

Performance Analysis of a MFVCR Engine in SI Mode using Variable Loading Conditions

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Abstract--- An analysis has been made on a multi fuel variable compression ratio internal combustion engine using gasoline as fuel. The performance characteristics of the engine using CR8 with respect to variation in load have been performed. Five (5) different loading conditions such as No load, 2.5kg, 5.0kg, 7.5kg and 10.0 kg were taken for the study. The fuel consumption varies between $0.230 \text{ cm}^3/\text{sec}$ to $0.294 \text{ cm}^3/\text{sec}$. The air consumed for the study has been found to range between 6.501 kg/hr to 15.6 kg/hr respectively. The exhaust gas has a temperature and pressure of 150°C and 1.034 bar respectively. The maximum heat release of 1107.55 Joules has been obtained from the 10.0kg loading condition.

Keywords--- Combustion, Gasoline, Variable Loading, VCR

I. INTRODUCTION

THE variable compression ratio engine is a modern engine by which the compression ratio can be changed. This technique allows the user/researcher to perform numerous analysis of the fuel under study in various parameters. Rinu T et al.[1] have conducted experiments at different compression ratios (CR= 7:1, 8.5:1 and 10:1) using pure gasoline and 20% n-butanol blend (B20). The result indicated the increase in brake thermal efficiency with increase in CR at all loads.

Biodiesel in VCR engine was tested in B10 and B20 blend by Ashok Kumar T et al. [2]. The compression ratio ranged between 15:1 to 18:1 and torque varied from zero to maximum value of 22 N-m. The result shows that exhaust gas temperature increases with increase in CR and load.

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DOI:10.9756/BIJEMS.8310

The performance and exhaust emissions of ethanol-gasoline blend was carried out by Hakan Bayraktar et al. [3] at operating conditions of speed 1500 rpm and CR of 7.75 and 8.85.

II. EXPERIMENT SET UP

A. Experimentation

The experimental set-up is located on the premises of NIT Manipur. Figure 1 shows the arrangement of the experiment, from which the analysis was made. The set up consists of: Main frame, Engine Assembly, Data Acquisition systems.

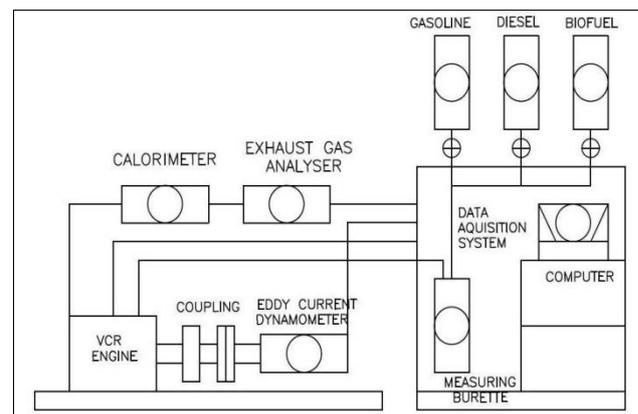


Figure 1: Experimental Layout of MFVCR Engine

The VCR engine is set to a compression ratio- 8. The GUI is set onto PFI mode. Gasoline is filled onto the gasoline tanks before starting the experiment. The Rotameter checked to verify the flow of cooling water into the engine and calorimeter.

The module is set to SI mode and the engine is started using key. Provisions are provided to make sure that the engine runs for 5-10 minutes before the data were taken. The load is provided by turning the knob on the dynamometer module on the main frame.

B. Data Analysis

The recorded data for the various loading conditions were extracted from the computer and analysed. The data were taken on various loading conditions, such as : No load Conditions, 2.5kg, 5.0kg, 7.5kg and 10kg.

III. RESULTS AND DISCUSSION

The various results which were analysed in the engine were plotted as under.

A. Crank Angle and Heat Release Rate

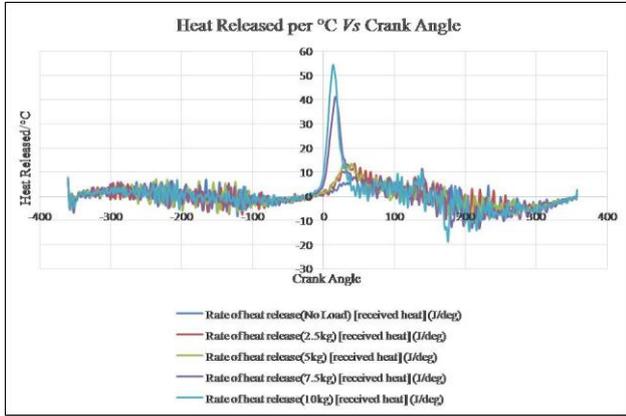


Figure 2: Variation of Heat release with respect to crank angle.

Figure 2 depicts the variation of the rate of heat release with respect to the change in crank angle. The maximum heat released was found during the loading condition of 10kg, with a value of 57.45 Joules.

B. Crank angle and Maximum pressure in the cylinder

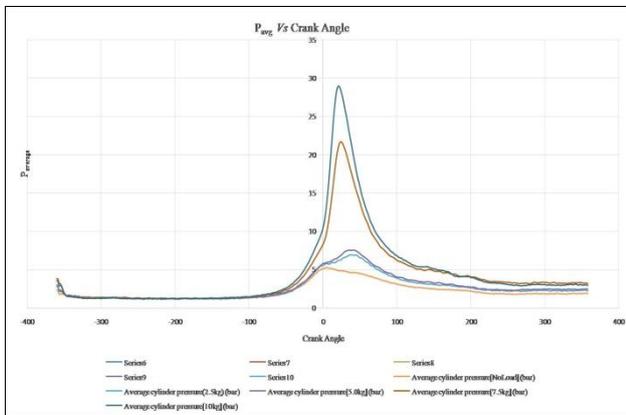


Figure 3: Variation of average cylinder pressure with respect to crank angle.

The deviation of cylinder pressure during the various strokes of an engine working in otto cycle can be seen from the graph plotted in Figure 3. The average maximum cylinder pressure was obtained to be 28.676 bar.

C. Crank angle and Maximum cylinder gas temperature

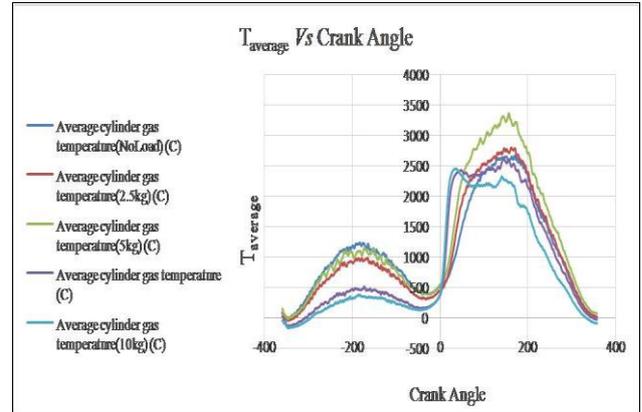


Figure 3: Variation of average cylinder gas temperature with varying crank angle.

The variation of the average cylinder temperature in the engine chamber with respect to the change in crank angle is shown by the Figure 3. The maximum average cylinder gas temperature was recorded to be 3088.57 °C, found on 5.0kg loading condition.

D. Pressure and Average cylinder displacement

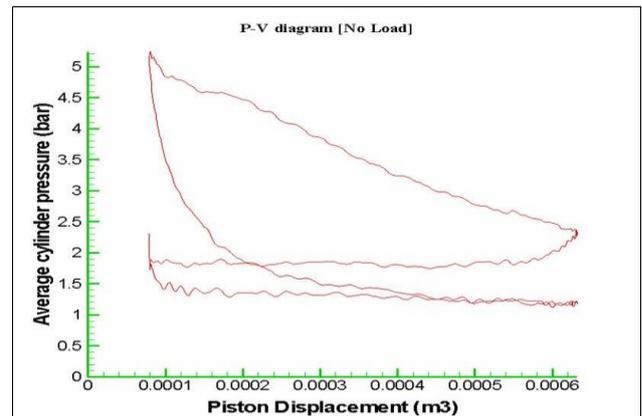


Figure 4: Pressure and cylinder displacement (No Load)

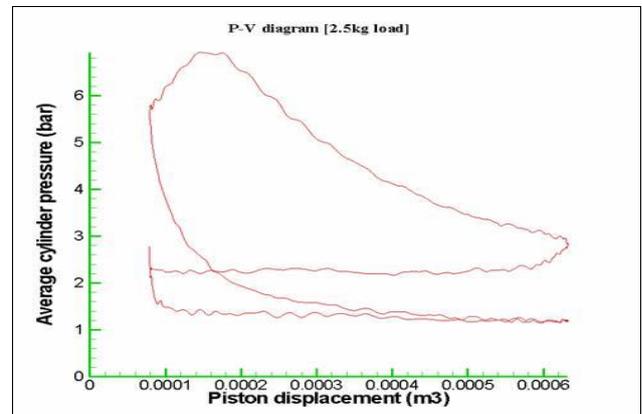


Figure 5: Pressure and cylinder displacement (2.5kg Load)

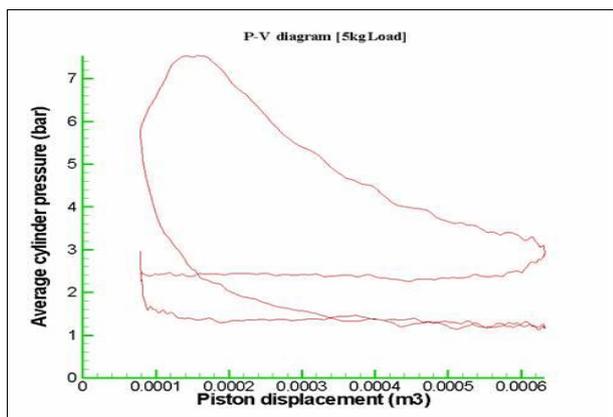


Figure 6: Pressure and cylinder displacement (5.0kg Load)

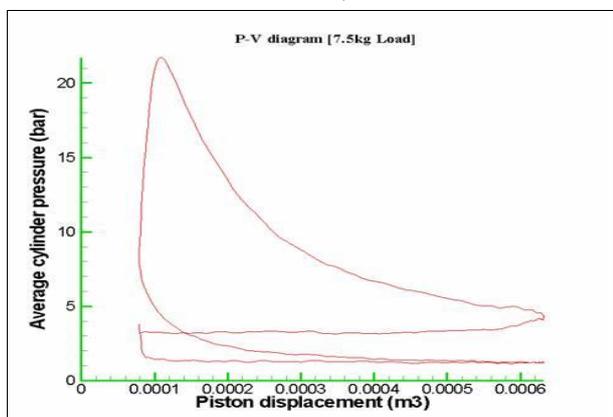


Figure 7: Pressure and cylinder displacement (7.5kg Load)

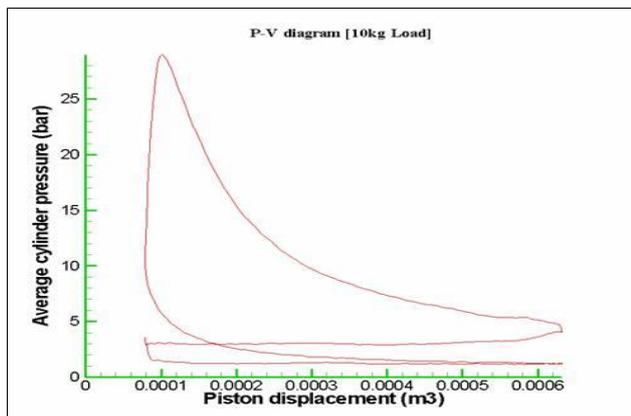


Figure 8: Pressure and cylinder displacement (10kg Load)

Figure 4,5,6,7 and 8 shows the pressure and average cylinder displacement graph for various loading conditions.

IV. CONCLUSION

The experiment has been performed to check the performance of the VCR engine using standard gasoline

fuel using CR8 with various loading conditions. The results showed that Maximum heat released and maximum average cylinder pressure were found to be highest in 10kg loading condition with value of 57.45Joules and 27.676 bar. The maximum cylinder temperature was obtained to be 3088.57 °C in 5.0kg loading conditions.

ACKNOWLEDGMENT

The authors acknowledge the support provided by NIT Manipur during the course of the project.

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