PERFORMANCE AND EXHAUST GAS ANALYSIS OF CI ENGINE USING DIESEL BIODIESEL BLEND

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ABSTRACT

India is developing country also it is one of the largest countries in world by population. Our country mainly depends upon gulf countries for supply of fuel. It is necessary to reduce energy dependency and problems cause due to pollution. Use of fossil fuels is continuously increasing due to use of vehicles and transportation. In India various cities are listed as most polluted cities in the world. Therefore it is important to find an alternative fuels to decrease the consumption of fossil fuel. In this paper the research work is carried to study emission and performance analysis of diesel- biodiesel blends on Variable compression ratio engine at 4 different loads and 3compression ratios and result obtained are compared with pure diesel at same load and compression ratio.

Keyword: - *Diesel, Biodiesel, VCR engine*

1. INTRODUCTION

Industrialization and transportation is at rapid growth which has increased the consumption of fossil fuel.Also they are major sources of CO_2 emission, greenhouse gases and global warming. Hence we need to find an alternative fuels. Many scientists are working to find alternative fuels. Among the proposed alternative fuels biodiesel and ethanol are suitable fuels for diesel engines. In country like India which is known as land of agriculture, fuels like biodiesel and ethanol can be best alternative fuels. This experiment is carried out by using castor oil, ethanol and diesel in different volumes at fixed speed of 1500 rpm and loads of 3, 6, 9 and 12 kg and 3 different compression ratios of 16, 17.5, 18.

S.Gomasta et. al. [1] in 'An Experimental Investigation of Ethanol Blended Diesel Fuel on Engine Performance and Emission of a Diesel Engine.' Studied that the engine is found to run cooler across the range of fuel proportions and load conditions. The reason being, lower calorific value of the fuel used. With increase in load the exhaust gas temperature is also increased which states that the engine is consuming more amount of fuel and same is translated in the BSEC and BSFC curve as well.

S.S.Ingle and V.Nandedkar [2] in 'Castor oil Biodiesel an alternative fuel for Diesel in Compression Ignition Engine' stated that blend B80 shows the overall optimum performance. Also they found that overall performance characteristics of castor oil biodiesel and diesel are similar.

R.Sattanathan [3] in 'Production of Biodiesel from Castor Oil with its Performance and Emission Test' observed that the brake power of biodiesel was nearly the same as with diesel and the SFC was higher than that of petro diesel. Carbon particles inside the engine were normal, with the exception of inlet valve deposits. The engine performance of the oxidized and unoxidized biodiesels and their blends was similar to that diesel fuel with nearly the same thermal efficiency, but with higher fuel consumption reflecting their lower energy content.

Neelesh Soni and Om Prakash [4] in 'thermal analysis of exhaust gas of compression ignition engine using diesel and WCO biodiesel blend.' stated that temperature of exhaust gas is gradually increasing with power and ranges from 110 °c for B20 to 295°c for B100 for Diesel, B5, B10, B20, B40, B60, B80, and B100. Minimum temperature is taken at no load and maximum temperature taken is at 3000 watt. Fuel consumption ranges from 0.47 kg/hr (for diesel) to 1.34 kg/hr (for B100). They concluded that the temperature of exhaust is minimum (110°C) for B20 blend and maximum (295°C) for B100 for the power variation 0 watt to 3000 watt. Fuel consumption is minimum (0.47 kg/hr) for diesel and maximum (1.34 kg/hr) for B100 for the power variation 0 watt to 3000 watt.

2. EXPERIMENTAL SETUP

The setup consists of single cylinder, four stroke, VCR (Variable Compression Ratio) Diesel engine connected to eddy current type dynamometer for loading. The compression ratio can be changed by special tilting cylinder block arrangement. Setup is provided with necessary instruments for combustion pressure and crank-angle measurements. These signals are interfaced to computer through engine indicator for Pθ−PV diagrams. Provision is also made for interfacing airflow, fuel flow, temperatures and load measurement. The set up consists of stand-alone panel box consisting of fuel measuring unit, transmitters for air and fuel flow measurements, process indicator and engine indicator air box, 2 fuel tanks for duel fuel test, manometer. Rotameters are provided for cooling water and calorimeter water flow measurement. By using this setup one can check VCR engine performance for brake thermal efficiency, indicated thermal efficiency, Mechanical efficiency, volumetric efficiency, specific fuel consumption, brake power (BP), indicated power (IP), frictional power (FP), BMEP, IMEP. Lab view based Engine Performance Analysis software package ―Enginesoft_9.0 is provided for on line performance evaluation.

3. RESULTS AND DISCUSSION

3.1 Exhaust gas analysis

3.1.1 Carbon dioxide (CO_2) emissions

CO_2 is the major source of pollution when it comes to cars, planes, power plants.

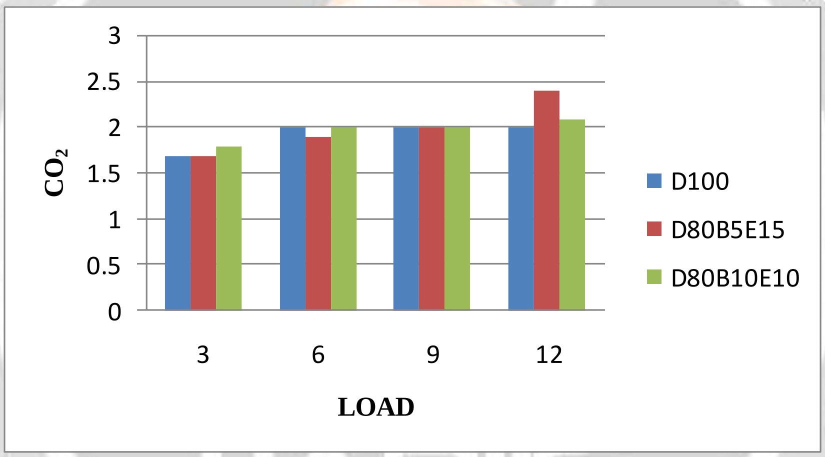

Chart -1: CO_2 emission for CR 16

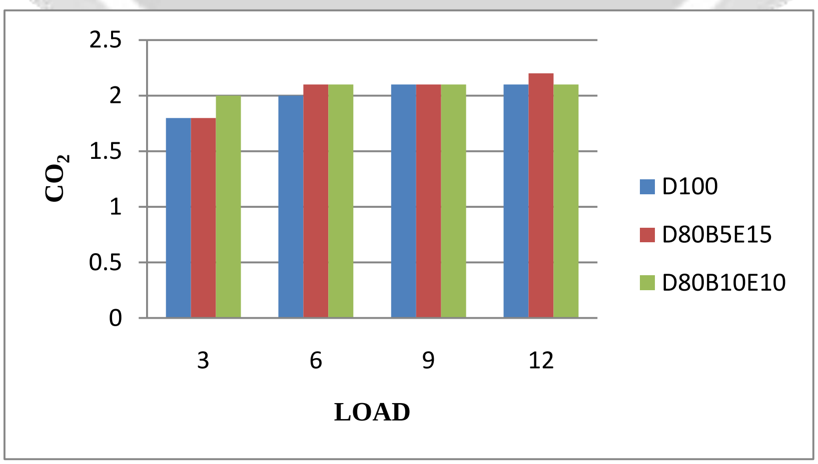

Chart -2: CO_2 emission for CR 17.5

Chart 1 shows variation of CO_2 emission with load for pure diesel and blends Diesel 80% +Castor Oil 5%+ Ethanol 15% (D80B5E15) and Diesel 80% +Castor Oil 10%+ Ethanol 10% (D80B10E10). Results shows that with increase in load there is increase in CO_2 emission, however for smaller loads there is nearly equal emission of CO_2 for pure diesel and blends but at higher load blend D80B5E15 shows higher emission.

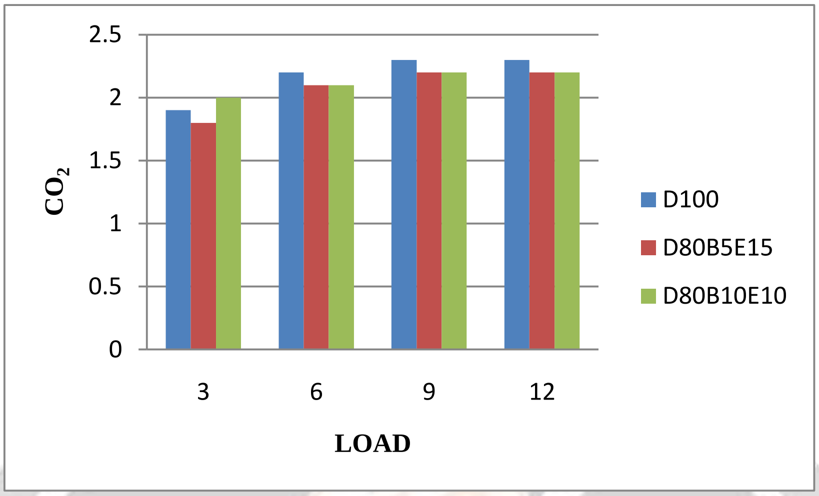

Chart -3: CO_2 emission for CR 18

Chart 2 and Chart 3 shows variation of CO_2 emission with load for CR 17.5 and 18, result shows that for CR 18 there is slight decrease in CO_2 emission for blend as compared to pure diesel at higher loads.

3.2 Performance Analysis

3.2.1 Mechanical Efficiency

Mechanical efficiency is defined as the ratio of brake power to indicated power.

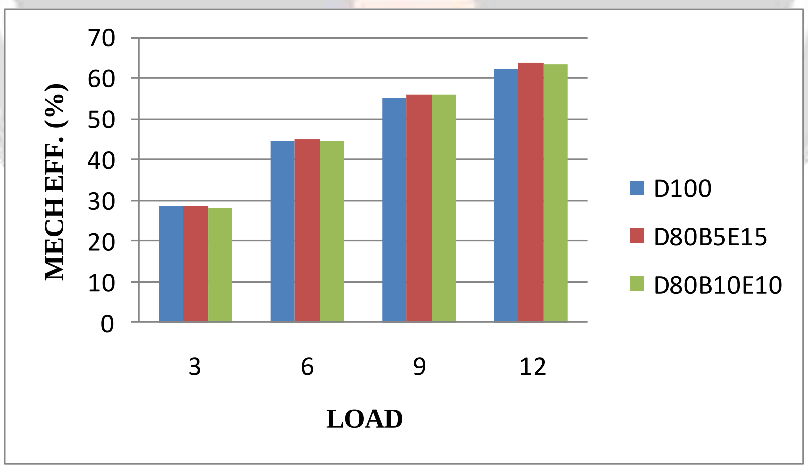

Chart -4: Mechanical efficiency VS. Load CR 16

Chart 4, Chart 5 and Chart 6 shows Mechanical efficiency VS. Load for CR 16, 17.5 and 18, it is observed that with increase in load and compression ratio mechanical efficiency increases. From Chart 4 it is observed that at higher loads mechanical efficiency for blends D80B5E15 and D80B10E10 is slightly higher than pure diesel. For CR 17.5 Mechanical efficiency for blend D80B5E15 is higher than pure diesel. Also with increase in compression ratio there is increase in mechanical efficiency for all loads.

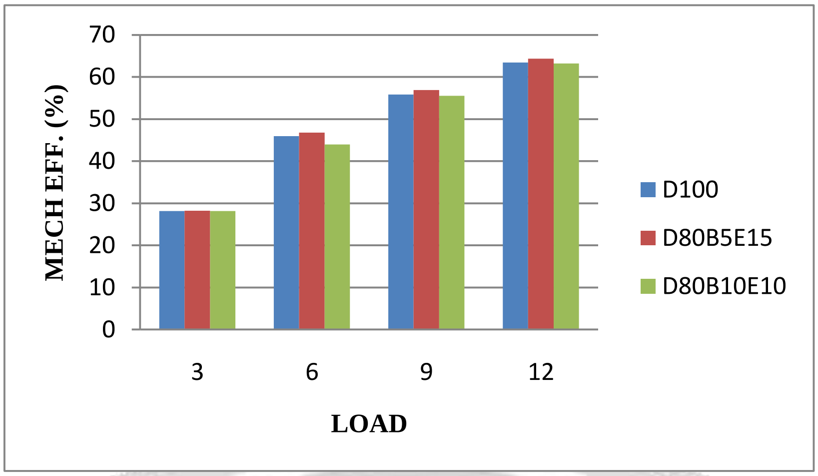

Chart -5: Mechanical efficiency VS. Load CR 17.5

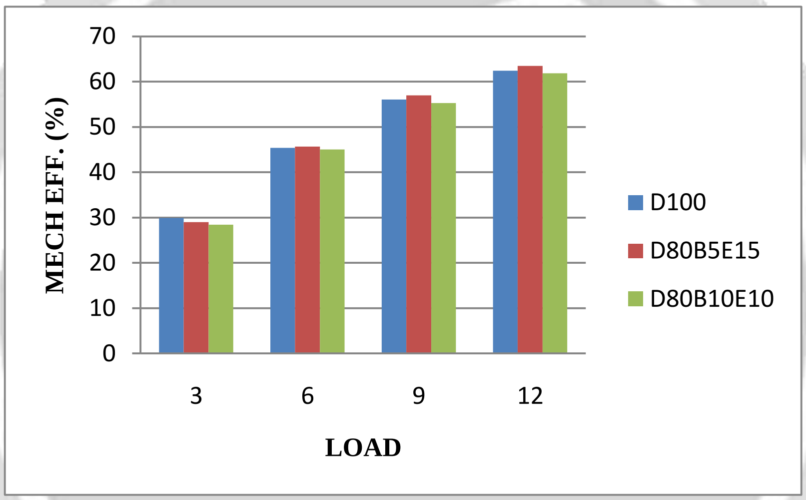

Chart -6: Mechanical efficiency VS. Load CR 18

3.2.2 Volumetric Efficiency

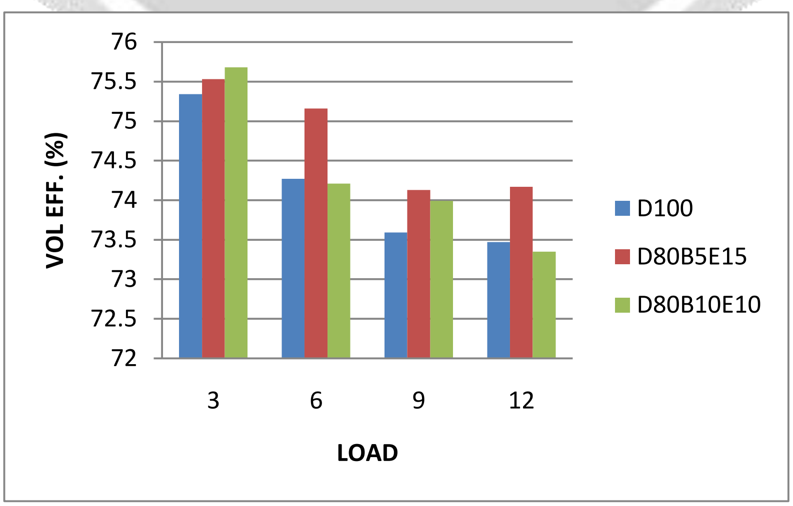

Chart -7: Volumetric efficiency VS. Load CR 16

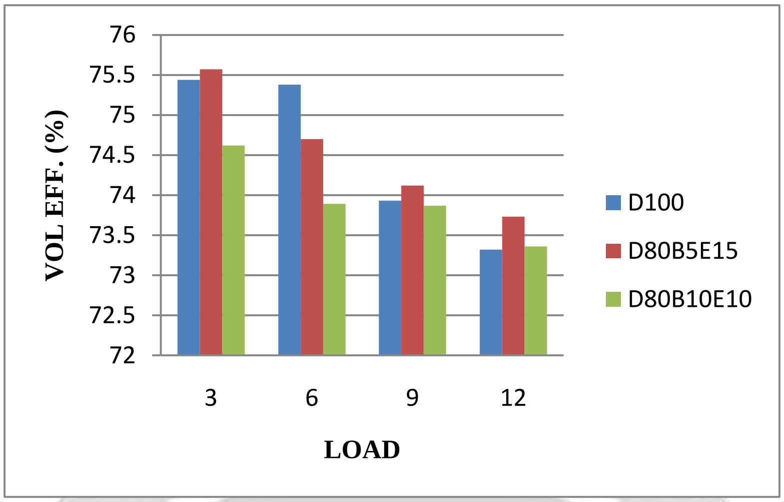

Chart -8: Volumetric efficiency VS. Load CR 17.5

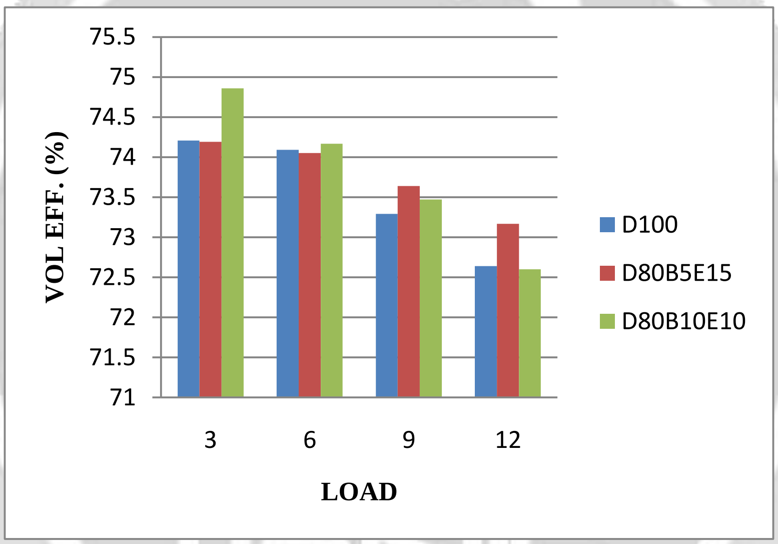

Chart -9: Volumetric efficiency VS. Load CR 18

Chart 7, Chart 8 and Chart 9 shows volumetric efficiency VS. Load for CR 16, 17.5 and 18, It is observed that initially at low load volumetric efficiency is higher but as load increases the volumetric efficiency goes on decreasing for all blended fuel at CR 16, 17.5 and 18 respectively. For CR 16 blend D80B5E15 shows higher volumetric efficiency than pure diesel at all loads and for CR 18 also blends D80B5E15 and D80B10E10 shows higher volumetric efficiency than pure diesel.

3.2.3 Brake Thermal Efficiency

Thermal efficiency of an engine indicates conversion of heat provided into work energy, it is based on either indicated power or brake power. For CR 16 blends D80B5E15 and D80B10E10 show higher Brake Thermal Efficiency than pure diesel. For CR 17.5 at higher load blend D80B5E15 shows nearly same higher Brake Thermal Efficiency as pure diesel. At CR 18 blend D80B5E15 shows higher Brake Thermal Efficiency but Brake Thermal Efficiency of blend D80B10E10 is lower than pure diesel.

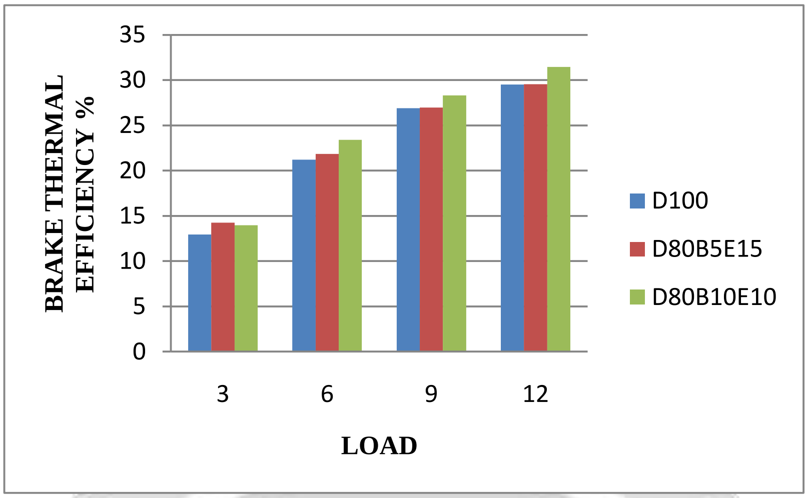

Chart -10: Brake Thermal Efficiency VS. Load CR 16

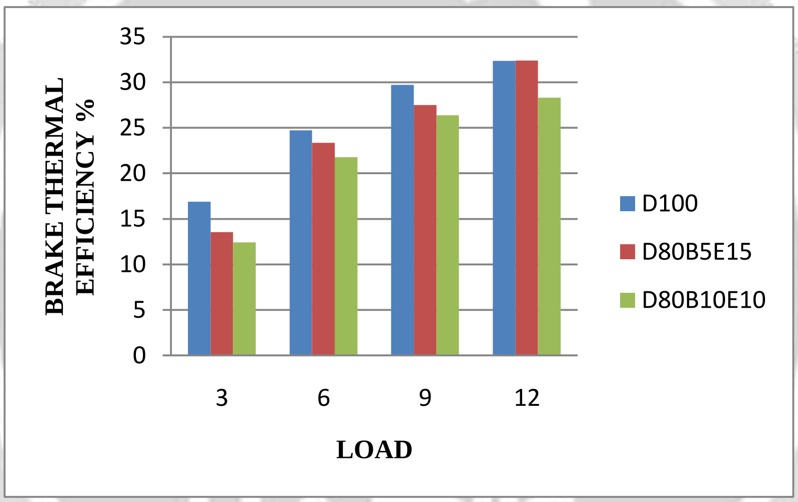

Chart -11: Brake Thermal Efficiency VS. Load CR 17.5

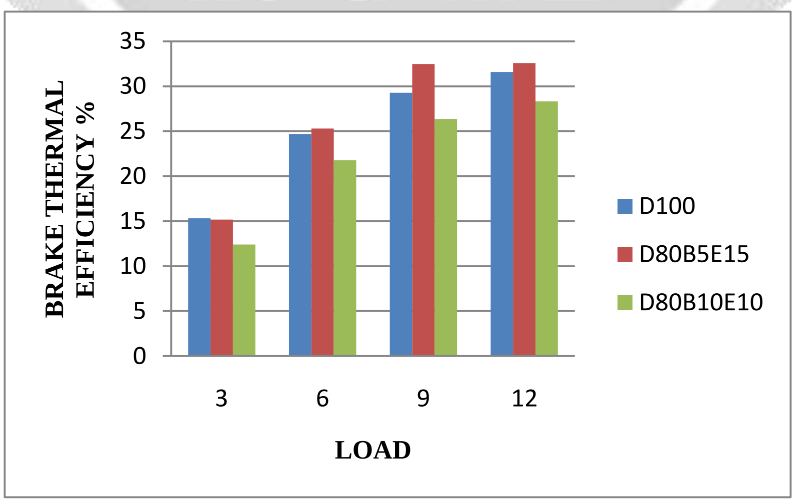

Chart -12: Brake Thermal Efficiency VS. Load CR 18

4. CONCLUSIONS

1. CO2 emissions are increases with increase in load, for CR 16 there is nearly equal emission of CO_2 for pure diesel and blends but at higher load blend D80B5E15 shows higher emission.
2. For CR 16 at higher loads mechanical efficiency for blends D80B5E15 and D80B10E10 is slightly higher than pure diesel also For CR 17.5 mechanical efficiency for blend D80B5E15 is higher than pure diesel and with increase in compression ratio there is increase in mechanical efficiency for all loads.
3. Initially at low load volumetric efficiency is higher but as load increases the volumetric efficiency goes on decreasing for all fuel at CR 16, 17.5 and 18. At CR 16 blend D80B5E15 shows higher volumetric efficiency than pure diesel at all loads.
4. At CR 16 blends D80B5E15 and D80B10E10 show higher Brake Thermal Efficiency than pure diesel.

5. REFERENCES

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