Performance of single cylinder diesel engines fueled with higher alcohol and biodiesel

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***Abstract-* A nation's economic progress is significantly influenced by the production of energy. Energy is the main source of electricity for the home, the commercial and manufacturing sectors, transportation, agriculture, and industry. The demand for diesel engines has shown two levels of uncertainty over the last 20 years. First, the cost of pure fossil fuels is out of control, and the wealth disparity between importing and exporting nations has grown. Compression ignition (CI) engines use biodiesel, gradually replacing non-renewable fossil fuels. In the presence of a catalyst, they interacted with alcohol. The main benefit of biodiesel is that it is based on renewable energy sources and causes less environmental harm. The results of various studies in the literature concluded that because biodiesel has a higher oxygen content, less aromatic compounds, and a lower compressibility than diesel, it performs better as an engine fuel than diesel in terms of unburned hydrocarbon, carbon monoxide, smoke, and NOx emissions. The primary goals of the research are to improve the overall performance of the single-cylinder, four-stroke compression ignition engine using biodiesel fueled by various blends of jatropha and palm oil in accordance with the trends and regulations currently in place in the internal combustion engine industries.**

***Keywords:* CI Engine, Fuel, Performance, Emissions.**

1. INTRODUCTION

The increasing concern about the environment has been one of the major forces behind ongoing research to obtain cleaner sources of energy and to optimize the use of existing technologies. Fossil fuels such as oil, natural gas and coal are the main sources of the current global energy. They account for about 88% of the global energy supply [1]. With the depletion of the fossil fuels, researchers are focusing on alternative fuels which are more compatible with environment and produce less emission. Higher alcohol such as bio ethanol and biodiesel are two of these alternative fuels. Biodiesel fuel can be easily used in diesel engines instead of diesel fuel. Harmful emissions from a diesel engine can be significantly decrease by adding 20% waste cooking biodiesel to the diesel fuel. The blends of higher alcohol and biodiesel in varying proportions were used in this research. Performance parameters like torque, brake power, brake thermal efficiency and brake specific fuel consumption were studied.

NEED FOR SHIFTING TO ALTERNATING FELS

Probably in this century, it is believed that crude oil and petroleum products will become very scarce and costly to find and produce. Although fuel economy of engine is greatly improved, increase in the number of automobile alone dictates that there will be great demand for fuel in the near future. Alternative fuel technology, Availability, and use must and will become more common in the coming decades. Another reason motivating the development of alternative fuels for the IC engine is concerned over the emission problem of gasoline engines. Combined with the air polluting systems, the large number of automobiles is the major contributor to the air quality problem of the world. A third reason for the alternative fuel development is the fact that a larger percentage of crude oil must be imported from other countries which control the larger oil fields.

2. MATERIAL AND METHODS

2.1 Materials

2.1.1 Ethanol

The chemical formula for ethanol is C2H5OH, sometimes written as C2H6O. It is also sometimes known under the names ethyl alcohol or hydroxyethane and is the type of alcohol found in alcoholic beverages. The ethanol molecule is small and light, having molecular weight of 46 g/mol.

2.1.2 Biodiesel

Biodiesel is a safe alterative fuel to replace traditional petroleum diesel. It is high lubricity, is a clean burning fuel and can be a fuel component for use in existing, unmodified diesel engines. This means that no retrofits are necessary when using biodiesel fuel in any diesel powered combustion engine. It is the only alternative fuel that offers such convenience. Biodiesel acts like petroleum diesel, but produces less air pollution, comes from renewable sources, is biodegradable and is safer for the environment. Producing biodiesel fuels can help create local economic revitalization and local environmental benefits.

2.1.3 Diesel Fuel

Diesel fuel is general in any liquid fuel used in the diesel engines, whose fuel ignition takes place, without any spark, as a result of compression of the inlet air mixture and then injection of fuel. Diesel fuel is produced from various sources, the most common being petroleum, also called the petro diesel or fossil diesel is the most common type of diesel fuel. Other sources include biomass, animal fat, biogas, natural gas, and coal liquefaction. The average chemical formula for common diesel fuel is $C_{12}H_{23}$, ranging approximately from $C_{10}H_{20}$ to $C_{15}H_{28}$.

2.2 Methods

2.2.1 Blending of the samples

The biodiesel, the ethanol and the diesel were blended in dry flasked equipped with a magnetic stirrer. The biodiesel ethanol diesel blends were produced with (% v/v) 5, 10, 15, 20, 25, 30 and 35% ethanol with 85, 80, 75, 70, 65, 60 and 55% diesel and biodiesel was kept at 10% throughout. Thus, the blends were labeled as B5, B10, B15, B20, B25, B30 and B35, respectively.

2.2.2 Engine tests for the performance of blends

2.2.2.1 Brake power

The force or torque is measured by dynamometer and speed by tachometer. The power developed by an engine and measured at the output shaft is called the brake power(Pb). The flywheel power is commonly referred to as brake power, Pb. The brake power was calculated using the following relation:

Pb = 2piTbNs/60,000

Where: Tb = engine brake torque, Nm

Ns = engine speed, rpm

Pb = brake power, kW

2.2.2.2 Brake thermal efficiency

The brake thermal efficiency is the product of the indicated thermal efficiency and the mechanical efficiency. The indicated thermal efficiency is a measure of the combustion efficiency of the engine, while the mechanical efficiency indicates the efficiency in converting the indicated power to brake power. The indicated thermal and the mechanical efficiencies are defined respectively as follows:

Eff(indicated) = Pi/Pfe

Eff(mechanical) = Pb/Pi

Therefore, the brake thermal efficiency is given as:

Eff(bt) = Pb/Pfe

Tb = engine brake torque, Nm

Ns = engine speed, rpm

2.2.2.3 Brake specific fuel consumption

It is defined as the amount of fuel consumed for each unit of brake power per hour; it indicatyes the efficiency with which the engine develops the power from fuel. It is used to compare performance of different engines.

The amount of fuel which an engine consumes is ratyd by its brake specific fuel consumption(BSFC). For most internal combustion engines, the BSFC will be in range of 0.5 to 0.6 anf the fuel efficiency will tend to peak at higher engine speeds.At near wide open throttle the BSFC values are in order of 0.35.The estimate of brake specific fuel consumption for two straoke engines ranges from 0.55 to as high as 0.8.

Thebrae specific fuel consumption was calculated by dividing the fuel mass flow rate, mf, with brake power. Mathematically,

BSFC = mf/Pb

Where: mf = fuel consumption rate, kg/h

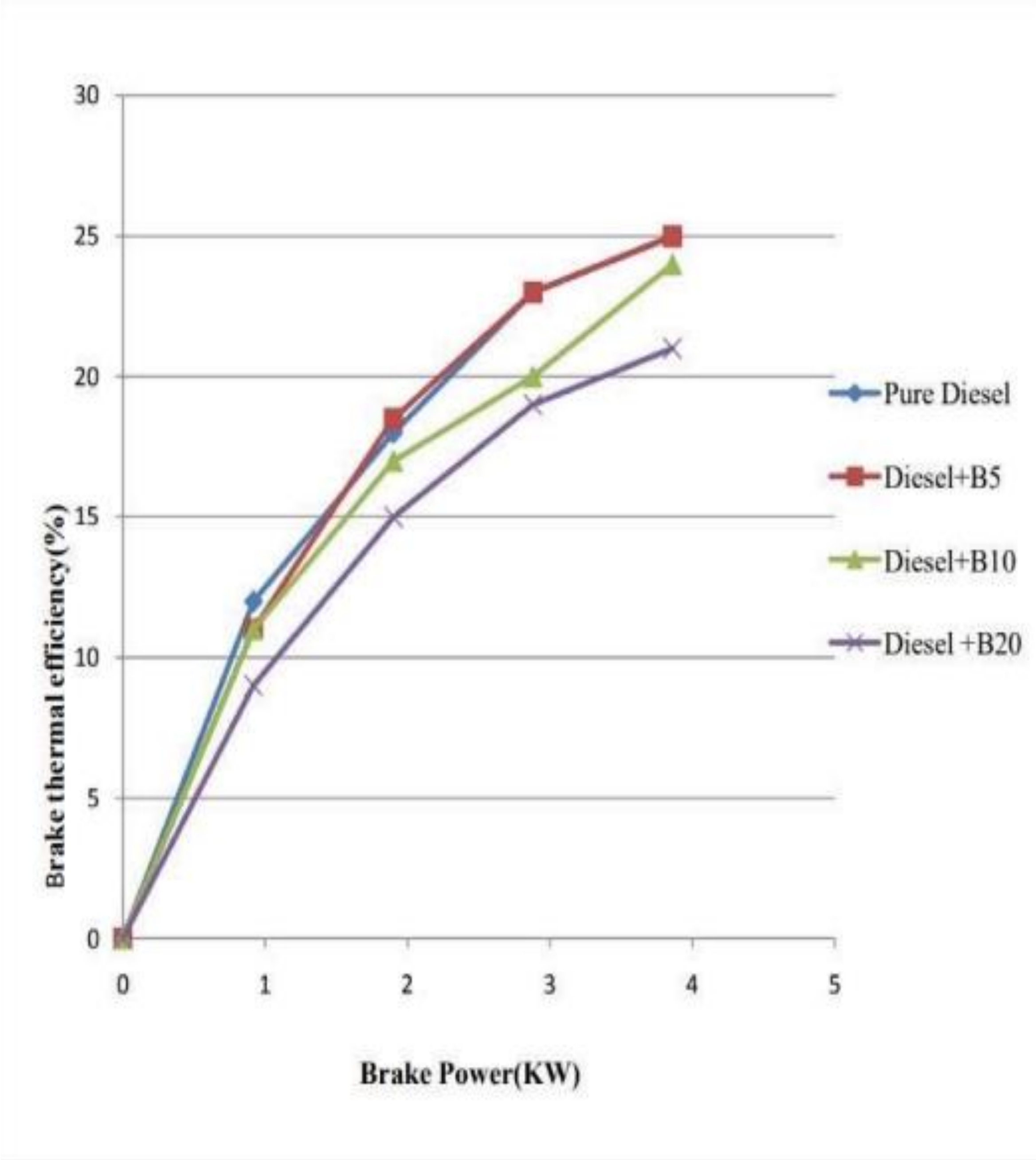
Pb = brake power, Kw

3. RESULT AND DISCUSSION

The basic engine performance measuring parameters are Brake thermal efficiency , fuel consumption and brake specific fuel consumption has been obtained from different blends and results are compared with pure diesel.

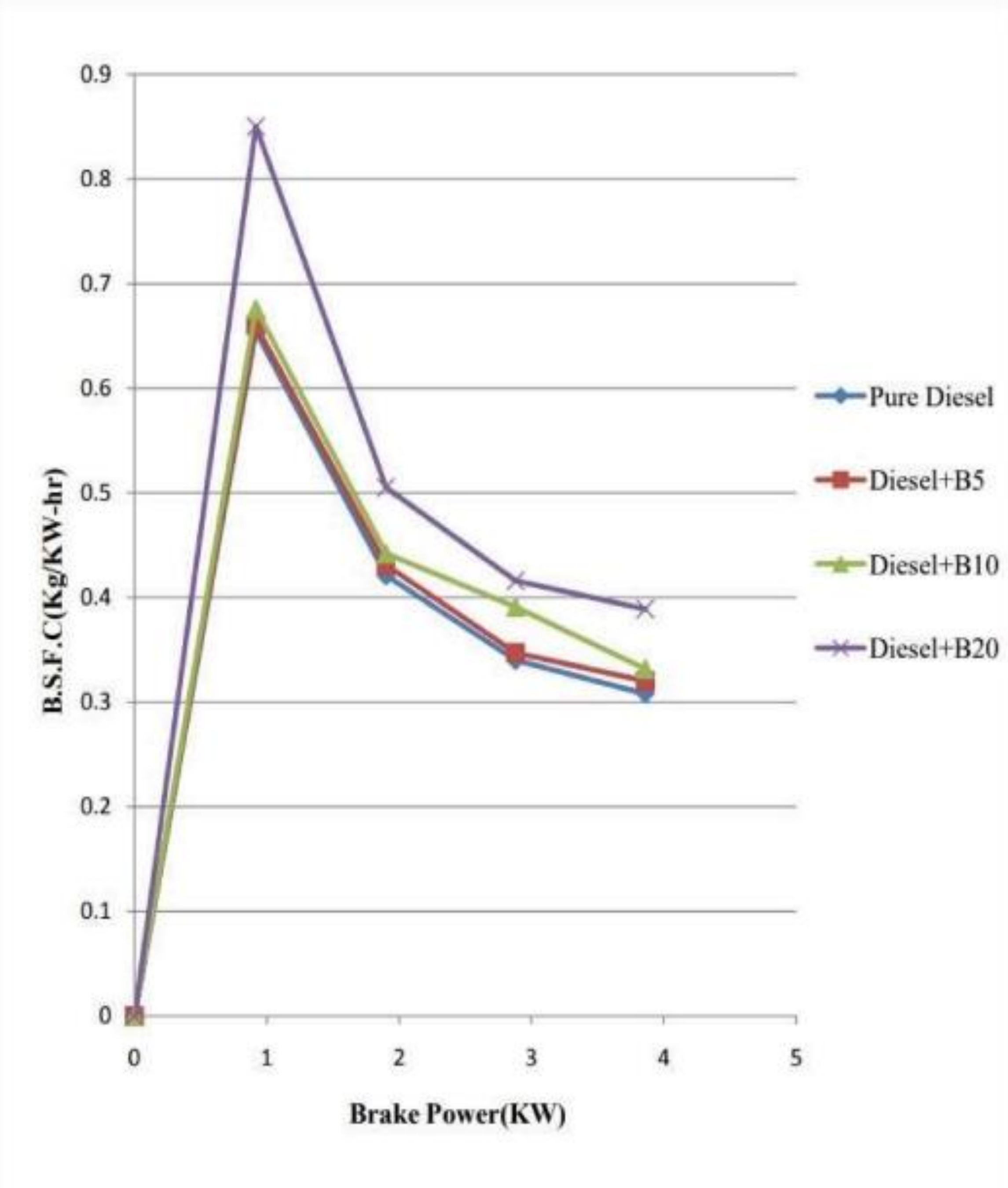
3.1 Effect of brake power on brake thermal efficiency

It shows the variation of BP on brake thermal efficiency when diesel engine has run on B5, B10 and B20 respectively. The figure shows that with increase in the brake power brake thermal efficiency also increase. It is observed that refined biodiesel blend B5 have thermal efficiency is close to diesel. Brake thermal efficiency is decreases in percentage of biodiesel blends.



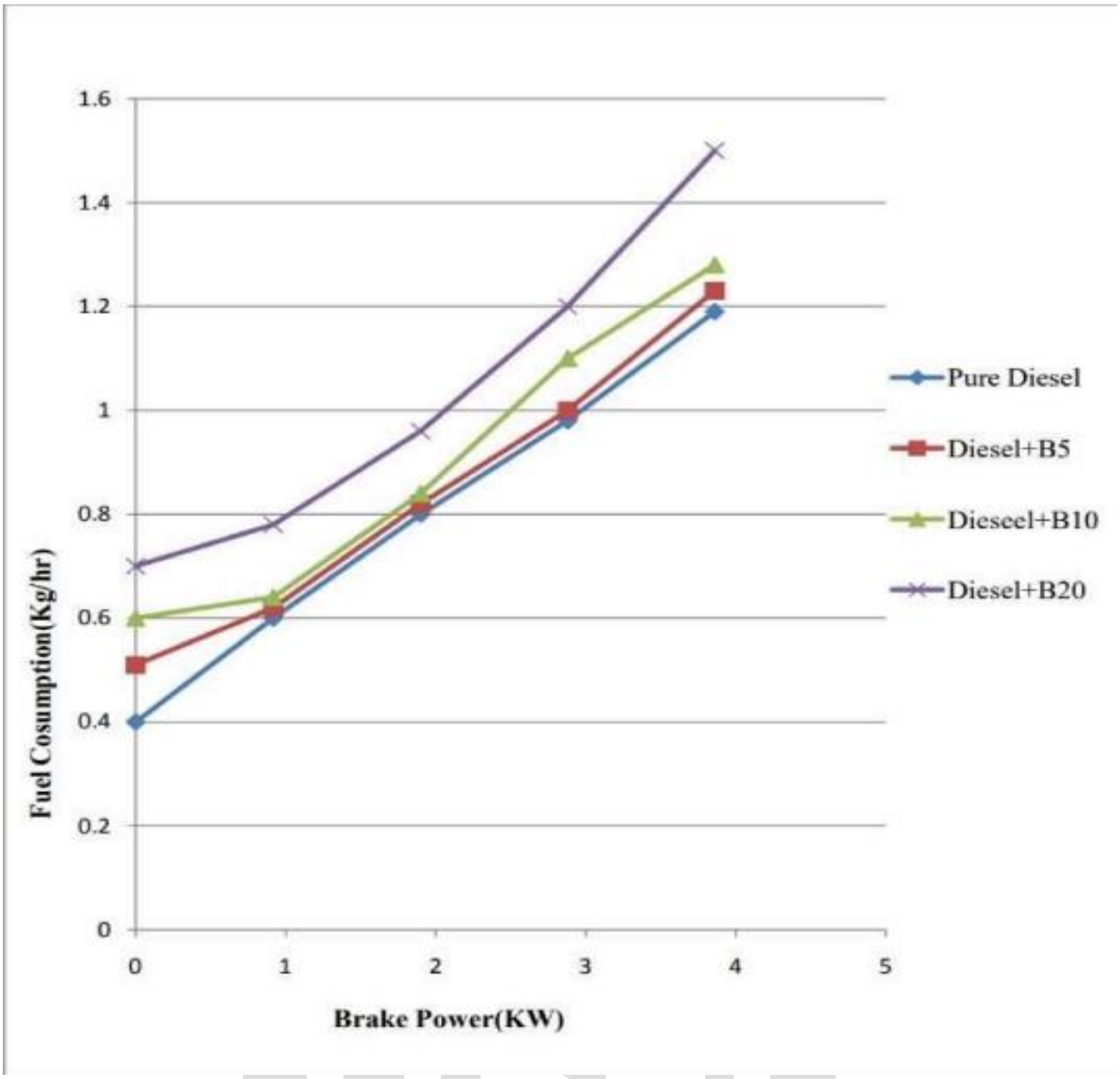
5.2 Effect of brake power on brake specific fuel consumption:

It shows the variation of BP on brake specific fuel consumption when diesel engine has run on B5, B10 and B20 respectively. The figure shows that with increase in the brake power brake specific fuel consumption decreases. It is observed that refined biodiesel blend B5 and B10 have brake specific fuel consumption is close to diesel. Brake specific fuel consumption increases in percentage of biodiesel blends.



3.3 Effect of brake power on fuel consumption:

It shows the variation of BP fuel consumption when diesel engine has run on B5, B10 and B20 respectively. The figure shows that with increase in the brake power fuel consumption also increases. It is observed that refined biodiesel blend B5 and B10 have fuel consumption is close to the diesel fuel consumption increase in percentage of biodiesel blends.



4. CONCLUSION

1) From the experiment we conclude that this process can be used as a secondary energy source or fuel. There is difficulty in manufacturing but it's economical and sustainable. As there is no cot or raw material its production is low.
2) Blending higher alcohol with fossil fuel contributes to reducing the dependence on conventional fuels, which are becoming scarce.
3) Although there was a decreasing trend in performance parameters with alcohol blends, the emission values were improved. If less dependence on conventional fuels is desired and environmental concerns are a priority, using these fuels is recommended.
4) The increased alcohol ratio in the blends led to a weaker engine performance, albeit with reduced levels of CO and NOx emissions.

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