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Performance and Characteristics of Biodiesel by Using Compression Ignition Engine

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Abstract

The growing concern due to environmental pollution caused by the conventional fossil fuels and the realization that they are non-renewable have led to search for more environment friendly and renewable fuels. Among various options investigated for diesel fuel, biodiesel obtained from vegetable oils has been recognized world over as one of the strong contenders for reductions in exhaust emissions. Several countries including India have already begun substituting the conventional diesel by a certain amount of biodiesel. Worldwide biodiesel production is mainly from edible oils such as soybean, sunflower and canola oils. In this project the cashew oil is used as a bio fuel. The performance and characteristics are tested by using compression ignition engine. The cashew oil -diesel B10 and B20 blends are used for performance test at various load in CI engine .Biodiesel was made by transesterification process. The fuel blends were tested in single cylinder, direct injection, water cooled diesel engine. The effect of test sample and commercial diesel on the engine power, engine torque, BSFCs and exhaust gas temperature were ascertained by performance tests. The influence of blends emission CO, HC and NO were investigated by gas analyser. The experimental results showed that the fuel blends improve the performance parameters and decrease the CO and HC emission as compared to diesel fuel.

Index Terms — Bio fuel, Cashew oil, Transesterifiction.

I. Introduction

The whole world is facing the crises of depletion of fossil fuels as well as the problem of environmental degradation. The rapid depletion of fossil fuel reserves with increasing demand and uncertainty in their supply, as well as the rapid rise in petroleum prices, has stimulated the search for other alternatives to fossil fuels. In view of this, there is an urgent need to explore new alternatives, which are likely to reduce our dependency on oil imports as well as can help in protecting the environment for sustainable development. Many alternative fuels are being recently explored as potential alternatives for the present high-pollutant diesel fuel derived from diminishing commercial resources. Vegetable oils either from seasonal plant crops or from perennial forest tree's origin, after being formulated, have been found suitable for utilization in diesel engines. Many traditional oil seeds like pongamia glabra, jatropha, mallous philippines, garcinia indica, thumba, karanja and madhuca indica etc. are available in our country in abundance, which can be exploited for biodiesel production purpose. Many vegetable oils, animal fats and recycled cooking greases can also be transformed into biodiesel. Biodiesel can be used neat or as a diesel additive in compression ignition [1] while biodiesel possesses many similarities to conventional diesel fuel, biodiesel possesses many unique properties that need to be considered for its application in current and emerging engine Technologies. Biodiesel can increase NOx emissions in engines with pump-line–nozzle fuel systems due to its elevated bulk modulus of compressibility, That biodiesel also can yield a NOx increase in common rail engines cannot be explained by the difference in compressibility.[2] Diesel engine performance and emission characteristics of biodiesel produced by the per oxidation process The increase in engine speed caused an increase in fuel consumption rate, brake thermal efficiency, equivalence ratio, and exhaust gas temperature, while at the same time decreasing the bsfc, emission indices of CO2, CO and the NOx for the four fuels.[3] Diesel engine performance and exhaust emission analysis using waste cooking biodiesel fuel with an artificial neural network This study deals with artificial neural network (ANN) modelling of a diesel engine using waste cooking. [4] Effect of biodiesel fuels on diesel engine emissions at partial load operation, no differences in power output should be expected, since an increase in fuel consumption in the case of biodiesel would compensate its reduced heating value. At full-load conditions, a certain decrease in power has been found with biodiesel, but such a decrease is lower than that corresponding to the decrease in heating value, which means that a small power recovery is often observed.[5] Effect of biodiesel on engine performances and emissions An increase in biodiesel fuel consumption, due to low heating value and high density and viscosity of biodiesel, has been found, but this trend will be weakened as the proportion of biodiesel reduces in the blend. [6] Effect of diethyl ether and ethanol additives on the combustion and emission characteristics of biodiesel-diesel blended fuel engine. The oxygen content of biodiesel is an important factor in the NOx formation. The addition of higher oxygen content and high volatility fuels, such as diethyl ether and ethanol, can be a promising technique for using biodiesel/diesel blend efficiently in diesel engines without any modifications in the engine. [7] Effect of ethanol blending with biodiesel on engine performance and exhaust emissions in a CI engine Commercial diesel fuel, 20% biodiesel and 80% diesel fuel, called here as B20,. The torque of engine obtained for BE20 was higher than both those obtained for diesel and B20 fuels.[8] Emissions characteristics of a diesel engine operating on biodiesel and biodiesel blended with ethanol and methanol, Euro V diesel fuel, pure biodiesel and biodiesel blended with 5%, 10% and 15% of ethanol or methanol were tested on a 4-cylinder naturally-aspirated direct-diesel engine.[9] Engine performance and emission characteristics of a three-phase emulsion of biodiesel produced by per oxidation The biodiesel product was then emulsified with distilled water and emulsifying surfactant by a high-speed mechanical.[10] Experimental investigation of control of NOx emissions in biodiesel-fuelled compression ignition engine. A two-cylinder, air-cooled, constant speed direct injection diesel engine was used for experiments. HCs, NOx, CO, and opacity of the exhaust gas were measured to estimate the emissions. The solar energy is the most capable of the alternative energy source. Due to increasing demand for energy and rising cost of fossil fuels like gas or oil solar energy is considered an attractive source of renewable energy that can be used for water heating in both homes and industry. Heating water consumes nearly 20% of total energy consumption for an average family. Solar water heating system is classified into three type's namely (A) Active system (B) Passive system (C) Batch system

II. Experimental Setup

In this study, the Cashew Nut Shell Liquid is utilized to prepare the blends. The volume ratio of CN and diesel is B10/ B20. The fuel injector is set at four different loads 0kw, 1kw, 2kw and 3kw. A kirloskar make diesel engine, constant speed, single cylinder, water cooled, direct injection was selected due to its widespread use in agricultural sector and household electricity generation. The detailed specifications of the test engine are summarizes in table 4.1. All experiments were conducted at standard temperature and pressure. The engine speed was measured directly from the RPM sensor attached near its flywheel.

Fig 1: Engine set-up

The engine sped was kept fixed at 1500rpm. Engine start at no load and feed control was so adjusted that it can attain the rated speed and steady state condition. Fuel consumption, rpm, exhausts gas temperature and power output were measured and displayed in the monitor. Engine was loaded gradually to keep the speed with in the permissible range. The pressure and crank angle

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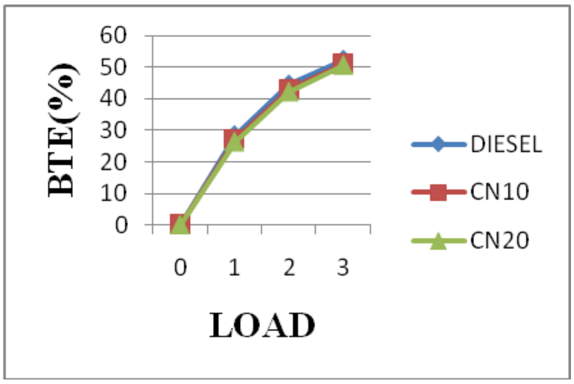
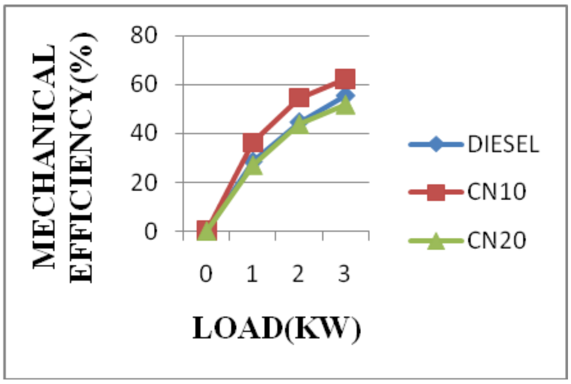
diagrams of the test engine for bio-diesel at full load are arrived and analysed. And the performance and emission characteristics bio-diesel in various fuel injection ranges are evaluated and analysed. Each experimental data was taken three times and the mean of the three was taken.

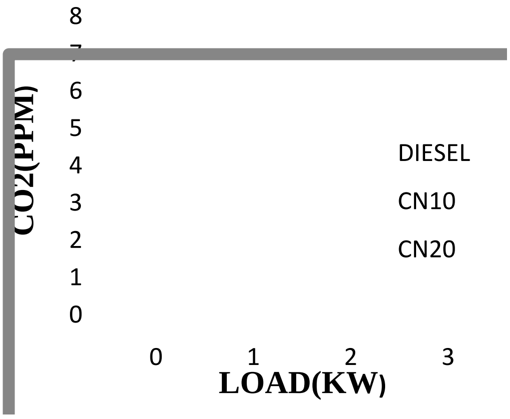
III. Result & Discussion

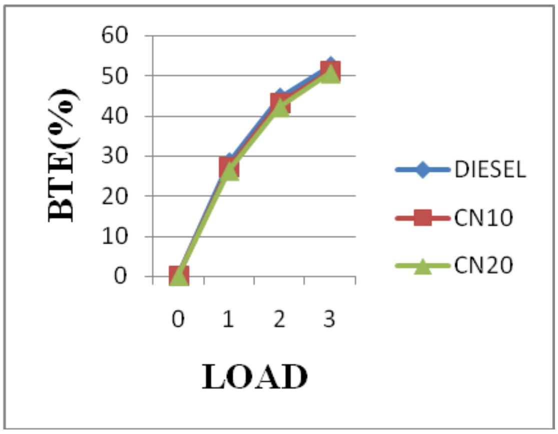
ENGINE PERFORMANCES & EMISSION

The engine efficiency variation with load for various fuel injection ranges shown in fig 5.1 as it was expected, the engine efficiency decreases at full load for fuel injection ranges.









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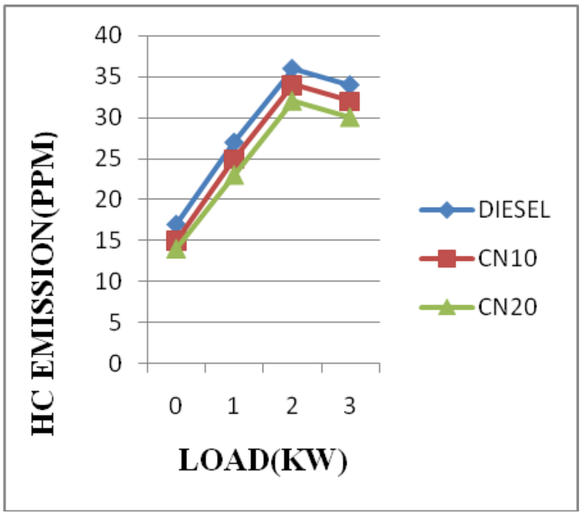

TABLE 1 PERFORMANCE TEST FOR CN10 AT VARIOUS LOADS

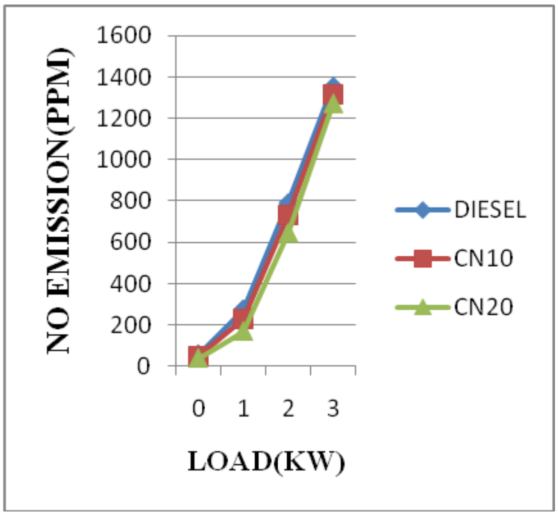

TABLE.2 PERFORMANCE TEST FOR CN20 AT VARIOUS LOADS

TABLE 1 PERFORMANCE TEST FOR CN10 AT VARIOUS LOADS

Load (KW)	Load Current (Amps	FC (KG/Hr)	Exhaust Temp C	Water Flow Rate (Kg/Hr	Break Power (KW)	TFC (Kg/hr)	SFC Kg/Kwh	Br.Th Efficiency %	Mech. Efficiency %	Indicated Efficiency %
0	0	0.469	124	52	0	0.469	0	0	0	30.73
1	4.2	0.734	177	51	0.95	0.734	0.77	11.09	36.1	30.73
2	9	0.96	230	52	2.01	0.96	0.48	17.95	54.45	32.96
3	12.9	1.12	314	51	2.76	1.12	0.41	21.12	62.14	33.99

TABLE.2 PERFORMANCE TEST FOR CN20 AT VARIOUS LOAD

Load (KW)	Load Current (Amps)	FC (KG/Hr)	Exhaust Temp C	Water Flow Rate (Kg/Hr)	Break Power (KW)	TFC (Kg/hr)	SFC Kg/Kwh	Br.Th Efficiency %	Mech. Efficiency %	Indicated Efficiency %
0	0	0.533	124	52	0	0.533	0	0	0	40.46
1	4.2	0.73	177	51	0.93	0.73	0.78	10.92	26.99	40.46
2	8.8	0.95	230	52	1.96	0.95	0.48	17.68	43.79	40.39
3	12.8	1.11	314	51	2.71	1.11	0.41	20.93	51.85	40.36

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TABLE.3 PERFORMANCE TEST FOR DIESEL AT VARIOUS LOAD

Load (KW)	Load Current (Amps)	FC (KG/Hr)	Exhaust Temp C	Water Flow Rate (Kg/Hr)	Break Power (KW)	TFC (Kg/hr)	SFC Kg/Kwh	Br.Th Efficiency %	Mech. Efficiency %	Indicated Efficiency %
0	0	0.533	124	52	0	0.469	0	0	0	40.43
1	4.4	0.735	177	51	1	0.734	0.75	28.46	28.46	40.43
2	8.9	0.96	230	52	2.02	0.96	0.48	44.55	44.55	40.4
3	12.9	1.12	314	51	2.97	1.12	0.41	52.42	52.42	40.33

TABLE 4 EMISSION OF DIESEL WITH RESPECT TO VARIOUS LOADS

LOAD(KW)	CO	HC	CO2	O2	NO
0	0.04	16	1.60	18.57	58
1	0.04	21	2.90	16.88	276
2	0.05	28	4.90	13.89	791
3	0.07	26	6.10	11.77	1205

TABLE 5 EMISSION OF CN10 WITH RESPECT TO VARIOUS LOADS

LOAD(KW)	CO	HC	CO2	O2	NO
0	0.03	15	1.4	18.73	81
1	0.04	19	2.7	16.23	279
2	0.03	27	4.6	13.94	870
3	0.06	25	5.9	11.96	1280

TABLE 6 EMISSION OF CN20 WITH RESPECT TO VARIOUS LOADS

LOAD(KW)	CO	HC	CO2	O2	NO
0	0.07	15.5	1.2	18.39	106
1	0.07	19.32	2.5	16.14	319
2	0.05	26.48	4.4	14.23	912
3	0.05	24.57	5.8	11.47	1320

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IV. Conclusion

In the present investigation, CNSL which was extracted from Cashew Nut Shells is considered as a potential alternative fuel for compression ignition engines. The CNSL was transesterified under optimum reaction condition and obtained the CNSL bio-diesel. The important properties of this bio oil are quite close to that of diesel. The break thermal efficiency increases slightly by little increase of specific fuel consumption. The bio-diesel and its B10, B20 percentage blend with diesel was used as fuel in compression ignition engine and performance and emissions characteristics are analyzed with four various loads. The B10 and B20 reduced CO, HC and CO2 emission in the exhaust and smoke reduced significantly at various load. Therefore, bio-diesel blend improves the performance and reduces the exhaust emissions in diesel engine. Using of the CNSL as alternative fuel at various loads can improve the agriculture economy and diminish indecision of fuel availability.

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