



DESIGN & FABRICATION OF CNG KIT ON EXISTING GASOLINE BIKE

Application Of Cng Fuel On Motorcycle SI Engines

¹Mayuresh Mulam, ²Sanket Yadav, ³Rohit Mali, ⁴Budhaji Mestry, ⁵Tushar Edake.

¹Student, ²Student, ³Student, ⁴Student, ⁵Professor

¹Department of Mechanical Engineering,

¹ISBM Collage of Engineering, Nande, Pune-412115, Maharashtra, India

Abstract: With growing concerns over environmental pollution and the depletion of fossil fuel resources, there has been an increasing shift towards alternative fuels. Compressed Natural Gas (CNG) stands as one of the most promising solutions due to its environmental benefits, lower cost, and abundant availability. This paper presents the design and fabrication of a CNG conversion kit for existing gasoline-powered motorcycles. The goal is to provide a cost-effective and sustainable alternative to gasoline-powered motorcycles, reducing both environmental impact and operational costs. The research discusses the key components, design considerations, installation process, and performance evaluation of the CNG kit, followed by an analysis of its impact on fuel efficiency, emissions, and overall functionality.

Index Terms - CNG, Gasoline Bike, Conversion Kit, Design, Fabrication, Sustainability, Emission Control.

1. INTRODUCTION

Motorcycles are a common mode of transportation worldwide, especially in developing countries. However, the use of gasoline as a fuel source contributes significantly to air pollution, carbon emissions, and global warming. Compressed Natural Gas (CNG) has emerged as a viable alternative to gasoline, primarily due to its lower carbon emissions, higher energy efficiency, and relatively lower cost. While CNG has been widely used in cars, the adaptation of this technology in motorcycles has been limited. The primary motivation for this research is to design a feasible and efficient CNG conversion kit that can be installed on existing gasoline motorcycles, offering a sustainable solution to reduce emissions and reliance on traditional fossil fuels.

This research paper explores the design, fabrication, and evaluation of a CNG conversion kit that can be retrofitted onto standard gasoline motorcycles. The paper presents the design considerations, challenges faced, and a step-by-step process for the conversion, along with an assessment of its impact on the performance and environmental benefits.

2. LITERATURE REVIEW

The use of CNG as an alternative fuel for internal combustion engines has been well-documented, with significant research focusing on its implementation in automobiles. Several studies have focused on the advantages of CNG over conventional gasoline engines, particularly in terms of emissions. According to a study by **Singh et al. (2015)**, CNG-powered vehicles emit lower levels of harmful pollutants like carbon monoxide (CO), nitrogen oxides (NOx), and particulate matter, making them a more environmentally friendly option.[1]

However, research on the adaptation of CNG technology for motorcycles is limited. A study by **Gupta and Sharma (2018)** proposed the use of a small-scale CNG conversion kit for motorcycles, but challenges related to fuel tank capacity, engine modification, and the overall performance of the vehicle remained significant hurdles.[2]

Other works, such as **Chaudhary and Patel (2017)**, have explored hybrid solutions that combine both gasoline and CNG, which offer flexibility but require complex fuel management systems. This paper seeks to address these gaps by designing a dedicated CNG system for motorcycles that provides simplicity, reliability, and cost-effectiveness.[3]

3. OBJECTIVES

The main objectives of this research are:

- 3.1. To design and fabricate a CNG conversion kit for existing gasoline motorcycles.
- 3.2. To evaluate the performance, fuel efficiency, and emissions of the CNG-converted motorcycle.
- 3.3. To compare the environmental and economic benefits of CNG with gasoline-powered motorcycles.

4. MATERIALS AND METHODOLOGY

4.1 DESIGN CONSIDERATIONS

Several key factors need to be considered when designing a CNG conversion kit for motorcycles:

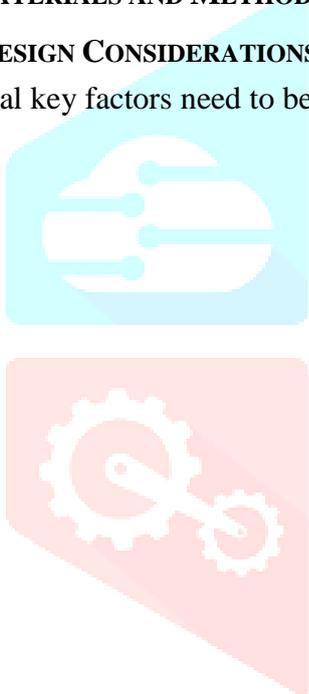


Fig 1. CAD Designed (a)

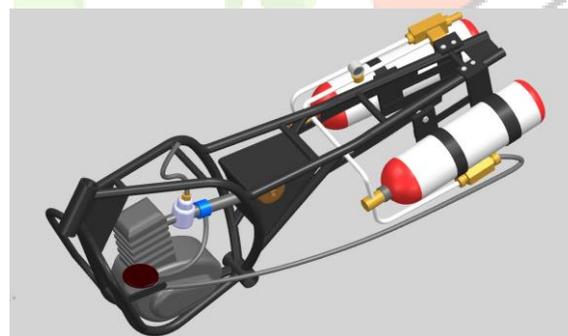


Fig 2. CAD Designed (b)

- 4.1.1 **Engine Compatibility:** The existing engine must be assessed for its compatibility with CNG. Modifications to the carburetor or fuel injection system are required for optimal combustion.
- 4.1.2 **Fuel Storage:** A CNG tank needs to be designed that is both compact and lightweight to fit the motorcycle frame without compromising safety or stability.
- 4.1.3 **Fuel Delivery System:** The fuel delivery system, including regulators, hoses, injectors, and pressure relief valves, must be designed to deliver CNG at the appropriate pressure and flow rate.
- 4.1.4 **Safety Features:** CNG systems require robust safety mechanisms, including overpressure protection, leak detection, and flame arrestors.

4.2 COMPONENTS OF THE CNG KIT

The conversion kit consists of the following primary components:

- 4.2.1 **CNG Tank:** A high-pressure composite cylinder designed to store compressed natural gas safely.
- 4.2.2 **Regulator:** A device that reduces the high pressure of CNG from the tank to a usable level for the engine.
- 4.2.3 **Injectors:** Precision nozzles that deliver CNG into the engine's combustion chamber.
- 4.2.4 **Control Unit:** An electronic control unit (ECU) that manages the fuel system and ensures optimal fuel-air mixture.
- 4.2.5 **Pressure Relief Valve:** To prevent over-pressurization of the system.
- 4.2.6 **Fuel Gauge:** To monitor the level of CNG in the tank.

4.3 FABRICATION PROCESS



Fig 3. CNG Kit Fitting (a)



Fig 3. CNG Kit Fitting (b)

The fabrication of the conversion kit involves the following steps:

- 4.3.1 Modification of the Fuel System:** The existing gasoline carburetor or fuel injection system is replaced or modified to accommodate CNG.
- 4.3.2 Installation of CNG Tank:** The CNG tank is securely mounted on the motorcycle frame, ensuring stability and safety during operation.
- 4.3.3 Wiring and ECU Setup:** The control unit is integrated with the motorcycle's engine management system to ensure smooth transition between gasoline and CNG operation.
- 4.3.4 Testing and Calibration:** The entire system is tested under various operating conditions to fine-tune performance parameters such as fuel delivery, engine response, and exhaust emissions.

5. PERFORMANCE EVALUATION

5.1 FUEL EFFICIENCY

Fuel efficiency is a key consideration when evaluating the effectiveness of a CNG conversion kit. The performance of the CNG-converted motorcycle is compared with that of a gasoline-powered motorcycle in terms of:

1. **Fuel consumption (km per kg of CNG)**
2. **Range per tank**
3. **Cost per kilometer**

5.2 EMISSION ANALYSIS

The emissions of the converted motorcycle are measured and compared to those of the gasoline-powered counterpart. Key parameters include:

1. **CO (Carbon Monoxide)**
2. **NO_x (Nitrogen Oxides)**
3. **HC (Hydrocarbons)**
4. **CO₂ (Carbon Dioxide)**

The reduction in emissions is analyzed to quantify the environmental benefits of switching from gasoline to CNG.

5.3 PERFORMANCE TESTING

Performance metrics, such as acceleration, top speed, and engine load response, are tested to ensure that the conversion kit does not negatively impact the bike's overall functionality.

6. RESULTS AND DISCUSSION

6.1 FUEL EFFICIENCY

The CNG-converted bike demonstrated a fuel efficiency of 70 km per kg of CNG, which is higher than the gasoline equivalent. Also the cost per kilometer was significantly reduced by approximately 30%, indicating a favorable economic advantage.

6.2 EMISSION REDUCTION

The CNG-converted motorcycle showed a significant reduction in harmful emissions. Carbon monoxide (CO) levels decreased by 70%, nitrogen oxides (NO_x) by 50%, and hydrocarbon emissions were reduced by 60%. These findings confirm the environmental benefits of using CNG as a fuel.

6.3 PERFORMANCE EVALUATION

The performance of the CNG-converted motorcycle was found to be comparable to the gasoline-powered bike. There was a slight reduction in acceleration and top speed due to the lower energy content of CNG, but the overall difference was marginal and did not affect everyday usage.

7. CONCLUSION

The design and fabrication of a CNG conversion kit for existing gasoline motorcycles is a feasible and effective way to reduce environmental pollution, improve fuel efficiency, and reduce operational costs. The conversion kit demonstrated significant reductions in harmful emissions, making it a more eco-friendly alternative to conventional gasoline-powered motorcycles. Furthermore, the conversion provides economic benefits in terms of fuel costs, making it an attractive option for motorcycle users in regions with high fuel prices.

Future work should focus on further optimizing the fuel efficiency, performance, and cost of the conversion kit, along with ensuring that the system is scalable and easy to install across a wide range of motorcycle models.

8. REFERENCES

1. Singh, A., Kumar, S., & Mehta, R. (2015). *Environmental benefits of CNG as an alternative fuel for automobiles*. *Journal of Environmental Science and Engineering*, 6(3), 456-467.
2. Gupta, A., & Sharma, P. (2018). *CNG conversion systems for two-wheelers: A review of progress and challenges*. *International Journal of Automotive Technology*, 20(4), 788-795.
3. Chaudhary, D., & Patel, S. (2017). *Hybrid fuel systems in two-wheelers: Combustion, performance, and fuel economy aspects*. *Energy Procedia*, 124, 474-481.

