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Study and Effect of Exhaust Gas Recirculation (EGR) on the Performance and Emission Characteristics of Compression Ignition Engine.

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ABSTARCT:

In this study, the effect of the injection pressure of the injection characteristics, and combustion performance of a single cylinder, four-stroke, direct injection, has been diesel engine investigated naturally aspirated experimentally using methyl esters of canola oil (Ven) and mixed with diesel fuel. Tests were conducted for four different injection pressures (18, 20, 22 and 24 MPa) at a constant engine speed and different loads. The experimental results showed that the different exposure fuel injection, combustion and performance characteristics of different motor loads and pressure injection. The investigation showed the characteristics of fuel injection is used in its diesel resulted in the timing of the previous injections instead. The maximum cylinder pressure and the maximum rate of pressure rise and the maximum rate of fire is a little less to come and mixtures. Consumption of certain types of fuel and brake specific energy consumption between brake higher than that of diesel, while the brake thermal efficiency is generally lower than diesel fuel. Increasing injection pressure gave better results for the specific consumption of fuel and brake brake thermal efficiency compared to the initial injection pressure was reduced..

INTRODUCTION: India is one of the fastest stable economic growth, doubling transport demand in many areas of developing countries. Fuel consumption is directly proportional to this request. India relies heavily on fuel imports due to lack of reserves of fossil fuels and have a significant impact on the economy. India has to find an alternative to maintain the growth rate. Biodiesel is a promising to the needs of our alternative diesel. With the wide availability of plants and earth, and of course the biodiesel is a viable fuel source for Indian

conditions. Studies and recent research biodiesel can be extracted in the economic costs and quantities are made. A blend of biodiesel with fossil diesel has many benefits, such as reducing emissions and increase engine efficiency, the highest rating Alcetana, less engine wear and reduces fuel consumption, reduce oil consumption, and so can see that increases the engine efficiency through the use of bio diesel fuel. This will have a significant impact on the Indian economy.

The diesel engine plays a dominant role in the energy field, payment and energy. The diesel engine is a type of internal combustion engine, and more specifically the pressure ignition engine, which fuel only fired high temperature generated by the pressure of the mixture of air and fuel. Diesel cycle engine fuel.More efficient than the gasoline engine, because the spark ignition engine consumes more fuel engine ignition pressure.fuel injection system is the most important work IC engine components. Engine performance, output power, and economy and so on depends largely on the effectiveness of fuel injection system. The injection has to perform an important duty to initiate and control the combustion process system. The performance characteristics and diesel engine emissions depends on several factors such as the amount of fuel injection timing of fuel injection pressure fuel injection, the shape of the combustion chamber, the position and hole size the injection nozzle, the spray pattern of fuel, air vortex, so that the system fuel injection in a direct injection diesel engine has been to achieve a high degree of decomposition penetrate better than fuel in order to take advantage of the full charge of air and improve evaporation in a very short time and to achieve greater combustion efficiency. A large number of studies have shown that biodiesel is one of the renewable and alternative biofuels and the environment and the promise that can be used in diesel engines with little or no engine modification engines. laws exhaust gases, and depletion of fossil fuels and for fuel with politics and forced the world to find alternatives to fossil fuels. Has been investigated in many plant oil esters (biodiesel) for use in internal combustion engines, it has been shown that has the highest reduction in CO2 capacity. It is reported in a wide range of implications of different types of fuel to the engine performance characteristics. common motor parameters that effect has been quantified

include specific fuel consumption brake and brake thermal efficiency of real power. Compare and many researchers engines running on biodiesel and blends with engines running on conventional diesel performance. It has been reported a large number of researchers to use the results of biodiesel to be higher fuel consumption and brake thermal efficiency increased use of diesel in the engine. However, the use of different outcomes of biological diesel engines a variation in the engine and the difference is due to emissions in the physical and chemical properties of biodiesel performance. Already it reported the effects of physical and chemical characteristics of the fuel supply system, such as the mixture of fuel pump, fuel, air and fuel filter cartridge. To improve engine performance and emissions with biodiesel and understand the implications of the physical properties of fuel to the engine and emissions latent detailed research on the combustion characteristics and the release of the performance characteristics of heat operation is required . Emanating temperature fields resulting heat and pressure affect performance and emissions characteristics more, but most researchers still correlated performance and emissions of biodiesel against the parameters analyzed, such as the characteristics of biodiesel blend part, engine speed, engine load, injection timing and injection pressure and engine speed compression. However, there are very few companies that have been reported in the diesel combustion and firing phenomena corresponding to different biological properties motor. Therefore, the objective of this work was to study the behavior and characteristics of the phenomena of fire ignition engine combustion pressure by operating at a rate of biodiesel.

LITERATURE REVIEW:

Machacon.et.al [1] studied the effect of EGR to enrich O2 on tailpipe emissionsDiesel engine. They concluded that the highest equitable geographical representation of uranium O2 da reduce emissions of nitrogen oxides And the smoke. Avinash kumar.et.al [2] study the effect of equitable geographical representation in the degree of the exhaust gas temperature and ambiguity exhaust ignition engines. The researchers found that the degrees of temperatures of exhaust gases reduced Largely thanks to the use of equitable geographical representation. brake thermal efficiency and fuel consumption are not greatly affected equitable geographical representation. However particulate

emissions in exhaust increase, as Evidenced by the notes ofsmoke opacity. Shahadat.et.al [3] studied the combined effect of EGRHeating the intake air in the engine performance in diesel engines. The researchers found that, on average,Pregnancy conditions, nitrogen oxides, carbon monoxide (CO), engine noise, brakes

Fuel consumption was reduced when the hot air inlet and equitable geographical representation set of applications Compared with those during normal engine operations. Ghazikhani.et.al [4] study the effect of The speed of equitable geographical representation and engine emissions of carbon dioxide HCCI engine and dual fuel HC. I noticed The increase in engine speed when equitable geographical representation of the rate constant leads to increased emissions of carbon dioxide and UHC Due to incomplete combustion caused by the combustion period it is shorter and less homogeneous Mixture. The results also show that increasing EGR reduces the amount of oxygen and leads to Incomplete combustion, and therefore increases emissions of carbon dioxide due to the lower flue Temperature. increased HC emissions also due to temperatures lower combustion.

Salim [5] studied the effect of recycling exhaust gases of combustion dual properties engine fuel. Found that the combustion noise and thermal efficiency of the engine and dual fuel Affected when equitable geographical representation is used in the dual fuel engine. Mahla [6] study the effect of equitable geographical representation The performance characteristics and emissions of diesel engines to natural gas. Experimental The results indicate that the application of equitable geographical representation greatly reduces nitrogen oxides measure carbon dioxide and smoke. Rajan and Senthil Kumar [7] studied the effect of EGR on the performance characteristics and emissions diesel methyl ester of sunflower oil engine. He noted that B20 SFME with 15% EGR production rate of 25% lower NOx emissions compared with diesel fuel smoking at the same level The emissions. Arjun Krishnan et.al [8] studied predicting NOx reduction with EGR using correlation technique flame temperature. They developed methods to calculate the limit NOx levels due to equitable geographical representation, taking into account only the database engine. This approach is used torch Technology related to temperature predictions of nitrogen oxides

with sufficient accuracy - 6.5% partial loads. In the present study we have done experiments with variable compression diesel engine By changing the compression ratio, the engine load and the proportion of recirculated exhaust gas. The output parameters of this study is fuel consumption, thermal brakeEfficiency and shutter speed, part of the burnt mass and composition of the exhaust gases.

METHODOLOGY:

The Kirloskar engine is one of the widely used engines in agriculture pump sets, farm machinery and medium scale commercial purposes. The setup consists of a single cylinder, four strokes, naturally aspirated, water cooled Diesel engine connected to eddy current dynamometer. This eddy current dynamometer is used for loading the engine. The engine is interfaced with Engine Soft Software for the measurement of combustion parameters. It is provided with necessary instruments for combustion chamber pressure and crank-angle measurements. For the measurement of cylinder pressure, a pressure transducer is fitted on the engine cylinder head and a crank angle encoder is used for the measurement of crank angle and TDC position. The pressure and crank angle signals are fed to a data acquisition card fitted with Pentium 4 personal computer. The engine speed is sensed and indicated by an inductive pick up sensor in conjunction with a digital rpm indicator, which is a part of eddy current dynamometer. The liquid fuel flow rate is measured on the volumetric basis using a burette and a stopwatch. Provision is also made for interfacing airflow, temperatures and load measurement. The airflow is measured using an orifice meter and the exhaust gas temperatures are recorded with chromel- alumel thermocouples.The set up has stand-alone panel box consisting of air box, fuel tank, manometer, fuel measuring unit, transmitters for air and fuel flow measurements, process indicator and engine indicator. Rota meters are provided for cooling water and calorimeter water flow measurement. A computerized Diesel injection

pressure measurement can be conducted through sensor transmitters.

The various components of experimental set up are described below. Fig.3.1 shows line diagram & Fig.3.2 shows the photograph of the experimental set up. The Instruments of theExperimental Setup are

The engine

Dynamometer

Exhaust Gas Analyzer

The Engine:

The Engine chosen to carry out experimentation is a single cylinder, four stroke, vertical, water cooled, direct injection computerized Kirloskar make CI Engine. This engine can withstand higher pressures encountered and also is used extensively in agriculture and industrial sectors. Therefore this Engine is selected for carrying experiments. Fig.3.3 shows the actual photos of the C.I. Engine and its attachments.

Dynamometer:

The engine has a DC electrical dynamometer to measure its output. The dynamometer is calibrated statistically before use. The dynamometer is reversible i.e., it works as monitoring as well as an absorbing device. Load is controlled by changing the field current. Eddy-Current Dynamometer's theory is based on Eddy-Current (Fleming's right hand law). The construction of eddy-current dynamometer has a notched disc(rotor) which is driven by a prime mover(such as engine, etc.) and magnetic poles(stators) are located outside with a gap. The coil which excites the magnetic pole is wound in circumferential direction. When current runs through exciting coil, a magnetic flux loop is formed around the exciting coil through stators and a rotor. The rotation of rotor produces density difference, then eddy-current goes to stator. The electromagnetic force is applied

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opposite to the rotational direction by the product of this eddy-current.

Exhaust Gas Analyzer

All emissions like Carbon monoxide, Carbon dioxide,Un-Burnt Hydrocarbons, Nitrogen oxide and unused oxygen are found in 5 gas emission analyzer of modelMULTI" GAS ANALYZER MN-05" is used this cable one end is connected to the inlet of the analyzer and the other end is connected at the end of the exhaust gas outlet. Continuous charging of the analyzer is essential to work in an effective way.Fig.3.4 show the actual photos of Exhaust Gas Analyzer. The measuring method is based on the principle of light absorption in the infrared region, known as "non-dispersive infrared absorption".The broadband infrared radiation produced by the light source passes through a chamber filled with gas, generally methane or carbon dioxide. This gas absorbs radiation of a known wavelength and this absorption is a measure of the concentration of the gas. There is a narrow bandwidth optical filter at the end of the chamber to remove all other wavelengths before it is measured with a pyro-electric detector.

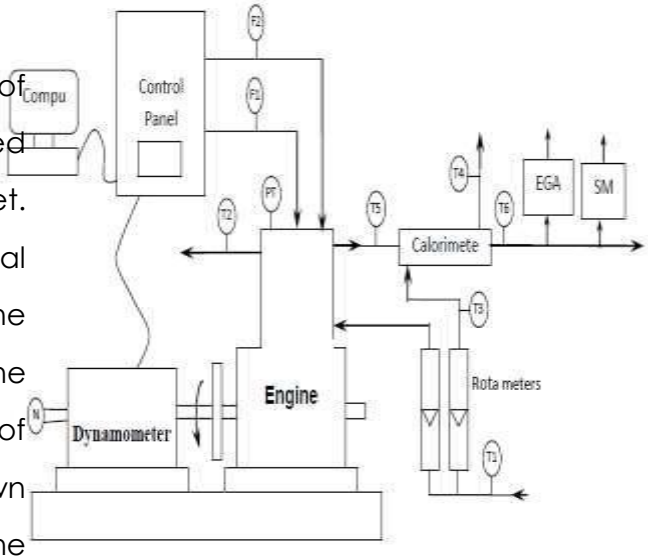

Fig.Line diagram of Experimental set up

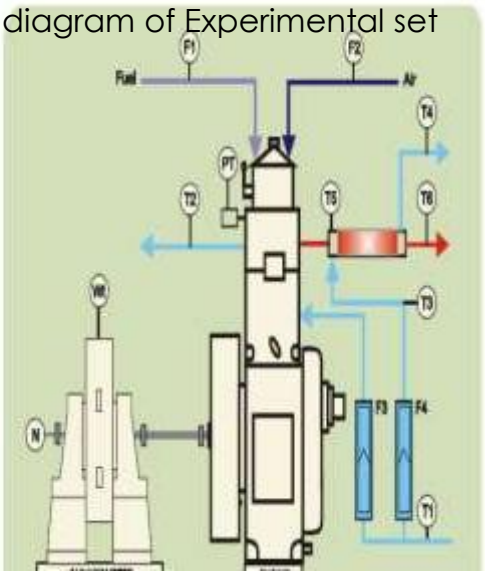

Fig. Five Gas Emission Analyzer

Fig.Experimental setup with Instrumentation

Engine specifications

Fig Experimental setup of computerized CI Engine

Number of cylinders	01
Number of Strokes	04
Fuel	Diesel
Rated Power & Speed	5.2 KW/7 hp @ 1500 RPM
Cylinder bore & Stroke	87.5 & 110 mm
Compression Ratio	17.5:1
Dynamometer arm length	185 mm
Dynamometer Type	Eddy current

Type of cooling	Water cooled

Table2. Engine specifications

RESULTS AND DISCUSSIONS ON ENGINE PERFORMANCE Graphs at Injection Pressure of 180, 200, 220, 240 bar

Piston1-Hemispherical
Piston2-Flat

PSME- Palm Stearin Methyl Ester

ATME-Animal Tallow Methyl Ester

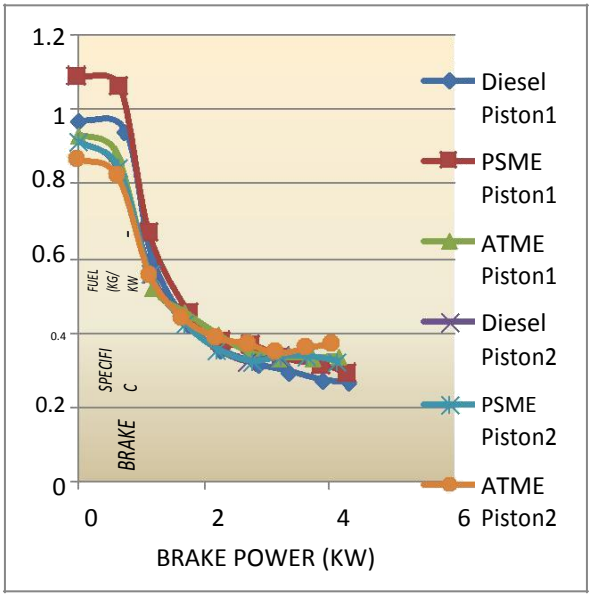

Fig Comparison Graph for BP vs BSFC at Injection pressure of 180

bar

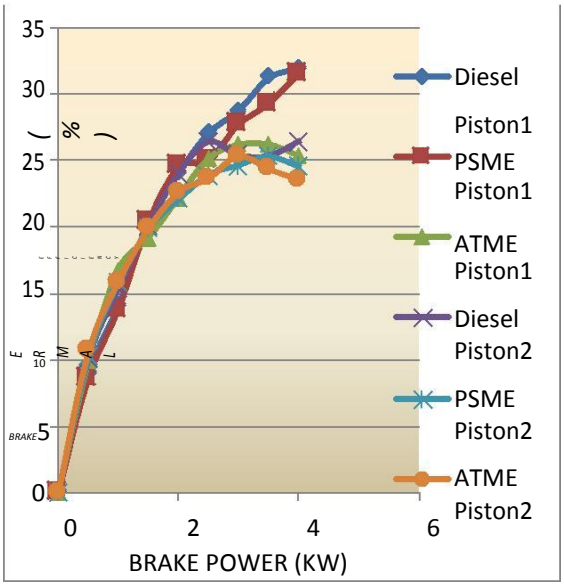

Fig 4.2 Comparison Graph for BP vs BTHE at Injection Pressure of

180 bar

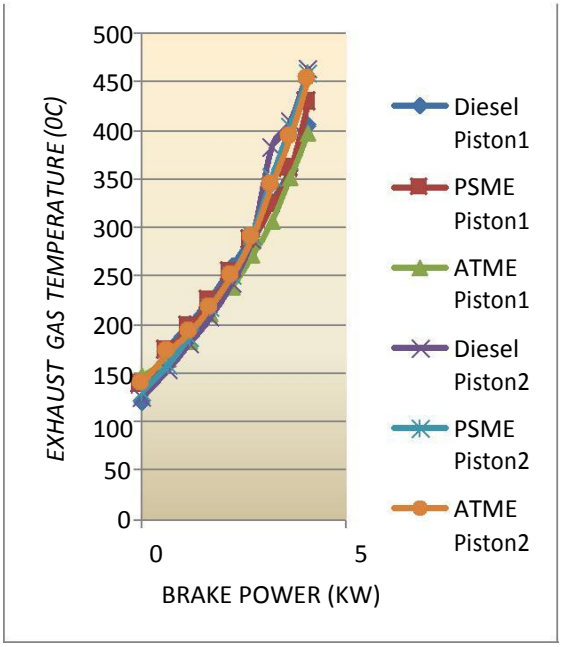

Fig Comparison Graph for BP vs EGT at Injection Pressure of 180

Bar

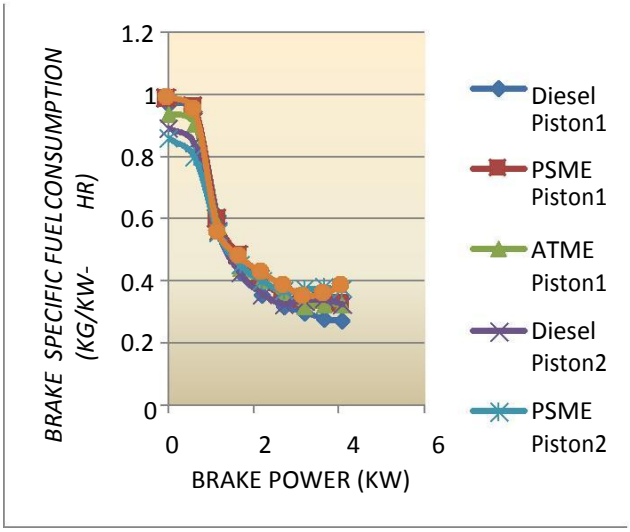

Fig Comparison Graph for BP vs BSFC at Injection pressure of 200 bar

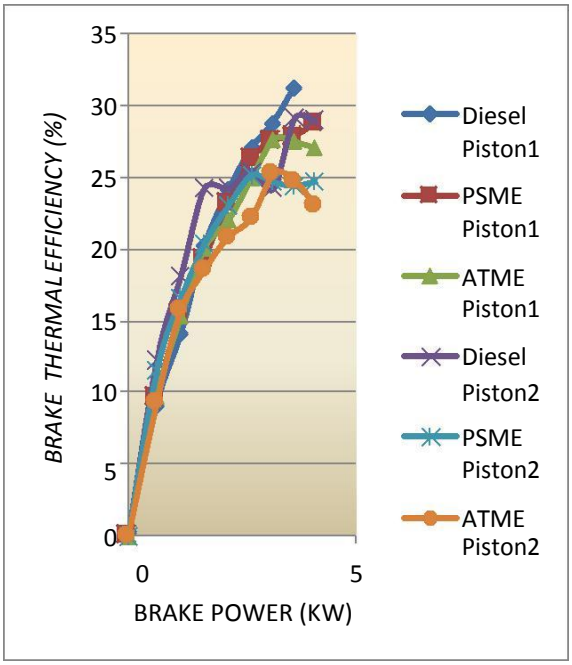

Fig Comparison Graph for BP vs BTHE at Injection Pressure of 200 bar

CONCLUSIONS

In this work the experiments are conducted at varied injection pressures using two types of piston geometry. These experiments are conducted using Diesel, Palm Stearin Methyl Ester and Animal Tallow Methyl Ester to evaluate engine performance, emissions and combustion characteristics of CI diesel engine.

The conclusions drawn from this work are as follows:

The Brake Specific Fuel Consumption for Palm Stearin Methyl Ester (PSME) for Hemispherical and Flat bowl Pistons at Injection pressures of 180, 200, 220, 240 bar is higher than that of diesel. The PSME for Flat bowl piston at injection pressure of 240 bar is 49.81% higher than that of normal diesel, this is due to higher viscosity.

The Brake Thermal Efficiency for Animal Tallow Methyl Ester (ATME) for hemispherical bowl

piston at injection pressure of 240 bar is higher than that of normal diesel. This is because of lower calorific value of fuel, lower viscosity coupled with density of fuel.

The CO emissions for Animal Tallow Methyl Ester (ATME) forFlat bowl piston at Injection pressure of 240 bar at a rated load is higher by 85.99% compared to diesel. This is as a result ofincomplete combustion of fuel.

The CO2 emissions for Palm Stearin Methyl Ester (PSME) for Flat bowl piston at injection pressure of 240 bar at a rated load is higher by 5.95% compared to diesel. The oxygen % is more in the combustion chamber for biodiesel compared to diesel, so there will be better combustion in the combustion chamber.

The NOX emissions for Palm Stearin Methyl Ester (PSME) for Hemispherical bowl Piston for 200 bar at a rated load is higher by 11.59% compared to diesel. This is owing to higher peak combustion temperature in the combustion chamber influences this factor.

The HC emissions for Palm Stearin Methyl Ester (PSME) for Hemispherical bowl Piston at 180 bar is lower by 7.67% compared to diesel.

The in-cylinder pressure for Animal Tallow Methyl Ester (ATME) for Hemispherical bowl piston at injection pressure of 220 bar is having higher incylinder pressure compared to diesel near to TDC i.e., 325°-450° crank angle.The main cause for higher peakincylinder pressure in the CI engine running with biodiesel is attributable to the advanced combustion process initiated by easy flow-ability of bio-diesel due to the physical properties of biodiesel REFERENCES

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