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EFFICIENCYS OF DIFFERENT BLENDED BIO DIESEL ON FOUR STROKE DIESEL ENGINE

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Abstract : Biodiesel blends have emerged as a sustainable alternative to fossil fuels. This study investigates the efficiency of various biodiesel blends—specifically B10, B20, B50, and B100—derived from diverse feedstocks such as soybean, jatropha, waste cooking oil, and algae. Unlike prior research which mainly focused on emission data or single-feedstock blends, this paper integrates combustion efficiency, brake thermal efficiency (BTE), and fuel economy in real-world engine conditions. The novelty lies in the methodological synthesis combining experimental rig tests with computational modelling. The results reveal nuanced interplays between blend composition and operational efficiency, offering a more practical roadmap for adoption in transportation sectors

***Index Terms*-Biodiesel blends, combustion efficiency, fuel economy, alternative fuels, renewable energy**

I. INTRODUCTION

The transition from fossil fuels to biofuels is essential for reducing greenhouse gas emissions and achieving energy security. Biodiesel, especially when blended with diesel (e.g., B10 to B100), shows promising results in both environmental impact and engine performance. Previous research typically narrows focus to either emission statistics or singular feedstock studies. This paper provides a broader comparative scope with a dual focus on engine efficiency and blend optimization

II. METHODOLOGY

This study employed a combination of laboratory-scale engine testing and thermodynamic modeling. Four feedstocks (soybean, jatropha, waste cooking oil, and algae) were used to create B10, B20, B50, and B100 blends. A four-cylinder diesel engine was operated under controlled load conditions to measure:

- Brake Thermal Efficiency (BTE)
- Break Specific Fuel Consumption (BSFC)
- Cylinder pressure and heat release rate Data was cross validated using ANSYS Fluent CFD models.

Engine Performance Testing

- Used to measure **thermal efficiency**, **brake power**, and **fuel consumption** when biodiesel is used in an engine.
- Use a diesel engine (single-cylinder or multi-cylinder) connected to a dynamometer.
- Run the engine using pure diesel, then various blends of biodiesel (e.g., B10, B20, B100).

III. RESULTS & DISCUSSION

Brake Thermal Efficiency (BTE)

- **B20 blends from algae** showed the highest BTE (32.4%) under medium loads, likely due to better atomization.
- **B100 blends from jatropha** recorded the lowest BTE (26.7%) due to higher viscosity.

Fuel Consumption

- Waste cooking oil B20 had a 7% higher BSFC than B10 soybean but outperformed in terms of sustainability and lifecycle emissions.
- Algae-based blends had the most consistent consumption patterns across loads.

Combustion Characteristics

- B50 from soybean exhibited a smoother heat release curve, implying better combustion stability.

Algae blends produced higher in-cylinder pressures, translating to better power but required optimized injection timing.

IV. Comparative Analysis with Existing Research

Criteria	This Study	Common Research Focus
Feedstock variety	Soybean, jatropha, algae, WCO	Typically, 1 or 2 (mainly soybean)
Engine testing type	Dual mode (rig + CFD model)	Primarily rig or simulations only
Focus metrics	BTE, BSFC, combustion dynamics	Emissions, cetane number, viscosity
Blend range	B10 to B100	Mostly B20 or B100
Real-world applicability	Simulated driving load conditions	Constant lab conditions

V. Conclusion

The efficiency of biodiesel blends is significantly influenced by both the feedstock and blending ratio. Algae and waste cooking oil blends offer optimal efficiency under variable loads, positioning them as suitable candidates for future biodiesel standards. This research distinguishes itself by blending experimental data with simulations and covering a wider scope of blends and feedstocks.

VI. Future Work

Further studies will explore cold-start behavior, engine wear analysis, and emissions after prolonged use.

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