Use of Acetylene Gas as an Alternative Fuel in SI Engine

Abhishek Hule, Nilesh Deokar , Rohan Ghogare, Bhushan Bhagat,Sanket Jadhav

Abstract— The conventional petroleum fuels for internal combustion engines will be available for few years only, due to tremendous increase in the vehicular population. Moreover, these fuels cause serious environmental problems by emitting harmful gases into the atmosphere at higher rates. Generally, pollutants released by engines are CO, NOx, Unburnt hydrocarbons, smoke and limited amount of particulate matter. At present, alternative fuels like methyl esters of vegetable oil (commonly known as biodiesels), alcohols etc. which are in the form of liquid and hydrogen, acetylene, CNG, LPG etc. in gaseous fuels are in the line to replace the petroleum fuels for IC engines. This project leads to the idea of using acetylene gas in the internal combustion engine such that it reduces the demand of the petroleum products that is going to be extinct in near future. It includes about the emissions of harmful gases that can be reduced by the use of acetylene instead of petroleum products. Various fuels have been tested on IC engines for their suitability as alternate fuels. Expect few alcohols, CNG and LPG, not many fuels have been found to be matched with IC Engines requirements .Thus this project is an attempt for the use of an alternative resource such that it can prove to be useful for the peoples in near future.

Keyword: Alternative Fuel, I C Engine, Emission, Efficiency

I. INTRODUCTION

Depletion of fossils fuels and environmental degradation initiated the researchers throughout the world to search for a suitable alternative fuel for diesel engine in the last two decades. The enormous growth of the world's population during the last decade, technical developments and increase in standard of living in the developed nations led to the twin crisis of fossil fuel depletion and environmental degradation resulting local air pollution to global warming, climatic changes and sea level rise. The search for an alternative fuel promises a harmonious correlation with sustainable development, energy conservation and management, efficiency and environmental preservation. Therefore, any attempt to reduce the consumption of petroleum based possible alternative fuels will be the most welcome.

Hence fuels which are renewable, clean burning and can be produced easily are being investigated as alternative fuels. Over few decades, a lot of research has gone into use of alternative fuels in IC engines. Vegetable oils seem to be a forerunner as they are renewable and easily available. In an agricultural country like India use of vegetable oil would be economical because of large productivity and reduced dependability on import of petroleum products.

But because of high viscosity and poor atomization of straight vegetable oils leads to improper mixing and causes improper combustion. Further to reduce viscosity problem researchers went for biodiesels of vegetable oils. The cost of production and performance losses shows other alternative to use gaseous fuels as alternative fuels in IC engines.

One approach in this direction is to utilize the gaseous fuels like biogas, LPG (liquefied petroleum gas), LNG (liquefied natural gas), hydrogen and acetylene gas. They have a high self-ignition temperature; hence they cannot be used directly in diesel engine. Diesel engines however can be made to use a considerable amount of gaseous fuels in dual fuel mode without incorporating any major changes in engine construction. It is possible to trace the origin of the dual fuel engines to Rudolf Diesel, who patented an engine running on essentially the dual fuel principle. In dual fuel mode gaseous fuel called primary fuel is either inducted along with intake

air or injected directly into the cylinder and compressed but does not auto-ignite due to its very high self-ignition temperature. Ignition of homogeneous mixture of air and gas is achieved by timed injection of small quantity of diesel called pilot fuel near the end of the compression stroke. The pilot diesel fuel auto-ignites first and acts as a deliberate source of ignition for the primary fuel–air mixture. The combustion of the gaseous fuel occurs by the flame initiation by auto-ignition of diesel pilot injection at unspecified location in the combustion chamber. This ignition source can develop into propagation flame, similar to spark ignition (SI) engine combustion. Thus, dual fuel engine combines the features of both SI and CI (compression ignition) engine in a complex manner. So using of gaseous fuel in CI engine means the engine is running on dual fuel mode. This work proves the use of acetylene gas as an alternative fuel without a large investment. This method involves burning of acetylene gas along with diesel of little quantity in engines.

II. OBJECTIVES

1. To produce acetylene gas (cheap and eco friendly) from chemical reaction of calcium carbide & water.
2. To produce alternative fuel for IC engine.
3. To reduce exhaust & hazardous emissions from engine.
4. To make more efficient alternative fuel.
5. To eliminate use of primary (starting) fuel.

III. LITERATURE REVIEW

1. Anshu Kumar & Raj N Mishra (2016) "Acetylene used as alternative fuel in Petrol Engine": In this paper they studied that, Acetylene gas produced from lime stone ($CaCO_3$) is renewable in nature and exhibits Similar properties to those of hydrogen. An experimental investigation has been carried out on a Single cylinder, direct injection (DI), and Spark ignition (SI) engine tested with pure petrol and petrol - Acetylene dual fuel mode with diethyl ether (DEE) as oxygenated additive. Experiments were conducted to study the performance characteristics of DI petrol engine in dual fuel mode by aspirating Acetylene gas in the inlet manifold, with petrol- diethyl ether blends (DEE) as an ignition source. Fixed quantity of Acetylene gas was aspirated and Blend of diethyl ether with petrol (DEE10, DEE20 and DEE30) was taken and then readings were taken at various loads. From the detailed study it has been concluded that the blending ratio of DEE20 gives better performance. Dual fuel operation along with addition of diethyl ether resulted in higher thermal efficiency when compared to neat petrol operation. Acetylene aspiration reduces smoke and exhaust temperature. [1]

2. Shaik Khader Basha (2016) "Experimental study on the Performance of an acetylene aspirated Diesel Engine using EGR": Internal combustion engine research community has been working seriously on best alternative fuels to safeguard the environment ever since the transport and industry started growing extensively. Among such alternatives acetylene has proved to be one of the better fuels for internal combustion engines due to its low cost, simplicity in manufacturing and excellent combustion characteristics. Acetylene is less in carbon content compared to other fuels, which plays a central role in environmental degradation. However the fuel must be safe and also readily usable in existing engines without any significant design modifications. It is proposed in the present work that acetylene is safe and appropriate fuel for a compression ignition engine with minor design modifications. The engine is tested at various loads, keeping track of combustion performance to find out the optimum fuel flow rates and also to have reduced emissions. The results show that the performance of the Acetylene enriched engine is nearer to the pure diesel engine with reduced emissions. Exhaust gas recirculation technique is implemented to safely bring NOx leaves to the acceptable limits. [2]

3. Mr. Rushikesh D. Jadhav (2016) "Experimental Analysis of Acetylene Gas as an Alternative Fuel for SI Engine": The search for an alternative fuel is one of the needs for sustainable development, energy conservation, efficiency, management and environmental preservation. Therefore, any attempt to reduce the consumption of petrol and diesel possible alternative fuels is mostly preferable. Many research activities were developed in order to study the Internal Combustion Engines with alternative fuels. Acetylene is one of the tested fuels. The present project includes: providing a fuel comprising acetylene as a primary fuel and Alcohol as a Secondary fuel avoiding knocking for an internal combustion

engine. The paper investigates working of SI engine on acetylene minor changes required to be done. Thus reducing the running cost and minimum pollutant emission, this makes it fit for use on economic and environment standard. It is more effective and eco-friendly alternative fuel option. [3]

IV. PROBLEM STATEMENT

1. In the present days fossil fuel is on the verge to exhaust, the need is to search for an alternative fuel.
2. Exhaust of other fuels emits very hazardous gases and dangerous emissions in environment which causes ozone depletion, global warming etc.
3. In so alternative fuels need of the primary fuel for starting.

V. THEORY

A .Production of Acetylene

The reaction of calcium carbide with water, producing acetylene and calcium hydroxide, was discovered by Friedrich Wöhler in 1862.

$$CaC2 + 2\ H2O \rightarrow C2H2 + Ca(OH)2$$

Fig.1. Chemical Reaction

This reaction was the basis of the industrial manufacture of acetylene, and is the major industrial use of calcium carbide. Today acetylene is mainly manufactured by the partial combustion of methane or appears as a side product in the ethylene stream from cracking of hydrocarbons. Approximately 400,000 tonnes are produced this way annually.

B. Safety and handling

Most regulators and pressure gauges on equipment report gauge pressure and the safe limit for acetylene therefore is 101 kPaor 15 psi. It is therefore shipped and stored dissolved in acetone or dimethyl formamide (DMF), contained in a metal cylinder with a porous filling (Agamas an), which renders it safe to transport and use, given proper handling.

C. Properties

Table no.1. Properties of acetylene

Sr. no.	Terms	Values
1	Molecular Weight	Molecular weight : 26.038 g/mol
2	Solid phase	Melting point : -84 °C Solid density : 729 kg/m3
3	Liquid phase	Liquid/gas equivalent (1.013 bar and 15 °C Boiling point (1.013 bar) : -83.8 °C Latent heat of vaporization (1.013 bar Vapor pressure (at 20 °C or 68 °F) : 44 bar
4	Critical point	Critical temperature : 35.1 °C Critical pressure : 61.91 bar Critical density : 230.8 kg/m3
5	Triple point	Triple point temperature : -80.6 °C Triple point pressure : 1.282 bar
6	Gaseous phase	Gas density (at sublimation point) : 1.729 kg/m3 Gas density (1.013 bar and 0 °C (32 °F)) : 1.171 kg/m3 Specific gravity (air =1) (1.013 bar and 15 °C (59 °F)) : 0.91 Specific volume (1.013 bar and 21 °C) 0.918 m3/kg

Table no.2 Comparison with other Fuels

Sr. No.	Properties of Fuels	Acetylene	Petrol
1	Fuel	C2H2	CnH2n
2	Density	1.092	750
3	Auto ignition temp. ◦C	305	280
4	Stoich- A/F ratio kg/kg	13.2	14.7
5	Flammability limit	2.5-81	4-75
6	Lower C.V. KJ/Kg	48,225	44000
7	Ignition energy (m/s)	0.019	0.25

D. Engine Modification

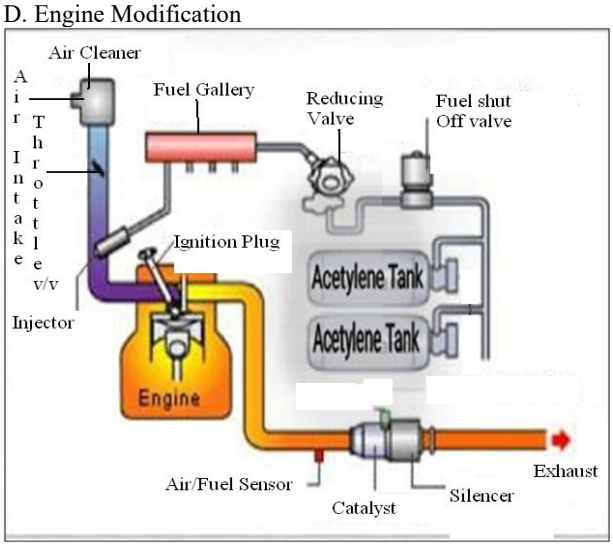

Fig.2.Engine Modification

VI. PROBABLE OUTCOME

It would be best alternative fuel which replaces the conventional fuels.

As it can be produces very easily & economically it has great future.

The reduction in HC & CO2 emissions at maximum load is of 8% & 3% respectively when compared with diesel operation.

VII. ACKNOWLEDGEMENT

Authors thanks to project guide Prof. Navale V. R. who always being with presence & constant, constructive criticism to made this paper. We would also like to thank all the staff of Mechanical Department for their valuable guidance, suggestion and support through the project work, who has given co-operation for the project with personal attention. Above all we express our deepest gratitude to all of them for their kind-hearted support which helped us a lot during project work. At the last we thankful to our friends, colleagues for the inspirational help provided to us through a project work.

REFERENCES

[1] Anshu Kumar, Raj N Mishra“Acetylene used as alternative fuel in Petrol Engine”IJESRT Mechanical Department, Bhopal ISSN:2277-9655 July 2016

[2] Shaik Khader Basha“Experimental study on the Performance of an acetylene aspirated Diesel Engine using EGR”, INTERNATIONAL JOURNAL OF APPLIED ENGINEERING RESEARCH ISSN 0973-4562 Volume 11, Number 7, 2016

[3] Mr.Rushikesh D. Jadhav “Experimental Analysis of Acetylene Gas as an Alternative Fuel for SI Engine”, IERJ,ISSN 2395-1621 June 2016

[4] Kapil Dev Choudhary, Ashish Nayyar“Optimization of Indian Flow Rate of Acetylene in CI Engine Operated on Duel Fuel Mode”International Journal of Engineering Technology and Advanced Engineering, Vol 3Dec-2013

[5] Pritinka Behera, Abhihek Kumar Jha, “Duel fuel Operation of Used Transformer Oil with Acetylene in a DI Diesel Engine”Department of Mechanical Engineering,NIT Rourkela, ISSN:2319-3182 2013

[6] S.K.Mahla, Som Kumar, “Study The Performance Characteristics of Acetylene Gas In Dual Fuel Engine with Diethyl Ether Blends” International Journal on Emerging Technologies, ISSN 0975-8364, 2012

[7] PRABIN k. Sharma, Harikar Kuinkel, “Use of Acetylene as an Alternative Fuel in IC Engine” Rentech Symposium Compendium, Vol 1, March 2012