

# Review of Performance Testing of Biofuel Blends on a Small Petrol Engine

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**Abstract** - The depletion of fossil fuels and increasing environmental pollution have accelerated research in renewable energy sources. Biofuels such as ethanol are considered promising alternatives for spark ignition engines. This research investigates the performance and emission characteristics of ethanol-petrol blends (E10, E20, and E30) in a small single-cylinder four-stroke petrol engine. Performance parameters including brake power, brake thermal efficiency, specific fuel consumption, and mechanical efficiency are evaluated under varying load conditions. Emission characteristics such as carbon monoxide, hydrocarbons, carbon dioxide, and nitrogen oxides are also analyzed. Experimental results indicate that low percentage ethanol blends improve combustion efficiency and significantly reduce harmful emissions without requiring engine modification.

**Keywords:** Biofuel Blends, Ethanol, Petrol Engine, Brake Thermal Efficiency, Emission Analysis

## 1. INTRODUCTION

Global energy consumption is increasing due to industrialization and urbanization. Conventional fossil fuels are finite and contribute to greenhouse gas emissions. The transportation sector significantly depends on petroleum-based fuels, leading to environmental concerns. Biofuels provide a renewable and environmentally friendly alternative.

Ethanol is an oxygenated fuel produced from biomass such as sugarcane, corn, and agricultural waste. Its higher octane number improves anti-knocking characteristics in spark ignition engines. The oxygen content in ethanol promotes more complete combustion, reducing carbon monoxide emissions.

This study focuses on evaluating the performance and emission characteristics of ethanol-petrol blends in a small petrol engine commonly used in generators and agricultural equipment.

## 2. Literature Review

Previous research indicates that ethanol blending enhances combustion efficiency due to its oxygenated nature. Studies show significant reduction in carbon monoxide and hydrocarbon emissions with E10 and E20 blends.

However, the lower calorific value of ethanol results in increased fuel consumption at higher blend ratios. Engine durability and material compatibility are also important factors when using higher ethanol concentrations.

Most researchers conclude that blends up to 20 percent ethanol provide an optimal balance between performance, fuel economy, and emissions.

## 3. Experimental Setup

The experimental setup consists of a single-cylinder, four-stroke, air-cooled petrol engine coupled with an eddy current dynamometer. Fuel consumption is measured using a burette and stopwatch method. Exhaust emissions are measured using a digital gas analyzer.

Engine Specifications:

Engine Type: Single Cylinder, Four Stroke, Air Cooled

Rated Power: 3.5 kW

Rated Speed: 3000 rpm

Compression Ratio: 8.5:1

Fuel Blends Tested: E0, E10, E20, E30

## 4. Methodology

The engine is operated at constant speed under different load conditions (0%, 25%, 50%, 75%, and 100%). For each fuel blend, parameters such as fuel consumption, torque, speed, and exhaust emissions are recorded after steady-state conditions are reached.

Brake Power (BP) =  $(2 \times \pi \times N \times T) \div 60$

Brake Thermal Efficiency (BTE) =  $\text{Brake Power} \div (\text{Fuel Flow Rate} \times \text{Calorific Value})$

Specific Fuel Consumption (SFC) =  $\text{Fuel Flow Rate} \div \text{Brake Power}$

Mechanical Efficiency =  $\text{Brake Power} \div \text{Indicated Power}$

## 5. Results and Discussion

Brake thermal efficiency increases slightly for E10 due to improved combustion. E20 shows comparable efficiency, while E30 shows marginal reduction because of lower heating value.

Specific fuel consumption increases with ethanol percentage because ethanol has lower calorific value than petrol.

Carbon monoxide and hydrocarbon emissions decrease significantly for ethanol blends. Nitrogen oxides show slight increase at higher loads due to higher combustion temperature.

## 6. Comparative Analysis

A comparative analysis between pure petrol and ethanol blends indicates that E10 provides the best compromise between performance improvement and emission reduction. E20 is suitable for moderate environmental benefits, while E30 may require engine tuning adjustments.

Overall engine smoothness and knocking tendency are reduced with ethanol blends due to improved octane rating.

## 7. Environmental Impact Assessment

The use of ethanol blends contributes to reduction in greenhouse gas emissions. Since ethanol is derived from biomass, the carbon dioxide released during combustion is partially offset by carbon absorption during crop growth.

Adoption of biofuel blends can reduce dependence on imported crude oil and enhance energy security.

## 8. Future Scope

Future research may include long-term durability testing, optimization of ignition timing, and performance evaluation under variable compression ratios. Advanced studies may also investigate the use of other biofuels such as methanol and butanol in small petrol engines.

## 9. Conclusion

The experimental investigation concludes that ethanol blends up to 20 percent can be effectively used in small petrol engines without modification. Biofuel blends provide environmental benefits, sustainable energy solutions, and improved combustion characteristics. Higher blend ratios may require minor engine adjustments for optimal performance.

## 10. References

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