A Study on Used Engine Oil Refinement In Lab Scale And Its Applications

Nandish H[1], K M Sham Sundar[2], Chethan S G[3]
[1]Dept of Civil Engineering
[2] Professor, Dept of Civil Engineering
[3]Assistant Professor, Dept of Chemistry
[1, 2] U.B.D.T. College of Engineering Davangere, Karnataka, India
[3]J N N College of Engineering, Shivamogga, Karnataka, India

Abstract- *This report address the recycling of used lubricating engine oils by distillation process. Used lubricating oils due to their volatile composition cannot be dispersed of randomly into water or land but can be recycled by using a lot of conventional methods. The Economic problem and Environmental protection keeping them in mind it seems to be more appropriate to regenerate the used lubricants and re-use them. The used engine oils are mainly composed of PAH's and a lot more pollutants including acids, water etc. The solvent extraction by distillation process is one of the conventional methods of recycling used oil. In this work a pilot distillation plant is fabricated and used engine oil is distilled till up to 3400 C. The distilled fraction is is treated with activated charcoal and filtered. The final product is tested for its physical parameters, fatty acid profile and for its metallic composition like Fe, Cd, and Pb. The obtained results are being compared with the standards and found their suitability for its applications.*

Keywords- Fe, Cd, Pb & PAH's Heavy Metals & Hydrocarbons.TR-PID-ZN-Fuzzy-MRAM-MATLAB.

I. INTRODUCTION

A lubricant is a liquid or semi liquid medium which is capable of reducing friction, heat and wear when it is being introduced as a filter between two solid surfaces. The main purpose of using lubricants in engine is to reduce friction between the moving parts. The use of lubricants in engine reduces the materials wears and results in improved efficiency of the engines and also moves same amounts of fuel. The oils are classified by their physical properties mainly according to their viscosity, density, flash and fire point and others. Suiting the properties of oil for viscous application its being used till they loose their lubricating abilities after a period of time and are replaced with a new or fresh lubricating oils. The waste liquid which is obtained after its used to the fullest extend is called used or waste lubricating oils. These used lubricating oils have several contaminants like aliphatic and aromatic hydrocarbons, lubrication additives, metals and various organic and inorganic compounds. Hence forth these cannot be disposed of randomly into any water bodies or sanitary pit or landfill sites. It's because it may cause serious problems to the aquatic life and may intrude into ground water and spoil the ground water quality. The pollutants and contaminants which are present in waste oils tend to pose adverse impacts on both environment and human health. The main source of generation of used lubricating oil are from motor vehicles. Apart from motor waste oils also gets contributed from hydraulic system, transformation and various other industrial applications. These waste oils are found more in small quantities in various stations, like garages workshop and some private premises. There are also some sources which generate waste oils in large amount viz railways, marine oils , industrial etc.

II. STUDY AREA

For this work the used or waste oil samples were collected from an Industry which processes oil refining. The industry collects the waste or used oils from various service stations and garages in and around Shivamogga District. The location of sample collection is showed in figure 1.

Figure 1 : Location of Sample Collection

III. METHODOLOGY

Refining the waste or used oil involves several physical and chemical processes. The used engine oils are first collected from the service stations and let to settle for a day or two undisturbed this is done to achieve sedimentation. After this the used oil is checked for their physical parameters. The used oil is distilled in a pilot distillation unit which was fabricated for this work.

A. Meteorological Data

Meteorological data is very important in order to understand the characteristics of the waste oil. The appearance of the waste oil itself reflects it impurity and also various pollutants induced in it. It is also necessary to understand or even predict the impacts of those oils if left untreated and are disposed of randomly. The acids, Heavy Metals present in waste oils are the most dangerous and as known the density of these oils are very high. It is said that one drop of oil has a potential to spoil one million liters of water. Hence the Meteorological data helps in finding structure of composition and suitability of refinement of used oil.

B. Method of Treatment

Vacuum distillation: Vacuum distillation of used oil is one of the conventional methods to treat used oil. When distillation is done at high temperatures it is easy to break the strong carbon chain present in the used oil. Distillation not only breaks the carbon chain but also helps in separating fractions. Further after distillation the lighter fraction is treated with activated charcoal which is a good adsorbent. Filter papers are used as a filter media to sustain carbonaceous traces.

Figure 2: Distillation Apparatus and Filtration

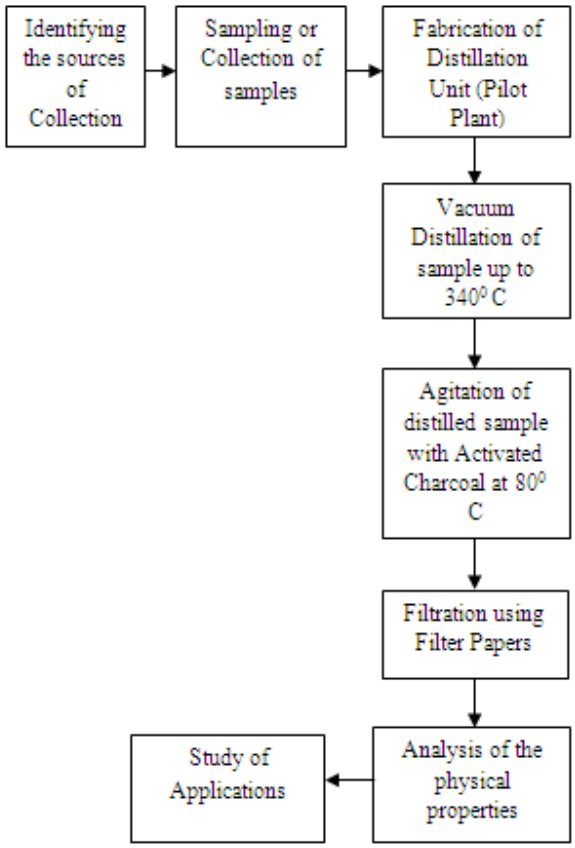

Figure 3 : Flow Chart of Experimentation

The Methodology of Experimentation in this Project Work is as shown as in figure 3.Firstly the locations for the sample collection are being identified. Sampling or Collection of samples were done in an oil refining industry where in the oil sample constitutes all kind of used engine oil are mixed, like heavy engine oils light engine oils other motor oils etc,. After the collection of samples its being stored till the experimental set up is ready. The experimental set up consists of a simple vacuum distillation unit, heating coil, measuring jar, funnel, filter papers and miscellaneous. 1000ml of oil sample is being measured and then poured into the round bottom flask in the distillation unit and all the other connections are made in order to start the process a water bath is kept running through the condenser to liquefy the steam derived by heating. After about 35mins at 210^0 c light ends like water comes as a product and after about 50mins at 320^0c black coloured base oil starts to get out as an end product of distillation. About 325 to 350 ml of end product is recovered in this distillation process. As said it contains light ends it should get evaporated hence it is again heated up to 80^0c with 2-3 grams of activated clay with continous agitation. here the water gets evaporated and by the use of activated charcoal the blackish colour gets breaked into reddish orange after filtration using filter paper. Finally after all these processes the

quantity of base oil remained is about 600ml. This means 60% efficiency.

IV. RESULTS AND DISCUSSIONS

The most feasible method to treat/refine used oil is by Vacuum Distillation method. By this process it is found that oil retrieved after refining is up to 60%. Hence in this work oil is distillated and treated with Activated Charcoal and Filtered using Filter Paper. The end product which is the refined oil obtained from this process is tested for their physical parameters. Not only the refined oil the raw oil/used oil is also tested for its physical parameters to observe the difference in the result.

The Physical and Chemical Properties of Used and Refined engine oil of Mix Grade are shown in table1

Table 1 : Parameters of Used and Refined engine oil

Sl No	PARAMETERS	UNITS	RAW OIL	REFINED OIL
1.	Density @ 40°c	g/ml	0.925	0.8195
2.	Viscosity @ 40°c	cSt	72.4	3.6
3.	Refractive Index @ 40°c	Deg C	1.47566	1.45263
4.	Moisture Content	%w/w	5.3	Nil
5.	Ash Content	%w/w	0.82	Nil
6.	Flash Point	°c	220	173
7.	Fire Point	°c	250	184
8.	Pour Point	°c	-30	-19
9.	Cloud point	°c	-5	15
10.	Heavy Metals			
	i. Iron	ppm	591.2	2.6
	ii. Cadmium	ppm	0.04	0.04
	iii. Lead	ppm	10.6	1.7
11.	Fatty Acid Composition			
	i. Capric Acid	%	15.82	11.295
	ii. Myristic Acid	%	12.44	Nil
	iii. Palmitic Acid	%	8.66	Nil
	iv. Behnic Acid	%	13.28	10.96
	v. Erucic Acid	%	40.92	36.945

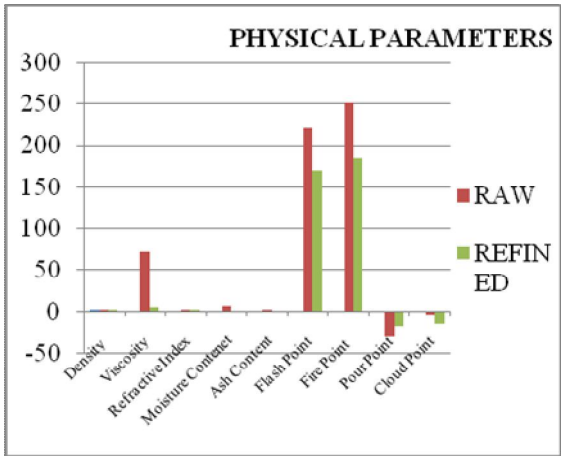

Figure 4 : Physical Parameters of Raw and Refined Oil

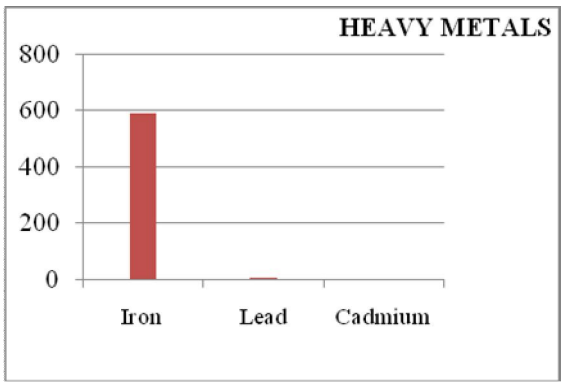

Figure 5 : Heavy Metals concentration in Raw and Refined Oil

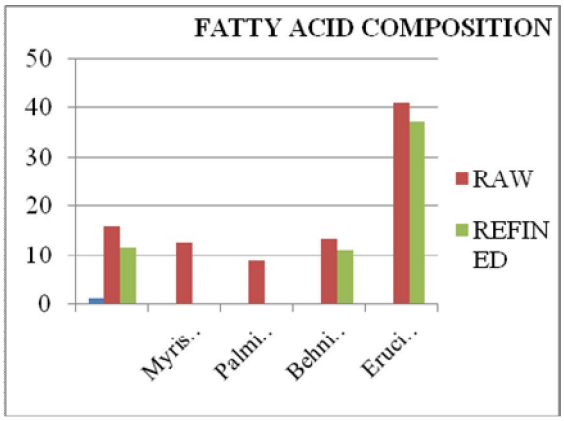

Figure 6 : Fatty Acid Composition of Raw and Refined Oil

There is a reduction in every physical parameter after the refinement of raw oil. The density, Viscosity, Reactive Index appear to be much lower than the raw oil values. This is mainly due to heat application, the raw oil are found to be more denser and viscous but due to the extreme heat the carbon chains break which results in less density and viscosity. The angle of refraction is more in raw oil because its denser after refinement the refractive index value comes down. The temperature resistance flash, fire, pour and cloud

points of oil refined by distillation is more. The temperature resistance mainly depend on the molecular weight of the oil. Less the molecular weight less is the resistance to temperature and vice versa. All these above physical parameters values are shown in table 1 and corresponding graph is plotted in figure 4. The heavy metals concentration are also reduced after refinement of raw oil by distillation. This is also happening due to the heat application. The variations of heavy metals are shown in figure 5. Coming to the Fatty acid composition the acids which are formed in the raw oil due to oxidation are also reduced when they are distilled. The acids like Capric, Myristic, Behnic, Palmitic and Erucic acids are being reduced at the maximum extent. Figure 6 shows the variations in fatty acid composition.

V. CONCLUSIONS

From the results incurred it is found that treatment of used oil yields good results and has a wide range of applications.

1. Treating the used oil by vacuum distillation process shows good efficiency of about 65-70 % than any other treatment methods.
2. The physical parameters tested after refining the used oil have shown better results when they are compared with virgin oil standards.
3. The density and viscosity of refined oil is lowered after distillation this implies the raw oil contains.
4. The moisture content and ash content of refined oils are zero. This shows that after distillation and filtration of used oil water and ash are completely removed.
5. The refractive index of raw oil was higher after refinement the refractive index number is reduced. This tells that the raw oil is more viscous and resists the propagation of light into it when compared to refined oil.
6. The flash and fire point of virgin oil is much more compared to raw and refined oil. After refinement of raw oil the values still reduced . This shows that the refined oil has lost its molecular weight.
7. The temperature of pour point of virgin and raw oil is almost same at about -30 deg C. The pour point of refined oil is as high as -15 to -20 deg C this is because the viscosities of virgin oil and raw oil is much more compared to refined oil. Refined oil gets freezed more quickly than raw and virgin oil.
8. The temperature cloud point of refined oil is much lower at about -15 deg C when compared to raw oil (-5deg C) and virgin oil (-10 deg C) this infers that refined oil need much more freezing to separate denser fraction from it and precipitate.
9. The heavy metals Iron and Lead drastically have been reduced after refinement from 500 to 3 ppm and 10 to 3 ppm respectively. Where cadmium content remains the same. Hence the requirement in heavy metals for the stability of oil is sustained even after refinement.
10. The long chain fatty acids present in used oil have been broken to an acceptable limit after distillation.

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