International Journal of Engineering Research and General Science Volume 4, Issue 1, January-February, 2016
ISSN 2091-2730

Influence of variable compression ratio on emission using single cylinder four stroke diesel engines

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Abstract – This paper present the influence of variable compression ratio on emission using single cylinder four stroke diesel engine. The measurement is carried out for the compression ratio for 15.5, 17.5 and 18 with varying loads. The performance character such as brake thermal efficiency, specific fuel consumption, exhaust gas temperature, brake power for emission like HC, NOx, CO. The effect of variable compression ratio has a very great effect on emission. The results show that NOx decreases with higher compression ratio but increases with increase in load condition. Up to 25% reduction is seen in NOx with compression ratio 18 and slightly improvement in CO and HC.

Key Words: *Diesel Engine, Variable compression engine, Exhaust Emission, Emission, Diesel, Compression ratio, Performance*

1. Introduction:

Variable compression ratio is a technology to adjust the compression ratio of an internal combustion engine while the engine is in operation. This is done to increase fuel efficiency while under varying loads. Higher loads require lower ratios to be more efficient and vice versa. Variable compression engines allow for the volume above the piston at top dead centre to be changed Variable Compression Ratio (VCR) is becoming increasingly desirable as oil prices increase and car buyers have an increased interest in fuel economy. In addition to this, Global Climate Warming requires measures from international community. To Automobile industry it means stricter limits to car emissions, especially CO2. Variable compression ratio is one cost effective way achieving these targets. Variable compression engines have existed for decades but only in laboratories for the purposes of studying combustion processes. These designs usually have a second adjustable piston set in the head opposing the working piston. (very much like model aircraft 'Diesel' engines). Earlier variable compression engines have been highly desirable but technically unobtainable for production vehicles due to the mechanical complexity and difficulty of controlling all of the parameters.

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 without stopping the engine and without altering the combustion chamber geometry by specially designed 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 Pø - PV diagrams. Provision is also made for interfacing airflow, fuel flow, temperatures and load measurement. The set up has stand-alone panel box consisting of air box, two fuel tanks for duel fuel test, 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.

The setup enables study of VCR engine performance for brake power, indicated power, frictional power, BMEP, IMEP, brake thermal efficiency, indicated thermal efficiency, Mechanical efficiency, volumetric efficiency, specific fuel consumption, A/F ratio

2.1 Specifications:

VCR Engine test setup 1 cylinder, 4 stroke, Diesel (Computerized).
Engine Make Kirloskar, Type 1 cylinder, 4 stroke Diesel, water cooled, power 3.5 kW at 1500 rpm, stroke 110 mm, bore 87.5 mm. 661 cc, CR 17.5, Modified to VCR engine, CR range 12 to 18.
Dynamometer Type eddy current, water cooled, with loading unit.
Fuel tank Capacity 15 lit with glass fuel metering column.

Overall dimensions: W 2000 x D 2500 x H 1500 mm.
Rotameter: Engine cooling 40-400 LPH; Calorimeter 25-250 LPH

Fig -1: Four Stroke diesel (VCR) engine

3. Result and Discussion:

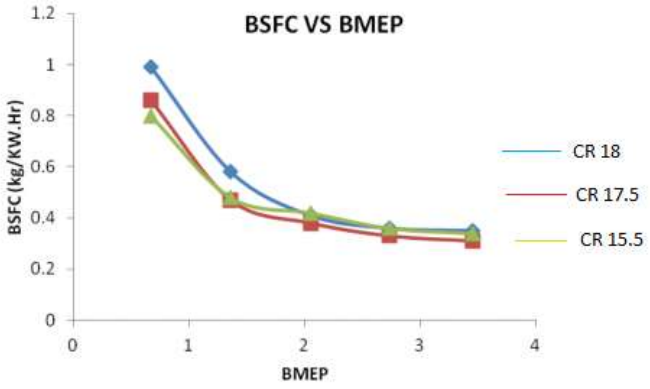

Chart.1: Brake specific consumption for variable compression ratio.

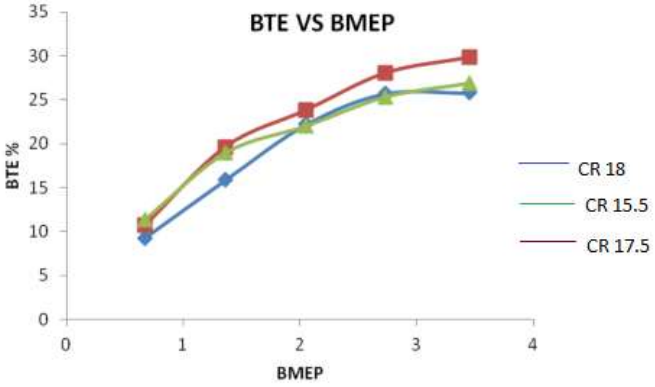

Chart.2: Brake thermal efficiency vs brake mean effective pressure for variable compression.

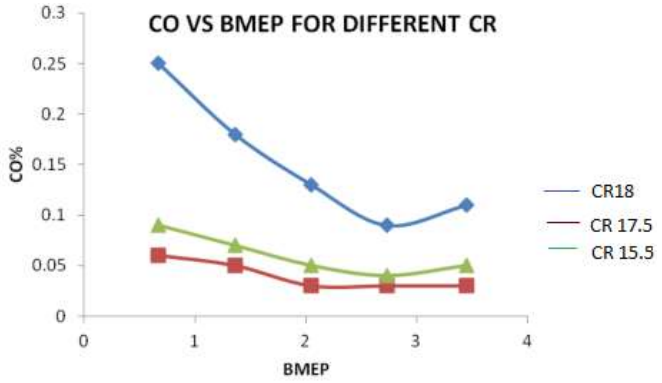

Chart.3: CO emission

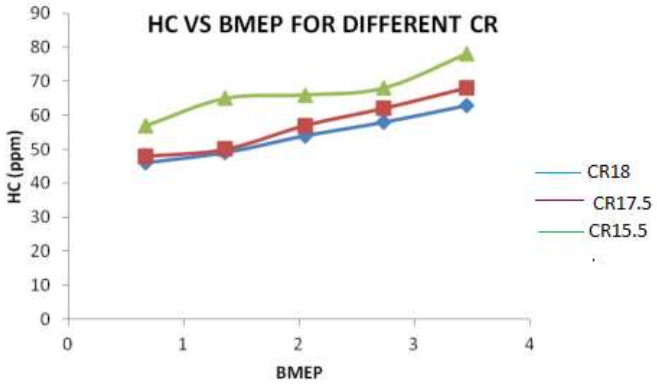

Chart.4: HC emission.

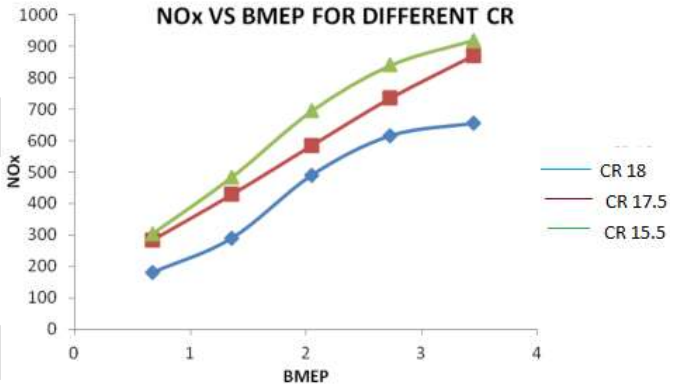

Chart.5: NOx emission.

From the charts 1 and 2 it has been observed that brake specific fuel consumption increases for Compression ratio 18 and thermal efficiency decreases as compared to compression ratio of 17.5 and 15.5.

From the charts 3, 4 and 5 it has been observed that from, NOx decreases with higher compression and increases with load condition. Up to 25% reduction is seen in NOx.

4. CONCULSION:

- From the results we conclude that NOx gives better results during performance.
- Compression was considered the best CR for the performance of single cylinder diesel engine.
- Brake thermal efficiency increases with increase in load.
- Brake specific fuel consumption decreases with increase in load.

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