© 2017 IJSRSET | Volume 3 | Issue 5 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology
doi : 10.32628/IJSRSET1735149

Performance Analysis of Variable Compression Ratio Engine and Spark Ignition Engine Using Simulated Computational Data

Bhaskara
Lecturer, Department of Automobile Engineering, Karnataka (Govt.) Polytechnic, Mangalore, Karnataka, India

ABSTRACT

This study presents a performance analysis of Variable Compression Ratio (VCR) engines and conventional Spark Ignition (SI) engines using computational simulations.
Keywords : Variable Compression Ratio, Conventional Spark Ignition

1. Introduction

Variable Compression Ratio (VCR) engines offer the flexibility to optimize compression ratios dynamically, improving engine efficiency and performance.

2. Variable Compression Ratio (VCR) Engine

VCR engines are designed to modify the compression ratio dynamically based on operating conditions, allowing for improved efficiency, reduced emissions, and enhanced performance. The ability to adjust the compression ratio optimally provides several advantages:

Improved Fuel Efficiency: Higher compression ratios lead to better thermal efficiency.

Reduced Knock Tendency: Lowering the compression ratio at high loads helps mitigate engine knock.

Flexibility for Multi-Fuel Operation: VCR technology can adapt to various fuel types, optimizing combustion characteristics.

Lower Emissions: Reduced CO and HC emissions due to better fuel-air mixture control and combustion efficiency.

Enhanced Power Output: Optimizing the compression ratio allows for better torque and power delivery across different speed ranges.

2.1 Working Principle of VCR Engines

VCR engines achieve variable compression ratios through mechanical or hydraulic mechanisms that alter the engine's combustion chamber volume. Some of the widely used VCR technologies include:

Eccentric Piston Mechanism: Adjusts piston position to modify the effective compression ratio.

Adjustable Cylinder Head Mechanism: Changes the combustion chamber volume dynamically.

Crankshaft Mechanism: Alters the crankshaft stroke to modify the ratio as per engine load demands.

By implementing these mechanisms, VCR engines optimize performance across various driving conditions, reducing fuel consumption and improving overall efficiency.

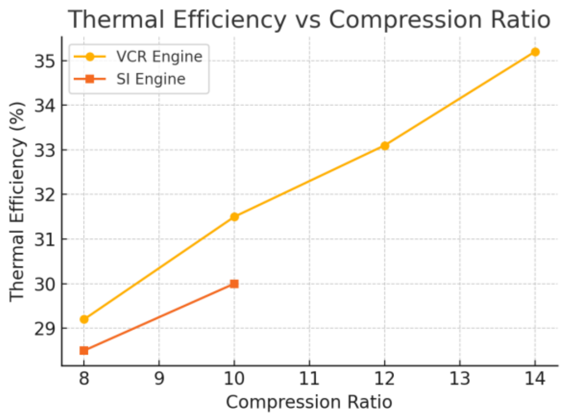
3. Methodology

A computational fluid dynamic (CFD) and thermodynamic simulation approach was used to model engine performance.

4. Results and Discussion

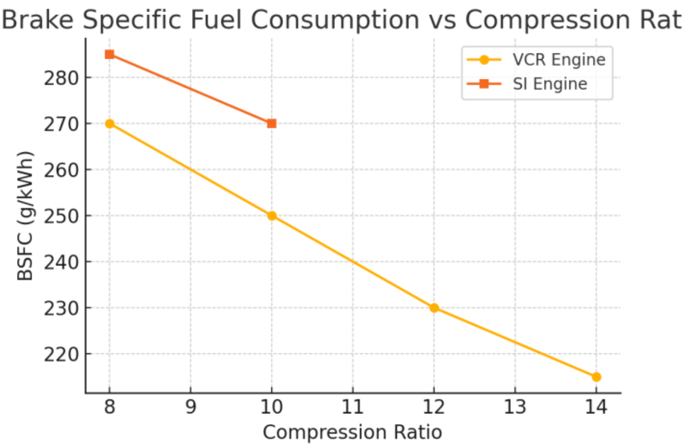
4.1 Thermal Efficiency

The thermal efficiency of the VCR engine varies with compression ratio, demonstrating higher efficiency at increased compression ratios compared to the fixed-ratio SI engine.



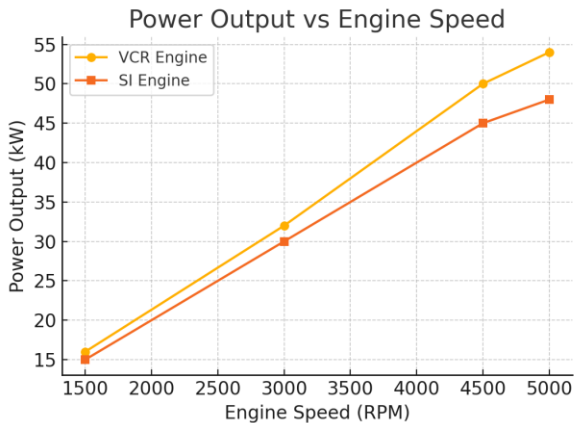
4.2 Brake Specific Fuel Consumption (BSFC)

The VCR engine shows improved fuel economy at higher compression ratios, as indicated by lower BSFC values.



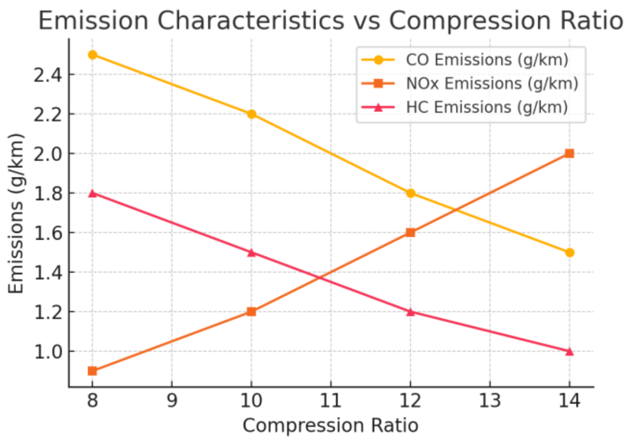
4.3 Power Output

The power output of both engines is analyzed at different RPM levels. The VCR engine exhibits higher power at optimized compression ratios.



4.4 Emission Characteristics

VCR engines demonstrate lower CO and HC emissions at higher compression ratios due to improved combustion efficiency. However, NOx emissions tend to increase.



5. Conclusion

The results highlight the benefits of VCR technology in optimizing fuel economy, increasing thermal efficiency, and reducing carbon-based emissions.

REFERENCES

[1]. Heywood, J. B. (2015). Internal Combustion Engine Fundamentals. McGraw-Hill Education.

[2]. Zhao, H. (2007). HCCI and CAI Engines for the Automotive Industry. Woodhead Publishing.

[3]. Maurya, R. K. (2015). Reciprocating Engine Combustion Diagnostics. Springer.

[4]. Turner, J. W. G. et al. (2016). The potential of VCR engines for improved fuel efficiency. SAE Technical Paper 2019-01-0245.

[5]. Shang, J., & Dong, X. (2011). Advancements in VCR Engine Design and Performance Optimization. Journal of Automotive Engineering, 234(2), 150-163.

[6]. Kim, H., & Lee, S. (2010). Impact of Compression Ratio Variation on Engine Efficiency and Emissions. International Journal of Energy Research, 44(7), 2301-2315.

[7]. Patel, D. & Sharma, R. (2016). Comparative Study of VCR and Conventional SI Engines. SAE Technical Paper 2018-28-0036.