

PRODUCTION OF ALTERNATIVE FUEL FROM WASTE ENGINE OIL FOR 4-S DIESEL ENGINE

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ABSTRACT

Industrial development and economy of India is mainly depends on its energy resources. Majority of the world's energy needs are supplied through petrochemical sources, coal, natural gases, hydroelectricity and nuclear energy due to increasing of energy demand and cost of the products of petroleum are the big troubles of today so our main focus is find the diesel fuel can be used in diesel engine as neat or blending with fresh diesel.

In presents works , a sample of railway waste engine oil was refined with some chemical treatments (Acid treatment, basic treatment, clay treatment, filtering, distillation and heating)and blending with different percentages (B10,B20, B30, B40, B50,B60,B70,B80,B90)into fresh diesel have been considered. Results show that the blending of B30 (30% refined waste engine oil and 70% fresh diesel) are suitable to use as a diesel fuel considering with the performance parameters of the diesel engine without any modification of the engine .

Keywords:- Railway waste engine oil, 98% H_2SO_4 , CH_3OH , NaOH , Bleaching power, Stirring , distillation , filter paper, 4-strock diesel engine

INTRODUCTION

Increasing of energy demand and oil depletion situation encourages the development of renewable energy and alternative fuel technology. samples of shipyard and light vehicles (bus and truck) pre-treated used engine oil and different percentage of blending of pre-treated used engine oil (including clay treatment, CT) into fresh diesel have been considered. Results show that pre-treated (including CT) used engine oil of shipyard (UEO) and 35% blending of pre-treated (including CT) used engine oil (UEO) into fresh diesel are suitable to use as a diesel fuel considering Caterpillar Specific Limit and comparing with the fresh diesel [1]. Waste lubricant oils and biofuels are two important alternative fuel sources proved to be the best substitutes for existing petro fuels, since waste generated oils represent more than 60% of used lubricant oils [2] In recent years, recycling of the waste lubricant oils and utilizing of the products as fuels have become important topics for researchers. Most of the lubricant oils are generally obtained from petroleum resources. Petroleum-derived base oils currently account for about 97% of the total lubricant production [3]. The used or waste oils can be refined and treated to produce fuels or lubricating oil base stock. On the other hand, the waste oils pose an environmental hazard due to both their metal content and other contaminants [4]. Municipal and industrial wastes that contain high heat value, such as waste plastics oil (WPO), waste cooking oil (WCO), and waste lubricating oil (WLO) are considered efficient feed stocks for energy production in a Waste-to-Energy regimen [5]. Tire pyrolysis has been investigated for more than 20 years. The process converts waste tire into potentially recyclable materials such as flammable gas, pyrolysis oil and carbon black [6] a comparison of the use of pyrolysis oils which are the tire pyrolysis oil, plastic

pyrolysis oil and diesel oil in the assessment of engine performance, and feasibility analysis. [7] the engine fueled with blends of diesel fuel with plastic oil in the ratio of diesel to waste plastic oil 75:25(blend25%), 50:50(blend50%) and 25:75(blend75%) are experimentally measured and analyzed and compared with that of diesel fuel. [8] the DTPO production value in Thailand and without engine modification. 100% DTPO is the most cost effective point as 0.2 US\$/kW-hr. with the load 2500W while the diesel oil offer 0.38 US\$/kW-hr. The result shows that the 75% DTPO affects the highest efficiency comparable to 100% DTPO in medium load also offer smoother condition for engine and nozzle. [9] the used engine oils can be used in engine as engine oil after purifying it. Production of gasoline like fuel from used engine oil is involving chemical filtrations and blending process. The GLF is produced from waste engine lubrication oil (WLO) using the pyrolytic distillation method. The gasoline like fuel can be used in gasoline engine without any problem and increases the engine performance.[10] .

METHODOLOGY

Purification of waste engine oil basically depends upon the sequence of operation of acid treatment($\text{CH}_3\text{OH} + \text{H}_2\text{SO}_4$), basic treatment (NaOH), clay treatment(bleaching power as a activated clay) ,distillation, filtration ,and blending with fresh diesel in this purification Acid & Basic treatment is the most important because total success of refining of waste engine oil (WEO) depends upon it. The whole processes are shown in the Fig-1.

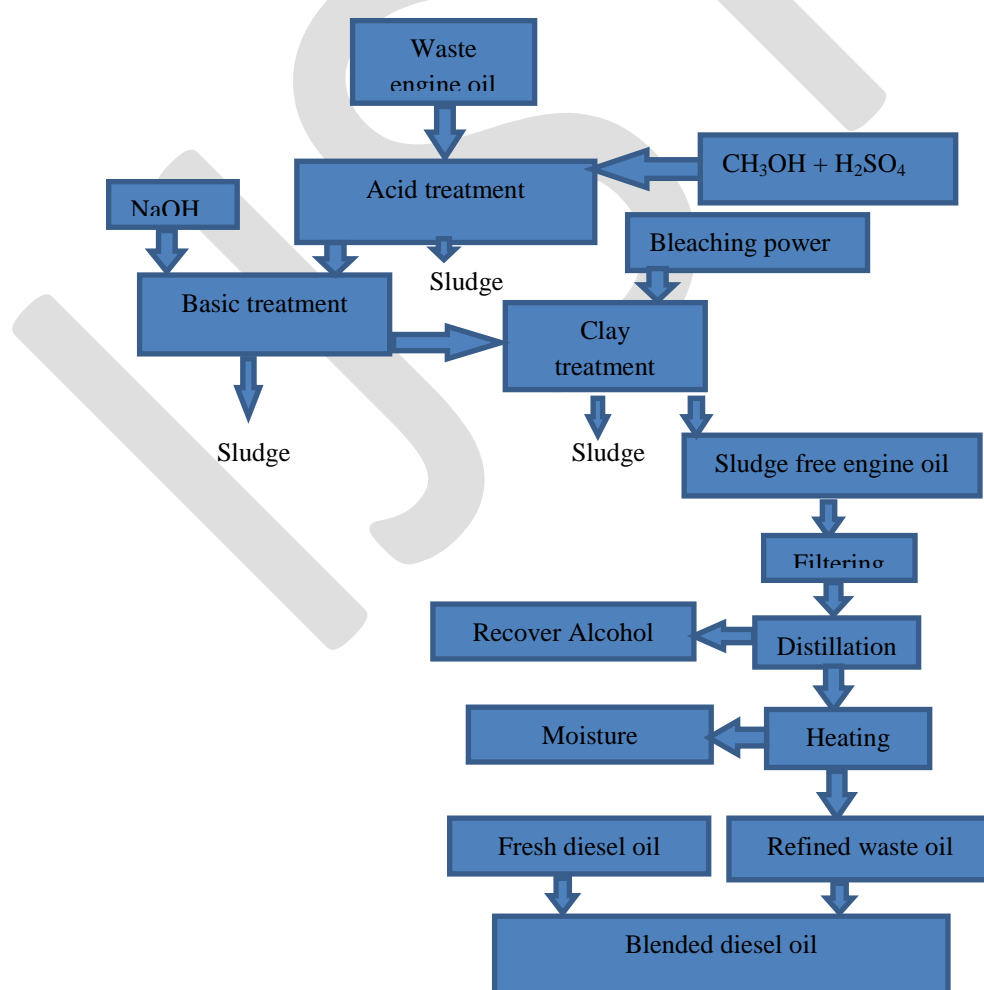


FIGURE-1

ANALYSIS OF DIFFERENT FUEL PROPERTIES

The important physical and chemical properties of diesel fuel and used engine oil were determined by standard methods. In order to measure the properties of diesel fuels, used engine oil and their blends, the test methods were used as follows

1. **Density.** Density is an important property of fuel. Density is defined as the mass per unit volume of any liquid at a given temperature.

$$\rho = \frac{M}{V}$$

Density measurements were carried out using a Density Hydrometer.

2. **Specific Gravity.** Specific gravity is the ratio of the [density](#) of a substance compared to the density (mass of the same unit volume) of a reference substance.

$$\text{Specific Gravity}_{\text{actual}} = \frac{\rho_{\text{sample}}}{\rho_{\text{water}}}$$

Where:

ρ_{Sample} = density of sample fuel.

ρ_{Water} = density of distilled water

The reference substance is nearly always [water](#) for liquids. It is a comparative property of fuel in which sample fuel density is compared with water density and it is also calculated by the hydrometer

3. **Viscosity.** Viscosity is a measure of internal fluid friction or resistance of oil to flow, which tends to oppose any dynamic change in the fluid motion.

Redwood viscometer. As the temperature of oil is increased its viscosity decreases and it is therefore able to flow more readily. The lower the viscosity of the oil, the easier it is to pump and atomize and achieve fine droplets. Viscosity is measured using Redwood viscometer is kinematic viscosity and using Ostwald's viscometer is kinematic as well as dynamic viscosity. The Redwood viscosity value is the number of seconds required for 50 ml of oil to flow out of a standard viscometer at a definite temperature and ASTM D445 is the test methods for measuring this fuel properties.

Kinematic viscosity equation for Redwood viscometer:

$$\vartheta = \left[At - \frac{B}{t} \right] \text{ mm}^2/\text{sec}$$

Where A and B are Constant and their values are

$$\left\{ \begin{array}{lll} 34 \leq t \leq 100 & A & B \\ t > 100 & 0.0026 & 1.79 \\ & 0.00247 & 0.5 \end{array} \right\}$$

ϑ = kinematic viscosity in mm^2/sec or cst

t = Time in seconds

4. Flash and Fire Point. The flash point temperature of biodiesel fuel is the minimum temperature at which the fuel will ignite (flash) on application of an ignition source. Flash point varies inversely with the fuel's volatility. Minimum flash point temperatures are required for proper safety and handling of diesel fuel. Fire point is the lowest temperature at which a specimen will sustain burning for 5 seconds. These two parameters have great importance while determining the fire hazard (temperature at which fuel will give off inflammable vapour). Flash point of the samples were measured in the temperature range of 60 to 190°C by an automated Pensky-Martens apparatus and ASTM D93 is the test methods for measuring this fuel properties.

5. Calorific Value. Calorific value of a fuel is the thermal energy released per unit quantity of fuel when the fuel is burnt completely and the products of combustion are cooled back to the initial temperature of the combustible mixture. It measures the energy content in a fuel. This is an important property of the bio-diesel that determines the suitability of the material as alternative to diesel fuels. The calorific value of waste oils was measured in a bomb calorimeter according to ASTM D240 standard method. An oxygen-bomb was pressurized to 3MPa with an oxygen container. The bomb was fired automatically after the jacket and bucket temperature equilibrated to within accuracy of each other.

6. Cloud point:- The oil change from liquid state to a plastic or solid state when subjected to low temperature. In some cases the oil start solidifying which makes it to appear cloudy. The temperature at which this takes place is called the cloud point.

7. Pour Point :- The pour point of an oil is the temperature at which the oil will just flow without disturbance when chilled.

RESULTS AND DISCUSSION

In the present study, Test were conducted with the sample of railway waste engine oil before the treatment so many properties are too different as diesel which shown in Table -1 and comparison with the diesel properties. Firstly acid & basic treatment was conducted after this treatment such properties was slightly near to the diesel properties which is shown in Table -2. After this treatment we were conducted clay treatment with the help of bleaching power as a activated clay after this treatment properties shown in Table -3. After clay treatment filtering ,distillation and heating were conducted so after these treatments properties shown in Table -4 and 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%blending of refined WEO into fresh diesel shown in Table - 5. And also perform 30% blend(B30) of refined waste engine oil on the single cylinder 4-strok diesel engine at different load such that 0 kg , 2 kg , 4 kg , 6 kg & 8 kg results show in Table-6. To determine optimum percentage of blending, blended diesel (fresh diesel and refined waste engine oil) and some important properties of the produced diesel of different percentage of blending and refined waste engine oil were evaluated. The values as obtained were compared with the fresh diesel in Table 5. It is clear that maximum blending percentage of refined waste engine oil of railways is 30% (B30). From Table-5 & Table -6 , it is evident that diesel Produced from railway waste engine oil are too viscous and that's why it has lower cloud point and pour point and comparatively high flash point and fire point from Table-5. It is also observed that all samples except 30% blending of refined waste engine oil of railway would be technically suitable.

COMPARISON OF WASTE ENGINE OIL WITH FRESH DIESEL BEFORE THE TREATMENT IN TABLE-1

S.N.	Property	Diesel	WEO
1	Density (Kg/m^3) at 1 atm. Pressure and 27°C	837	892
2	Gross Calorific Value (MJ/kg)	43.7	46.2
3	Kinematic Viscosity (mm^2/sec or cst) at 27°C	3.8	43
4	Sp. Gravity (at 27°C)	0.837	0.892
5	Flash Point ($^\circ\text{C}$)	68	137
6	Fire point ($^\circ\text{C}$)	77	149
7	Pour point ($^\circ\text{C}$)	-6	-16
8	Cloud point ($^\circ\text{C}$)	-14	-26
9	Carbon Residue (%)	0.01	0.11

TABLE-1

EXPERIMENTAL RESULTS AFTER ACID & BASIC TREATMENT COMPARISON WITH FRESH DIESEL IN TABLE-2

S.NO.	Property	Diesel	WEO
1	Density (Kg/m^3) at 1 atm. Pressure and 27°C	837	884
2	Gross Calorific Value (MJ/kg)	43.7	46.4
3	Kinematic Viscosity (mm^2/sec or cst) at 27°C	3.8	22.2
4	Sp. Gravity (at 27°C)	0.837	0.884
5	Flash Point ($^\circ\text{C}$)	68	102
6	Fire point ($^\circ\text{C}$)	77	111
7	Pour point ($^\circ\text{C}$)	-6	-10
8	Cloud point ($^\circ\text{C}$)	-14	-18.4
9	Carbon Residue (%)	0.01	0.1

TABLE-2

EXPERIMENTAL RESULTS AFTER CLAY TREATMENT AND COPARISON WITH FRESH DIESEL IN TABLE-3

S.NO.	Property	Diesel	WEO
1	Density (Kg/m ³) at 1 atm. Pressure and 27°C	837	882
2	Gross Calorific Value (MJ/kg)	43.7	46.5
3	Kinematic Viscosity (mm ² /sec or cst) at 27°C	3.8	19.8
4	Sp. Gravity (at 27°C)	0.837	0.882
5	Flash Point (°C)	68	94
6	Fire point (°C)	77	102
7	Pour point (°C)	-6	-8
8	Cloud point (°C)	-14	-13.6
9	Carbon Residue (%)	0.01	0.04

TABLE -3

EXPERIMENTAL RESULTS AFTER COMPLETE RE-FINING AND COMPARISON WITH FRESH DIESELIN TABLE-4

S.NO	Property	Diesel	Refined WEO
1	Density (Kg/m ³) at 1 atm. Pressure and 27°C	837	863
2	Gross Calorific Value (MJ/kg)	43.7	46.8
3	Kinematic Viscosity (mm ² /sec or cst) at 27°C	3.8	14.2
4	Sp. Gravity (at 27°C)	0.837	0.863
5	Flash Point (°C)	68	76
6	Fire point (°C)	77	84
7	Pour point (°C)	-6	-2
8	Cloud point (°C)	-14	-8
9	Carbon Residue (%)	0.01	0.02

TABLE-4

EXPERIMENTAL RESULTS AFTER BLENDING WITH FRESH DIESEL IN TABLE-5

S.No.	Property	Diesel	Treated WEO	B10	B20	B30	B40	B50
1	Density(Kg/m ³)	837	863	840	843	845	848	851
2	CV(MJ/kg)	43.7	46.8	44.1	44.3	44.5	44.7	44.8
3	K.Viscosity (cst)	3.8	14.2	5.5	5.8	6.2	7.3	8.2
4	Sp. Gravity	.837	.863	.840	0.843	0.845	0.848	0.851
5	Flash Point (°C)	68	76	68.6	69.4	70	71.5	72
6	Fire point (°C)	77	84	77.5	78.3	80	80.6	81
7	Pour point (°C)	-6	-2	-5.7	-5.4	-5	-4.8	-4.2
8	Cloud point(°C)	-14	-8	-13.4	-12.7	-12	-11.6	-11
9	Carbon Residue(%)	0.0100	0.0202	0.0112	0.0118	0.0123	0.0127	0.0132

TABLE-5

PERFORMANCE PARAMETERS OF DIESEL ENGINE FOR DIESEL IN TABLE -6

S.No	Property	Diesel	Treated WEO	B60	B70	B80	B90
1	Density(Kg/m ³)	837	863	854	856	858	860
2	CV(MJ/kg)	43.7	46.8	45	45.3	45.7	46
3	K.Viscosity (cst)	3.8	14.2	9.5	10.2	10.7	11.2
4	Sp. Gravity	.837	.863	.854	0.856	0.858	0.860
5	Flash Point (°C)	68	76	72.7	73.1	73.9	74.8
6	Fire point (°C)	77	84	81.6	82	82.7	83.2
7	Pour point (°C)	-6	-2	-3.8	-3.4	-3.1	-2.8
8	Cloud point(°C)	-14	-8	-10.7	-10	-9.4	-8.9
9	Carbon Residue(%)	0.0100	0.0202	0.0141	0.0159	0.0177	0.0189

S.NO	LOAD	B.P(KW)	T.F.C(KG/SEC)	B.T.E %
1	2	0.496	0.0001430	7.54
2	4	0.975	0.0001924	11.02
3	6	1.461	0.0002146	14.80
4	8	1.907	0.0002575	16.09

TABLE -6

PERFORMANCE PARAMETERS OF DIESEL ENGINE FOR B30 IN TABLE-7

S.NO	LOAD	B.P(KW)	T.F.C(KG/SEC)	B.T.E %
1	2	0.489	0.0001422	7.47
2	4	0.974	0.00018449	11.47
3	6	1.484	0.0002259	14.28
4	8	1.959	0.0002761	15.42

TABLE-7

CONCLUSION

In the current investigation, it has confirmed that waste engine oil may be used as resource to obtain diesel. The experimental results show that B30 (30% blending of refined waste engine oil of railway in to fresh diesel) are suitable to use as a diesel fuel considering the comparing with the fresh diesel and the engine was operated successfully with B30.the performance parameters of B30 was near to the diesel fuel so Produced diesel is technically suitable, economically viable and has more marketing aspects.

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