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Performance and emission analysis of Karanja oil blends with additives in diesel engine

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Abstract— The cost of crude oil, limited resources of fossil oil has been a renewed focus on vegetable oils and animal fats to make biodiesel fuels. The increasing energy demand in our day to day life causes depletion of available diesel. The experimental fuels are contained in single cylinder water cooled diesel engine under the various load conditions to evaluate the performance and emission parameters of the engine. Finally karanja oil 15-20%blends of karanja oil with 5-6 Ethanol along with 80-85% diesel is used as a fuel and the engine performance and emission characteristics will be analysed. The results prooved that the mixing of biodiesel with ethanol additive improves the parameters and reduces the CO and HC emission as compared to other fuels.

Keywords- performance,ethanol, emission, biodiesel, karanja oil,fuel efficiency,diesel engine, emission analysis.

I. INTRODUCTION

Ever increasing drift of energy consumption due to growth of population, transportation and luxurious lifestyle has motivated researchers to carry out research on biofuel as a sustainable alternative fuel for diesel engine..Bio-diesel is a promising alternative for our Diesel needs.Biodiesel is the name of a clean burning alternative fuel, produced from domestic, renewable resources. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend.With vast vegetation and land availability, certainly bio-diesel is a viable source of fuel for energy in the day today life. It is accounted to easy usability,availability and cost effectiveness.But the scarcity of fossil fuels are a great concern due to increase in world demand. Indian conditions.Biofuel such as biodiesel andethanol, produced from renewable feedstocks, are the most appropriate alternative of petroleum fuels.

Fossil fuel is the major source of also it is the major source of atmospheric pollution in today world. So efforts are on to find alternative sources for this depleting energy source .So, researches are going towards generation of alternative energy sources similar to the present day fuels . Diesel fuel serves as a major source of energy, mainly in the transportsector.Variable compression ratio is a technology to adjust the crank angle of an internal combustion engine while the engine is in operation. Bio-fuel such as Bio-diesel and ethanol produced from renewable feed stocks are the most appropriate alternative of petroleum fuels.

These oils cannot be directly used in the engine due to their high viscosity and density, and low calorific value.The glycerol component should be removed by transesterificationreaction.Fuel injection pressure and additives play an important role in diesel engine performance. Higher injection pressure decreases the diameter of fuel particles. This results in better fuel-air mixtures,improved combustion, and performance characteristics. High pressure injection with small orifices can achieve lean combustion, better fuel atomization and evaporation with improved emissions.The adding of ethanol into Biodiesel-diesel blend in diesel engines significantly reduces HC,PM,NO_x and smoke emissions but slightly increase in fuel consumption. Vegetable oils that is extracted from crops like soya bean, peanut, sunflower, coconut, karanja, neem, cotton, mustard, linseed and castor have been evaluated in many parts of the world. Karanja (pongamia) is an oil seed-bearing tree, which is non-edible and does not find any other suitable application due to its dark colour and odour.

II. LITERATURE SURVEY

[1].Jayashri N. Nair et al, **"***Analysis of performance and emission on compression ignition engine fuelled with blends of Neem biodiesel***"**has discussed the fossil fuels are depleting and greenhouse gases are increasing usage of came into existence. Biodiesel is a renewable, clean-burning diesel which can be produced from vegetable oils. This project deals with study of emission and performance characteristics on diesel engine with blends of Neem oil as biodiesel.

[2].G.R.K Sastry2 et al, **"***Effect of Fuel Injection Pressure, Isobutanol and Ethanol Addition on Performance of Diesel-Biodiesel Fuelled D.I. Diesel Engine***"**has discussed Biodiesel with additives is generally preferred for improvement of performance and emission characteristics of diesel engines. Higher fuel injection pressure is effective in improving the performance and reducing emissions. In the present work, Isobutanoland ethanol as additives to the diesel-biodiesel blends was investigated experimentally in a direct injection diesel engine. Isobutanol (A1) and Ethanol (A2) were added 5%-10% by volume to diesel-biodiesel blends and the performance and emissions characteristics at different injection pressures viz. 200, 225, 250 and 275 bars were studied.

[3].M. Mofijur* et al, **"***Recent Developments on Internal Combustion Engine Performance and Emissions Fuelled With Biodiesel-Diesel-Ethanol Blends***"**Ever increasing drift of energy consumption due to growth of population, transportation and luxurious lifestyle has motivated researchers to carry out research on biofuel as a sustainable alternative fuel for diesel engine. Biofuel such as biodiesel and ethanol, produced from renewable feedstocks, are the most appropriate alternative of petroleum fuels. However, direct using of ethanol in diesel fuel face some technical problem especially in cold weather, due toLow cetane number, lower flash point and poor solubility. Biodiesel can be blended with both ethanol and diesel fuel and biodiesel–alcohol–diesel blends can be used in diesel engines. The aim of this review paper is to discuss the effect of mixed blends of biodiesel alcohol and diesel on engine performance and emission parameters of a diesel engine.

[4].Prof.Vimal V Prajapati, et al, **"***Performance and emissionanalysis of diesel engine fuelled with karanja oil and diesel***"**has discussed This paper evaluates the possibility of using Karanja oil from Karanja seed by chemical extraction process and mixing of the diesel in varying volume proportions in order to prepare a number of test fuels for engine application. The prepared test fuels are used in single cylinder water cooled diesel engine at various load conditions to evaluate the performance and emission parameters of the engine.

[5].Papade Chetan, et al, **"***Performance and emissionanalysis of diesel engine fuelled with karanja oil and diesel***"**has discussed the study investigates the feasibility of biodiesel as a petroleum diesel substitute. This paper presents the results of tests carried out on diesel engine run on biodiesel produced by transesterification of Karanja oil and its blends with petroleum diesel. Engine tests have been carried out with the aim of comparing emissions parameters such as CO, CO2, NOx, etc. For biodiesel mixtures CO emissions is lower than that of diesel fuel. As the amount of biodiesel in the blend increases, the amount of CO emission decreases**.**

III. PROBLEM IDENTIFICATION

The major threats for usage diesel are Rising price for petroleum fuel, Engine exhaust emissions, Depletion for fossil fuels, Global warming effect, In order to overcome the aboveissues, the search of alternative fuels for diesel engines from conventional fuel is highly increasing.B20 blend is taken because thereis no need of modification in engine.

IV. SCOPE OF THE PROJECT

1. Changing the mixture ratio of the diesel and karanja oil.

2. Modifying the percentage of the ethanol in the mixture.

3. Designing the crank angle if it is necessaryto obtain the maximum efficiency.

V. EXPERIMENTAL SETUP

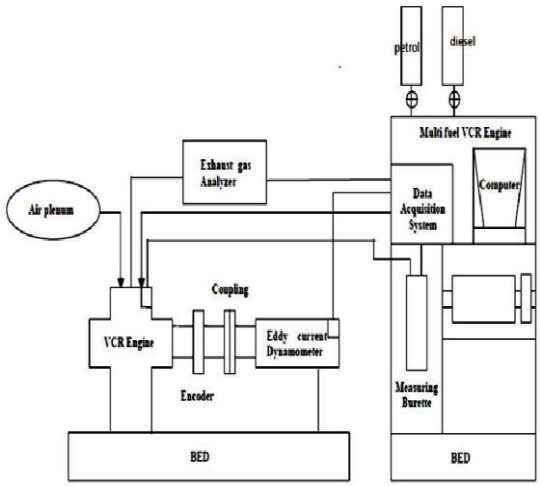

Fig.1 Experimental setup

The properties of Karanja oil before transesterification, Karanja oil after transesterification and Diesel are compared in the table below:

Table 1. Properties of fuel

PROPERTIES	RAW OIL	DIESEL	BIODIESEL
Density(kg/m^3)	924	832	860
Calorific value(KJ/kg)	34000	42800	37270
Viscosity at 40°C (cSt)	69.6	3.8	5.6
Flash point(°C)	241	74	120
Fire point(°C)	253	63	130

VII. WORKING PROCEDURE

The karanja oil and castor oil are used to extract biodiesel. The biodiesel is blended with petroleum diesel in different proportions to prepare testing blends which are tested on 4 stroke CI engine. The study of performance and emission characteristics of CI engine will be carried out.The engine was coupled with rope brake dynamometer to apply different engine loads. The emissions from the engine were studied at different engine loads. After the engine reached the stabilized working condition, emissions like CO, HC and NOx were measured using an exhaust gas analyzer.

Variable Compression Ratio engine:

The performance characteristics of the engine can be analyzed by carrying out a load test on the engine. The load can be varied continuously at regular intervals of time. The loading is done on a variable compression ratio engine manufactured by Kirloskar which is a largest producer of portable multi-fuel engines. The cylinder we used is a single cylinder four stroke diesel engine and it is an air cooled engine. A fuel tank with a measuring burette is present which helps to measure the fuel consumed.

Table.2: Specifications of VCR engine

SPECIFICATIONS	
General details	4- stroke Kirloskar Water cooled Single cylinder
Power	3.5kW at 1500 rpm
Speed	1500rpm
Compression ratio	17.5:1(variable from 12 to 18)
Bore	87.5 mm
Stroke	110mm
Combustion principle	Compression ignition

VIII. RESULTS AND DISCUSSION

Effect on Brake Thermal Efficiency:

The results of Brake Thermal Efficiency are evaluated with the help of various loading conditions like 0%, 25%, 50%, 75%, and 100% by running the engine with different blends prepared. From the graph, it can be concluded that the brake thermal efficiency of the engine increases with increase in loads when the blend 2 (B20) is used.

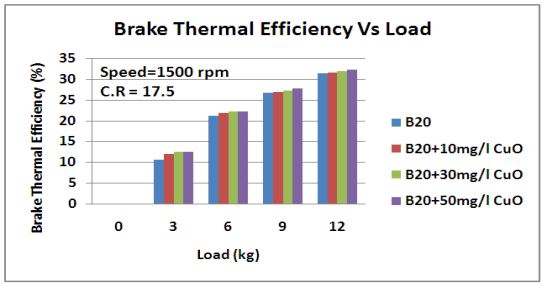

Fig.2 Load vs Brake thermal efficiency

Effect of NO_x Emission:

The slower burning character of the fuel causes a slight delay in the energy release, which results in higher temperature in later part of power stroke and exhaust stroke. Increased exhaust gas temperature is due lower heat transfer and the fact that biodiesel has some oxygen content in it which facilitate NOx formation.

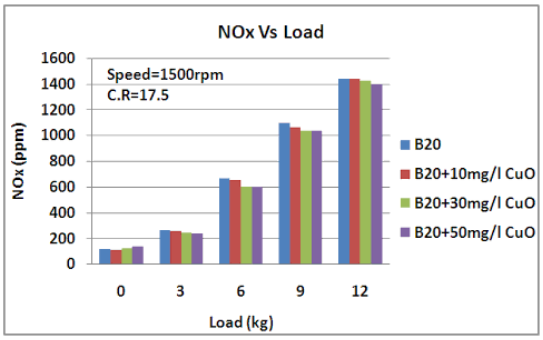

Fig.3 Load vs NO_x

IX. CONCLUSION

The following outcomes are arrived from VCR engine with operation of various biodiesel blends, loads and injection pressure. The emissions of this experiment satisfies the BHARAT STAGE - 4 standard emissions.

1.When ethanol is used as a fuel at injection pressure,the lowest CO emission is arrived.

2.The lowest NO_X emission is arrived.

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