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Evaluation And Performance Analysis of Ethanol-Methanol Blended SI Engine Using Rice Straw Feedstock

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Abstract - This research focuses on producing biofuel from agricultural waste, specifically rice straw, and testing its performance in a spark ignition (SI) engine. Ethanol and methanol were produced using chemical and biological methods, then blended with petrol in various ratios. The engine was tested using these blends, and results were analyzed for performance and emissions. The study shows that ethanol-methanol blends offer improved combustion and lower harmful emissions, making them a sustainable alternative to fossil fuels.

Keywords: Ethanol, Methanol, Rice Straw, Spark Ignition Engine, Biofuel, Emission Control

1. INTRODUCTION

Due to rising fuel costs and environmental issues, there is a growing need for alternative fuels. Ethanol and methanol are renewable fuels that can be blended with petrol and used in SI engines. Rice straw, an agricultural waste, is often burned and causes pollution. This project uses rice straw to produce ethanol and methanol, helping reduce pollution and dependence on fossil fuels. Rice straw, a widely available agricultural waste, is often burned, causing air pollution. Converting it into biofuels not only reduces pollution but also provides a sustainable fuel source, addressing both energy needs and waste management

2. OBJECTIVE:

1. To produce ethanol and methanol from rice straw.
2. To blend these biofuels with petrol.
3. To test the blends in an SI engine.
4. To analyze engine performance and emissions.

METHODOLOGY

3.1 Biofuel Production:

1. Collection & Pretreatment: Rice straw was collected, dried, ground, and treated with 5% NaOH.
2. Hydrolysis: Enzymes were used to break down cellulose into sugars.
3. Fermentation: Sugars were fermented using Saccharomyces cerevisiae to produce ethanol.
4. Methanol: Sourced separately through synthesis or industrial methods.
5. Distillation: Ethanol was purified to fuel-grade quality (99.7%).

3.2 Fuel Blending:

1. Blends of ethanol, methanol, and petrol were prepared:
2. E10M10P80 (10% Ethanol, 10% Methanol, 80% Petrol)
3. E10M15P75
4. E15M15P70

3.3 Engine Testing:

1. A 4-stroke, single-cylinder SI engine was used.
2. Parameters measured: Brake Power, Brake Thermal Efficiency (BTE), Specific Fuel Consumption (SFC), and Emissions (CO, HC, NOx).

RESULTS

1. Performance: E15M15P70 showed the highest Brake Thermal Efficiency (36.54%).

2. Emissions: CO and HC levels were lower in all blends compared to pure petrol.

3. Fuel Properties: Blends had good combustion due to high oxygen content in ethanol and methanol.

Fig -1: distillation setup for ethanol distillation

Fig -2: test engine setup

Fig -3: result

CONCLUSIONS

This project focused on producing bioethanol from rice straw and evaluating its use in an SI engine.

Part A – Ethanol Production:

Rice straw was used as raw material.

Process included:

1. Pretreatment
2. Enzymatic hydrolysis
3. Fermentation
4. Distillation

Output: 247 mL of ethanol, proving the feasibility of converting agricultural waste into fuel.

Part B – Engine Testing:

Ethanol used in blends:

E10 M10 P80

E10 M15 P75

E15 M15 P70

Tested on performance parameters: BTE, BSFC, VE, and EGT.

Key Results:

1. E15 M15 P70 showed highest BTE (36.54%) due to better combustion.
2. BSFC remained stable at 360 g/kWh for all blends.

3. VE was highest for E10 M10 P80 (69.2%) but slightly dropped with higher alcohol content.

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