



# Efficiency of Biofuel as an Alternative Fuel for Reducing IC Engine Fuel Consumption

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**ABSTRACT:** The demand for fuels is going up and their use is bad for the environment. This has made people look for fuels like biofuels. Biofuels come from sources such as vegetable oils, animal fats and farm waste. They can replace diesel and gasoline in combustion engines. This study checks how well biofuels work in reducing the use of engine fuels while keeping the engine performance good. We tested blends of biodiesel to see how they affect the engines efficiency, fuel consumption and emissions. The results show that biofuel blends can reduce our dependence on fuels improve engine efficiency and decrease harmful emissions. We conclude that biofuels are an eco-friendly alternative for internal combustion engines if optimized properly.

**KEYWORDS:** Biofuel, alternative fuel, internal combustion engine, fuel efficiency, emission reduction, renewable energy, engine performance, combustion characteristics, sustainable energy, fuel consumption reduction

## I. INTRODUCTION

The worlds need for energy is increasing fast because of industrialization and population growth. Fossil fuels like diesel and petrol are. Pollute the environment a lot, including releasing greenhouse gases. Internal combustion engines are used a lot in transportation and industries making them a major contributor to fuel consumption and pollution.

Biofuels are an alternative because they are renewable biodegradable and have a lower environmental impact. Biodiesel in particular can be used in diesel engines with no change. It is made by converting oils or animal fats into a usable form and can be mixed with conventional diesel in different proportions.

The main goal of this project is to check how well biofuels work as a fuel in internal combustion engines and how they affect fuel consumption and performance.

## II. LITERATURE REVIEW

Many studies have looked into using biofuels in combustion engines. Research shows that biodiesel blends like B10, B20 and B50 can be used effectively in diesel engines.

Some key findings are:

- Biodiesel improves combustion because it has oxygen.
- Brake thermal efficiency is slightly lower or similar to diesel.
- Specific fuel consumption is generally higher because biodiesel has a lower energy value.
- Emissions like carbon monoxide, hydrocarbons and particulate matter are reduced.

Studies also note that:

- Nitrogen oxide emissions may increase slightly.



- Engine modifications and optimization techniques can improve performance.
  - Using waste cooking oil biodiesel is cost-effective and environmentally friendly.
- Overall literature supports the use of biofuels as an complete substitute for conventional fuels.

### III. MATERIALS AND METHODS

#### Materials

- Diesel fuel (baseline fuel)
- Biodiesel (produced from oil or waste cooking oil)
- Blends: B10 (10% biodiesel) B20 (20%) B50 (50%)

#### Equipment

- Single-cylinder, four-stroke diesel engine
- Fuel measuring system
- Exhaust gas analyzer
- Dynamometer for load measurement

#### Methodology

- Prepare biodiesel using a conversion process.
- Create different biodiesel-diesel blends.
- Run the engine at varying loads (0%, 25%, 50%, 75%, 100%).
- Measure parameters:

Fuel consumption  
Brake power  
Exhaust emissions

- Calculate:  
Brake thermal efficiency (BTE)  
Specific fuel consumption (SFC)

### IV. RESULTS AND DISCUSSION

#### Brake Thermal Efficiency

Biodiesel blends showed lower efficiency compared to diesel. The B20 blend performed closest to diesel. Improved combustion due to oxygen in biodiesel enhanced efficiency at loads.

#### Specific Fuel Consumption

SFC increased with biodiesel content. This is due to the energy value of biodiesel. However fossil diesel consumption reduced proportionally.

#### Emission Characteristics

- CO and HC emissions decreased significantly.
- Smoke opacity was reduced due to combustion.
- NOx emissions showed a slight increase.

### V. DISCUSSION

The results indicate that biofuel blends can effectively reduce fossil fuel consumption while maintaining engine performance. Among all blends B20 provides the balance between efficiency and emission reduction.

### VI. OPTIMIZATION

To improve biofuel-powered IC engines the following can be applied:

- Fuel Injection Timing Adjustment: Optimizing injection timing improves combustion efficiency.
- Engine Modification: Slight modifications in compression ratio enhance performance.



- Additives: Use of combustion enhancers improves fuel properties.
  - Preheating of Fuel: Reduces viscosity. Improves atomization.
  - Blending Optimization: Selecting blend ratios like B20 or B30.
- Optimization helps overcome drawbacks such as higher fuel consumption and NO<sub>x</sub> emissions.

## VII. FUTURE SCOPE

This study shows that biofuels are an alternative to conventional IC engine fuels. Although biodiesel has an energy value it offers several advantages such as reduced emissions, renewable availability and decreased dependence on fossil fuels.

The B20 blend is identified as the efficient and practical option providing a good balance between performance and environmental benefits. With optimization biofuels can significantly contribute to sustainable energy solutions and environmental protection.

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