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Effect of Oxygenated Fuel Dibutyl Ether on Diesel Engine

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Abstract- Stringent emission norms and environment degradation due to pollutants from the automotive vehicles lead us to find the suitable alternative for the petro-diesel. The oxygenated fuel used is dibutyl ether(DBE). While injection pressure is 200 bar and injection timing is 20.5^0BTDC we get higher brake thermal efficiency and lower brake specific fuel consumption for DBE10 compare to diesel.

Index Terms- injection pressure, oxygenated fuel, brake thermal efficiency

I. Introduction

Diesel engines have been widely used in recent decades as an alternative power source for light-duty vehicles because of the economic and environmental reasons. Therefore, the global diesel fuel consumption has increased with the pollutions sourced from diesel engines [1,2]. The unburned or partially burned (total) hydrocarbon (THC) emissions, smoke (soot) or particulate matter (PM), nitrogen oxides (NOx), sulfur oxides (SOx) emitted from compression ignition (CI) engines and particularly carbon dioxide (CO2) create severe environmental problems [2-4], which have been tried to be reduced by the stringent emission legislations. The different alternatives such as the investigation of viable alternative fuels and the reformulation of conventional fuels have been evaluated for meeting the emission standards and future energy demand [5,6]. The reformulation of diesel fuel contains the reduction of the sulfur and aromatic contents or the oxygen addition to diesel fuel [7]. A lot of works have been performed to show the effects of using alternative diesel fuels and additives including synthetic diesel fuels, biodiesels, alcohols and ethers.

The properties of DBE are almost similar to diesel, expect DBE as higher cetane number and lower density compare to diesel. DBE as higher oxygen content.

II. Research Process

An effort is made in this study to evaluate the effect of varying the injection timing on the performance and emissions of a 5.2 kW engine fuelled with dibutyl ether (DBE10) for establishing the appropriate injection pressure and also to study the effect of oxygenated fuel.

III. Studies and Findings

Properties of diesel and simarouba biodiesel

Property comparison of Diesel and Simarouba bio diesel are shown in table 1

SL.NO.	Characteristics	Diesel	DBE 100%	DBE10
1	Calorific value (KJ/Kg)	43000	42800	42998
2	Viscosity at 40^0C	2.6-5	0.23	2.7
3	Cetane number	50	91	51
4	Flash point (^{0}C)	55	25	55
5	Specific gravity	0.84	0.767	0.839

IV. Experimental Set Up, Procedure and Observation

The experiment aims at determining appropriate proportions of biodiesel & diesel for which higher efficiency is obtainable. Hence .experiments are carried out at constant speed, comparing the performance of compression ignition engine operated on blends of diesel. The S20 blend is checked under loads 20%,40%,60% and 80% with injection timing 15.1^0 by varying injection pressure 200

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bar,250 bar,300 bar and compression ratio 17.5. The samples are prepared by using the 1000 ml measuring jar and a 10 ml graduated test tube.

Fig.1 shows the schematic diagram of the complete experimental setup for determining the effects of waste cooking oil as bio diesel fuel additives on the performance and emission characteristics of compression ignition engine. It consists of a single cylinder four stroke water cooled compression ignition engine connected to an eddy current dynamometer. It is provided with temperature sensors for the measurement of jacket water, calorimeter water, and calorimeter exhaust gas inlet and outlet temperature. It is also provided with pressure sensors for the measurement of combustion gas pressure and fuel injection pressure. An encoder is fixed for crank angle record. The signals from these sensors are interfaced with a computer to an engine indicator to display P-ϴ, P-V and fuel injection pressure versus crank angle plots. The provision is also made for the measurement of volumetric fuel flow. The built in program in the system calculates indicated power, brake power, thermal efficiency, volumetric efficiency and heat balance. The software package is fully configurable and averaged P-ϴ diagram, P-V plot and liquid fuel injection pressure diagram can be obtained for various operating conditions.

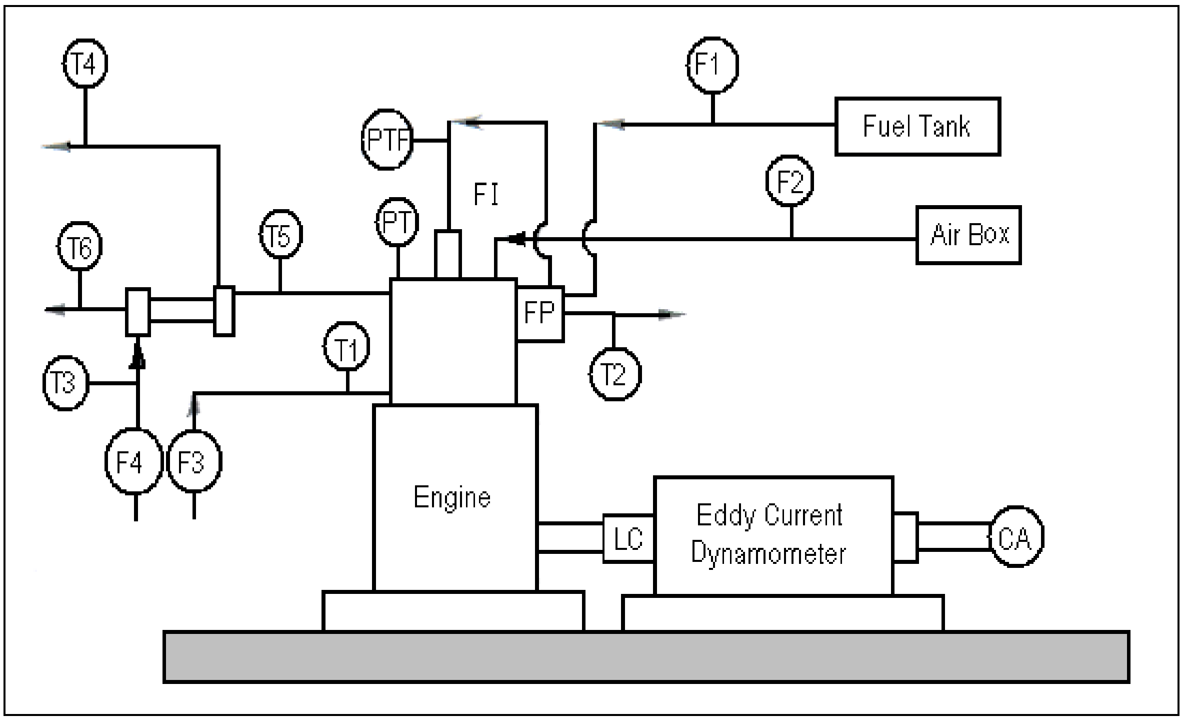

Fig. 3.1 Schematic Diagram of the Experimental Set-up

PT Combustion Chamber Pressure Sensor	F1 Liquid fuel flow rate
PTF Fuel Injection Pressure Sensor	F2 Air Flow Rate
FI Fuel Injector	F3 Jacket water flow rate
FP Fuel Pump	F4 Calorimeter water flow rate
T1 Jacket Water Inlet Temperature	LC Load Cell
T2 Jacket Water Outlet Temperature	CA Crank Angle Encoder
T3 Inlet Water Temperature at Calorimeter	EGC Exhaust Gas Calorimeter
T4 Outlet Water Temperature at Calorimeter	
T5 Exhaust Gas Temperature before Calorimeter	
T6 Exhaust Gas Temperature after Calorimeter	

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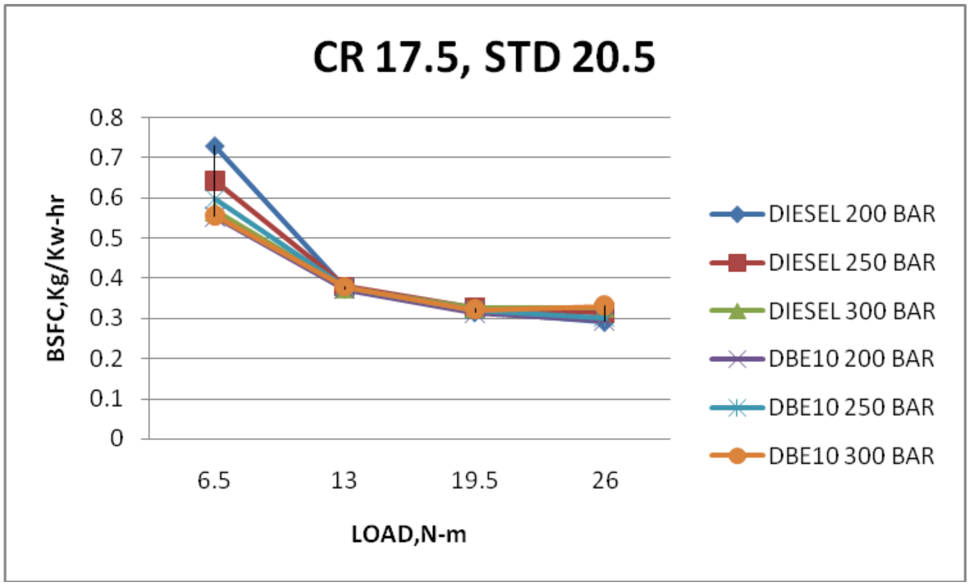
ENGINE SPECIFICATIONS

SL.NO	Engine parameters	specification
1	Engine type	TV1(Kirloskar ,four stroke)
2	Rated power	5.2 KW at 1500 rpm
3	Bore	87.5 mm
4	Stroke	110 mm
5	Cubic capacity	661 cc
6	Compression ratio	17.5:1
7	Injection pressure	200 bar
8	Injection timing	20.5^0 BTDC

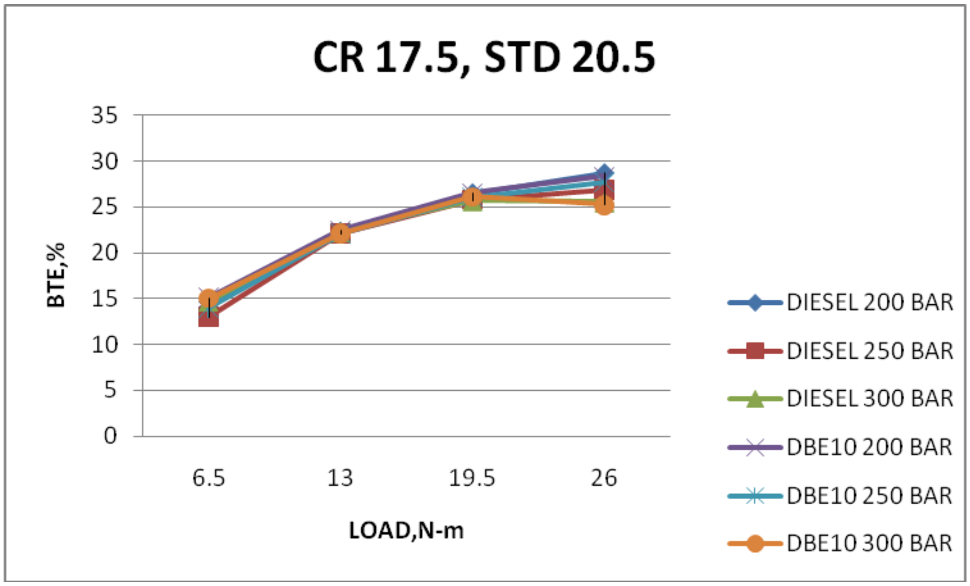
V. RESULTS AND DISCUSSIONS

Brake specific fuel consumption



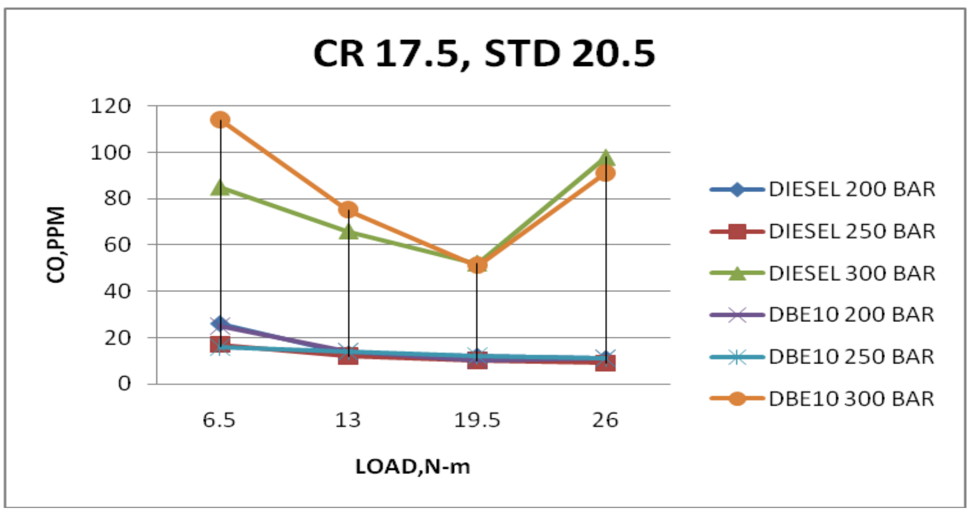
At 200 bar brake fuel consumption of DBE10 is lower than diesel.

Brake thermal efficiency



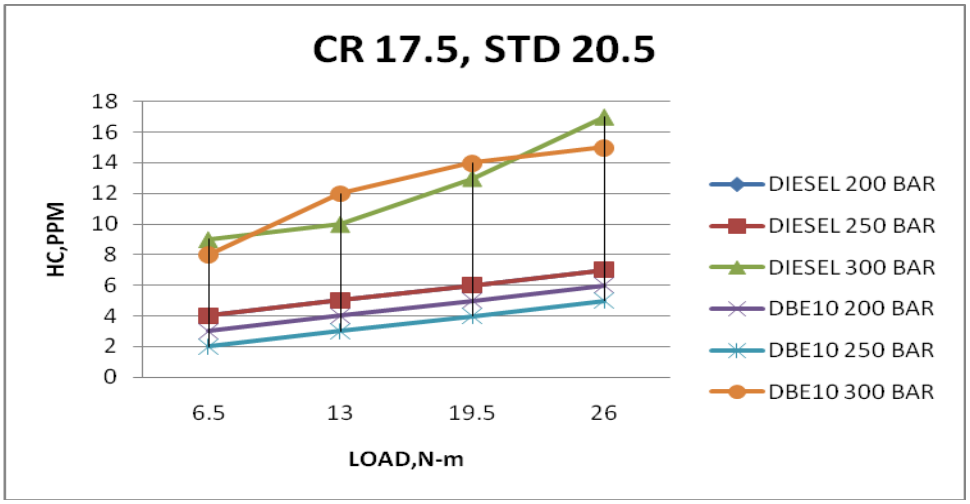
DBE10 gives better brake thermal efficiency compare to diesel in most of the cases.

Carbon monoxide



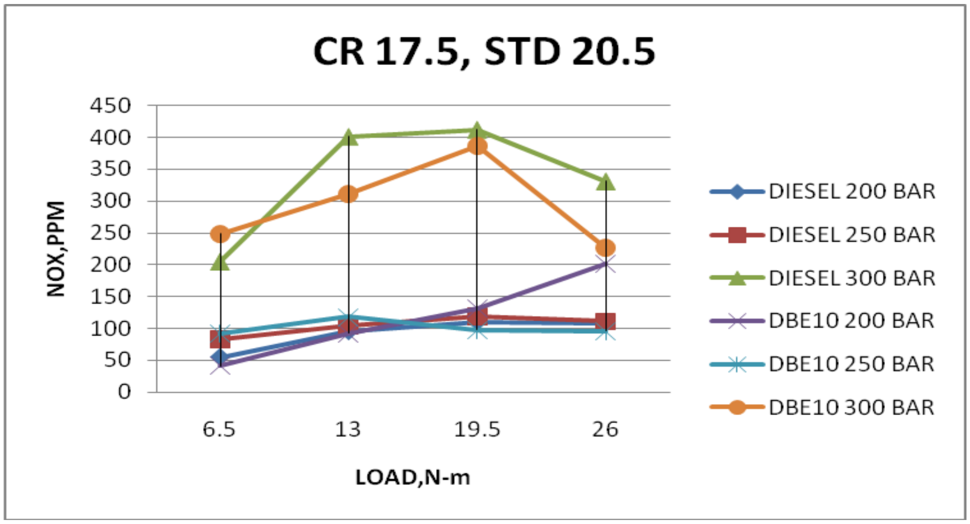
At 250 bar both DBE10 and diesel gives lower carbon monoxide emission.

Hydrocarbons



Lowest hydrocarbons emisson is observed at 250 bar for DBE10 compare to diesel.

Oxides of nitrogen



Lowest NOX emission is observed at 250 bar for DBE10 compare to diesel.

APPENDIX

BSFC-BRAKE SPECIFIC FUEL CONSUMPTION

BTE -BRAKE THERMAL EFFICIENCY

BTDC-BEFORE TOP DEAD CENTRE

CO- CARBON MONOXIDE

HC- HYDROCARBONS

NOX- OXIDES OF NOTROGEN

PPM- PARTS PER MILLENNIUM

DBE10-DIESEL+10 DROPS OF DIBUTYL ETHER

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