Production of Biofuels and Performance and Emission characteristics of Biofuels and Diesel in Four stroke Single Cylinder Diesel Engine

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Abstract: In present days, all over the world diesel vehicles are increasing at an enormous rate. The emission from these diesel vehicles causes health deceases to human and animal lives. Now it became serious issue in pollution point of view. Conventional fossil fuels demand increasing day by day and become end at another 40 to 50 years and its cost also increasing day by day. Emission from these vehicles causes air pollution. Under developed countries like india largly depends on fossil fuels, importing large amount of crude from other countris decresse the rupee value and economy of the country. To overcome above drawbacks it is necessary to find alternate fuels for existing engine. In order to reduce the pressure on crude oil import from other countrie it is sustaible to produce alternate fuels like alcohol and vegitable oils from various plants and seeds. Now a days experiments conduct on alternate fuels like vegitable oil (palm oil, bunge oil,sunflower oil, rice bran oil etc) blended with diesel. A single cylinder four stroke diesel engine adopted to conduct experiments on alternate fuel blended diesel and record the brake thermal effinciency, total fuel consumption , emission and other parameters. Emission parameters like HC and CO and performance parameters are compare with pure diesel engine parameters.

Key Words: Palm oil, Sunflower oil, Transesterification, Testing.

1 INTRODUCTION

1.1 Preface

According to increasing world population there is increasing demand of energy as development of standard of living and industrialization. To meet energy demand producing alternate fuel to ix with some proportion in diesel is one of the sustainable solution. As increasing the demand of petroleum fuels increases the crude oil price flucyuating day to day and increases the petroleum product rate. Excessive use of petroleum product also causes increasing green house gases that causes increasing green house effect and global warming, some exaust causes ozone layer depletion and changes the climate. Daily variation of prices of petroleum product causes serious effect on country economy in fact petroleum products are neither available in sufficient quantity nor in reasonable price. These factors promote to find alternative fuels for existing engines. Find of alternate fuels uses can decreases the emission, conserve energy, manage the afficiency and smooth running of engines. Non conventional energy technology recognized ,decentralized and local particified. The test on four stroke diesel engine based on engine performance and emiision characteristics for various alternate fuels like palm oil, bunge oil, sunflower oil etc. Biodiesel is a nonpetroleum product produced by plants and seeds used combustion in diesel engines and heating plants Therefore these alternate fuels substitute petroleum products and reducing emission effectively. The cost of producing alternate fuels 10 to 50% more than petroulium based diesel is one of major drawback that causes increasing the final cost alternate fuel than the petroleum disel fuel.the price of alternate fuel in doubled in 2009 as compared to 2000, since the cost of plants and seeds effects around 70 to 90% of total oprating cost which is depends on availability and locality of plant.

A major drawback of alternate fuel higher the cost of manufacturing than petroleum diesel and raw material cost. One of the economical source is used cooking oil for biodiesel production.

1.2. Scope of the present work

In my work alternate fuel (Palm oil,Sunflower oil, groundnut oil honge oil) was select for experiments. The properties of the these fuel blends was found. Experiments conducted on these biodiesel blends in four stroke direct ignition diesel engine with the following objectives. 1. To produce biodiesel from crude oil (Linseed oil,Palm oil,Sunflower oil, groundnut oil) by esterification process that reduce viscocity and seperates the glycerin in the crude oil.

2. Present study objectives are:

- Prepare biodiesel from Crude oils.
- To promote to use alternate fuel blended diesel in diesel engine.
- Reduce the emission like HC, CO and smoke in the diesel engine during combustion.
- To compare the performance of diesel engine by alternate fuel blended diesel with petro diesel.
- To study, measure and compare exhaust emissions reduction with petrodisel.

3. Methodology

- Selection of Crude oils Linseed oil,Palm oil,Sunflower oil,Grount oil).
- Transestrification of above mentioned Crude oils.
- After Transestrification process and the Biofuels blended with diesel.

- Select diesel engine (single cylinder four stroke).
- Conduct a experiments for above mentioned biofuel and compare parameters with petro diesel.

1.3. Outline of the Thesis

The organization of the report takes shape in the form of following chapters.

- Chapter.1: Introduction

In this chapter aspects related to the present work explained.

- Chapter.2: Literature Review.

In this chapter study the overview of the literature survey to related to the present work.

- Chapter.3: Transesterification reaction.

This chapter brings about details of the chemistry of transesterification, biodiesel process, process variables and preparation of methyl ester of Crude oil in the present work.

- Chapter.4: Equipment arrangement and procedure.

This chapter give knowledge about the experimental setup and the instrumentations for the current work and the procedure followed.

- Chapter.5: Experimental outcomes and Discussion.
- Chapter.6: Conclusion and Scope of the Future Work
- Chapter.7: References

2. LITERATURE REVIEW

The outcomes (performance and emission characteristics) of various alternate fuels from test rigl work carried by earlier researchers were studied in this chapter.

Su Han Park et al. [1] They were study the effect of ethanol blended diesel in combustion and emission characteristic in four stroke four cylinder common rain injection diesel engine.. The spray characteristics like cone angle and tip penentration for different ethanol blending ratio was studied. By this study they found that ethanol blended fuel has a short tip penentration compared to petro diesel. They also found that incrasing ethanol blending ratio decreases the NOx emission due to low ignition temperature however HC and CO emissions increases. The CO and HC emission can be deceased with varieng engine load and injection timing.

Mário L. Randazzo et al. [2] They conduct an experiments soyben biodiesel blends concentration of 3%(B3), 5%(B5), 10%(B10), and 20%(B20) and also with B20 fuel, additive of anhydrous ethanol of 2%(B20E2) and 5%(B20E5) on New European Driving Cycle (NEDC). They found that lowering fuel blends in biodiesel increases the CO2 and NOx emission, but CO,HC and particulate matters are reduced. They also found that addition of anhydrous ethanol are decreases the NOx and CO2 emission, but increases the CO,HC and PM emission.

P.Selva Havarasi et al. [3]. They conduct experiments on used cooking oil to optimize transesterification process and testing its performance. They study the effect of temperature, catalyst propotion, increasing methanol, , reaction time under same experimental conditions. The testing was done in diesel engine. They found that minor reduce in thermal efficiency, significantly reduces the HC, CO and PM emissions

N.R.Banapurmath et al. [4] They conduct test on Rice bran oils, Neem and Honge as a single fuel mode and they also done experiments on duel fuel mode of three oils and producer gas at varying injection pressure and timing. They found that the performance of duel fuel mode is poor at all loads compared to single fuel mode at all injection timing and pressure but brake thermal efficiency increases and CO2 and NOx emission decreases compared to single fuel mode.

3. TRANSESTERIFICATION REACTION

3.1. Introduction

In this chapter we study about transesterification chemistry , variables of reaction and transesterification procedure followed for the Crude oils (Linseed oil,Palm oil,Sunflower oil, Groundnut oil).

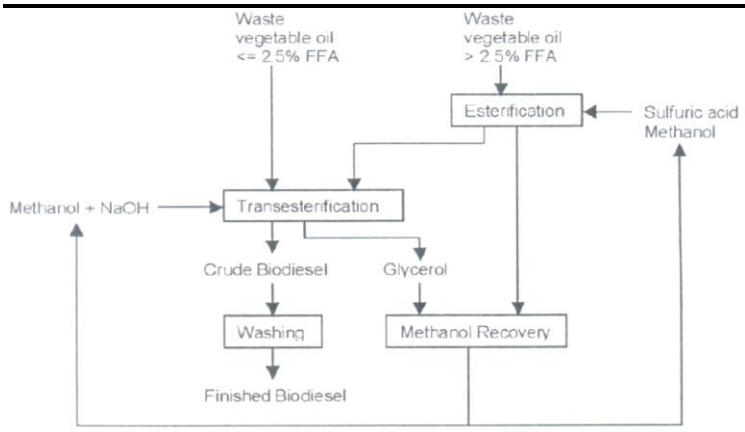
3.2. Chemistry of transesterification reaction

The raw biofuel or vegetable oil react in present of alcohol to form ester and glycerine called Transesterification reaction . The overall chemical reaction is shown in Fig.3.1. A substance catalyst is used to increase the rate of reaction and yield. This reversible process bring the equilibrium to the product side using excess alcohol.. Methanol, ethanol, proponal, amyl alcohol and butanol, are the alcohol used in reaction process. Due to low cost, better physical and chemical properties ethanol and methanol are used. Methanol frequently react with catalyst. sodium hydrauxide (NaOH) and Triglycerides are used as catalyst. It can react at faster rate in present of triglycerides and sodium hydroxide (NaOH). Stoichiometric ratio of alcohol to triglycerides is 3:1 for complete transesterification process but in practice higher the ratio needed for better ester yield.

Alkalis, acids, or enzymes are catalize the reaction., Sodium propoxide, sodium ethaxide,sodium methaxide are the alkoxides of potassium and sodium butoxide and sodium hydraxide(NaOH),potassium hydrauxide(KOH), carbonates and corresponding sodium are alkolis. Acid catalyst are suffonic acids, Sulfuric acid (H2SO4), and hydrochloric acid(HCI). Biocatalysts include lipases oil. With long chain hydrocarbons i.e, R1,R2 and R3 which may be the same or the different, alkali-catalyzed transetsrification carried out.

3.3. Biodiesel processes

The process of prodcing biodiesel is shown in figure 3.2. if vegitable below 2.5%FFA, esterification is not required but above 2.5FFA esterification is necessary.



3.4. Process variables

Transesterification process reaction depends on following variables:

1. Temperature of reaction.
2. Molar ratio (Ratio of alcohol to vegetable oil).
3. Concetration of catalyst.
4. Time of reaction.

3.4.1. Temparature of reaction

Reaction rate of transesterification highly depends on temperature at which reaction takes place. The reaction process carried out around methanol boiling point (60˚C) at atmosphere pressure. Therefore it is required to refining or pre-esterification to remove free fatty acid from the oil. If reaction is done at high temperature (240° C) and higher pressure (9000kPa) pretreatment is not required. Maximum yield obtained at 60°C to 70° C at a molar ratio of 6:1.

3.4.2. Concenration of catalysts

Acidic catalysts are less effective compared to alkali metal alkoxides such as sodium alkoxide, KOH, NaOH. Acidic catalyst and alkaline catalyst both are present in Transmethylation process. Alkaline catalyst are less corrosive to equipment than acidic catalysts therefore alkaline catalyst are preferred. For yield of 94 -99% WCO ester, 0.5-1% concentration has been found. Catalysts are taken out from the substance after reaction.

3.4.3. Time of reaction

During transesterification process initially reactants forms system of two phase liquid. The effect of mixing impprtant parameter for the reaction time. If the mixing effect is effective decreases the reaction time and increases reaction time as mixing effect decreased.

4. ARRANGEMENT OF TEST RIG AND PROCEDURE

4.1. Introduction

In this chapter we studied and arrange the experiment setup and measurement system and know the procedure to carry out experimental work. The experiment conducted for different biofuel blends at constant speed and performance and emission compared each other and with petro diesel.

4.2. Transesterification setup

Figure:4.1. Transesterification setup

Figure:4.2. Separating funnel

4.3. Experimental setup

The testing arrangement is shown in figure is a four stroke single cylinder diesel engine. The arrangement consist rope brake dynamometer, emission monitoring system etc for performance and emission study

engine specification

engine parameters	details
bhp	5hp
speed	1500
cylinder bore	80mm
stroke length	110mm
torque arm distance	0.2m/s
compression ratio	16:5:1

Figure:4.3. Single cylinder four stroke Diesel engine (single cylinder four stroke)

Figure:4.4. Engine setup

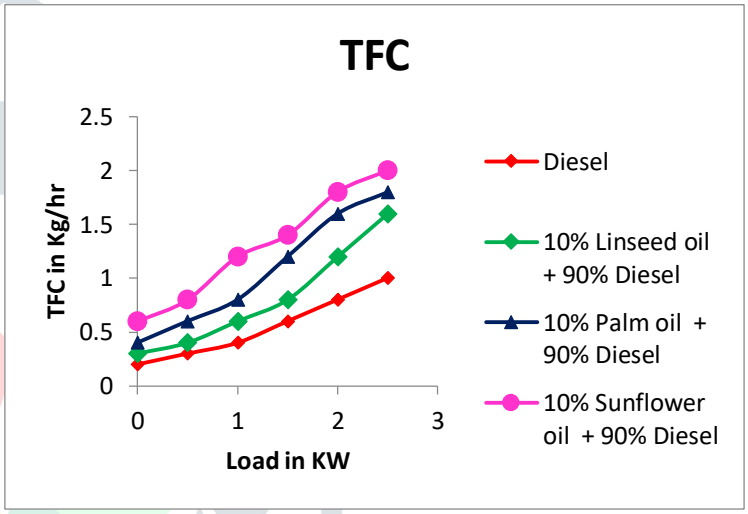
4.4. Calorific value of Diesel and Bio-Fuel

Table-1

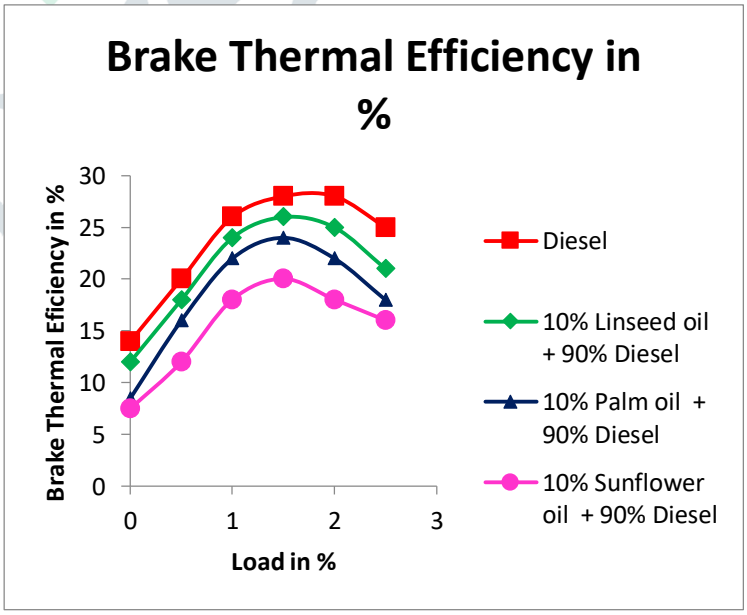
Sl.No	Biofuel	Calorific Value KJ/Kg
1.	Diesel	44800
2.	Linseed oil	38000
3.	Plama oil	39540
4.	Sunflower oil	39810

5: RESULTS AND DISCUSSION

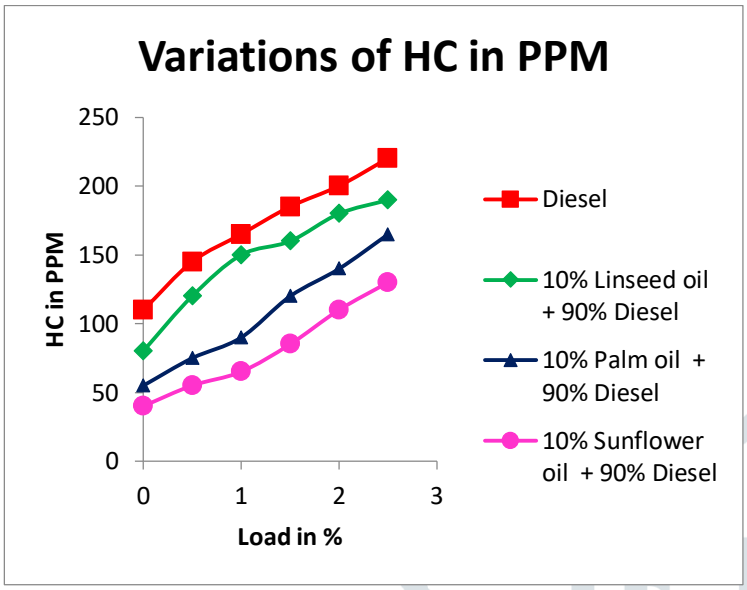
5.1. TOTAL FUEL CONSUMPTION



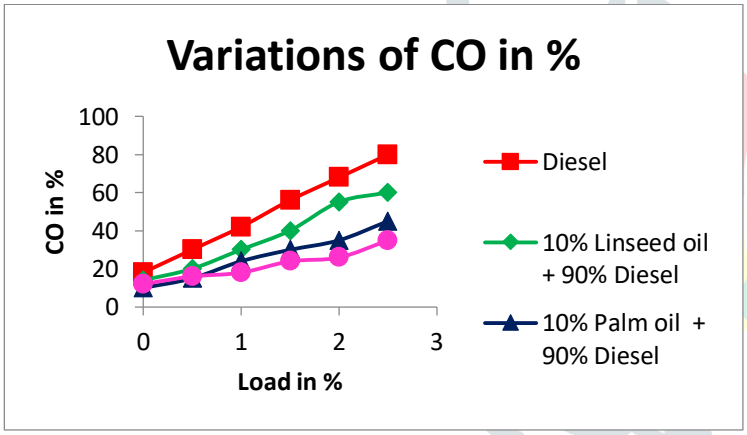
5.2. BRAKE THERMAL EFFICIENCY



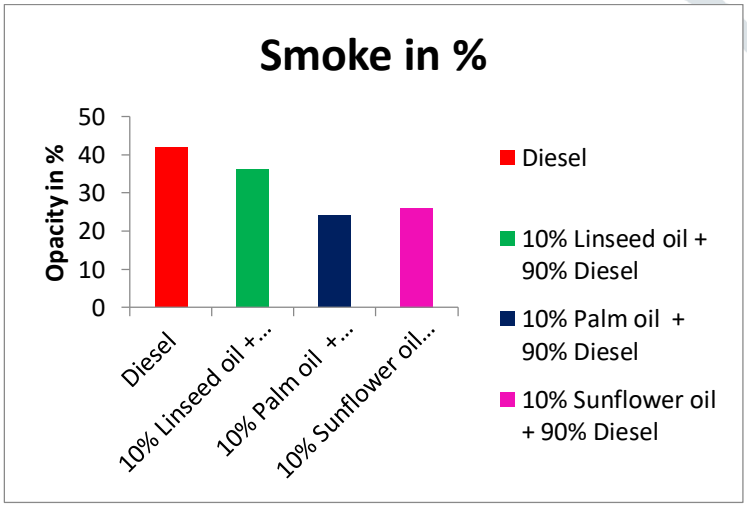
5.3. UNBRUNT HYDROCARBON EMISSION



5.4. CARBON MONOXIDE EMISSION IN %



5.5. SMOKE IN %



6. CONCLUSIONS

As increasing population of the world increases the energy demand and increases consumption of fossil fuels. It is difficult to meet these increasing demand in future because fossil fuels are become end in another 40 to 50 years. The large amount of crude oil imports inceases the rate of petroleum product and also effect on economy of the country. To overcome these difficulties it is necessary to find alternate fuel which are produced independent of other countris. Use of renewable energy sources decreases demand for fossil fuels. Biodiesel is aproduced from vegitable oil,s or animal fats used for diesel engine and heating equipments. These fuels also reduces the emission in turn green house gases and global warming. The cost biodiesel is higher compared to petrodiesel is the major drawback for commercialization.

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