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Emission and performance characteristics of CI engine with Diesel - Butanol blends using intake pressure boost

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Biofuels like ethanol, biodiesel, butanol have attracted attention of people worldwide and found to be the successful alternates of petroleum products. In the present work, the Performance and emission characteristics of CI engine with diesel-butanol blends using intake pressure boost is shown. For improving the performance of any engine either we have to go with fuel properties or we have to use advance technologies. In this study we are doing both by using diesel-butanol blends and by using an intake pressure boost by varying its intake pressure to cylinder. The investigation results showed that the emission and performance parameters of the engine with intake pressure boost was improved in comparison with naturally aspirated engine.

***Keywords*:** Diesel-butanol blends, intake pressure boost, emissions.

1. Introduction

Use of Bio-fuels potentially reduce the bourdon on fossil fuels and fulfil the growing energy need of the world, while conserving the nature. The compression ignition mode of combustion promotes the use of biodiesel and butanol blends in the aim of achieving high performance with improved emissions. Still NO_X emissions are major issue with diffusion combustion. Several engine modifications were done to increase the percentage of butanol in butanol diesel blends.

In SI engines the air-fuel mixture at stoichiometric ratio provides clean burn and negligible smoke emissions. Due to lower sizes and compression ratio mixture burns at a lower temperature, reducing the NO_X emissions. It, however, has lower part load and fuel efficiency on account of lower compression ratio and throttling losses

The CI engines are regarded as the most fuel-efficient engines for automotive transportation due to its lean operation, high compression ratio and better part load efficiency. In CI engines, fuel is directly injected into the engine cylinder at the end compression stroke, where auto-ignition of heterogeneous air-fuel mixture causes diffusion combustion at high temperature. As a result, the CI engine emits high NO_X and soot emissions. Oxygenated nature biofuels that are derived from the agricultural products offers the benefits of reducing the dangerous diesel engine emissions up to certain levels.

Here we have taken the blends on the basis of percent volume in proportion B10, B20, B30, B40, at different BMEP with pressure boost and without pressure boost and observed its behaviour on the basis of performance and emission parameters.

2. Experimental setup

Naturally aspirated, water cooled, single cylinder, DI diesel engine was modified to allow variable direct injection timing. The engine specifications of Diesel Engine are given in table 1

Engine	Original CI Engine
Bore	80 mm
Stroke	110 mm
Displacement	553 CC
Piston Bowl diameter	52 mm
Compression ratio	16.5
No. of valves	02
No of cylinder	01
Engine cooling system	Water cooled
Fuel injector	Multi-hole
Fuel pressure	20 MPa
Fuel system	Direct injection
Engine speed (RPM)	1350

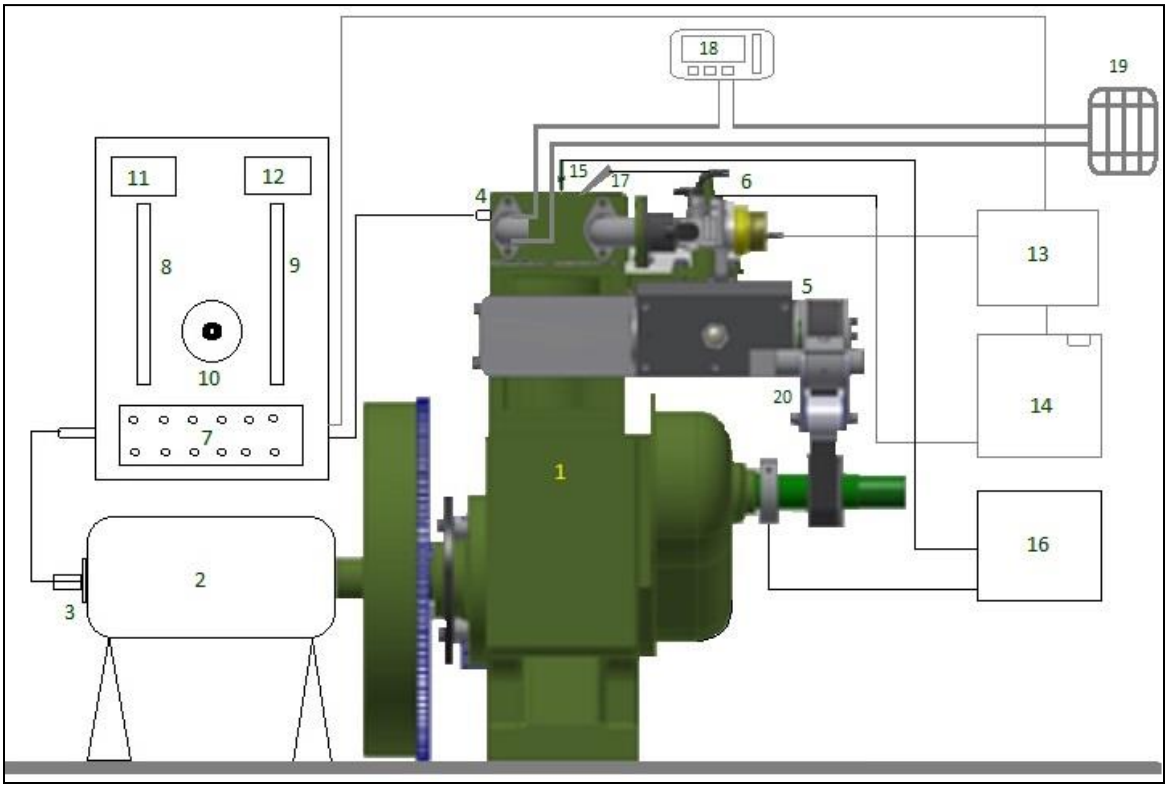


Figure 1: Schematic layout of experimental set up

1. Engine, 2. Eddy current dynamometer, 3.Shaft encoder, 4.Pressure transducer, 5. Variable fuel injection timing component, 6. Intake air Heater 7. Data acquisition system, 8. Air manometer, 9. Fuel manometer, 10. Load Regulator, 11.rpm display, 12.Temperature display. 13. Air tank, 14. Fuel tank, 15. Spark plug, 16. Electronic spark ignition system, 17. Fuel injector, 18. Gas

The experiments were carried out on a single-cylinder, four stroke, naturally aspirated, water cooled, direct injection diesel engine. The engine specifications are shown inTable.1. Several modifications in the diesel engine pump set have been done to achieve variable DI timings, intake temperature and intake pressure adjustment shown in Fig. 1. The Mechanical fuel injection component was developed to inject the fuel during the early compression stroke of the engine cycle. Camshaft motion was transmitted to the fuel injection pump pulley in 1:1 ratio. The pump pulley connected with fuel injection component which has a capability to change injection timing. Fuel injection timing was set by adjusting timer pulley with respect to end of injection (EOI) mark on fuel injection component and with TDC marker on engine. Ball type governor was used to maintain 1350 RPM engine speed by controlling fuel supply to the engine. Fuel was injected early in the compression stroke directly inside the cylinder to form homogeneous mixture in high load condition. Late injection required to get more fuel economy during part load condition.

The experimental set-up is shown in Figure 2 an eddy current dynamometer was directly coupled to the engine output shaft to measure engine torque. Fuel consumption was measured in terms of the volume of gasoline consumed during a specified period of time. In-cylinder pressure was measured using M111A22 quartz crystal dynamic pressure transducer with built in amplifier having 1mV/psi sensitivity. The crankshaft position was obtained using an encoder with 1degree resolution to determine the in-cylinder pressure as a function of crank angle. All temperatures were measured with K type thermocouples. The exhaust emissions were measured with AVL DiTEST GMBH A-8020 Graz exhaust gas analyzer. The detection limits of NOx, HC and CO are 1 ppm, 1 ppm and 0.01% respectively

3. Results and discussion

3.1 Following were the emission obtained when the engine was running at 1350 rpm with diesel B10, B20, B30

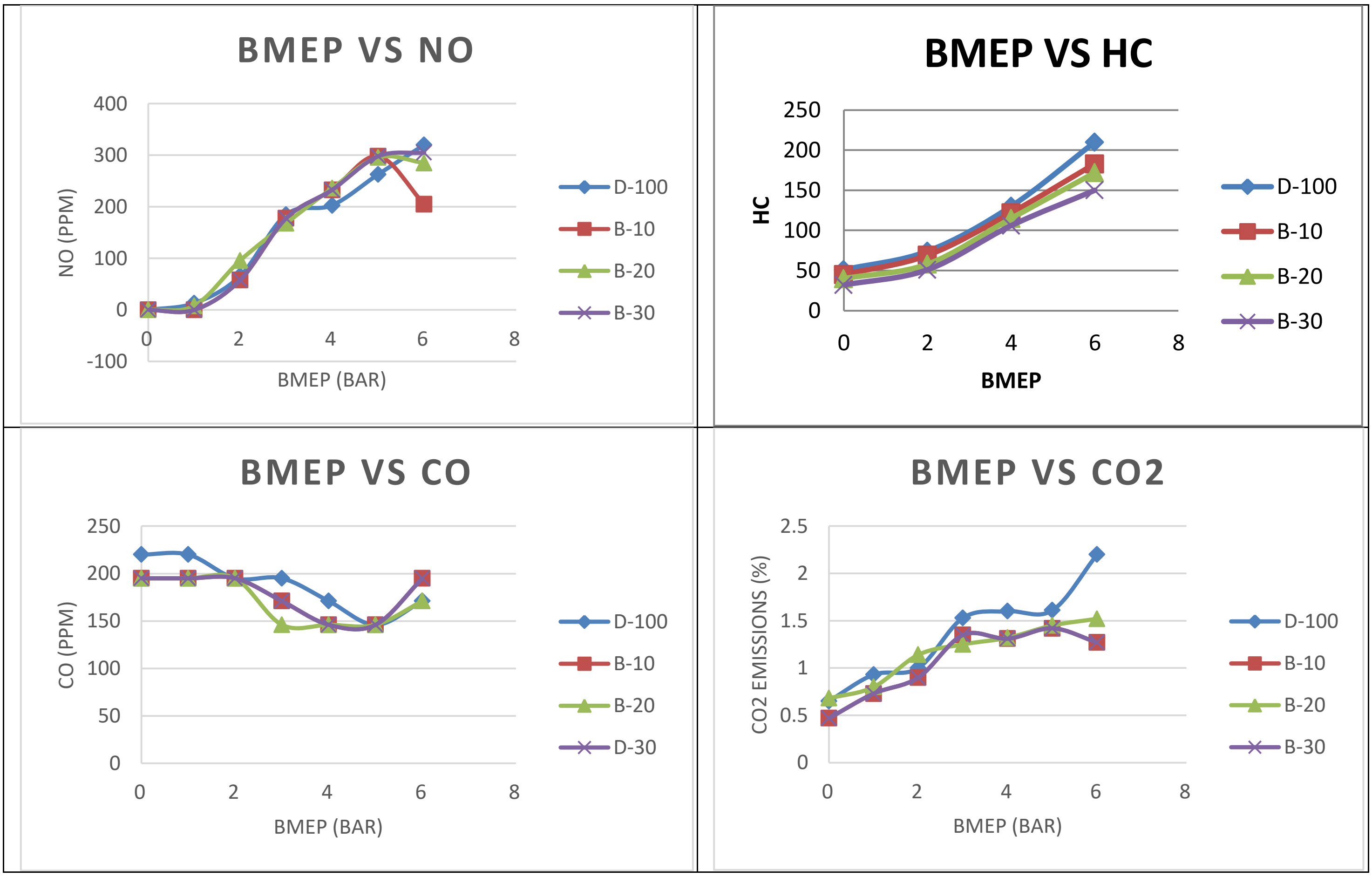


Fig2. Following were the emission obtained when the engine was running at 1350 rpm with diesel B10, B20, B30

1.1 Following were the emissions obtained when the engine was running at 1350 rpm using intake pressure boost with various intake pressures using diesel as fuel.

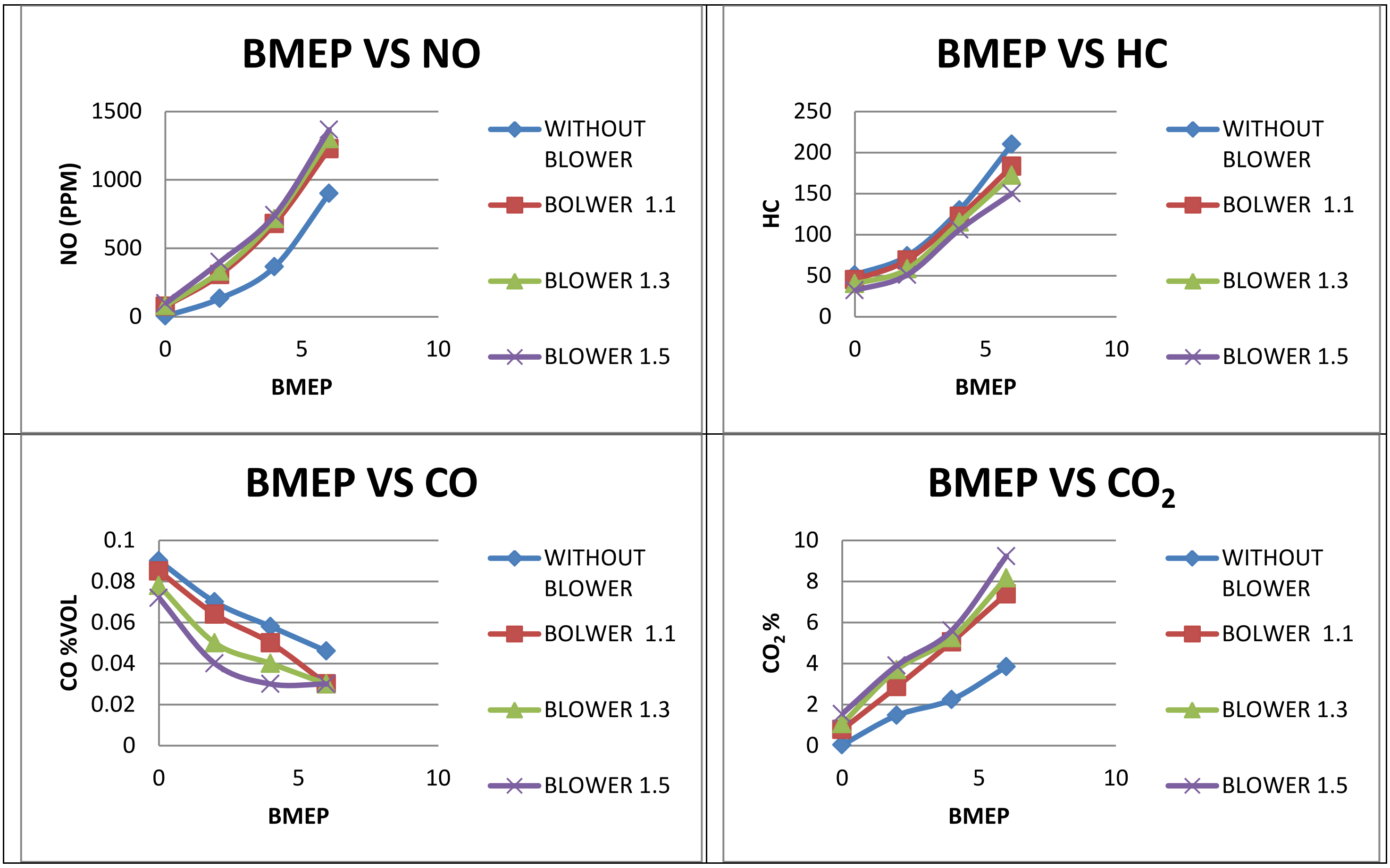
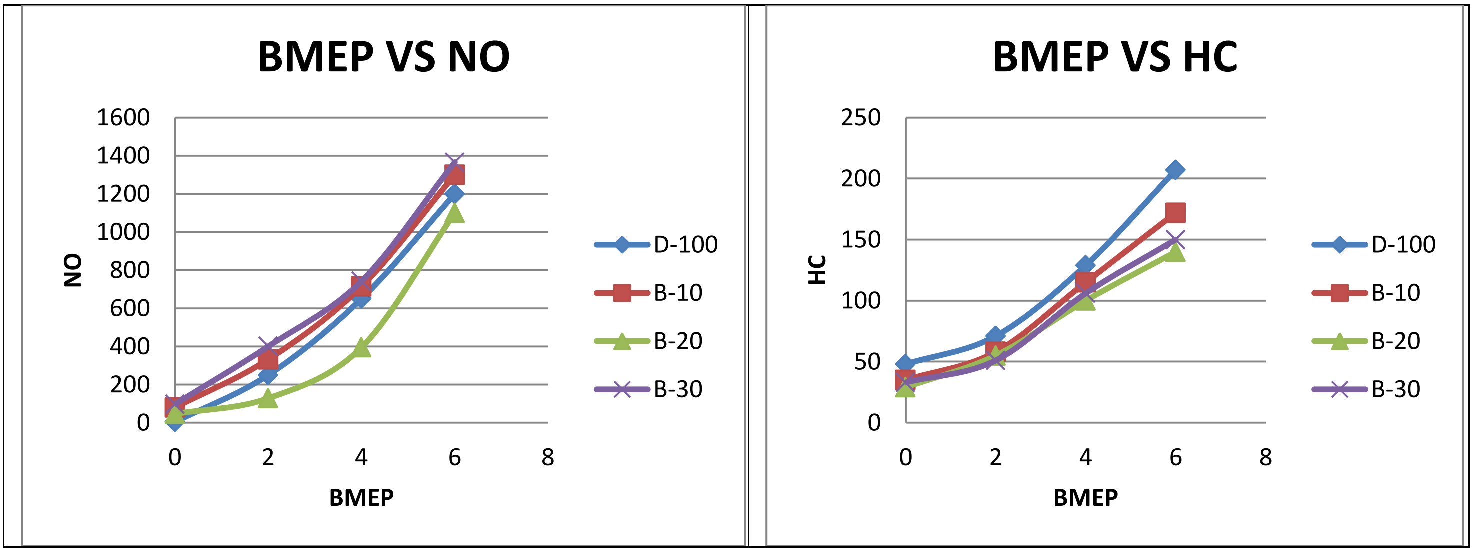
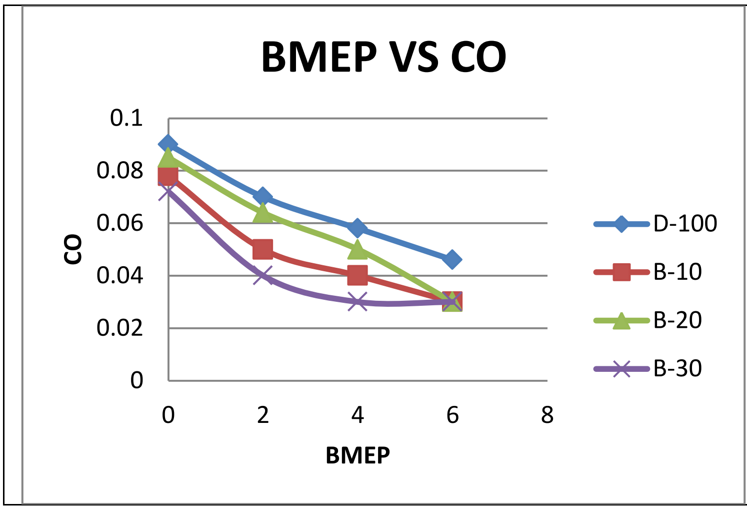


Fig3. Following were the emissions obtained when the engine was running at 1350 rpm using intake pressure boost with various intake pressures using diesel as fuel.

1.2 The same was performed with taking the diesel butanol blends but the blend of B20 using the intake pressure boost, showed improved emissions Following are the obtained results





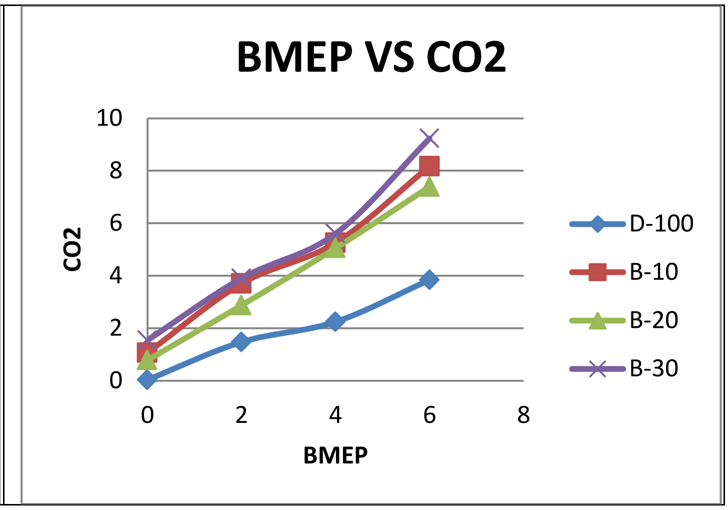


Fig4. Following were the emissions obtained when the engine was running at 1350 rpm the diesel butanol blends but the blend of B20 using the intake pressure boost.

4. Observation and conclusion

- NO values are lowered with Diesel-butanol blends, when compared with pure diesel operation and with using intake pressure boost, NO formation is little increased.
- But when used B-20 it showed showed improved and better readings than pure diesel, B-10 and B-30
- Unburned HC and CO emissions seem to increase as the butanol percent increases in the blend, but with the use of intake pressure boost these emissions are little lowered.

5. References

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