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EFFECT OF SPARK ASSISTED DIESEL ENGINE USING ETHANOL AND BIO – DIESEL BLEND AS A FUEL

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ABSTRACT

An experimental investigation was conducted on the Effect of spark assisted diesel engine using Ethanol and Pongamia oil blend. A single cylinder, four stroke, water cooled engine of 5.2 Kw rating was used for this experiment. The effects of injection timing, ignition timing, and injection nozzle parameters on the regulated emissions from a high-compression ratio direct-injection spark-ignition Ethanol engine were investigated experimentally and its emission characteristics were compared with the diesel counterpart. Best compromises between the brake thermal efficiency and three emission pollutants at the optimal injection and ignition timings were obtained.

Smoke has been found reduced by 2-3 % at operating speeds of 2500 rpm-3000 rpm and 3 % increase in brake thermal efficiency and 3% improvement in specific fuel consumption (SFC) at the same operating speed range.

Keywords: Spark assisted ethanol engine, Pongamia oil, injection timing, ignition timing, and regulated emissions.

INTRODUCTION

Stringent emission legislation all over the world has lead to the search for alternative fuels for I.C. Engines. The major pollutants from a diesel engine are oxides of nitrogen (NOx), smoke and particulate matter. Concentration is very much focused on compression ignition engines because they have been recognized as the most ideal power plants in transportation, industrial and agricultural sectors, due to their high efficiency of fuel. The difficulty in meeting the increasingly stringent limitations on particulate and NOx emissions has stimulated interest in ethanol-fueled compression ignition engines because ethanol diffusion flames produce virtually no soot. Unfortunately ethanol does not have suitable ignition properties under typical diesel conditions because the temperatures and pressures characteristic of the diesel engines causes a longer ignition delay while using ethanol. Therefore, in order to make use of ethanol in a diesel engine, either a system to improve the ignition quality of ethanol or a system of some ignition aids is necessary. This paper describes the spark assisted systems of using ethanol in diesel engines.

ENGINE INSTALLATION

Engine Selection

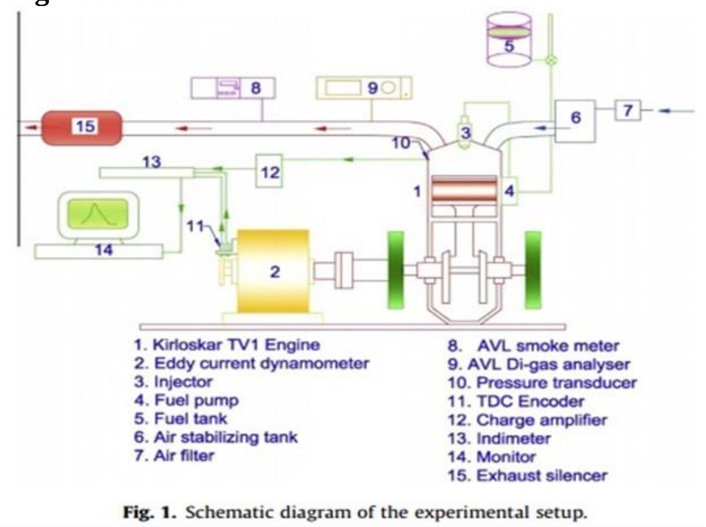

Fig.1.Schematic layout of Engine setup

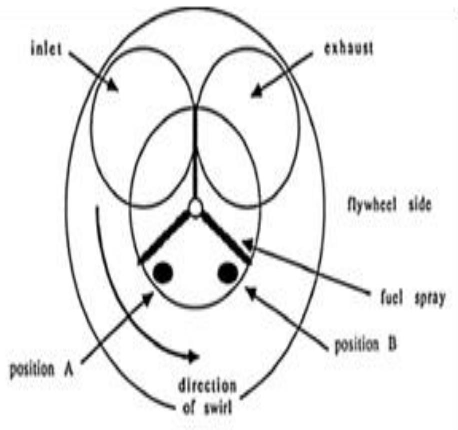

Fig.2. Possible locations for providing spark plugs

SPECIFICATION OF ENGINE

Table.1. Technical Specification of test Engine

DETAILS	SPECIFICATION
Make	Kirloskar-TV1
BHP& speed	5.2HP& 1500 rpm
Type of engine	single cylinder, 4 stroke, Diesel engine (Computerized)
Compression ratio	17.5:1
Bore& stroke	87.5mm & 110mm
Method of loading	Eddy current dynamometer
Load indicator	Digital, Range 0-50 Kg, Supply 230VAC
Load sensor	Load cell, type strain gauge, range 0-50 Kg
Method of cooling	Water
Orifice diameter	20mm
Type of ignition	Compression ignition
Inlet valve opening	4.5°before TDC
Inlet valve closing	35.55°after TDC
Exhaust valve opening	35.55°before BDC
Exhaust valve closing	4.5°after TDC
Injection timing	23°before TDC

ENGINE MODIFICATION

Cylinder Head Modification

The main modification carried out to the engine was the fitting of a spark plug into the cylinder head. The geometry of the head severely restricted the possible locations of the plug. Ideally the plug electrodes should have been located centrally in the combustion space to give the shortest flame travel path and so lead to short burn times, and also in the vaporized fuel spray. It was decided to use 14 mm plugs in order that the widest range of commercially available plugs were usable. Only two locations on the side of the head were suitable where the spark plug seating would not interfere with any studs or bolt holes.. The non-flywheel side of the cylinder head (position A) was chosen in preference to the corresponding position on the flywheel side. This plug position meant the electrodes would be located close to and downstream of one of the fuel spray plumes where a flammable gas mixture separate from the dense fuel spray is available at the electrodes of the spark plug. Use of different reach spark plugs allowed the electrode gap to be varied in relation to the fuel spray. The plug was angled into the combustion space at 45 degrees.


Fig.3.Hole provision for to accommodate spark plugs in cylinder head

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Ignition system components and their technical specifications:

Component Name	Description
Pulsar Coil /Source Coil	Pulsar/Source Coil (300 OHM): This is the piece that is dovetailed into the stator.
Trigger Coil	To control ignition timing 10 degree btdc.
CDI (Condenser Discharge Ignition)	Part No: DJ 1110103. Couple is brown in colour.Double input brown coupler.
HT Coil (2 Nos)	It is only having 2 input terminals. Off white in colour.
Spark Plug (2 Nos)	M10 X 1 Pitch, 2cm through.

IGNITION SYSTEM LAYOUT

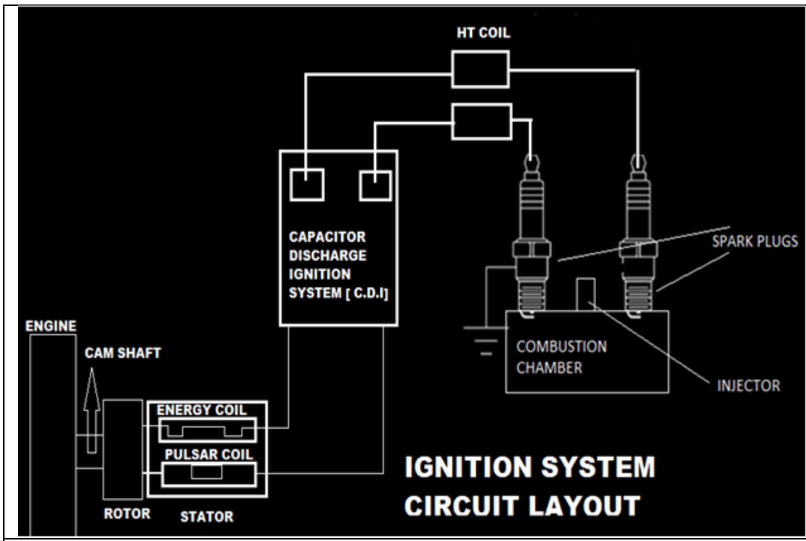
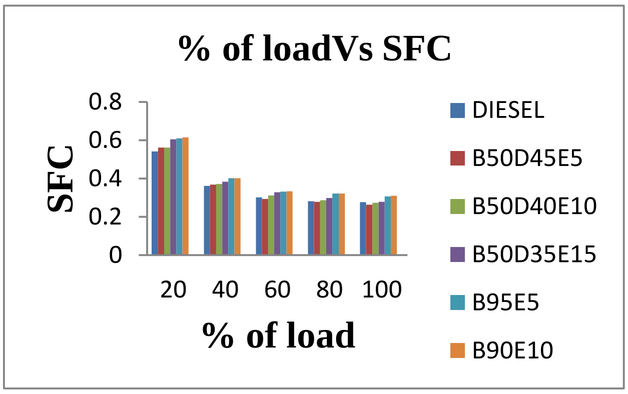
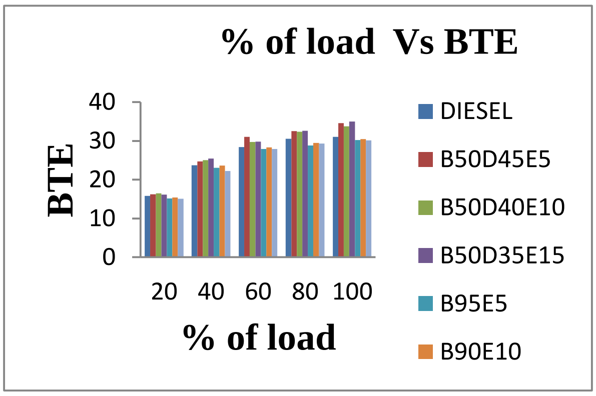


Fig.4. Ignition system circuit layout

RESULT & DISCUSSION

LOAD Vs BRAKE SPECIFIC FUEL CONSUMPTION



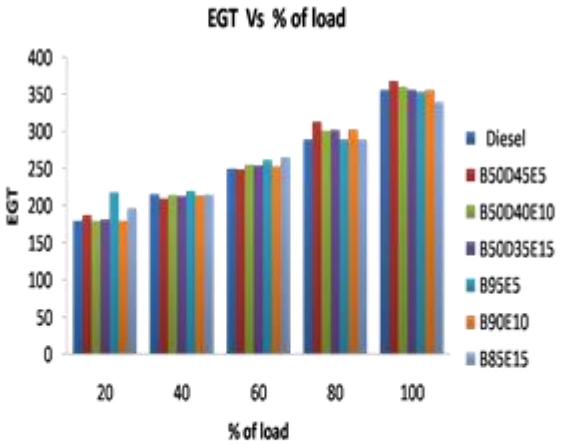


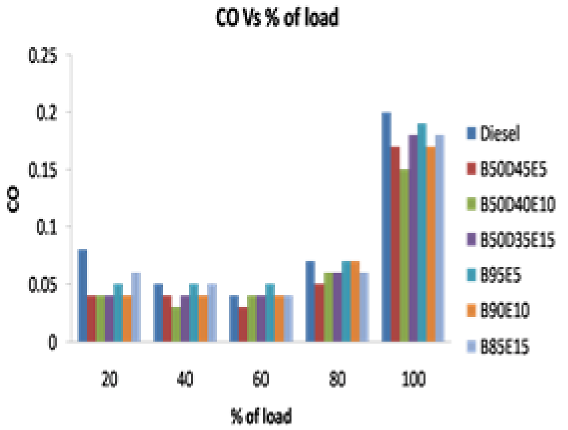
The Brake Specific energy consumption (BSFC) is an ideal variable to compare fuels with different densities. Because it gives an idea of amount of heat energy supplied to develop the same power. Better the combustion, lower will be the BSFC. The BSFC decreased with increase in load due to better combustion and lower heat losses. The variation Brake specific fuel consumption with Percentage of load for different blends of biodiesel, Ethanol and neat diesel are shown in Graph at constant speed. It was observed that consumption of fuel increases with the increase of load. The diesel fuel consumption was less in all load conditions due to the high calorific value of diesel than the biodiesel blends. At low load condition biodiesel B50D45E5, B50D40E10 consumption was 0.368Kg/KW-hr & 0.371 Kg/KW-hr slightly higher than neat diesel and at full load condition it was 0.263 Kg/KW-hr & 0.272 Kg/KW-hr higher than neat diesel due to low calorific value of biodiesel and ethanol.

LOAD Vs. BRAKE THERMAL EFFICIENCY

The Brake Thermal Efficiency is plotted against Percentage of load for various blends at constant speed of the engine. It was observed that with the increase of the load brake thermal efficiency increase in all POME, Diesel, Ethanol blends. This may be due to lower heat losses at higher loads. At medium load condition BTE of B50D45E5 was slightly higher than the neat diesel. All POME, Diesel, ethanol blends BTE is comparable with diesel. The addition of ethanol to vegetable oil reduces the viscosity of the fuel and increases volatility. This results in improved combustion phenomenon with higher thermal efficiency. Further, it can be stated that inherent oxygen in ethanol improves the combustion phenomenon. As the percentage of ethanol in emulsion increases the brake thermal efficiency increases due to lower viscosity, better atomization and improved volatility.

LOAD Vs EXHAUST GAS TEMPERATURE





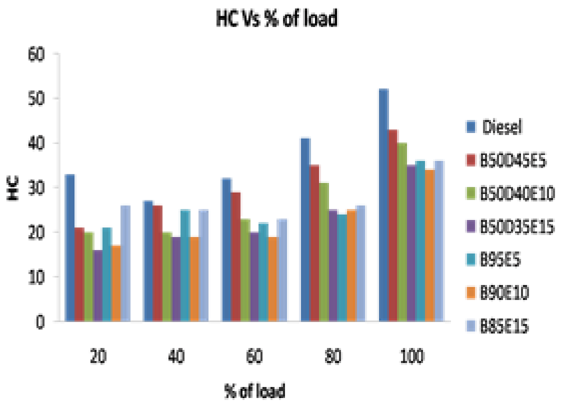
The variation of exhaust temperature with load for different fuels tested is compared with diesel. Exhaust gas temperature increases with increase in load for all tested fuels. This increase in EGT is due to fact that higher load extra amount of fuel is injected to develop more power. For B95E5&B90E10 EGT slightly increases with compare to diesel. And for other blends EGT is comparable with diesel. It is also observed that increase in ethanol percentage leads to decrease in EGT due to improvement in combustion process.

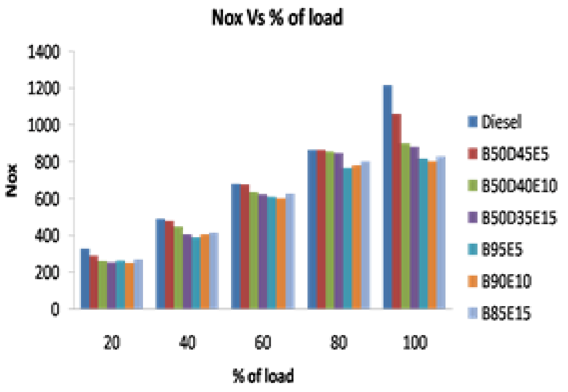
LOAD Vs CARBON MONOXIDE

Carbon monoxide emission changes with fuel and engine load. At medium load B95E5 CO emission is greater with compared to diesel. For remaining blends shows lesser CO emission. At low and medium load B50D45E5 shows slightly lesser CO emission as compared to B50D40E10. At maximum loads B50D45E5 shows slightly higher CO emission as compare to B50D40E10.

LOAD Vs HYDROCARBON

The variation of hydrocarbon emission with load for different blends of biodiesel and neat diesel & ethanol at constant speed 1500rpm.





From the graph it is observed that the hydrocarbon emission of different blends of is less than the neat diesel fuel due to the less amount of carbon and hydrogen content of the biodiesel blends. Among various blends B50D35E15 shows lesser hydrocarbon emission.

LOAD Vs OXIDES OF NITROGEN

The engines NOx emission level for the analyzed fuels at different loads are shown in graph. At small and medium engine load NOx emission level is slightly decreased, which is comparable to diesel fuel. But at high and full load, the NOx emission greatly decreased for all the fuel blends. The decreased NOx emission level is explained by the increased ethanol concentration in the fuel blends, which reduces the generation of NOx. At full engine loads, NOx emission level decreases for all the fuel blends. The NOX emission is found to decrease with ethanol addition. As ethanol contains oxygen it can be thought of adding oxygen in the same way as biodiesel.

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However, for ethanol other factors such as heat of evaporation and flame temperature also dominate. Ethanol has a higher heat of evaporation and reduces the combustion temperature.

CONCLUSIONS

In this study, the effects of Spark assisted Pongamia biodiesel blended with ethanol & diesel as an alternative fuel on engine performance were investigated experimentally. Based on the experimental results of this study, the following conclusions can be drawn:

- The engine test of blended oil performed smoothly and exhibited no starting problems.
- Blended oils can be directly used in diesel engines with any engine modifications.
- Exhaust gas temperature of B50D40E10 are compared with diesel and found to be effective as characteristics of diesel.
- CO emissions of the blend B50D45E5 decreased significantly when compared with those of standard diesel and all other blends are also found to be effective.
- The carbon dioxide emission is found to increase with increase in the concentration of biodiesel blends as the fuel.
- The NOX emissions were slightly decreased with the use of all fuel lends with respect to those of the neat diesel fuel.
- The HC emissions were slightly reduced for Pongamia, Diesel, Ethanol blends with respect to those of the neat diesel fuel, with this decrease being higher the percentage of ethanol in the blend.
- The engine brake thermal efficiency with all the Pongamia, Diesel, Ethanol blends was practically the same with that of the neat diesel fuel case.
- At medium and high load BSFC is slightly reduced for B50D45E5 fuel compared with diesel.

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