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Investigation of Effect of Chicken Biodiesel Blended Diesel on Engine Performance

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ABSTRACT

Now a day's fossil fuels usage has become more, hence the fossil fuels are getting depleted day by day. So in order to overcome this problem we have to go for alternative fuels. Rendered animal fats and restaurant waste oils are appealing feedstock to produce biodiesel. The price of virgin vegetable oil is about two times more than that of animal fat, but drawbacks of using animal fat as a raw material for biodiesel production is its physical properties which could be eliminated by adding necessary amount of alcohol, catalyst for a required period of time. Extracted fat is heated to produce chicken biodiesel. Trans esterification of chicken fat is done. KOH is used as catalyst and methanol will increase the reaction. The blending process was carried out with appropriate volume of diesel and chicken biodiesel and kept for 24 hours to observe the formation of layer. The fuel properties like flash point, fire point, calorific value, viscosity are found. Test is carried out on single cylinder four stroke engines with different composition like 5%, 10%, 15% and 20% of chicken biodiesel blend with diesel. The fuel properties like flash point, fire point, calorific value, viscosity are found for chicken biodiesel and for different blend compositions. Variation of brake power, calorific value, kinematic viscosity and density for different blends and specific fuel consumption and brake thermal efficiency for constant loads are shown with the help of graphs. The biodiesel with 20% blend gives higher value of brake power and brake thermal efficiency compare to diesel and other blends. Result shows chicken biodiesel is an effective biofuel for future.

Key Words: *Trans esterification, Engine performance, Calorific value, Alternative biofuel, Brake power.*

1. INTRODUCTION

Biodiesel is an alternative fuel for diesel engines that is receiving great attention worldwide as it reduces the dependence on petroleum products, the energy crisis, global climate changes and environmental pollution and also non- toxic. Biodiesel and its blends can be used in diesel engines without any major modification. Many studies have shown that the fuel properties of biodiesel are very close to diesel fuel. Rendered animal fats and restaurant waste oils are appealing feedstock to produce biodiesel. They are sold commercially as animal feed. The price of virgin vegetable oil is about two times more than that of animal fat, but drawbacks of using animal fat as a raw material for Biodiesel production is its physical properties which could be eliminated by adding necessary amount of alcohol, catalyst for a required period of time. Investigations have shown that chicken fat is a promising feedstock for biodiesel production. A reaction between an ester of one alcohol and a second alcohol to form the ester of the second alcohol and an alcohol from the original ester is known as transesterification. Oils of high free fatty acids content can be converted into biodiesel via dual step transesterification process. In the first step, the oil is treated by an acid dissolved in methanol to reduce FFA content, whereas in the second step the pretreated oil is trans esterified with methanol in the presence of a base catalyst to form ester and glycerol. Another dual step method has two successive base catalyzed transesterification. In the first step of this type of transesterification, oil is treated with the catalyst (KOH or NaOH in alcohol) at specific reaction conditions, then the glycerol layer is removed and another specified amount of the same catalyst is added. Biodiesel is a nonpetroleum-based fuel defined as fatty acid methyl or ethyl esters derived from vegetable oils or animal fats and it is used in diesel engines and heating systems. Thus, this fuel could be regarded as mineral diesel substitute with the advantage of reducing greenhouse emissions because it is a renewable resource.The transesterification is the reaction between oil and fat, with a short chain alcohol (methanol or ethanol), in the presence of a suitable catalyst, to produce biodiesel. Sodium or potassium hydroxide and sodium or potassium methoxide are used widely as catalysts in the transesterification reaction, as they give high production yield[1].

Many studies investigated the availability of animal fats for biodiesel production. Biodiesel fuels from animal fats including beef tallow, mutton tallow and chicken fat used edible beef tallow as a feedstock for biodiesel preparation. Chung prepared biodiesel from duck tallow using methanol and potassium hydroxide. Awaluddin prepared biodiesel from waste chicken fat using CaO as heterogeneous base catalyst [2]. Chicken fat was pretreated with different acids to reduce the FFA content, and then base catalyzed transesterification was conducted using potassium hydroxide and methanol [3,4].

2. METHODOLOGY

2.1 Materials and additives

Waste chicken skin is a waste which is produced in chicken stall. The stock is disposed at the end of the day as a waste. Methanol is the simplest alcohol, being only a methyl group linked to a hydroxyl group. It is light, volatile, colourless, flammable liquid with a distinctive odour very similar to that of ethanol. However, unlike ethanol, methanol is highly toxic and unfit for consumption. It is polar liquid, and is used as an antifreeze, solvent, fuel, and as a denaturant for ethanol. It is also used for producing biodiesel via transesterification reaction. Potassium hydroxide is an inorganic compound with the formula KOH, and is commonly called caustic potash. Along with sodium hydroxide (NaOH), this colourless solid is a prototypical strong base. It has many industrial and niche applications, most of which exploit its corrosive nature and its reactivity towards acid.

2.2 Production of chicken waste oil

Waste chicken fat extraction. The waste chicken skin is collected from the chicken stall & it was cleaned by using water. It was later heated till it reaches 120^{o}C to lose all its moisture and fat was strained which in turn filtered. After the filtration process purified chicken oil was obtained. Extracted fat was used to produce biodiesel.

Transesterification. A reaction between an ester of one alcohol and a second alcohol to form the ester of the second alcohol and an alcohol from the original ester is known as transesterification. The 1000ml of chicken oil obtained after filtration is heated for 70°C. In a beaker add 230ml of methanol (30% in oil) and 3 grams of KOH (potassium hydroxide) pellets and allow it to dissolve. Transfer the heated oil to the round bottom flask of the esterification set up. Pour the methanol and KOH mixture to the other beaker in the set up. Slowly allow the methanol KOH mixture by opening the valve into the flask containing chicken oil. The magnetic stirrer speed is maintained to 900rpm, it stirs the mixture of oil, and methanol and KOH, thereby does not allow the mixture to solidify. The stirring is carried on for 90 minutes. In a test tube a sample of mixture is taken and kept aside for few minutes to check if the glycerine is forming a separate layer in the bottom. If the glycerine forms a separate layer the process is complete. Pour the mixture in the flask to the settling flask and allow settling for 60 minutes for the glycerine to form a separate layer. Separate the glycerine layer from the remaining biodiesel.

Blending of fuels. The produced biodiesel is blended with the regular diesel in different percentages. Below are the notations for different fuel samples which are blended. The blending process was carried out with the help of a measuring jar and beaker. The appropriate percentages of diesel and biodiesel were added to the beaker and then transferred to bottle. The bottles were shaking well and were allowed to stay upside down to ensure proper mixing of fuels. The bottles were stored in dry place and kept still for the next 24 hours. Blends were checked for every 6 hour time intervals for any layer formation. All the blends were stable and passed the 24 hours. Stability test and were ready to be used on engine.

Table 2.1. Engine Specification

Sl.no.	Parameters	Specifications
01	Type	TV 1(Kirloskar made)
02	Nozzle opening pressure	220 to 225 bar
03	Governor type	Mechanical centrifugal type
04	Number of cylinders	Single cylinder
05	Number of strokes	Four stroke
06	Fuel	Diesel
07	Compression ratio	16.5:1
08	Cylinder diameter (bore)	80 mm
09	Stroke length	110 mm

3. RESULTS AND DISCUSSION

The experiments were, therefore, conducted on methyl esters transesterification process for chicken biodiesel CB100 and blends of different volumes of chicken biodiesel and diesel CB05, CB10, CB15 and CB20 were carried out. The fuel consumption test and rating test of a constant speed CI engine was also conducted to evaluate the performance of the engine on diesel and methyl esters of chicken biodiesel CB100 and blends of different volumes of chicken biodiesel and diesel CB05, CB10, CB15 and CB20. The fuel characteristics are presented in this chapter with results obtained from the experiments, important property like specific gravity of different blends on the addition of biodiesel; blends are also studied with comparing with the fossil diesel & 100% biodiesel.

Table 3.1. Properties of chicken biodiesel and diesel blends

Parameter	D100	CB05D95	CB10D90	CB15D85	CB20D80	CB100D0
Flash point ($^{\circ}$C)	50	50	51	52	54	60
Fire point (^{o}C)	55	56	57	58	58	65
Density (kg/m^{3})	840	843	847	852	858	870
Kinematic viscosity (Cst)	2.3	2.316	2.321	2.329	2.338	2.513
Calorific value(kJ/kg)	44000	43756	42386	41131	40059	37639

3.1 Variation of brake thermal efficiency v/s load

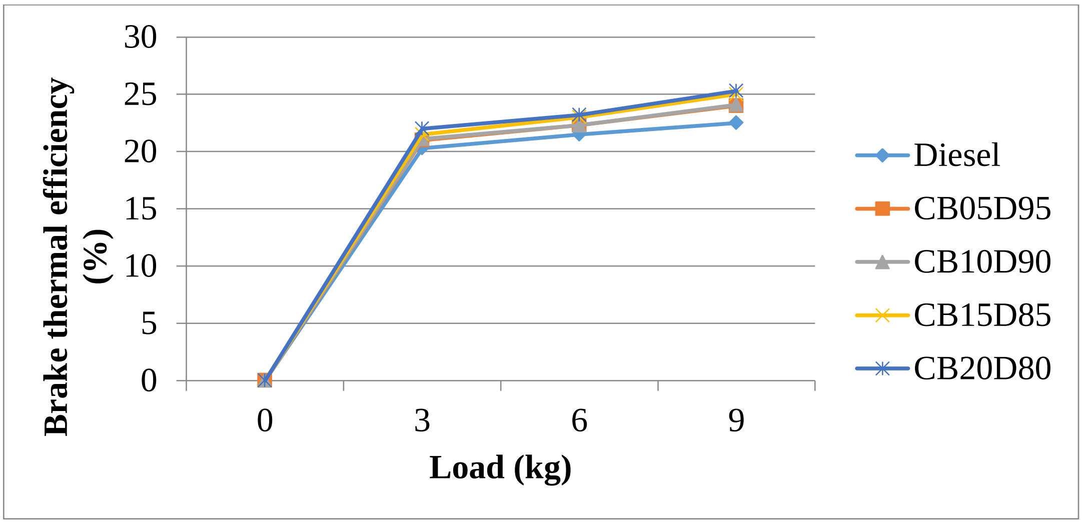

Figure 3.1. Brake thermal efficiency v/s Load.

From the above graph we come to know that the brake thermal efficiency increases with respect to increase in the blending ratios and load.

3.2 Variation of specific fuel consumption v/s load

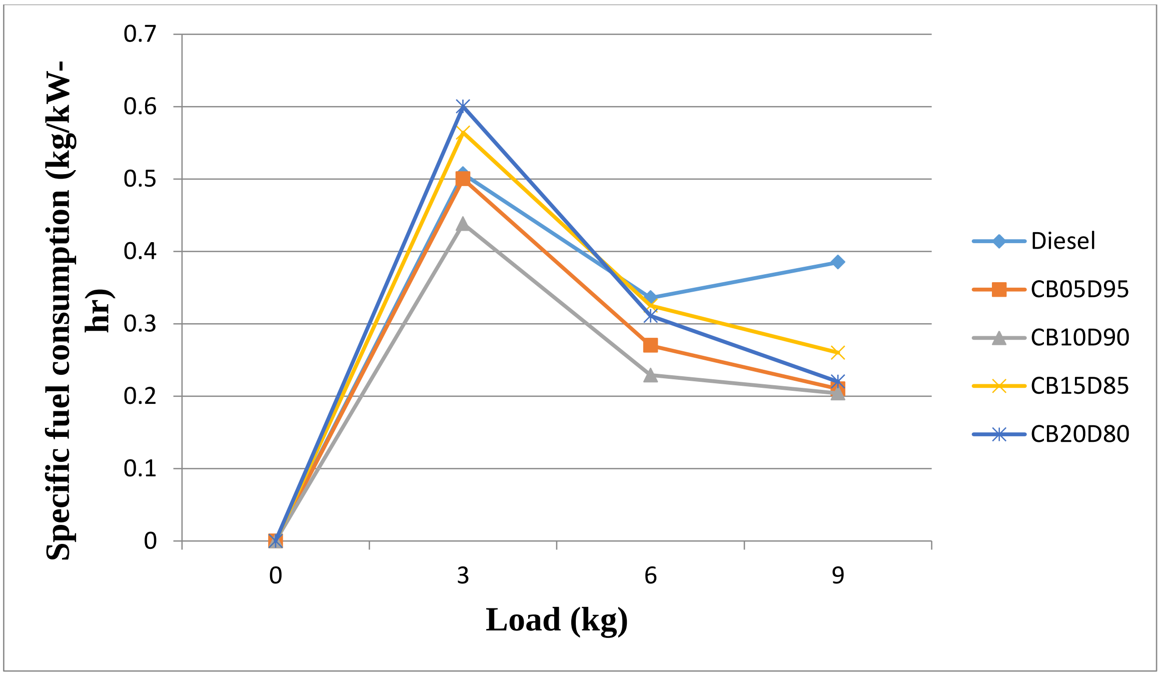

Figure3.2.Specific fuel consumption v/s Load

The graph represents that, the specific fuel consumption increases with respect to the load increase. Since the calorific value of the blends is less when compared to the diesel, the engine consumes more fuel as the load increases.

3.3. Variation of brake power v/s fuel blends

The below graph shows the variation of brake power when different blends used to run the engine. The graph plotted for different blends and applied load is 6 kg.

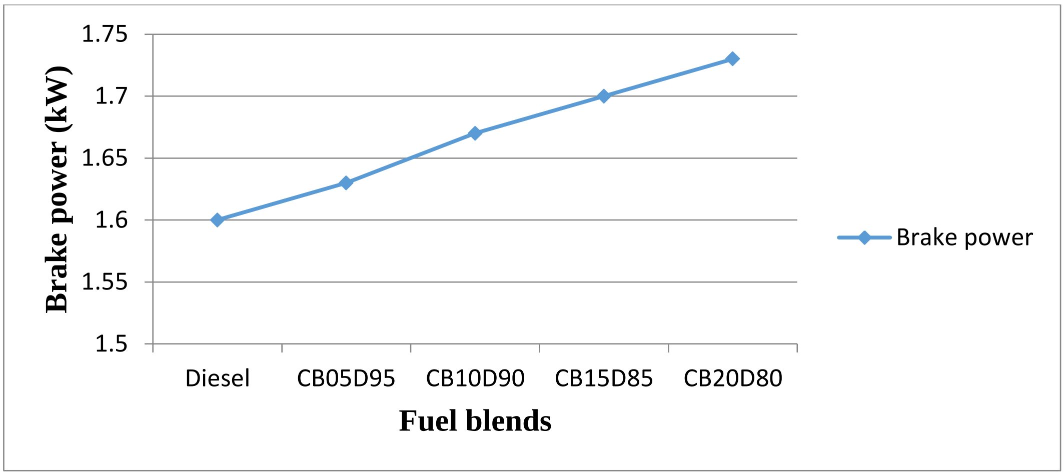

Figure 3.3. Variation of brake power v/s fuel blends.

4. CONCLUSION

The production of biodiesel is one stage transestrification process.The time required to produce the biodiesel is less. The density of biodiesel is 870kg/m^3 which is more than the diesel that is 840kg/m^3. The calorific value of chicken biodiesel is 37639 kJ/kg. Production cost of biodiesel is less. Properties of chicken biodiesel and its blends satisfy the ASTM standards hence we can use chicken biodiesel and its blends as fuel in IC engines effectively.The brake thermal efficiency of CB20D80 is 24.78% which is more than the diesel that is 22.09% at maximum load. It is found from results and discussion that brake specific fuel consumption of CB20D80 is 0.403kg/KW-hr which is less than the diesel that is0.281kg/kW-hr at maximum load.

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