for lubrication with the addition of additives like 2- butonol, 2-isopropane and by combining the filtration process with the acid treatment like acetic and formic acid process it can be again used in the engines as well but is it increases the cost of operation hence for minimum budget is can be used for the lubrication purpose. Finally we can observe that the revamping of spent oil endowed a durable solution to avoid pollution caused by directing the used oil into the waste chambers.

FUTURE SCOPE

1. It can be used for filtration of automotive oils.
2. With small modification it can be used for filtration of dielectric oils.
3. Filtrated oil can also be used as lubricant in different processes by alkaline balancing.
4. Filtration plant can also provide employment to the people hence generation of taxes to the government.

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