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Comparative Study of Waste Cooking Oil with Diesel for performance and emission analysis

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Abstract : The present scenario indicating to look at an alternative for the fuels for an alternative. Looking into this context, many researches is going on for the fuels extracted from various sources like, oil extracted from honge, neem, Jatropa, Rice, Sunflower etc …. With all this many experiments are going on, among all Waste Cooking Oil (WCO) as a Biodiesel was found little reliable due its easy in availability. The present work includes the experimentation on diesel and biodiesel (WCO) for different loads. The results of the experiments showed, there is an increase in BSFC of WCO and most important is reduction of NOx emissions in WCO was observed.

IndexTerms - Diesel, Bio diesel, Waste cooking oil, NOx, Hydrocarbons

I. INTRODUCTION

In recent years pollution had become the challenge in automotive sector due to the use of fossil fuels which is slowly affecting the atmosphere. Searching for the alternatives has become a mandatory to overcome the environmental pollution issues. Biodiesel can be a one of the alternative to diesel to handle the pollution and fossil fuels.

The demand for the fuel is increasing day by day in the present scenario hence there is a huge demand is creating for the fuels. The production of the biodiesel from the edible and non edible oil will be concentrated to minimal the pollution issues and improve efficiency. Improvement in the resources for the biodiesel production in the country helps the dependency on oil import will reduce and also the country can prepare alone fuels which are eco friendly.

II. LITERTATURE SURVEY

K A Abed et al. [1] had conducted an experiment on blends of waste cooking oil by varying the load and found emission of hydrocarbons is lower than a diesel and slightly higher in CO2

Haseeb Yaqoob et al. [2] in his review studied about the effect of waste cooking oil on environment and economic issues and suggest this could be a best alternative. Experiment gave a result of reduction in emission parameters like, SO_2, CO_2 and hydrocarbons which saves the environment effectively

Ganaprakasam et al. [3] had examined the cost of production of the biodiesel from vegetable oils are slightly more and conducted an experiments which results in the cost effective production of the waste cooking oil and discussed how various parameters like temperature, catalyst type, and temperature influence the process of production of biodiesel.

Yahya Ulusoy et al. [4] has examined the performance and emission of Waste Cooking Oil by 8 mode test and compared the results of the conventional diesel with the various biodiesel blends and found increase in NOx when waste cooking oil is used but reduction in CO and Hydrocarbons gives a significant results

F Um Min Allah et al. [5] had examined the various parameters like pH, catalyst type, oil ratio, temperature, free fatty acids which would have more impact in the transterification process and hence suggested proper concentration of these would give a better yield in the production of biodiesel

Gopal K N et al. [6] conducted an experiment and compared the performance results with the conventional diesel. It was found that the characteristics are almost same when it is compared with the waste cooking oil. The emission characteristics of waste cooking oil to that diesel is almost same emission properties such as smoke opacity and unburnt hydrocarbon is low

III. COMPARISON OF PROPERTIES

Below table shows the various properties of different edible and non edible oils. Jatropa oil and pongamia oil gives the cetane number almost near as the conventional diesel. The calorific values of all the oils listed are less than the diesel, but there is no much difference hence suggested can also try even its not up to diesel. The major challenging property is viscosity. The viscosity is slightly higher than compared to diesel. The proper treatment has to be adopted to reduce it because it causes a lower efficiency due to improper movement of the fuel. The densities of all the edible and non edible oils are almost same compared to diesel. The table of comparison gives the information about the selection of the oils which can be proposed to use as an alternative fuel for the diesel.

Table 4.1: Descriptive Statics

Type of vegetable oil	CN	HV (kJ/kg)	Viscosity (mm^2/s) Temp)	Cloud Point (°C)	Pour Point (°C)	Flash Point (° C)	Density (kg/m^3)
Castor oil	N.A	39500	297 (38°C)	N.A	-31.7	260	961
Coconut oil	N.A	N.A	N.A	N.A	N.A	N.A	924.27
Cottonseed oil	41.8	39468	33.5 (38 °C)	1.7	-15.0	234	925.87
Linseed oil	34.6	39307	27.2 (38°C)	1.7	-15.0	241	929.07
Olive oil	N.A	N.A	N.A	N.A	N.A	N.A	918
Palm oil	42	N.A	N.A	N.A	N.A	N.A	910.1
Peanut oil	41.8	39782	39.6 (38 °C)	12.8	-6.7	271	914
Rapeseed oil	37.6	39709	37.0 (38 °C)	-3.9	-31.7	246	920
Sesame oil	40.2	39349	35.5 (38 °C)	-3.9	-9.4	260	922
Soybean oil	37.9	39623	32.6 (38°C)	-3.9	-12.2	254	997.5
Sunflower oil	37.1	39575	37.1 (38 °C)	7.2	-15.0	274	920
Tallow oil	N.A	40054	51.15 (40°C)	N.A	N.A	201	820
Jatropha oil	51	39700	51 (30^0C)	16	N.A	242	932
Pongamia oil	51	46000	55.1(30^0C)	23	N.A	110	884
Diesel	47	45343	2.7 (38 °C)	-15.0	-33.0	52	870.20

IV. EXPERIMENTAL SET UP

The experimental setup consists of a single cylinder 4 stroke vertical diesel engine with a power of 5kWat 1400rpm. Which consists of bore diameter of 100mm and stroke length of 105mm which have the compression ratio of 17. The experiment is conducted for the varying the load in terms of percentage and compared the characteristics of fuel consumption, brake power, BSFC and Brake thermal efficiency. The emission parameters like Hydrocarbons, carbon di oxide, carbon monoxide and NOx are examined and tabulated.

V. RESULTS AND DISCUSSION

TABLE 5.1. Load vs Fuel consumption

Load %	Fuel consumption in Kg/hr.	
	Diesel	*WCO*
25	0.58	0.71
50	0.77	0.98
75	1.02	1.2
100	1.31	1.53

TABLE 5.2. Load vs BP

Load %	Break Power in kW	
	Diesel	*WCO*
25	1.33	1.32
50	2.6	2.61
75	3.85	3.87
100	5.07	5.09

TABLE 5.3. Load vs BSFC

Load %	BSFC in Kg/kw-h	
	Diesel	*WCO*
25	0.44	0.54
50	0.3	0.38
75	0.26	0.31
100	0.26	0.3

TABLE 5.4. Load vs BTE

Load %	BTE in %	
	Diesel	*WCO*
25	18.08	17.28
50	26.57	24.64
75	29.98	29.94
100	30.73	30.94

TABLE 5.5. Load vs HC

Load %	HC in PPM	
	Diesel	*WCO*
25	18	15
50	22	18
75	29	25
100	42	36

TABLE 5.6. Load vs CO

Load %	CO in %	
	Diesel	*WCO*
25	0.004	0.016
50	0	0.002
75	0.01	0.011
100	0.16	0.114

TABLE 5.7. Load vs CO2

Load %	CO2 in %	
	Diesel	*WCO*
25	3.79	4.01
50	5.44	5.77
75	7.09	7.56
100	9.61	10.1

TABLE 5.8. Load vs NO_X

Load %	NOx in PPM	
	Diesel	*WCO*
25	747	639
50	1231	1315
75	1987	1811
100	2162	2123

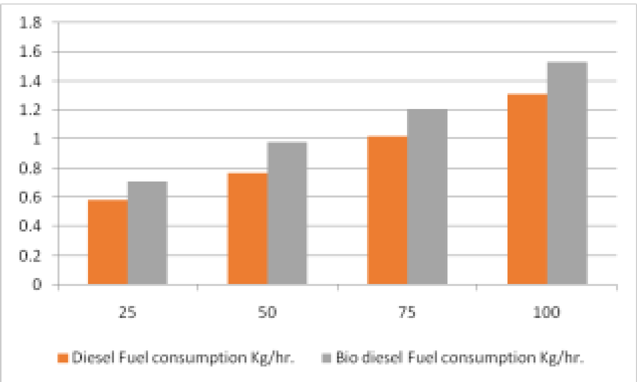

Fig 5.1. Load vs Fuel consumption

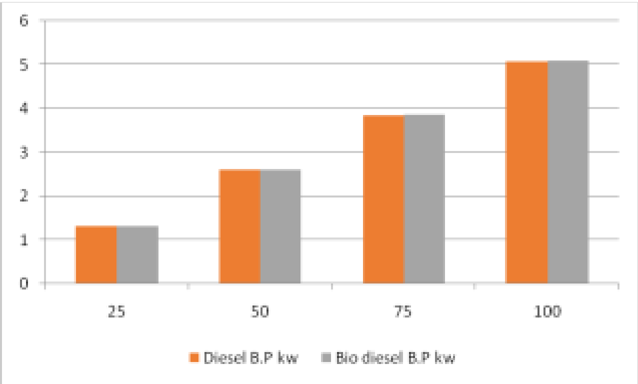

Fig 5.2. Load vs BP

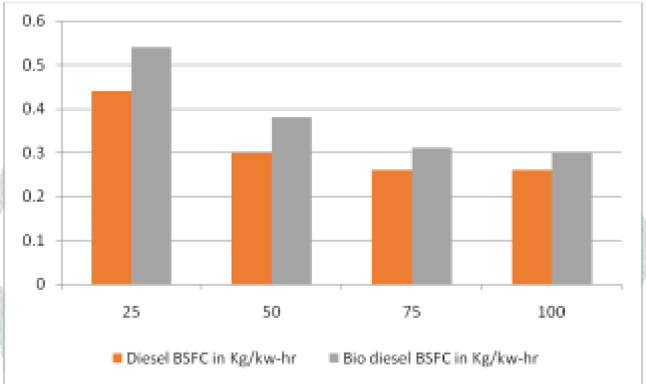

Fig 5.3. Load vs BSFC

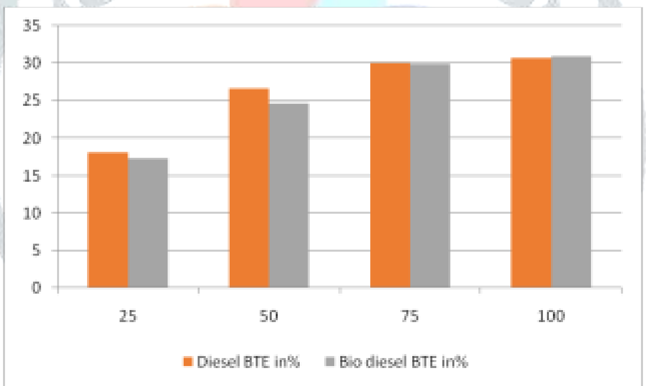

Fig 5.4. Load vs BTE

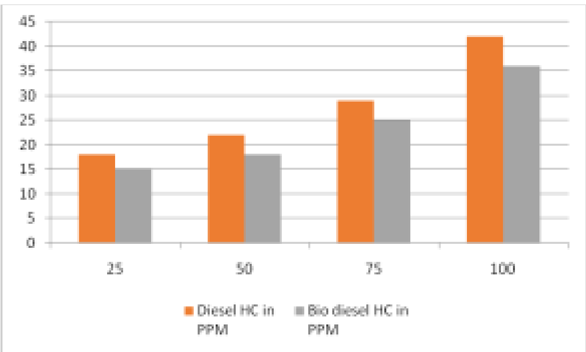

Fig 5.5. Load vs HC

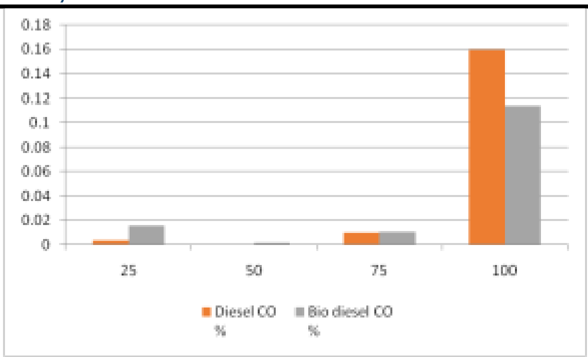

Fig 5.6. Load vs CO

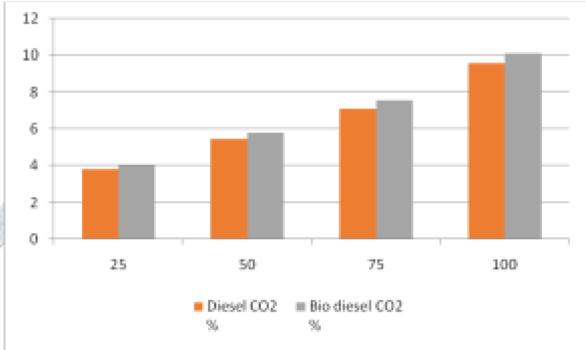

Fig 5.7. Load vs CO2

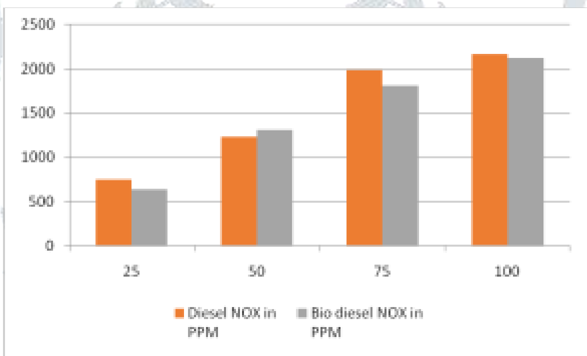

Fig 5.8. Load vs NOx

In figure 5.1 it can be notice that consumption of Biodiesel (WCO) is slightly more compared to diesel. But in large production will not make much effect. Fig 5.2 shows the Brake Power, which seems to be almost same where as the BSFC of WCO is more compared to diesel. In fig 5.3, Break specific fuel consumption is higher compared to conventional diesel. In fig 5.4, it can be observed that no much variation in BTE.

From fig 5.5 it is observed that the Unburnt hydro carbons are less in biodiesel i.e., waste cooking oil (WCO) compared to diesel, because more oxygen content in biodiesel. The much affect will take place in NOx emissions. In fig 5.6 it was found to be the reduction in CO was observed in full load. In fig 5.7 there is a slight increase in CO_2 of the waste cooking oil. In fig 5.8 it was seen that the NOx is reduced when WCO is used which makes an attention for the research.

VI. CONCLUSION

The experiment is conducted for the various loads and performance characteristics were analyzed. The results was so obtained that there is a good performance of waste cooking oil as compared to the conventional diesel. The waste cooking oil could be the best alternative for the future. The emission characteristics was also taken and compared with the conventional diesel. There is a drop in the emission which gives a positive approach to use of biodiesel. The results of the experiments showed, there is an increase in BSFC of WCO and most important is reduction of NOx emissions in WCO was observed.

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