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Conceptual Design & Development of Automobile by Using Acetylene Gas as a Fuel

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Abstract: ***The growing demand for renewable energy and the reduction of harmful emissions have driven the exploration of alternative fuels. Acetylene gas, produced from calcium carbide and water, offers a promising solution as it exhibits properties comparable to hydrogen. This research investigates the application of acetylene gas in a single-cylinder engine operating on a dual-fuel mode. A detailed study of the performance, efficiency, and emission characteristics was conducted, revealing significant advantages such as reduced smoke and emissions, alongside improved thermal efficiency. Challenges such as higher NOx emissions and operational drawbacks are discussed, along with future directions for acetylene-powered vehicles.***

Keywords: Acetylene, Calcium Carbide, Dual Fuel, Renewable Energy, Emission Control, Automobile Design

I. INTRODUCTION

Acetylene, a colorless gas with high energy potential, has been identified as a viable alternative to conventional fuels. Historically, acetylene-powered vehicles were conceptualized to address the dependency on petrol and diesel. The combustion of acetylene, produced by reacting calcium carbide with water, generates significantly lower emissions. This study aims to design and develop a vehicle powered by acetylene gas, evaluating its feasibility and potential as an eco-friendly fuel alternative.

II. LITERATURE REVIEW

Various researchers have explored acetylene as an alternative fuel:

1) G. Nagarajan and T. Lakshmanan conducted experiments on diesel engines aspirating acetylene and found reduced smoke, HC, and CO emissions compared to diesel.
2) Ashok Kumar et al. highlighted acetylene's compatibility with SI engines and its efficiency gains.
3) Swami Nathan et al. demonstrated high thermal efficiencies using acetylene in HCCI engines but identified challenges such as knocking.
4) John W.H. Price emphasized safety precautions when handling acetylene cylinders.
5) These studies highlight acetylene's potential while underscoring the need for advanced designs and safety measures.

III. PROBLEM STATEMENT

The environmental impact of conventional IC engine vehicles necessitates alternative fuel solutions. Acetylene gas, derived from calcium carbide and water, offers a sustainable and low-emission alternative. However, challenges such as engine modifications, higher NOx emissions, and limited infrastructure need to be addressed.

IV. OBJECTIVES

1) Design a frame for an acetylene-powered vehicle.
2) Select appropriate materials and components.
3) Optimize engine performance and reduce emissions.
4) Evaluate the economic and environmental benefits of acetylene as a fuel.

V. METHODOLOGY

The methodology focuses on utilizing the chemical reaction between calcium carbide (CaC_2) and water (H_2O) to produce acetylene gas (C_2H_2), which is stored and utilized as fuel. The steps include:

1) Gas Generation: Calcium carbide reacts with water to produce acetylene gas, stored in a regulated tank.
2) Engine Design: Acetylene gas is aspirated into the engine's inlet manifold for combustion.
3) Component Selection: Components such as wheels, brakes, suspension, and steering systems were selected for their compatibility and efficiency.
4) Emission Control: Adjustments were made to reduce NOx emissions while maintaining thermal efficiency.

VI. EXPERIMENTAL SETUP

The vehicle components include:

- Wheels & Tyres: Compact,high-traction tires for stability.
- Brakes: Disc brakes for efficient heat dissipation and stopping power.
- Suspension: wishbone suspension for stability and comfort.
- Steering System: Rack and pinion mechanism for precise control.

Acetylene Gas Generation and Supply Process [Full Experimental setup show in fig-1.1 , 1.2 , 1.3]

1) Gas Generation (Reaction Tank):Calcium carbide (CaC_2) is introduced into a specially designed reaction tank containing water. Upon contact, a chemical reaction occurs, producing acetylene gas (C_2H_2) and calcium hydroxide ($Ca(OH)_2$) as a byproduct:
2) Gas Filtration (Filter Section):The raw acetylene gas passes through a filtration unit where impurities such as moisture, calcium hydroxide particles, and other contaminants are removed to ensure clean gas for further use
3) Gas Storage (Storage Tank):The filtered acetylene gas is then directed into a pressurized storage tank. This tank is designed to safely store acetylene under controlled conditions, ready for use when needed.
4) Fuel Delivery (Carburetor):From the storage tank, the acetylene gas is fed into a carburetor system. The carburetor mixes the acetylene gas with air in appropriate ratios to prepare a combustible mixture suitable for engine use.
5) Combustion (Engine):The air-acetylene mixture is then supplied to the engine's combustion chamber, where it is ignited to produce power. This process is used in applications where acetylene serves as an alternative fuel source.

VII. RESULTS AND DISCUSSION

The study revealed the following key findings:

1) Efficiency Gains: Acetylene demonstrated higher thermal efficiency compared to petrol.
2) Emission Reduction: Smoke and CO emissions were significantly lower.
3) Challenges: Issues such as knocking, ignition delay, and the need for engine modifications were noted.

VIII. CONCLUSION

This research underscores the potential of acetylene gas as a sustainable alternative to conventional fuels. While challenges such as NOx emissions and infrastructure limitations persist, the environmental and economic benefits of acetylene make it a promising candidate for future automotive applications.

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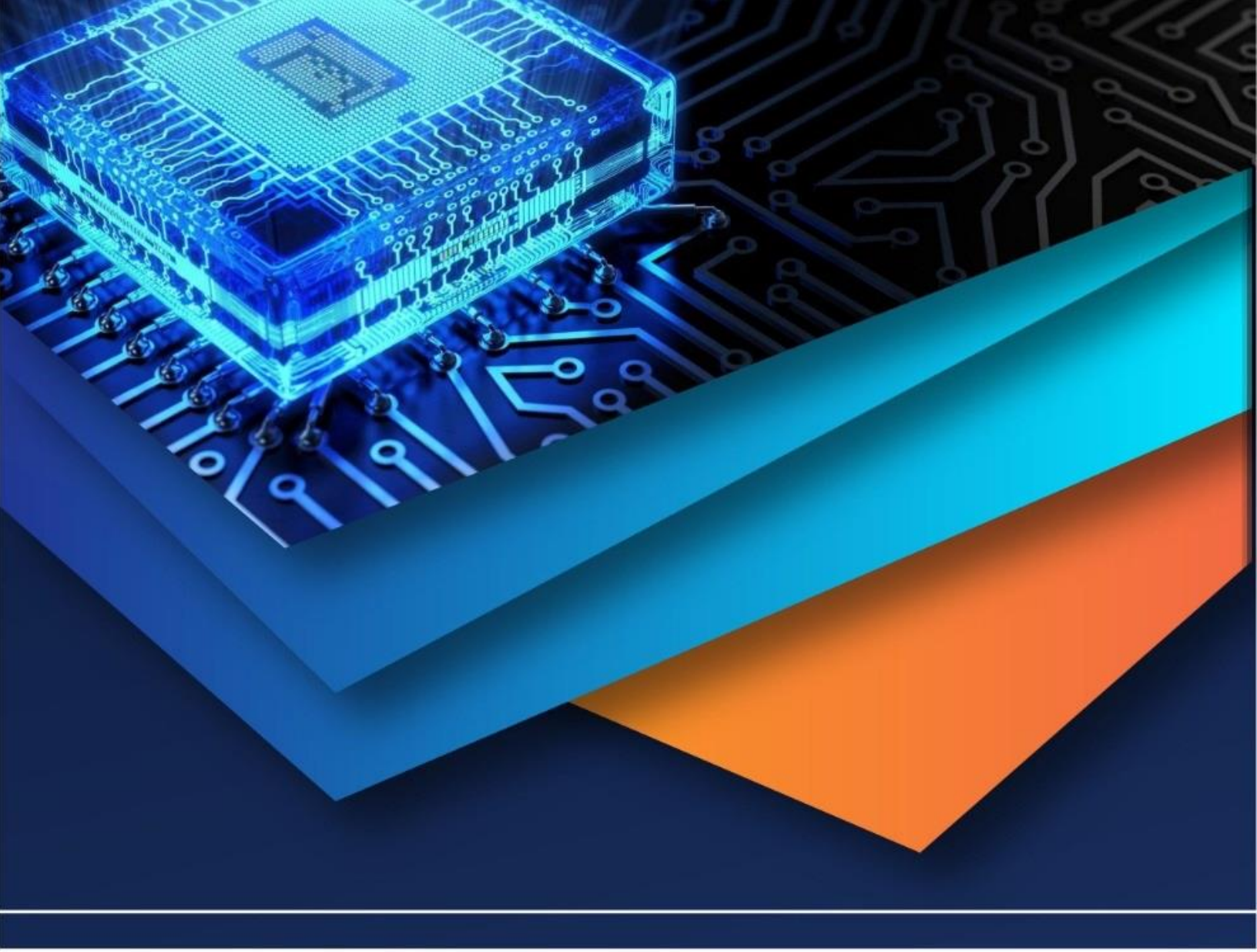
Fig-1.1

Fig-1.2

Fig-1.3



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