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Analysis on Cooking Oil As Sustainable Fuel Performance Analysis of Diesel Blended With Cooking Oil before and After Cooking

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Abstract

The increasing awareness of the depletion of fossil fuel resources and the environmental benefits of vegetable oil fuel has made it more attractive in recent times. Its primary advantages deal with it being one of the most renewable fuels currently available and it is also non-toxic and biodegradable. It can also be used directly in most diesel engines without requiring extensive engine modifications. However, the cost of biodiesel is the major hurdle to its commercialization in comparison to petroleum-based diesel fuel. The high cost is primarily due to the raw material. So in this project both the used and unused cooking oil is used to test the performance of the engine. Therefore the disposal of the waste cooking oil is also avoided. The production of biodiesel from waste vegetable oil offers a triple-facet solution: economic, environmental and waste management. The groundnut oil is most commonly used cooking oil. So in this project groundnut is taken for consideration before and after cooking. The performance of these is also compared.

Keywords: Groundnut Oil, Alternate Fule.

1. Introduction

Several billions of gallons of waste vegetable oil are produced every year around the world, mainly from industrial deep fat fryers found in potato processing plants, factories manufacturing foods, and restaurants. Some of this wastage is already being re-used by other industries, such as in animal feed and cosmetics, but the amount that is still being wasted and ending up in land-fill sites is alarming. Therefore it makes commercial and environmental sense to re-use this oil for making biodiesel. Making biodiesel from waste cooking oil (WCO) is much the same as when using straight vegetable oil, except that the oil will need filtering first to remove debris, and because it has been used and most likely reheated several times, more fatty acids will be present so we need to determine how much more sodium hydroxide (or potassium hydroxide) to add to neutralize these acids.

As the WCO are manufactured by blending the cooking oil with diesel. The main advantages of the using the biodiesel or cooking oil as alternate source of fuel are because it is economical, Renewable, Good for the Environment, Supports Country Development and Economy, Reduces dependency on Crude Oil, Easy Manufacturing, Good for the engine, and Perfect alternative fuel.

2. Literature Review

The cetane number of the fuel decreases with increase in aromatic content. Fuel structure is also a major parameter that affects the fuel properties, which in turn influence the combustion as reported by Murugan et al (2008). The viscosity of diesel fuel is an important property, which has an impact on the performance of fuel injection systems. Some injection pumps may experience excessive wear and power loss due to injector or pump leakages if viscosity is too low. If fuel viscosity is too high, it may cause higher pump resistance, filter damages and adversely affect fuel spray pattern. In general, fuels with low viscosity tend to have poor lubrication properties as reported by Walendzieuwski Jerzy (2002). The heating value or heat of combustion of diesel fuel is the measured amount of available energy content from a known quantity of fuel and is directly proportional to the fuel density (Williams 1990). The flash point of the fuel affects the boiling point of the fuel (Rajesh 2011). However, it is not related directly to engine performance. The flashpoint is the lowest temperature at which the vapour above a fuel sample will shortly ignite under the prescribed test conditions as reported by Murugan et al (2008). As per ASTM D 975, the flash point should be minimum of 52oC for No.2 diesel fuel. Pour point is the lowest temperature at which the fuel will flow and is used to predict the lowest temperature at which the fuel can be pumped. The nature of combustion depends on many parameters such as fuel air mixing, injection timing, spray characteristics, air motion, etc (Heywood 1988). Fuel vaporisation is also a parameter that affects combustion. Fuel content and self-ignition of fuel vapour are also related to the chemical process in the cylinder (Senthilkumar 2012).

3. Methodology

From the literature survey made it has been observed that experimental work done using WCO in a D.I. diesel engine to study the performance characteristics is essential. Hence the objective of the present work is to study the characteristics of a compression ignition engine with WCO such as oil before cooking and oil after cooking as a fuel in various forms. Both CO and WCO blended with diesel and are used as alternative fuels in a compression ignition engine by adopting the following techniques:

(i) Blending WCO with diesel in various propositions.

(ii) Performance analysis using WCO and diesel as fuel.

4. Blending and Performance Analysis Of WCO With Diesel

The WCO obtained have many containments, the containments are formed because if the heating, debris from the items and the vessels, etc. This should be eliminated and avoided before using for the engine. The oil is first filtered using the mesh filter. Used cooking oil will have a darker colour to it and will most likely have chunks of the fried foods floating around. It will need to get rid of these before making biodiesel. Larger chunks can contain water and can mess up the biodiesel reaction. A paint strainer or window screen will adequately remove the particles that are large enough to affect the biodiesel reaction. This filtration process can be fairly quick, but let the filtered biodiesel settle anywhere from a couple of hours to a couple of days to let the smaller particles settle out. Smaller suspended particles should also be allowed to settle so they doesn't attach to the engine cylinders. Once settling is complete, begin transferring the used cooking oil to the reaction tank. As cooking oil makes its way into the reaction tank, heat up the oil to about 120 or 130 degrees Fahrenheit. This heating and circulation process will take approximately one to four hours. Finally pure waste cooking oil obtained.

5. Experimental Set-Up

In the present work, tests were conducted on a single cylinder, air-cooled, four strokes, vertical, naturally aspirated, stationary, D.I diesel engine with a displacement volume of 661.5 cc, compression ratio of 16.5:1, developing 4.4 kW of power at 1500 rpm. The engine was modified to operate with waste cooking oil by changing the injection timing, provision for exhaust gas recirculation and for supplying the fuel at different nozzle opening pressures.

All the tests were conducted at the rated speed of 1500 rpm. All the readings were taken only after the engine attained the stable condition. All the instruments were periodically calibrated. The engine output was varied insteps of 20% from no load to full load in the normal operation of the engine. At each load, the fuel flow rate, exhaust gas temperature, emission of carbon monoxide, hydrocarbon, oxides of nitrogen and smoke readings were recorded. The pressure crank angle data for 100 consecutive cycles were also recorded by using the data acquisition system and a personal computer. The data were processed to get the average pressure crank angle variation.

6. Result and Discussion

Table 1 is the sample set of reading taken in the engine for different load conditions. The electrical dynamometer is used to apply the load to the engine.

Table 1: Break Thermal Efficiency Comparison

S.No.	Load KG	Cooking Oil	Diesel	Waste Cooking Oil
1	0.8	14.99	14.58	16.12
2	1.7	21.98	20.99	21.54
3	2.6	23.98	23.4	24.01
4	3.5	25.2	24.8	25.45
5	4.4	27.4	28.2	28

The figure 1 shows the comparative chart of the diesel and the waste cooking oil break thermal efficiency.

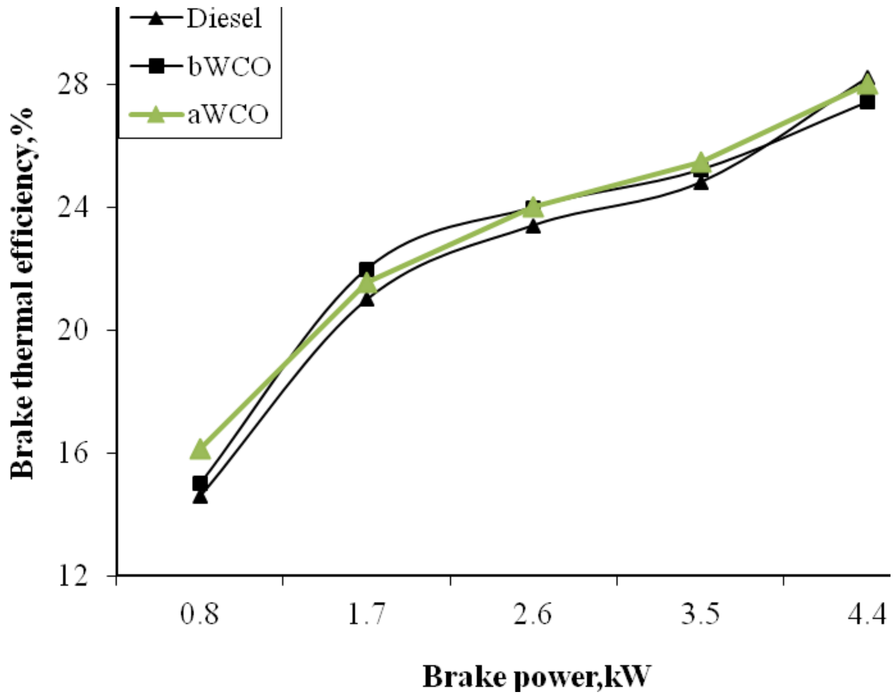

Figure 1: Break Thermal Efficiency for Diesel and Waste Cooking Oil

7. Waste Cooking Oil Exhaust Gas Temperature

The performance of the engine is also affected by the exhaust gas temperature. This temperature also plays a major role in atmospheric pollution. So this project also compared the exhaust gas temperature also.

Table 2: EGT Comparison SF

S.No.	Load KG	Waste cooking Oil	Diesel	Waste Cooking Oil
1	0.8	240	221	219
2	1.7	265	257	291
3	2.6	323	310	324
4	3.5	376	345	361
5	4.4	450	417	440

The comparative graph is given in the figure 2.

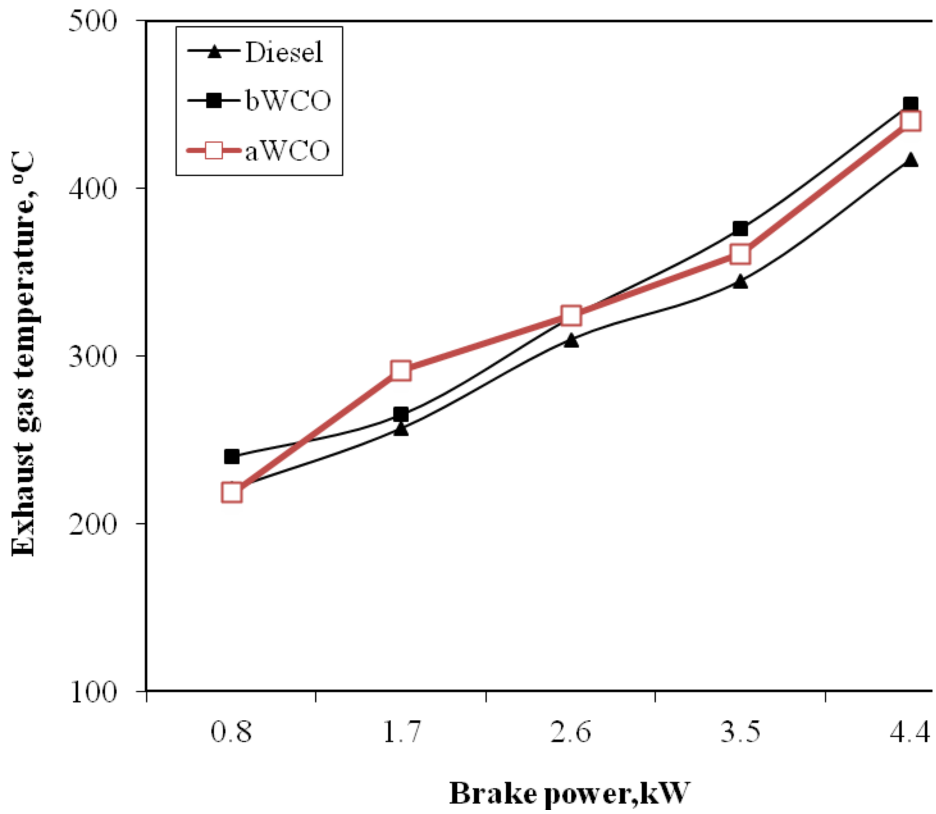

Figure 2: EGT for Diesel and Waste cooking Oil

8. Conclusion

The BTE of the waste cooking oil and the diesel remains same for the low load conditions and high load conditions. But the BTE of the waste cooking oil is higher compared to the diesel and cooking oil. So the performance of the engine will be improved using waste cooking oil blend compared to the cooking oil blend. The exhaust gas temperature of the waste cooking oil blend remains less compared to the diesel fuel. So waste cooking oil can be blended with diesel to reduce the atmospheric pollutions also. In comparison to petroleum and gasoline, performance of the waste cooking oil is better. Even the performance of the waste cooking oil is better than the cooking oil.

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