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Internal Combustion Engine Using Acetylene As An Alternative Fuel

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ABSTRACT: All most all the Vehicles use Crude Oil extracts as their fuel, the consumption of the fuel is increasing greatly with the increase in number of Vehicles on road. However , the Crude Oil reserves in the Earth crust is not going to improve .So there is a need for an alternative fuel which could meet the demands of the future and this alternative fuel must not be a derivative of Crude Oil. Many fuels were tested on the Internal Combustion Engines, Acetylene is one of the tested fuels. The present paper involves the use of Acetylene as a primary fuel and Alcohol as a Secondary fuel in order to avoid the knocking phenomenon in an internal combustion engine. Using Acetylene as a fuel had its own crests and troughs, the paper investigates working of SI engine on acetylene with minor changes being done to the Carburetor. Thus reducing the limitations of using acetylene as a fuel, this makes it fit for use on economic and environment standard. It is more powerful and eco-friendly alternative fuel option.

KEYWORDS: Alternative fuel, Secondary Fuel , SI engine, Acetylene, Carburetor.

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I INTRODUCTION

The reduction of air pollutants from internal combustion engines has been the subject of considerable study and investigation. Virtually all of the internal combustion engines in present use in automobiles employ a hydrocarbon, fossil fuel which exhausts hydrocarbons, nitric oxides, carbon dioxide and carbon monoxide. Because of the extent of pollution in the atmosphere from current engines, Governments across the world have set new emission standards for automotive vehicle engines which require a considerable reduction in pollutants over the next several years. Although electric battery driven and various other engines have been suggested for powering automotive vehicles, the gasoline internal combustion engine has retained widespread usage in automobiles because of its ability to operate over a wide range of power demands and speeds, its quick response to demand for changes in power or in speed and because of its ability to be relatively inexpensively manufactured. Also, in addition to performance characteristics, the current gasoline engines have proven reliability coupled with a reasonable cost of operation. In short, current internal combustion engines used in automobiles will idle at light or no loads, will respond quickly to increases in demand for power, will accelerate a vehicle rapidly, will operate at light loads while cruising at high speeds and will run for substantially long periods of operation without having to stop for re-fuelling.

The present paper is particularly directed to using the internal combustion engine because of its reliability and other proven qualities; and to adapting it to using acetylene as a fuel for the twin purposes of reducing exhaust emissions there from as contrasted with exhaust emissions from gasoline fuelled internal combustion engines and of providing a thermally more efficient engine.

[1].Gaseous fuels are good alternative fuels to improve the energy crisis of today's situation due to its clean burning characteristics. However, the incidence of backfire and knock remains a significant barrier in commercialization. With the invention of latest technology, the above barriers are eliminated. One such technique is timed injection of water into the intake port. In the present investigation, acetylene was aspirated in the intake manifold of a single cylinder diesel engine, with a gas flow rate of 390 g/h, along with water injected in the intake port, to overcome the backfire and knock problems in gaseous dual fuel engine. The brake thermal efficiency and emissions such as NOx, smoke, CO, HC, CO2 and exhaust gas temperature were studied. Dual fuel operation of acetylene induction with injection of water results in lowered NOx emissions with complete elimination of backfire and knock at the expense of brake thermal efficiency.

[2].Studies reveal that Acetylene gas produced from lime stone (CaCO3) 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 compression ignition (CI) engine tested with pure diesel and diesel- Acetylene dual fuel mode with diethyl ether (DEE) as oxygenated additive. Experiments were conducted to study the performance characteristics of DI diesel engine in dual fuel mode by aspirating Acetylene gas in the inlet manifold, with diesel- diethyl ether blends (DEE) as an ignition source. Fixed quantity of Acetylene gas was aspirated and Blend of diethyl ether with diesel (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 diesel operation. Acetylene aspiration reduces smoke and exhaust temperature.

[3].In a dual fuel engine a primary fuel that is generally gaseous is mixed with air, compressed and ignited by a small pilot spray of diesel as in a diesel engine. Dual fuel engine suffers from the problems of poor brake thermal efficiency and high HC emissions, particularly at low outputs and uncontrolled combustion at higher loads. Pilot fuel quantity, injector needle lift pressure and load are important parameters controlling the combustion process in dual fuel engines. Experiments were conducted on a LPG diesel dual fuel engine at different pilot fuel quantities, injector needle lift pressure and load. Heat release patterns have been presented at low and high loads. At high outputs, the combustion of the gas by flame propagation which follows the ignition process of the pilot and the entrained gas was the dominant feature. However, at low loads, combustion of the pilot fuel and the gas entrained in it were only significant. The rapid combustion of the gaseous fuel at high output conditions particularly when the injector needle pressure was low (150 bar), resulted in rough engine operation. Results indicate a possibility of determining an optimum combination of the parameters that were investigated.

[4].In this work biogas was used in a HCCI engine with charge temperature and amount of diesel injected into the intake manifold being used to control combustion. The presence of CO2 in biogas suppresses the high heat release rates encountered with neat diesel fuelling in HCCI engines. Normally biogas use leads to a drop in thermal efficiency in both SI and CI engines. However, present results indicate that thermal efficiencies close to diesel engine values can be obtained in the HCCI mode. The NO level was less than 20 ppm and the smoke level was less than 0.1 BSU at all conditions. The best energy ratio was 50%. HC levels were very high and were lowered when the charge temperature was raised. A charge temperature of about 80–135 C was needed, which can be attained though heating by exhaust gases. On the whole the HCCI mode can be a viable option to utilize biogas in a diesel engine.

[5].In the present scenario of energy resources most of the fuel used are fossil fuels and they are going to be exhaust very soon. The need of the present world is to search for some alternative resources. We have some choices like LPG, CNG, Hydrogen gas but due their drawbacks and lack of technology in some cases it is very complicated to use them. Acetylene is a very good fuel for running automobiles; this paper shows the mechanism with total setup for running IC engine by acetylene gas produced on board.

II ACETYLENE AS AFUEL IN SI ENGINE

The Acetylene gas is having high auto ignition temperature, very little ignition energy and low density which are close to that of hydrogen. The calorific value of acetylene gas is more than diesel fuel and having sufficient flammability limits. So acetylene gas can be preferred as an alternative fuel for SI engineAcetylene is conventionally produced by reacting calcium carbide with water. The reaction is spontaneously occurring and can be conducted without any sophisticated equipment or apparatus. Such produced acetylene has been utilized for lighting in mine areas, by street vendors, etc. People often call such lighting sources “carbide lights” or “carbide lamps”. An industrial use of acetylene as a fuel for motors or lighting sources, however, has been nearly nonexistent. In modern times, the use of acetylene as a fuel has been largely limited to acetylene torches for welding or welding-related applications. In most such applications, acetylene is generally handled in solution form, such as acetylene dissolved in acetone for example. The clean burning nature of acetylene is self-evident from the stoichiometric equation:

$$C_2H_2(g)+O_2(g)\rightarrow CO_2(g)+H_2O(l)$$

If acetylene is used either in pure form or in concentrated form, there is a strong tendency for detonation, which directly contributes to the difficulty in preventing undesirable spontaneous chemical reaction.acetylene as a single fuel cannot be burned in an IC engine without severe knock and early ignition in the intake port, and in the cylinder, causing engine stopping and damage.In another study reported in “Acetylene and Water as Fuels for Spark Ignition”. The acetylene-water mixture was sprayed directly into the manifold with a high pressure positive displacement pump. The results indicated that overall efficiencies were higher with acetylene-water fueling than with gasoline. In addition, injected water caused a sharp reduction of NOx emissions below that obtainable by means of exhaust gas recirculation (“EGR”). Unfortunately, since water is not a combustible compound and is devoid of any BTU value for combustion purposes, injection of water into the combustion chamber decreases the effective volume available for gas expansion in the combustion chamber of the engine, thereby decreasing the horsepower output of the engine. Thus, what is needed in a system for effectively and controllably utilizing acetylene, either as a mixture or con currently with an alcohol or other combustible fluid, as a clean fuel for internal combustion engines wherein the combustible fluid can be used in conjunction with acetylene as an anti-knock and early ignition-preventing agent without reducing horsepower output arising from depletion of effective volume available for gas expansion due to the presence of a non-combustible fluid, such as water.

III EXPERIMENTATION

Tests were run using a single cylinder, overhead-valve internal combustion. The method of fuel introduction was by a dual fuel, constant flow, as schematically. Pure acetylene was used as the primary fuel and methyl alcohol was used as the secondary fuel. The source for the acetylene was a standard cylinder, as customarily used for welding purposes, with the primary fuel valve mechanism comprising a standard pressure regulator. The methyl alcohol, which has a gross energy producing capability of 10,259 BTU/lb., was injected into the engine manifold at a relatively low rate that, upon introduction of the primary fuel, would avoid early ignition and knock thereof. The rate at which the secondary fuel was injected into the manifold caused the engine to operate at a fast idle speed (approximately 3030 r.p.m.). Such an injection rate of methyl alcohol was found to be sufficient to prevent early ignition and knock arising from the primary fuel regardless of the rate that the primary fuel was supplied to the engine and regardless of the resulting operating speed and load output of the engine. A brake-type dynamometer was used to determine the horsepower output of the engine. Brake-horsepower measurements of the test engine when operated on gasoline as the primary fuel as compared with those of the test engine when operated on the acetylene alone and inventive dual fuel.

IV OBESERVATIONS FROM THE TESTS CONDUCTED

Experiments observations of various fuels like petrol, acetylene gas, acetylene +methanol are represented in following tables.

Table 1. ***Only acetylene gas***

Speed (rpm)	Dead weight(kg)	Spring balance Reading (grams)	Torque (N-m)	Break Power (W)	B.H.P (HP)
730	2	250	1.422	108.74	`0.146
700	4	600	2.76	202.5	0.272
670	6	950	4.103	288	0.386
610	8	1450	5.322	340.1	0.456
570	10	1950	6.541	390.6	0.524

Table 2. ***Methanol + Acetylene***

Speed(rpm)	Dead weight(kg)	Spring balance Reading (grams)	Torque(N-m)	Break power (W)	B.H.P (HP)
780	2	200	1.146	119.5	0.160
700	4	500	2.844	208.542	0.280
660	6	900	4.144	286.5	0.384
620	8	1350	5.403	350.946	0.470
560	10	1950	6.541	383.717	0.514

Table 3.***Only petrol***

Speed(rpm)	Dead weight(kg)	Spring balance Reading(grams)	Torque (N-m)	Break power (W)	B.H.P (HP)
420	2	350	1.341	58.987	0.0790
410	4	650	2.722	116.911	0.157
390	6	1050	4.790	195.693	0.262
370	8	1450	5.332	206.286	0.277
360	10	1850	6.622	249.739	0.335

The performance tests on petrol, acetylene and acetylene + methanol, using a rope type dynamometer are done by the following equations.

TORQUE, T

T = Tangential force x radius

$T = (W-S)*(D+d)/2$

BRAKE POWER
BP = (22/7)*(W-S)*(D+d)*N/60
Where
T is torque in N.m
N is RPM
BRAKE HORSE POWER
BHP = BP/746

Where
W = Dead load
S = Spring Balance Reading
D = Diameter of the Wheel
N = Speed of the Engine Shaft
d = diameter of the rope
T = Torque transmitted by the engine
BP = Break Power
BHP = Break Horse Power

At all the dead loads applied to the Break Horse power while using acetylene and methanol +acetylene is greater than Petrol
Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). **This applies to papers in data storage.** For example, write "15 Gb/cm^2 (100 Gb/in^2)." An

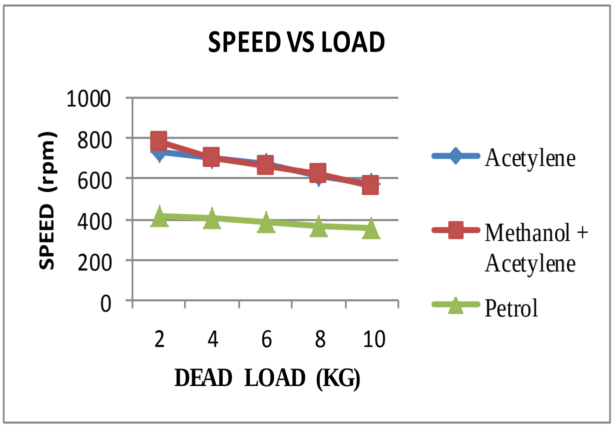

Figure 1 Speed of the engine shaft and dead load

While using acetylene and methanol +acetylene as a fuel, at all the dead loads applied to the speed of the engine shaft is twice the speed obtained while using Petrol as a fuel which is shown in figure 1

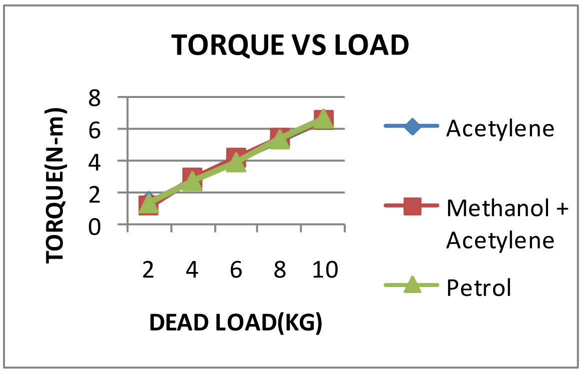

Figure 2 Torque of the engine shaft and dead load

Torque obtained while using acetylene and methanol +acetylene is in the similar range of values obtained while using Petrol as a fuel which is shown in figure2.

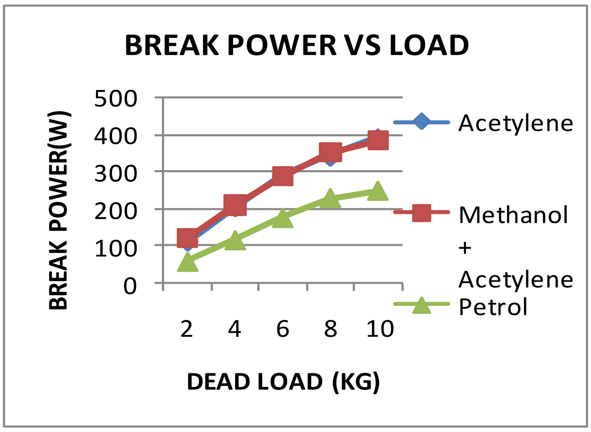

Figure 3. Indicated power of the shaft and dead load

At all the dead loads applied the Break power while using acetylene and methanol +acetylene is greater than Petrol which is shown in figure 3.

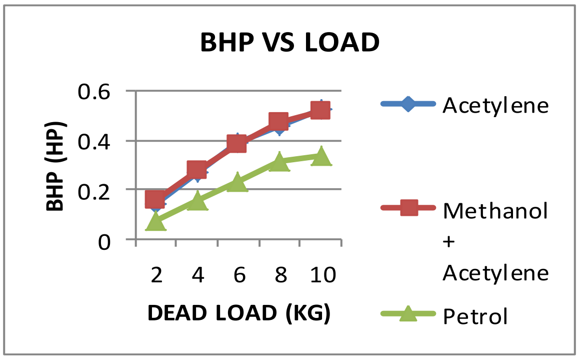

Figure 4 Break Horse Power and load

At all the dead loads applied the Break Horse power while using acetylene and methanol +acetylene is greater than Petrol which is shown in figure 4.

V CONCLUSION

The present work includes the total mechanism and setup for using acetylene as an alternative fuel for I.C. engine. As comparable to petrol and gasoline, acetylene can be produced easily and is very much cost effective. Many safety precautions should be taken for the storage of the petrol because of its low flash point and fire point where as the acetylene can be generated at the required amount by the addition of the water to the calcium carbide .Calcium Carbide is very safe to carry because it is in a non combustible solid state . Acetylene being a high calorific fuel can produce large amounts of energy than the petrol but it has poor octane number ,this problem is solved by the addition of methyl alcohol . The methyl alcohol not only increases the octane number of the acetylene but it reduces the large amounts of temperatures that are produced in the engine 'there by increasing the life time of the engine and decreasing the NOx emissions.

A. ***Some of the benefits and advantages provided by the cleaning burning of acetylene and methanol are***

a) The need for a three-way catalytic converter or other EGR device is eliminated
b) Proper exhaust design requirements are substantially reduced;
c) Due to reduced operating temperatures, there are fewer tendencies for viscosity breakdown of engine lubricants and less component wear;
d) Due to cleanliness of the combustion process, buildup of carbon- and sulphur compounds are eliminated thereby substantially extending the time intervals between routine maintenance requirements, such as tune-ups, oil changes, etc.;
e) An engine operated on such a fuel can be interchange ably utilized for indoor and outdoor operations without environmental concerns.

B. ***From the above results,***
a) Speed of the engine shaft while using acetylene and methanol +acetylene as a fuel is twice the speed obtained while using Petrol as a fuel.
b) Torque obtained while using acetylene and methanol + acetylene is in the similar range of values obtained while using Petrol as a fuel.
c) Break power while using acetylene and methanol +acetylene is greater than Petrol.
d) Break Horse power while using acetylene and methanol +acetylene is greater than Petrol
e) Speed , Torque, Break Power , Break Horse Power of the engine for methanol+acetylene dual fuel combination is better than for acetylene alone.
Major advantages of using the dual fuel are increase in the performance of engine, decrease in the detonation effect caused due to knocking, decrease in the NOx emissions.

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