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Research Paper

Performance and Emission Analysis of Four Stroke Twin Spark Single Cylinder SI Engine Fuelled with Gasoline and CNG -a Technical Review

Engineering

KEYWORDS : SI Engine, DTS-i engine, CNG Engine, Volumetric Efficiency, Maximum Torque, Emission

Imran G. Qureshi — PG Student (Mechanical) , L.D. College of Engineering Ahmedabad

Prof. R. J. Jani — Professor in Mechanical Engineering Department, L.D. College of Engineering Ahmedabad

ABSTRACT

This paper describes review on performance and emission characteristics of twin spark ignition engine fuelled by gasoline and natural gas. Here, it will be shown that due to lower volumetric efficiency and lean effect in CNG Fuelled SI engine, the maximum torque generated is diminished compared to gasoline fuelled engines. We showed that the torque reduction can be recovered and performance of single spark CNG engine can be enhanced by modifying twin spark ignition system.

I. INTRODUCTION

Gasoline engine is used for automotive application. The automobile plays an important role in the transportation system in India. With increase in population and living standard, the vehicles as well as pollution is increasing day by day. Among all of this, there is steep increase in the number of two wheelers during the last ten years. All these are increasing exhaust pollution. In recent years number of CNG run vehicle is increases day by day because of less emission and economical. The main problem associated with CNG run vehicle is safety.

II. reviews

Number of research papers and studies has been conducted on the use of CNG and effect of Engine emission and Performance in DTS-I engine**.** Effect of parameters like fuel consumption, emissions, torque, load capacity etc has been analyzed. Number of reviews has been taken below to complete the present study.

E. Ramjee and K. Vijaya Kumar Reddy in this paper , Compressed Natural Gas (CNG) has been introduced in the 4-stroke air cooled Bajaj- Kawasaki engine and investigation have been carried out pertaining to engine performance and exhaust emissions. The emission characteristics of HC and CO are better for CNG compared to petrol. For all range of speed the volumetric efficiency is reduced to 10-14%; except thermal efficiency the performance parameters viz. BMEP, Torque, Power, and BSFC are decreased for CNG fuelled engine.

Ismail Altın a, Atilla Bilgin b in this paper the performance parameters of twin spark SI engine has been studied. From the result of the study it was found that centre twin spark plug arrangement is favorable to single – spark plug configuration. This is a result of faster burning and lower heat losses achieved by twin spark engines in comparison to single-spark engines.

NICOLAS HADJICONSTANTINOU, KYOUNGDOUG MIN and JOHN B. HEYWOOD In this Paper, Relation between flame propagation characteristics and hydrocarbon emissions under lean operating condition in SI engines has been studied. Engine HC-emission levels increase when the relative air to fuel ratio from stoichiometry because of decreasing HC oxidation. This is attributed to decreasing flame speeds that result in lower peak cycle pressures and temperature and, eventually flame quenching.

Dashti Mehrnoosh1,*, Hamidi Ali Asghar2 and Mozafari Ali Asghar3, In this paper a thermodynamic cycle simulation of conventional four- stroke SI engine has been carried out to predict the engine performance and emissions. The first law of thermodynamics has been applied to determine in-cylinder pressure and temperature as a function of crank angle.

Effect of spark timing in the SI engine, if ignition occurs too early, work will be wasted in the compression stroke. On the other hand, if ignition is too late, the indicated power is lower due to lower peak pressure of the combustion. Therefore, there is an optimum spark timing at which the maximum torque is obtained. This timing is called MBT. It is clear that the indicated power is maximum at 20 bTDC for gasoline and 26 bTDC for CNG operations.

Omid Asgari1, Siamak Kazemzadeh Hannani1 and Reza Ebrahimi2 in this paper the experimental and theoretical results for a spark ignition engine working with compressed natural gas as a fuel.The theoretical part of this work uses a zero-dimensional, multi-zone combustion model in order to predict nitric oxide (NO) emission in a spark ignition (SI) engine.

Ramtilak, A., Joseph, A., Sivakumar, G., and Bhat, S., "Digital Twin Spark Ignition for Improved Fuel Economy and Emissions on Four Stroke Engines,". In this paper the

DTS-i concept allows the compression ratio of the engine to be increased from 9.65 to 9.85. At part load conditions the DTS-i technology allows the engine to run leaner at a lambda of 1.2 with excellent stability. On a bore size of 57 mm (150 DTS-i) the maximum flame travel length was reduced by 18 %. The power, torque and specific output per liter were increased, while the fuel consumption and emissions were reduced due to the rapid combustion brought about by the twin spark plugs.

III. DTS-I Technology and CnG engine fundamentals

DTS-I Engine

Introduction

Now a day's twin spark plug are fitted in the cylinder head for better combustion, high heat release rate and maximum peak pressure for same mass fraction of fuel as compare to conventional single spark plug engine.

Twin Spark Benefits

In case of twin spark, two spark-plugs fire at the same time. This simultaneous firing and swirl of the air-fuel mixture results in complete combustion. This action is digitally controlled by the DTS-I System (namely the twin spark plugs, TRICS III and intelligent CDI).

Triic-iii

Power and torque requirements constantly change, depending on whether the rider is cruising, accelerating or is at high speeds/max speed. Throttle Responsive Ignition Control System - III is an intelligent system which can quickly adapt ignition timing to suit different riding characteristics.

Intelligent CDI

The Intelligent Capacitor Discharge Ignition contains a microprocessor, which continuously senses different speeds and load on engine and responds by altering ignition timing. Working together with the TRICSIII system, the microprocessor's memory provides optimum ignition timings for any given engine rpm, thereby obtaining the best combustion performance.

CNG Engine Fundamentals

The high auto ignition temperature of CNG (540°C) means that

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CNG is more suitable as a fuel for spark ignition (SI) engines. Natural gas, commonly referred to as gas, is a gaseous fossil fuel consisting primarily of methane (CH4), the shortest and lightest hydrocarbon molecule. It is lighter than air, and so tend to dissipate

Table 1: Combustion related properties of gasoline & CNG [3,4,5]

Properties	Gasoline	CNG
H-Content (%weight)	12-15	25
Density kg/m3 (Ambient, 25°C)	730	0.66
Vapour density, (compared to air)	Heavier	Lighter
Boiling point (Temp °C)	27-225	-162
Flame propagation (Speed m/s)	0.5	0.43
Motor octane number	80-90	120
Research octane number	92-98	120
Molar mass (kg/mol)	110	16.04
Stoichiometric air-fuel ratio	14.6	17.3
Stoichiometric mixture density (kg/m3)	1.38	1.24
Lower heating value (MJ/kg)	43.6	47.377
Lower heating value of stoichimetric mixture(MJ/kg)	2.83	2.72
Flammability limits (vol% in air)	1.3-7.1	5-15
Spontaneous ignition temperature (°C)	257	540

Experimental Setup

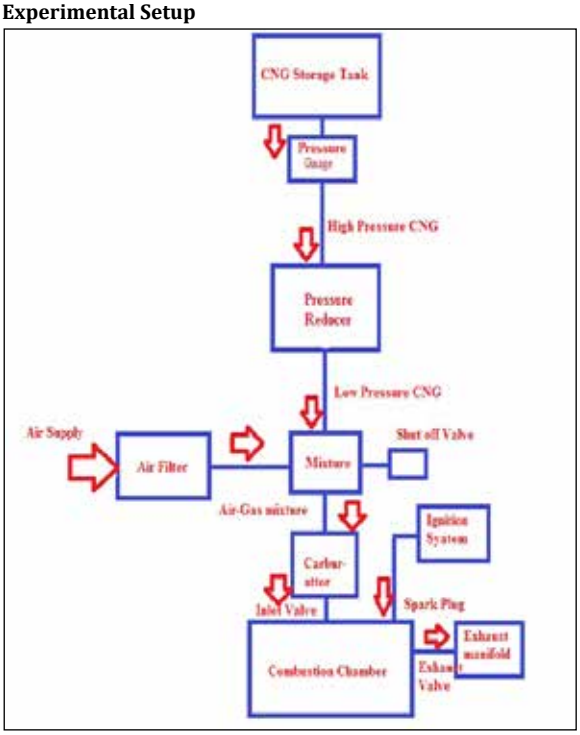

Figure : Flow Process Chart for CNG SI Engine

Conclusion

As CNG has lean combustion effect on the SI engine ignition system has to be modified for the batter performance and to optimize the power loss and drivability problems are reduced by conversions. The Performance of an existing single spark engine have been improved by DTS-I CNG engine.

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