PERFORMANCE AND EMISSION CHARACTERISTICS WITH KEROSENE BLENDING WITH DIESEL ON A SINGLE CYLINDER FOUR STROKE CYCLE DIRECT INJECTION DIESEL ENGINE

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ABSTRACT

This paper describes the experimental investigations with kerosene blending with diesel on a single cylinder four stroke cycle direct injection diesel engine. Kerosene is inferior petroleum distillation fraction and is conventionally used in stoves used for cooking. The engine was mounted on test bed and fitted with attachments like hydraulic dynamometer, fuel consumption and air consumption measuring systems. Exhaust gas analyzer was used for measuring emissions. The engine was run in the neat diesel mode and data was collected for power, speed, air and fuel consumption .Exhaust emissions were also measured. The experiments were repeated for 30% and 50% kerosene-diesel blends. Thermodynamic analysis was done in both cases. It was seen that the power output was improved with kerosene adulteration in diesel. There was also reduction in the brake specific fuel consumption and opacity (exhaust emissions) with increased kerosene substitution in diesel.

Keywords : Diesel Engine , Kerosene , Performance , Emissions, Experimental.

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INTRODUCTION

It is well known fact that the petroleum resources are getting depleted. On the other side the use of petroleum in automotive sector is increasing at an alarming rate. In order to meet future energy demands and to conserve petroleum, other alternative fuels have to be tested and used in vehicles. The internal combustion engine researchers have been trying and investigating the performance of diesel engines with fuels like ethanol, methanol, CNG substitution, Hydrogen substitution and bio-diesel substitution etc. Kerosene is an inferior petroleum distillate and is used for household uses in stoves. It contains between 6 and 16 carbon atoms per molecule. Kerosene is a fuel with lower cetane number than diesel fuel, thus giving a longer ignition delay, making it viable for lower emissions since the longer ignition delay gives a longer time for the fuel to mix with the in-cylinder gas prior to combustion onset. The authors have tried to investigate the effects of kerosene blending with diesel in a single cylinder direct injection diesel engine. The aim is to improve the performance and emission characteristics of diesel engines.

Comparison Of Physical And Chemical Properties Of Diesel And Kerosene. [1]

fuel property	kerosene	Diesel
density , Kg/m^3	780-810	840-880
lower heating value ,MJ/Kg	43.1	42.5
stochiometric air-fuel ratio , weight	15	14.5
Self Ignition Temperature , K	493	500
octane number	15-25	3
Cetane Number	55	45-55

EXPERIMENTAL SET UP

Test Engine

The engine used for the present experiments is a water cooled, 5 H.P, 1500 rpm , vertical , single cylinder diesel engine . The major specifications of the engine are given in Appendix 1. The experimental set up is shown in plate no. 1. The fuel metering system consists of a 5 litre tank for diesel / Kerosene-diesel blends. Fuel flow is measured with the help of calibrated burette and stop watch.

The air flow rate is measured with the help of a U-tube manometer and a drum fitted with an orifice. The engine is fitted with a constant speed governor which maintains the speed of the engine at 1500 rpm. The engine is lubricated by crankcase lubrication. The speed of the engine is measured by optical digital tachometer.

Engine Dynamometer

The test engine is coupled with a hydraulic dynamometer mounted on a cast iron test bed. The dynamometer has sufficient capacity to absorb the maximum power produced by the engine. The dynamometer is loaded hydraulically by controlling flow rate of water and the torque is measured with the help of a spring loaded meter.

Plate No.1: Experimental set up.

Instrumentation

The instruments used for measuring the basic quantities are described here.

Temperature Measurement

Temperatures were measured using dial gauge thermometers.

Smoke Meter.

The smoke emissions were measured with the help of smoke meter. The opacity of the exhaust gas was measured in HSU units by inserting the probe in the exhaust manifold.

TEST PROCEDURE

The basic quantities that were measured during the experimental investigations were, fuel consumption, air consumption, torque output, exhaust gas temperature and opacity in HSU units. Comprehensive experiments were carried out for neat diesel, 30% kerosene-diesel blend (K 30%), 50% kerosene-diesel (K 50%) and neat diesel over a wide range of load on the engine. The engine speed was maintained constant at 1500 RPM.

RESULTS AND DISCUSSIONS

Effect Of Load On Power

The Fig.1 shows the effect of load on power for neat diesel and kerosene diesel blends. It is clear that as the load increases the power developed also increases.

The pwer is slightly higher for higher percentage of kerosene in fuel as compared to neat diesel because kerosene has slightly higher calorific value than neat diesel , also the cetane number of kerosene is comparable to that of diesel. Due to higher ignition delay in kerosene it is assumed that diesel burns first followed by kerosene. Also the octane number of kerosene is higher than that of diesel and it burns smoothly with flame propagating from diesel to kerosene.

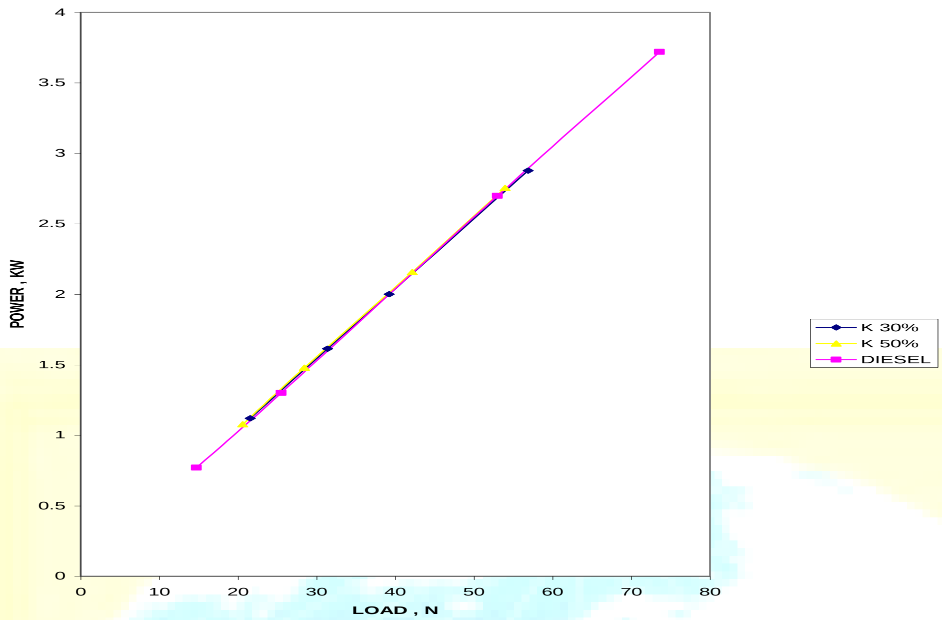

FIG 1 EFFECT OF LOAD ON POWER

Effect Of Load On BSFC

The Fig.2 shows the effect of load on BSFC for neat diesel and kerosene-diesel blends. The BSFC decreases with load as the power increases at higher rate than the fuel consumption rate for higher loads due to better combustion.

The BSFC is less for kerosene-diesel blends in comparison with neat diesel and in general it can be interpreted that with the increase in kerosene concentration BSFC decreases. This is due to the fact that more power is developed for the same load in case of kerosene-diesel blends due to higher calorific value of kerosene.

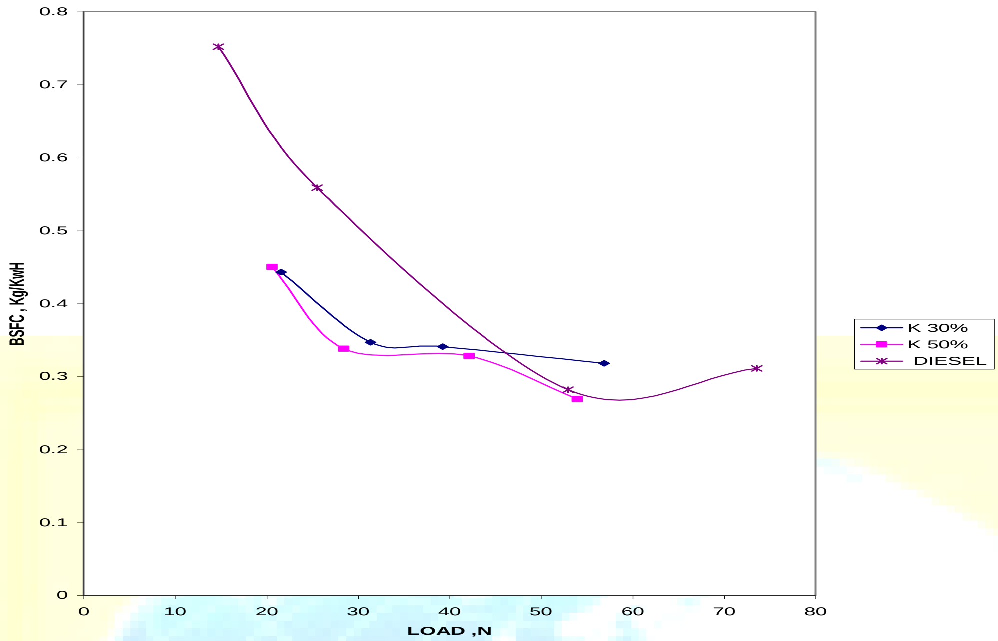

FIG. 2 EFFECT OF LOAD ON BSFC

Effect Of Load On Opacity And Emissions.

Fig.3 shows the effect of load on opacity for neat diesel and kerosene-diesel blends. The emissions increase as load is increased. This is because as the load on the engine increases, more quantity of fuel is required to drive the engine and hence results in increased opacity.

The emissions are comparatively less for various kerosene-diesel blends in comparison with neat diesel. It is observed from the graph that with the increase in kerosene concentration opacity tends to decrease because since the diesel engines are operated lean with respect to diesel , there is sufficient amount of air present in the engine to burn kerosene completely. Also since the ignition delay for kerosene is higher it gets further more time to form favourable air-fuel mixture for complete combustion.

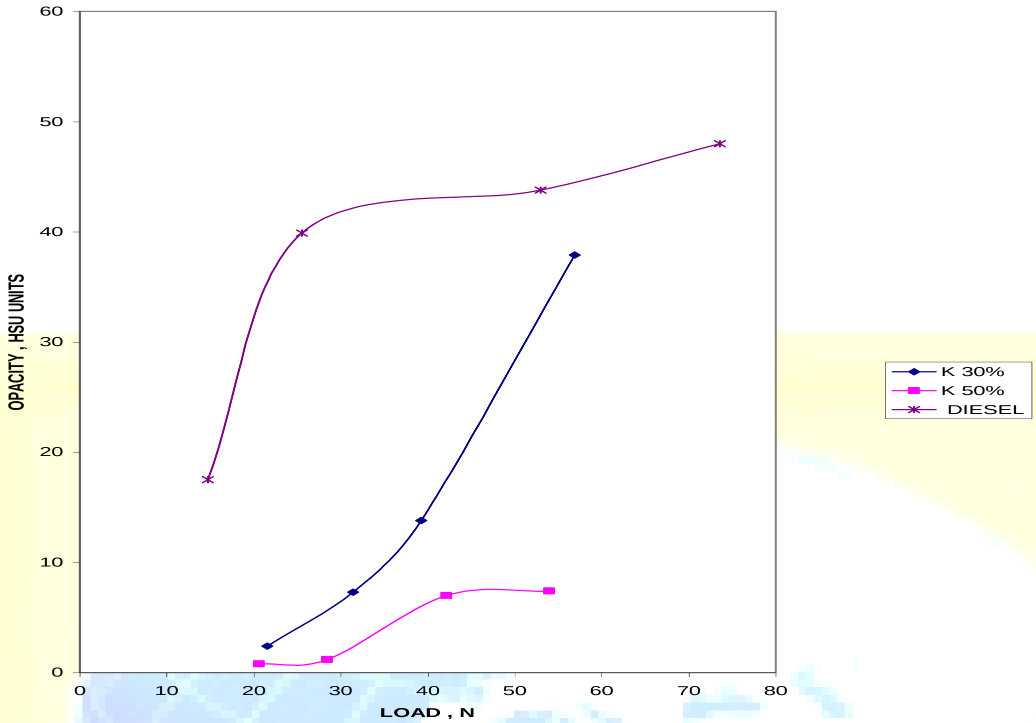

FIG 3. EFFECT OF LOAD ON EMISSIONS

Effect Of Load On Exhaust Gas Temperature

Fig.4 below shows the effect of load on exhaust gas temperature for neat diesel and kerosene-diesel blends. It can be interpreted from the graph that exhaust gas temperature values are higher for kerosene-diesel blends as compared to neat diesel for similar load. The exhaust gas temperature for kerosene blends is higher as compared to neat diesel due to higher thermal efficiency with kerosene-diesel blends and because of slightly higher calorific value of kerosene.

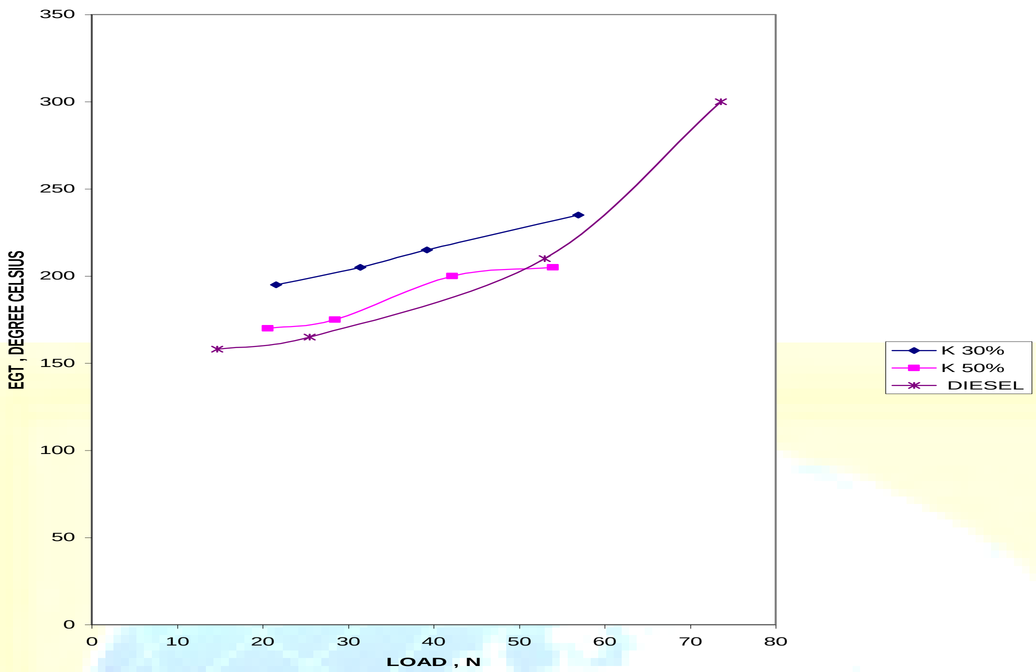

FIG. 4 EFFECT OF LOAD ON EXHAUST GAS TEMPERATURE

CONCLUSIONS

Kerosene can be safely be added to diesel up to 50% investigated substitution. This also results in up to 90% lower pollution levels with kerosene-diesel blends. Addition of kerosene may add to heterogeneous behavior but it is assumed that diesel gets ignited first because of its high cetane number which then ignites kerosene component with low cetane number. There is marginal increase in power with kerosene-diesel blends and there is subsequent fall in BSFC up to about 40%. This will still result in economical operation of engine due to increased power and reduction in BSFC. Kerosene blending with diesel makes it more environment friendly from smoke point of view.

REFERENCES

(1) Richard H Bechtold ,' alternative fuels guide book', SAE publication

APPENDIX 1

Engine Specifications

Type	A single cylinder, vertical, water cooled four stroke cycle direct injection diesel engine.
Number of cylinders	one
Cycle of operation	Four Stroke

Ignition	Compression Ignition
Cooling system	Water Cooled
Compression Ratio	16:1
R.P.M.	1500
Bore	80 mm
Stroke	110 mm
BHP	5