

“Performance of Hybrid Engine And Emission Analysis for Acetylene And Petrol in 4-stroke Engine”

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Abstract :-

The paper focuses on performance of hybrid engine vehicle i.e. more than one means of propulsion using two distinct fuels for power i.e. acetylene and petrol is used. This hybrid engine combines the benefits of acetylene with petrol as people across the global are facing gallons of difficulties with the crises of fossil fuel and depletion of environmental degradation. Hence an attempt has been made to combine advantage of hybrid engine and discover some alternative.

In present work, experimental investigation has been carried out on a 3-cylinder. Engine run on dual fuel mode here petrol is injected as primary fuel & acetylene is injected as secondary fuel to obtain the data on engine performance characteristics use of acetylene reduces pollution, cost & exhaust temperature.

Keywords:-*Hybrid Engine, Acetylene, Emission, Comparision, 4-Stroke Petrol Engine, Performance Characteristics*

INTRODUCTION

The fossil fuels which are most commonly used to produce power for various transportation modes like automobiles, locomotives etc. and also in standby power generation are depleting day by day. The use of fossil fuels also leads to emission from combustion products that cause atmospheric pollution like greenhouse effect, ozone layer depletion, acid rains etc. One of the major concerns for the climate change is the emission of carbon dioxide from the IC engines of automobiles. The environment is also badly affected during extracting, refining and transportation of crude oil for production of these fuels. In the recent years, one of the major areas of research in the field of IC engine is use of alternative fuels and hybrid engine. Gaseous fuels like CNG, LPG, hydrogen, Acetylene etc. are promising alternative fuels for their higher octane number, higher calorific value and of course, lower exhaust emission.

Alternative fuels and hybrid engine are very useful in reducing the pollution from conventional IC engine. Besides, alternative renewable fuels can play a major role in the economy of a country as well as the health of living beings of the globe. A lot of research works have been conducted on the use of Acetylene in IC engine and these works have confirmed encouraging results on the use of Acetylene as an alternative fuel.

ABOUT ACETYLENE

Acetylene is a colourless and highly combustible gas with a pungent odour. If it is compressed, heated or mixed

with air, it becomes highly explosive. It is produced by a straightforward chemical process in which calcium carbide reacts with water and generates acetylene gas and slurry of calcium carbonate. It needs no sophisticated apparatus or equipment and the reaction is spontaneous. It was widely used in acetylene lamps, to light homes and mining tunnels during 1980s. It is a gaseous hydrocarbon highly combustible and unstable. It also produces high flame temperatures ranging from 3000°C to 5400°C when combined with oxygen. Acetylene has been commonly utilized for lighting in mine areas by street vendors, besides which industrial uses of acetylene are many out of which it is used as a fuel for motors or lighting sources. The use of acetylene as a fuel has been largely limited in the recent times to acetylene torches for welding or welding related applications. The easy availability of economical and effective fuel which has better calorific value and effective flame speeds motivated to study and experiment on acetylene engine.

Hybrid engine :-

Hybrid cars are becoming more popular and more common. Basically, a hybrid car is one that uses two or more engines i.e. an acetylene engine and a conventional engine (either petrol or diesel). A hybrid car not only conserves fuel but also produces less CO₂ emissions. Though hybrid vehicles are now growing in popularity but still few people are actually using it mainly due to lack of knowledge

of how hybrid vehicles work and whether they're as good as other gasoline powered vehicles.

Spark ignition engine:-

A spark ignition engine is an internal combustion engine, generally a petrol engine, where the combustion process of the air-fuel mixture ignition by a spark from a spark plug. This is in contrast to compression-ignition engines, typically diesel engines, where the heat generated from compression together with the injection of fuel is enough to initiate the combustion process, without needing any external spark.

❖ Advantages of Hybrid Engine Vehicles over 4-stroke I.C. Engine using one fuel

1. Environmentally Friendly: One of the biggest advantage of hybrid car over gasoline powered car is that it runs cleaner and has better gas mileage which makes it environmentally friendly. A hybrid vehicle runs on twin powered engine (gasoline engine and acetylene engine) that cuts fuel consumption and conserves energy.

2. Financial Benefits: Hybrid cars are supported by many credits and incentives that help to make them affordable. Lower annual tax bills and exemption from congestion charges comes in the form of less amount of money spent on the fuel.

3. Less dependence on Fossil Fuels: A Hybrid car is much cleaner and requires less fuel to run which means less emissions and less dependence on fossil fuels. This in turn also helps to reduce the price of gasoline in domestic market.

4. Higher Resale Value: With continuous increase in price of gasoline, more and more people are turning towards hybrid cars. The result is that these green vehicles have started commanding higher than average resale values. So, in case you are not satisfied with your vehicle, you can always sell it at a premium price to buyers looking for it.

Comparison with other fuel

The specifications of the engine which has been selected for the experimentation are tabulated in Table 1 and Table 2 lists the physical properties of acetylene. The experimental setup is as shown in Figure 1 which illustrates the setup clearly

Table: 1

| Properties | Acetylene | CNG | Petrol | Diesel |
|-------------|-------------------------------|---|--------------------------------|--------------------------------|
| Composition | C ₂ H ₂ | CH ₄ :86.4-90% C ₂ H ₆ :3-6% C ₃ H ₈ | C ₈ C ₁₈ | C ₈ C ₂₀ |

| Density (kg/m ³) At 1atm &200c | 1.092 | 0.72 | OPEN ACCESS 800 | 840 |
|--|--------|--------|--------------------|---------|
| Auto ignition(k) Stoichiometric A/F ratio (kg/kg) | 598 | 723 | 519 | 530 |
| Flammability limit (vol %) Lower Calorific Value (kJ/kg) | 13.2 | 17.3 | 14.7 | 14.5 |
| | 2.5-81 | 5.3-15 | - | 0.6-5.5 |
| | 48225 | 45800 | 44500 | 42500 |
| Ignition energy (mJ) | 0.019 | 0.28 | - | - |

I. ENGINE SPECIFICATION OF MARUTI 800

| ENGINE | | |
|------------------------|--------------------------|-------------------|
| Type | Water Cooled SOHC Petrol | |
| Displacement | 796 cc | |
| Cylinder | 3 | |
| Valvetrain | 2 Valves/Cylinder | |
| Bore & Stroke | 68.5x72.0 mm | |
| Max Power | 37 BHP @ 5000 rpm | |
| Max Torque | 596N-m @ 2500 rpm | |
| Power/Weight Ratio | 56.92 BHP/ Ton | 55.63 BHP/Ton |
| Torque/Weight Ratio | 90.76 N- m/Ton | 88.72 N- m/Ton |
| BHP/Liter | 46.25 | |
| Drivetrain | RWD | |
| Transmission | 4 Speed Manual | |
| Service Intervals | | |
| | | |

III. OVERVIEW OF PROJECT

Step1: The first step involves the production of acetylene gas through the calcium carbide reacting with water in the reaction tank.



The reaction tank constitutes two chambers:
RESEARCH ARTICLE
first water is fill in tank

- Second the carbide is kept in desirable amount in the tank.

As both the reactant are fill into the tank the reaction process carried out in the tank and that final product form in the form of gas that gas is nothing but the acetylene gas



Step2: In this step the acetylene gas is store in the storage tank and the pressure is measured by the pressure gauge.

In this step the produced gas is stored and is passed through the pipes. Here the gas is stored to avoid moisture and the gas stored in the tank is provided pressure through pressure gauge so the gas is of high concentration.

Step3: The gas is passed in the pipes in a very sophisticated manner and then pipe is joined in the vaporizer

Step4: vaporizer needed when vapour acetylene from natural vaporization is not enough to meet high acetylene consumption demands, a vaporizer can assist to provide the sufficient vaporization rate required. So vaporizers are needed when consumption is greater than natural vaporization.



Step5: All over this vaporize gas is supply to the engine and over engine start running.

EMISSION ANALYSIS :-

Exhaust gas or flue gas is emitted as a result of the combination of fuels such as natural gas gasoline, petrol, biodiesel blends, diesel engine, it is discharged into the atmosphere through an exhaust pipe, flue gas stack, or propelling nozzle. It often disperses downwind in a pattern

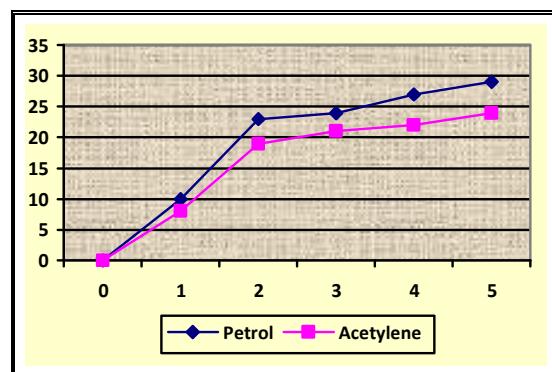
called an exhaust plume. Motor vehicle emissions contribute to air pollution and are a major ingredient in the creation of smog in some large cities.

III. EMISSION TEST RESULT

| Parameters | Petrol | Acetylene |
|------------|---------|-----------|
| CO | 4.731% | 0.049% |
| HC | 559 PPM | 72 PPM |
| CO2 | 10.30% | 6.30% |
| O2 | 3.18% | 12.47% |
| NOX | 0 PPM | 0 PPM |
| LDA | 0.981 | 0.00 |

V. EMISSION PARAMETERS

In the present work, acetylene gas was aspirated in the intake manifold in CI engine with petrol being the ignition source. The performance and emission characteristics are compared with baseline petrol operation.



Carbon monoxide(CO):-

This colourless gas is mainly produced by petrol engines due to insufficient combustion. The percentage of fuel which is not oxidized in the combustion chamber of the engine, comes out of the exhaust as carbon monoxide .it is highly toxic gas.

As compare to engine the carbon monoxide comes from petrol is 4.731% Which is high polluted than acetylene. Where as acetylene contain 0.049% which is less.

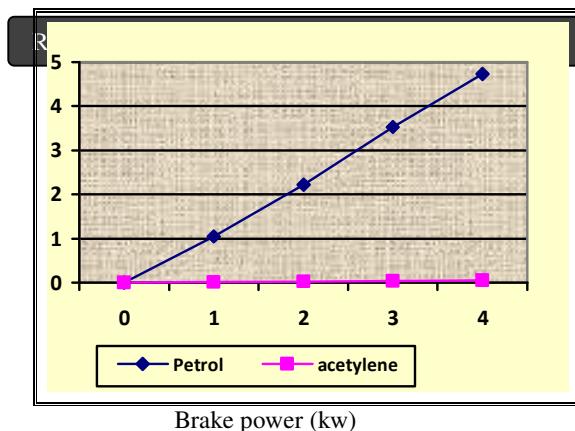


Figure .Variation of carbon monoxide with brake power.

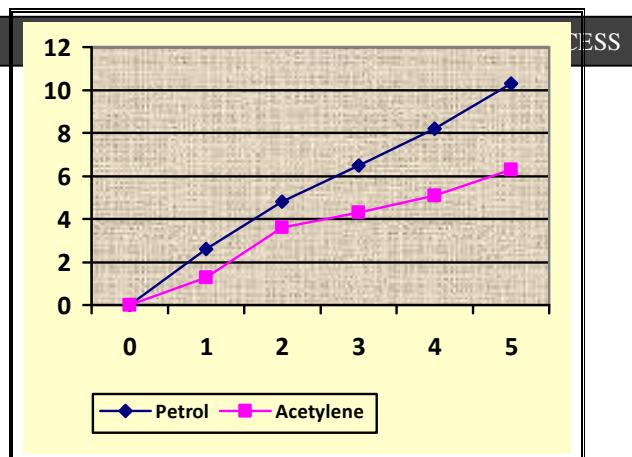


Figure .Variation of carbon dioxide with brake power

Hydrocarbons (HC) :-

This is also produced mainly from petrol engine. The main reason is the evaporation of petrol stroked in the tank . vapours from the petrol tanks and carburetor accounts for 15% of hydrocarbons released, 20%from crankcase and 65% from exhaust.

As compare to engine the hydrocarbons comes from petrol is 559 ppm which is high than acetylene. Where as acetylene contain 72 ppm which is less.

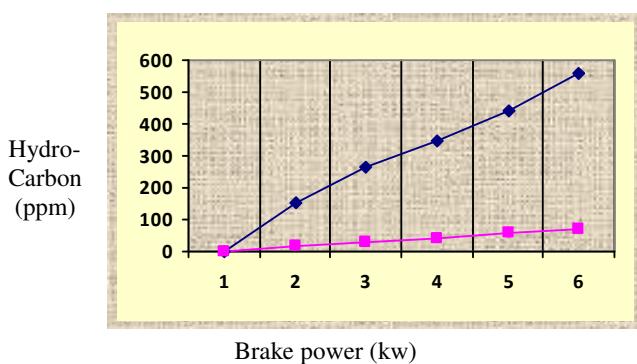


Figure .Variation of hydrocarbon with brake power

Carbon dioxide(CO2):-

The CO₂ emissions are lower

compared to the base line petrol, the minimum being 6.3% by volume at full load in acetylene induction technique followed by 10.30% by volume in baseline petrol operation, as shown in figure 8. The CO₂ emission of acetylene is lowered because of lower hydrogen to carbon ratio.

Exhaust gas temperature:-

The exhaust gas temperature at full load, depicted in figure3, reaches 368°C in acetylene induction technique and 444°C in the case of base line petrol operation. Acetylene induction decreased the exhaust gas temperature at all loads, indicating the advancement of energy release in the cycle and higher flame speed. Cylinder pressure diagram confirmed this, in which maximum pressure was observed to occur earlier in the cycle when acetylene was introduced along with the intake air.

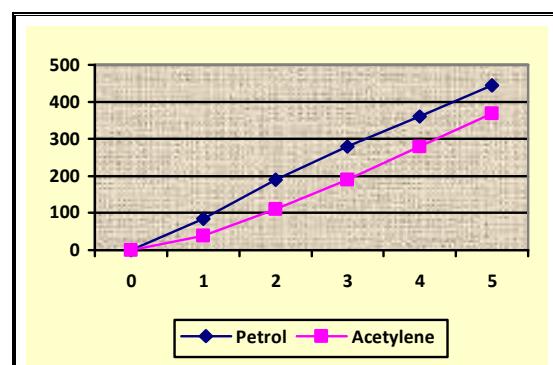


Fig: variation of exhaust gas with brake power

Smoke :-

Engine exhaust is the result of incomplete combustion . the fuel ratio greater than 1.5 and at pressure develop in engine produce soot. Once soot is formed, it can burn if find sufficient O₂ otherwise , it comes out with exhaust and become visible if it is burn. The size of soot particles affects the appearance of some.

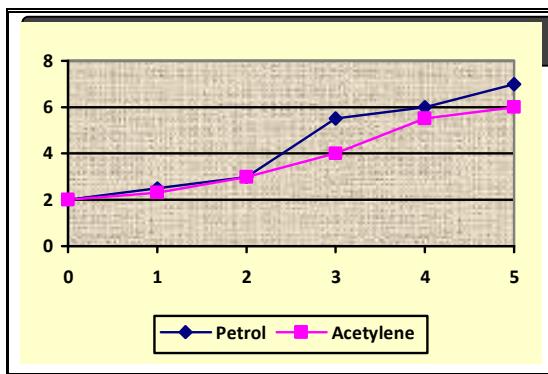


Figure 4. Variation of smoke with brake power.

VI CONCLUSIONS:-

Experiments were conducted to Study of Performance Characteristic of Acetylene- aspirated Petrol Engine of operation by aspirating acetylene gas in the inlet manifold for various loads, with petrol as an ignition source.

On the whole, it is concluded that acetylene induction resulted in a slight decrease in thermal efficiency, when compared to baseline petrol operation. Exhaust temperature, HC, CO, CO₂ and smoke emissions were less than baseline petrol operation. However, a significant increase in the NO_x emission is observed in the exhaust. To conclude, we state that acetylene would compete with hydrogen in near future for use of alternative fuel in internal combustion engine. By applying certain techniques like TMI, TPI of gas to get increased efficiency and reduced NOx emissions level.

After comparing the cost and mileage parameter, we conclude that engine working on acetylene is more better than petrol engine.

As per our vehicle consumption and condition

| | Petrol (In liter) | Acetylene (In kg) |
|-----------------------|----------------------|----------------------|
| Cost Per(liter/kg) | 80 | 80 |
| Average | 12 | 20 |

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