Performance,combustion and emission test on single cylinder diesel engine with blended Chicken oil

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***Abstract*—Mainly animal fats and vegetable oils are used for the production of biodiesel. In this study we use low cost waste of chicken fat.Biodiesel which is defined as the mono-alkyl esters of vegetable oils or animal fats. Biodiesel is produced by transesterifyingthefat with an alcohol (methanol/ethanol) under mild conditions in the presence of a base catalyst. This paper discuses fuel production, fuel properties, environmental effects including exhaust emissions and co-products. This also describes the use of glycerol which is the by-product in esterification process along with biodiesel. The impact of blending of biodiesel with ethanol and diesel on the diesel engine has described.**

Keywords*— *Biodiesel, chicken fats, transesterification, ethanol, biodiesel, petro, diesel, blends.

1. INTRODUCTION

One of the most important elements to effect world economy and politics is sustainability of petroleum resources, which is the main source of world energy supply. The petroleum crises since 1970s and uncertain situation in suppliers like Venezuela, Nigeria and Iraq have been accelerated the increment of oil prices. The increasing demand of petroleum in developing countries like China, Russia and India has increased oil prices [1]. The depletion of petroleum reserve and even increase in number of automobile in recent years makes it important to find alternative fuels. Of the various alternative fuels under consideration Bio diesel derived from chicken fat oil is one of the most promising alternative fuels to diesel due to following reasons. [2]

1. Bio diesel is an oxy rich fuel, emission of CO, HC reduce.
2. Bio diesel produced from fat oil/vegetable oil and hence improves energy securities and economy independence.
3. The life of diesel engine can be increased because bio diesel is more lubricant than diesel.
4. Bio diesel can be used in diesel engine without any modification.

Biodiesel which is defined as the mono-alkyl esters of vegetable oils or animal fats, obtained by trans- esterifying oil or fat with an alcohol. The major reason for not using a neat vegetable oil as fuel is its high viscosity (28-40mm^2/s), which leads to operational problems in diesel engine including formation of deposits into the injector choking due to poorer atomization upon injection into the combustion chamber [3]. Trans-esterification of the oil reduces the viscosity of the oil to a range (4-5mm^2/s) closer to that of petrol diesel. It was stated by Lloyd and Cackete[4]. Trans-esterification is a chemical process of converting very large, branched, triglyceride molecules of fat oil into smaller straight chain molecules similar in size of diesel. Many research works carried out on the engine characteristics with edible oils like Rice Bran Oil [5],
Soya bean [6], Palm [7], Cotton Seed [8], Coconut [9], Corn [10], etc. And non-edible oils like Jatropha [11], Pongamia [12], Tobacco seed [13], Tung [14]. It has been concluded by many studied that as an alternative engine biodiesel reduce the emissions of carbon monoxide (CO), hydrocarbons (HC), sulphur-di-oxide (SO2), Polycyclic Aromatic Hydrocarbons (PAH), nitric Polycyclic Aromatic Hydrocarbons (nPAH) and particulate matter (PM) by NOx to increase in the exhaust as compared with diesel fuel (4,5,6). Though biodiesel has some attractive properties like higher cetane number, no aromatics, almost no sulphur, high oxygen(by weight), non-toxic, bio-degradable, high lubricant ability (7,8,9) it has many properties need to improve such as Lower Calorific Value(LCV), Lower Effective Engine Power(LEEP), NOx emission, greater sensitivity to low temperature (9).

2. PREPARATION OF CHICKEN OIL

The waste chicken fat is bought from the shop for the amount of 5kg. The oil is extracted by means of solvent extraction method. In this method chicken fat is washed and gets dried.

Than it is placed in a separating funnel, and the chicken get heated by means of a heater. The fat gets melted and the fat oil is gets collected at the bottom, there is a stop valve at the bottom through which oil gets separated. From 1kg chicken fat we get 200ml chicken oil.

3. PRODUCTION OF BIODIESEL

Biodiesel is produced from the triacylglycerol-containing material by means of a transesterification reaction. In this process, alcohol (methanol/ethanol) and animal fats are mixed in the molar ratio of 6:1, heated at 60-65^{0}C for 1hr and the ambient pressure in the presence of catalyst such as NaOH/KOH. Before that, animal fat gets heated up to 105-110^{0}C so that it will be converted into fat oil then in the separate flat bottom flask, alcohol and NaOH/KOH (2% of fat)are mixed exothermic reaction take place. This mixer is then added to heated fat and keep it at 60-65^{0}C for 1hr. After this, it is poured into a bottle so that biodiesel and glycerol get separated. This biodiesel is used in diesel engine as a solvent in methanol-diesel mixer for avoiding a phase separation. The increasing % of biodiesel in methanol-diesel blends results in the increase of emissions NOx but it reduces the emissions of CO, HC, sulphur and particulate matter (PM) considerably. The preparation of biodiesel by transesterification process can be shown as:

Biodiesel is being produced from many of vegetable oils and animal fats. If it is produced from high quality edible oil and fats, it will resulted in high prices of raw material and biodiesel is more expensive than petroleum diesel fuel also shortage of edible oil for food purpose. Biodiesel may also be produced from less expensive animal fats including inedible tallow, pork lard and yellow grease. Animal fats are highly viscous and mostly in solid form at ambient temperature because of their high content of saturated fatty acids. The high viscous fuel leads to poor atomization of the fuel and result in incomplete combustion. Transesterification and emulsification are two main solutions that have appeared as effective methods for using animal fats in diesel engine. Animal tallow generated biodiesel offers a wide range of energy, environmental and economic advantage as stated by Nelon and Schrock [10]. Glycerol, which is a co-product in the biodiesel production, refining and unrefined, can be used in the manufacture of a variety of products as shown in figure given below. Glycerol obtain from biodiesel production does not require any further processing except purification.

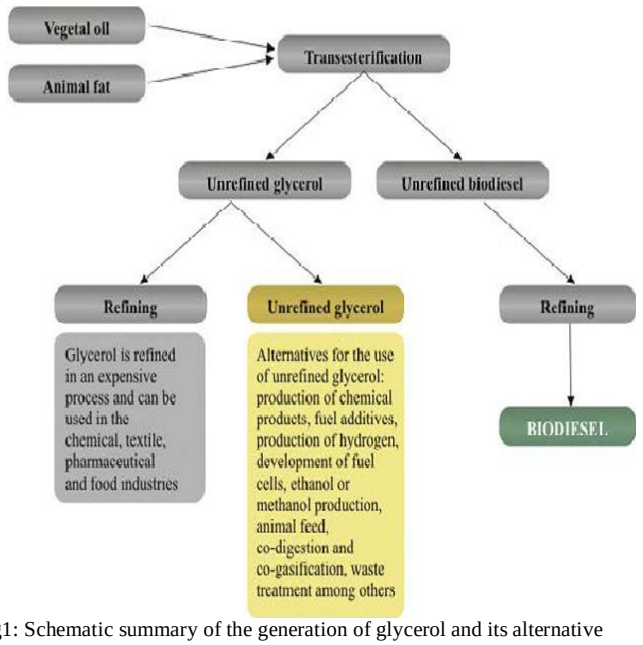

Fig1: Schematic summary of the generation of glycerol and its alternative routes[18]

Table 1:

Sample	Specific Gravity	Kinematic viscosity (m^2/s)	Flash point ^{0}C	Fire Point ^{0}C	Calorific value KJ/kg
Diesel	0.8454	2.58	5	68	42500
B10	0.8582	3.11	50	60	42034
B20	0.8598	3.59	62	68	41568
B30	0.8613	4.93	78	80	401750

4.EXPERIMENTAL PROCEDURE

4.1EXPERIMENTAL SET-UP

The experiment is carried out in single cylinder DI engine coupled with alternator. First allow the engine to run by diesel than allow it cool. Now fill the fuel tank by means of our fuel. Allow the engine to run and take reading for 5cc, before make

reading note our temperature must be constant. Emissioncharacteristics such as NOx, HC and CO were recorded in AVL analyzer five gases and smoke meter which is used to measure engine exhaust.

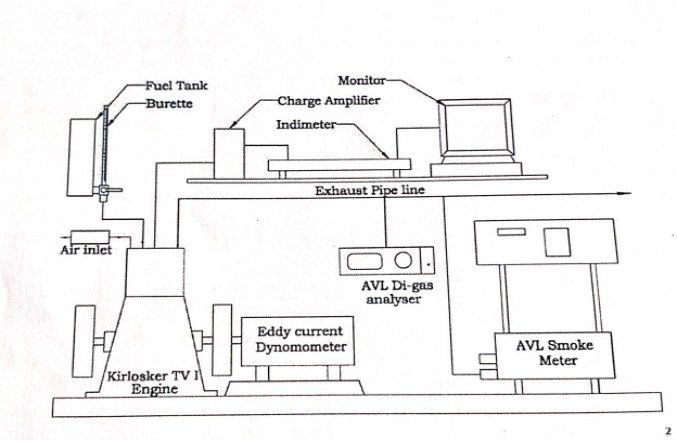

Fig.2Biodiesel in diesel engine

Table 1 Engine Specification

Engine Specification	
Make	Kirloskar AVL model
Type	Vertical, 4Stroke cycle, single acting high speed, DI Diesel engine
Number of cylinder	One
Speed	1500rpm
Max power output	3.7kw
Bore	80mm
Stroke	110mm
Compression ratio	16.5:1

5. RESULT AND DISCUSSION

It was observed that the operation of the engine was very smooth throughout the rated load,without operational problem. The performance and emission characteristics of the engine fuelled with chicken oil blended with diesel were discussed and compared with the neat diesel fuel.

5.1 Engine performance and parameters

5.1.1 Break thermal efficiency

Fig 3 shows the brake thermal efficiency with the brake power. The result shows that the addition of chicken oil improves in the blended bio-diesel. The maximum brake thermal efficiency obtained for B20 with the addition of 100ml of chicken bio oil. The increase of brake thermal efficiency is due to addition of chicken bio oil.

5.1.2 Brake specific fuel consumption

Fig 4 shows brake specific fuel consumption addition with brake power with different dosing level of bio diesel. The brake specific fuel consumption of B10 is lower and B20 is improved while compared with all three bio diesel. The addition of B20 which improves the combustion process.

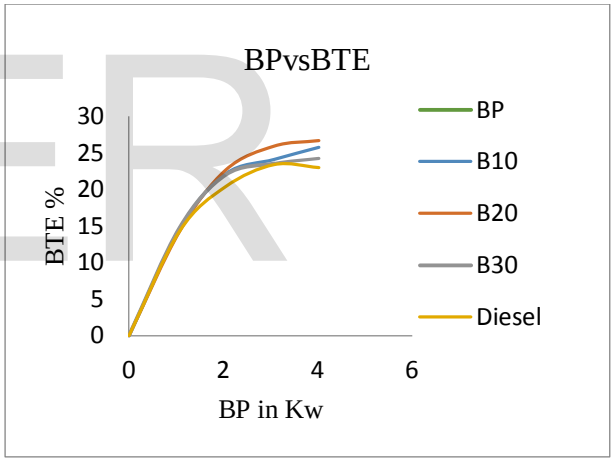

Fig3. Brake Power Vs Brake Thermal Efficiency

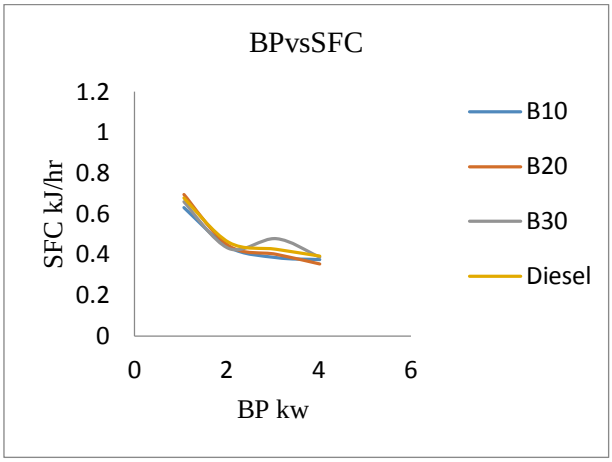

Fig4. Brake Power Vs Specific Fuel Consumption

5.2 Emission Parameters

5.2.1 Hydro Carbon

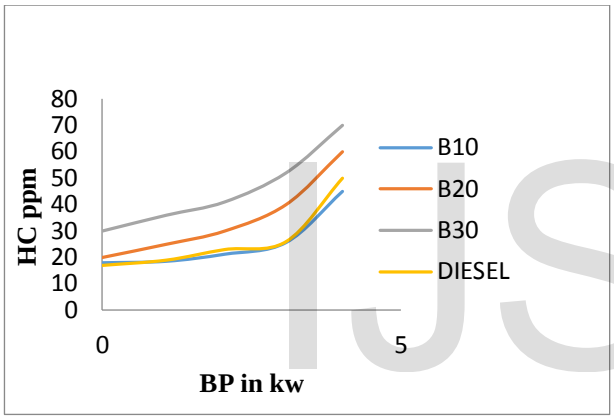

Fig5. BP Vs HC

The fig 5 shows the emission of HC vs BP by adding B20 the oxygen level in bio diesel tends to increase, better combustion leads to less formation of HC[11]. HC emissions for B10, B20, B30, 70, 50, 80 respectively.

5.2.2 Carbon Monoxide

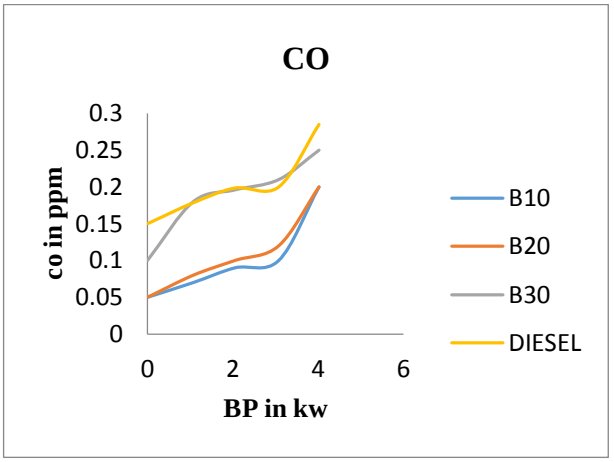

Fig6. BP Vs CO

The fig 6 shows the emission of BP Vs CO by adding B20 the oxygen level in bio diesel tends to increase, better combustion leads to less formation of CO[11]. CO emissions for B10, B20, B30, 0.23, 0.16, 0.24 respectively.

5.2.3 Nitrogen oxide

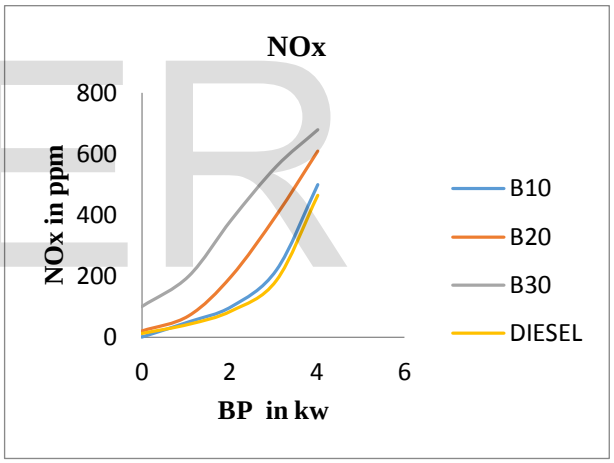

Fig7. BP Vs NOx

The fig 7 shows the emission of NOxvs BP by adding B20 the oxygen level in bio diesel tends to increase, better combustion leads to less formation of NOx [11]. NOx emissions for B10, B20, B30 650, 535, 728, respectively.

5.3 Combustion Characteristics

5.3.1 Cylinder Pressure

Fig shows the variation of cylinder pressure with crank angle for bio diesel and modified bio diesel blend with

different dosing level with diesel at different engine operating conditions.

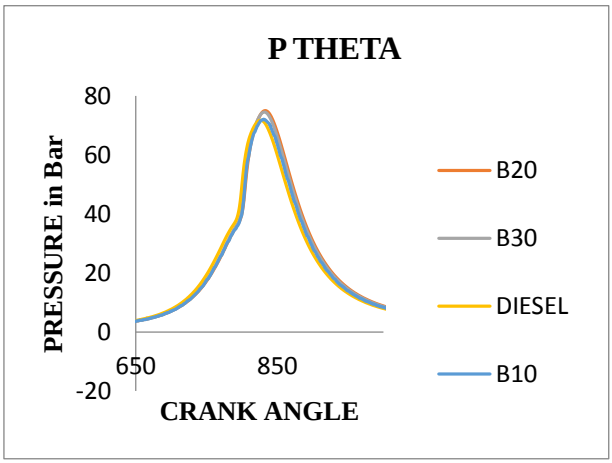

Fig8.Crank Angle Vs Pressure

5.3.2 Heat Release Rate

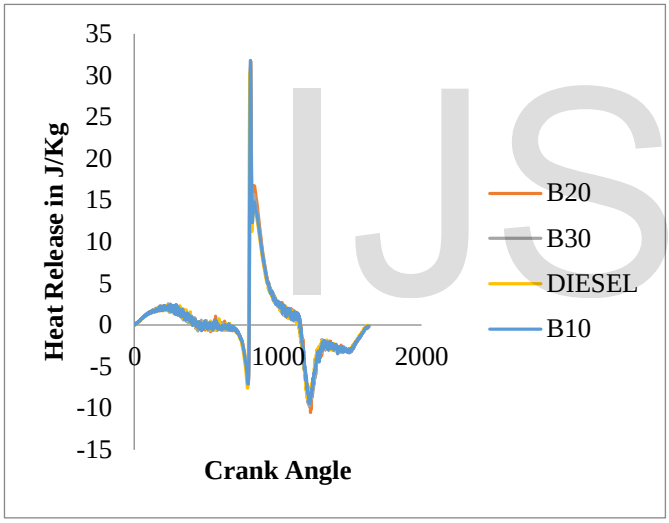

Fig9. Crank Angle VsHeat Transfer

6. CONCLUSION

The performance and emission characteristics of DI diesel engine with diesel blended with bio oil were investigated. The following conclusion were drawn the experimental result,

- The Break Thermal Efficiency was increased by adding B20 at all load than that of neat diesel.
- The Specific fuel consumption was increased by adding B20 at all load than the neat diesel.
- The overall performance and emission characteristics were clearly obtained that the addition of B10, B20,and B30 by small varying properties of blend.

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