

# Design Modification and Analysis of Exhaust Valve of an Single Cylinder Four Stroke IC Engine to Improve its Torque- A Review

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## Abstract

Increasing Industrialization and Urbanization has led to phenomenal growth in transportation sector. Due to depletion of fossil fuel in the nature, alternative of Gasoline and Diesel was obtained i.e CNG (Compressed Natural Gas) mainly composed of Methane. CNG emits less pollution and it has inherent clean nature of combustion. One of the main drawback of CNG is producing less Torque as compared to Gasoline and Diesel this is due to its less Volumetric efficiency, Heat transfer rate and flame propagation speed.

**Keywords:** CNG, Volumetric efficiency, low flame speed, power, torque

## I. INTRODUCTION

In the world today a total of 12,730Mtoe of energy is consumed, of which 7205Mtoe are oil and natural gas[1]. It is well known that Oil reserves are depleting at alarming rate. There is a need for alternative fuel to sustain oil reserves and to control air pollution, this has led to invention of CNG(Compressed Natural Gas). CNG is less polluting fuel it contains Methane, ethane, propane, carbon dioxide, nitrogen, oxygen and hydrogen. CNG comprises of nearly 95% of methane which provides inherent clean nature of combustion. CNG is produced by compressing Conventional Natural Gas (mainly composed of Methane CH<sub>4</sub>) less than 1% of its volume occupies at standard atmospheric pressure.

## II. TECHNICAL ASPECTS OF CNG

Compression ratio is one of the most important parameter of an IC engine higher the compression ratio higher is the efficiency. The compression ratio of CNG is 10:1. The octane number of CNG is ranging in between 120-130 which means engines could work at compression ratio upto16:1 without knocking. Therefore dedicated CNG engine may have efficiency upto 35% in contrast with Gasoline which have 25%. [2]

## III. IC ENGINE

It is an Engine in which the combustion of fuel occurs with an oxidizer in a combustion chamber. These engines are of two types

- 1) SI engine- This engine use spark plug to ignite the fuel. Gasoline and CNG engine uses spark plug to ignite the fuel.
- 2) CI engine- This engine ignites by itself. Diesel engine is CI engine.

IC engine mainly composed of Piston, Connecting rod, Crankshaft, Cylinder and Valves.

There are two valves in IC Engine one is Inlet valve and other one is Exhaust Valve. Mainly Poppet valve is used in IC Engine. Inlet valve allows the fuel to enter in the combustion chamber for combustion during Suction stroke and exhaust valve allows burnt gases to expel out from Combustion chamber during Exhaust stroke. The inlet valve is bigger than exhaust valve.

## IV. ENGINE PERFORMANCE SHORT COMINGS

The performance of engine dependent on engine design and type i.e. Bi-fuel or Dedicated CNG. However the major problems faced by investigators and manufacturers are Brake power loss in CNG Fuelled Engine. Several attributes that affect the engine power and torque are low Volumetric efficiency, Low Flame propagation speed, low Heat transfer rate.[2]

### A. Volumetric Efficiency

The volumetric efficiency of CNG Engine is lower than gasoline and diesel engine. The lower volumetric efficiency of CNG is due to its physical properties which is gas. Figure1 shows comparison of Volumetric efficiency of CNG and Gasoline.[1]

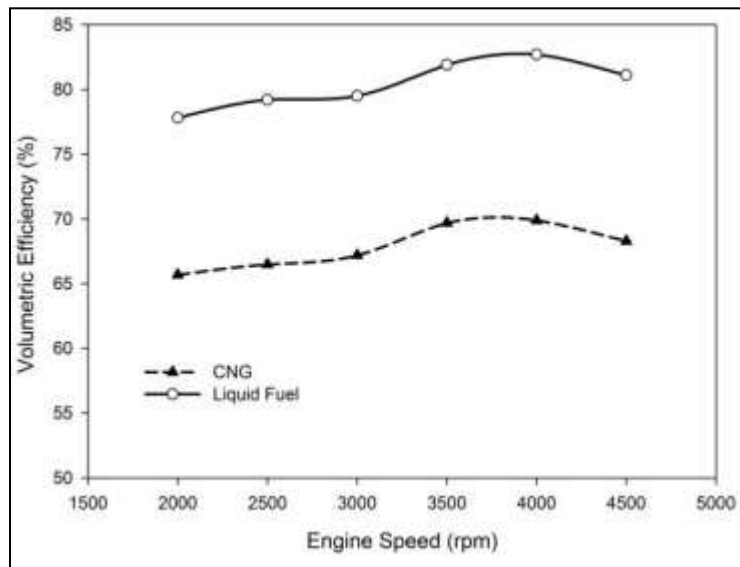


Fig. 1:

### B. Low Flame Speed

This lower flame propagation speed conduces to prolongation in total combustion duration compared with gasoline/diesel and allows exit of a greater amount of unburned natural gas through the exhaust. When engine fuelled with CNG operates at near lean limit, problem of misfiring occurs. This is due to huge amount of Methane( $\text{CH}_4$ ) present in the gas. And amongst all Hydrocarbons methane has slowest Flame speed. [2]

### C. Heat Transfer Rate

The pressure obtained by CNG inside the cylinder is low because of its Low Density. This causes low heat generated inside cylinder chamber. The low heat generated is dependent on temperature of combustion. The heat transfer rate to the wall by CNG is lower than liquid fuel.[1]

## V. VALVES MATERIAL

Recently, control of the gas-exchange process has come into focus as a critical internal (IC) engines. The intention of these strategies ranging from simple enhancement of volumetric efficiency to all engine speed. In the search for alternative valve materials, it was discovered that Silicon Nitride Ceramic (SiN or “ceramic”) was ideally suited for the poppet-valve component. After using SiN as valve material 50% reduction in the masses of valve train, about 15% reduction in the frictional losses, 6% increase in low speed engine torque.[3]

## VI. CONCLUSION

- 1) Compression Ratio is one of the most important factor
- 2) Major problem discovered in CNG Engine is Brake Power Loss.
- 3) Major factors which affect CNG Engine Power and Torque are volumetric efficiency, Low flame propagation speed, and low heat transfer rate.
- 4) Valves made from composite materials such as Silicon Nitride (SiN) or ceramic reduces weight of overall valve train by 50%.
- 5) 15% reduction in frictional losses and 6% increase in low speed Engine torque is obtained.

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