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Compressed Natural Gas Operated Two-Wheeler

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Abstract— *In this paper the results obtained on a 110cc two-wheeler S.I. engine using both petrol and CNG as fuel. Tests like Acceleration test, Emission test, Mileage test and Exhaust noise test were conducted at different operating condition. The basic petrol engine is converted into a bi-fuel engine and regulated by means of an electronically controlled Solenoid Actuated Valve system. On a comparative analysis CNG fuelled engine accelerated slower compared to petrol fuelled engine, but the CO and CO2 emissions were lesser indicated that CNG when used as fuel accelerates at a faster rate, the emission of hazardous gases is comparatively far lower than petrol, fuel consumption of CNG is less and it is economical. The noise test shows that the exhaust of CNG is louder as compared to petrol.*

Keywords— Acceleration, Bi-fuel, CNG, Mileage, Spark ignition engine.

I. INTRODUCTION

Compressed natural gas vehicles were first introduced to market in Italy in the mid-1930s and started to gain wider international attention during the oil crisis of 1970s and 80s.[1] 'Alternative fuels vehicle' has become an essential field of research momentarily due to the scarcity of conventional fuels and increasing air pollution, thus endangering the species. According to the World Health Organization (WHO) the safe limit of dust particles in atmosphere is 40-80 mg also the estimates state 15-18 million children in developing countries suffers from permanent brain damage due to the hazardous environment.[2] Therefore to ensure healthy environment CNG may play a vital role due to its advantages as high octane number, odourless, environment friendly and the limitations are low volumetric efficiency, low density, knocking at higher load.[3] Various initiatives are launched and mostly focused over road transport. Although this programs are still not been hiked throughout. Therefore developing a non-conventional fuelling method for the vehicle is must to keep the machine working. Our project 'CNG operated two wheeler' contributes to the efforts made for the promotion of alternative fuels for such problem as petrol shows no sign of quitting the energy scene. For the reasons such as its availability, environment friendly nature and most important is its compatibility with S.I. engine along with it CNG has higher octane number with respect to the petrol as it promotes better performance and longer life to engine.[4] There is a huge potential in road, marine, railway and stationary engine applications to make use of CNG.[5]

II. OBJECTIVE

- To make CNG operated two wheeler, for this we convert S.I. engine into the bi-fuel engine i.e. it can be operated on both CNG and petrol as fuel.
- To conduct Acceleration test and compare results of both fuels.
- To conduct Emission test on the S.I. engine and compare with both fuels.
- To conduct Mileage test and compare with the readings obtained with both fuels.
- To conduct Noise test to check the exhaust noise emission and relate values obtained with both fuels.

III. EXPERIMENTATION SET-UP

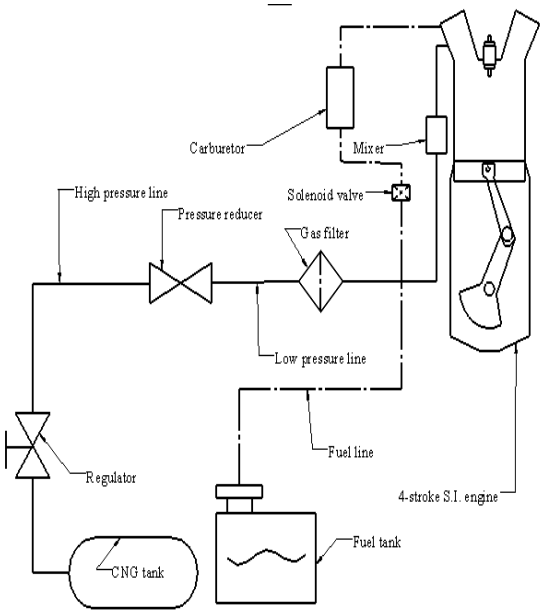

Fig 1. Working cycle

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To convert an existing petrol fuelled two-wheeler engine into a bi-fuelled engine where the driver can switch from CNG to petrol easily whereas while switching from petrol to CNG it is necessary to burn out the left over petrol in the engine during operation.

The components required for the conversion are:

- Pressure Reducer
- Gas Mixer
- Main Shut-Off Valve
- CNG Filling Valve
- High- Pressure Lines
- CNG Tank and Filling Valve
- Gasoline/CNG Selector Switch
- Pressure Gauge
- Petrol Solenoid
- Low Pressure Pipe

IV. EXPERIMENTATION

4.1. Acceleration Measurement Test:

Test is conducted by measuring the time taken by the vehicle to accelerate 0-40 km/hr. with the change of load for both petrol and CNG fuelled engine. Load applied by the weight of riders and dead weight.

Table no-1

Reading No.	Load (Kg)	Time CNG (sec)	Time Petrol (sec)
1.	80	11.35	8.95
2.	140	17.20	10.35
3.	200	21.30	11.50

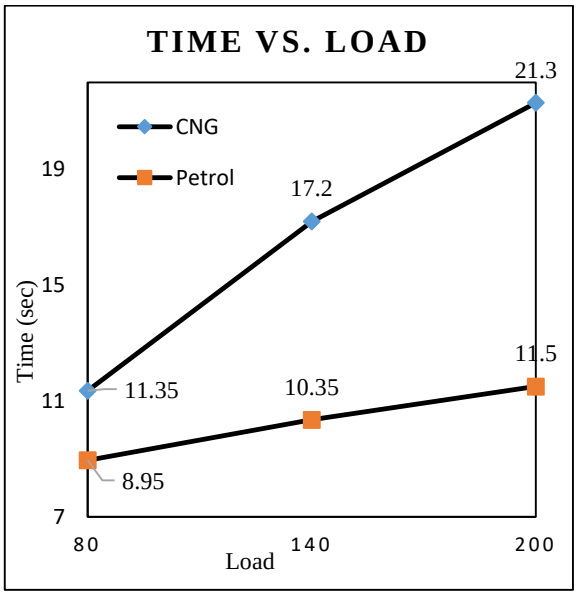

Fig No.-2

4.2. Emission test for petrol and CNG:

CNG reduces emissions of harmful gases like carbon monoxide (CO), carbon dioxide (CO_2) and nitrogen oxide (No_x). Burning gasoline on the other hand produces large amounts of CO and CO_2 which leads to the greenhouse effect. Checking emission by means of gas analyser at different speeds by means of an optical tachometer.

For CNG-

Table no-2

Emission	Speed (RPM)			
	0	100	200	300
CO (%)	0.021	0.044	0.067	0.178
CO_2 (%)	1.1	1.3	2	2.6
Non-methane HC(ppm)	0.0085	0.0346	0.0321	0.0281

For Petrol-

Table No-3

Emission	Speed (RPM)			
	0	100	200	300
CO (%)	0.395	1.146	2.116	2.625
CO_2 (%)	2.3	3	3.82	4.8
HC(ppm)	218	120	146	298

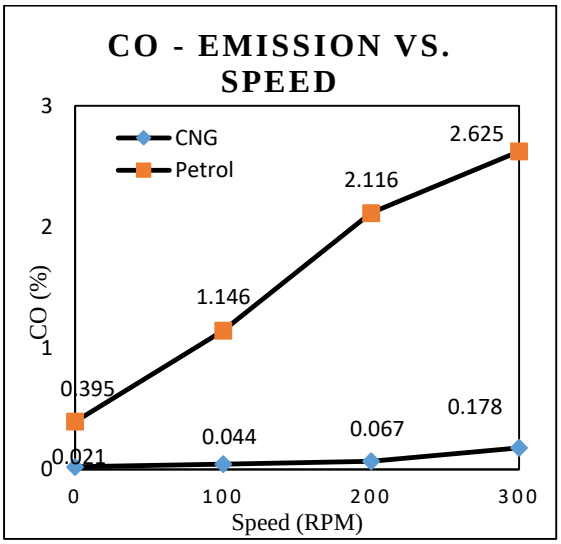

Fig No.-3

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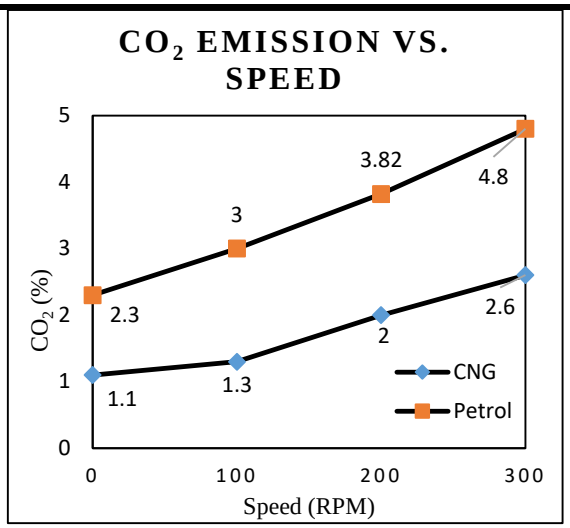

Fig No.-4

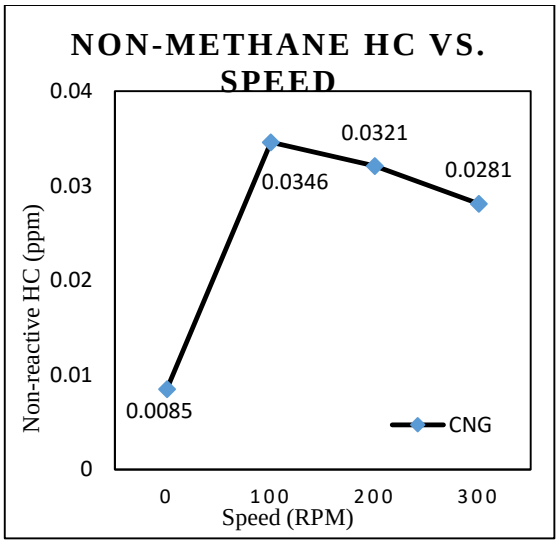

Fig No.-5

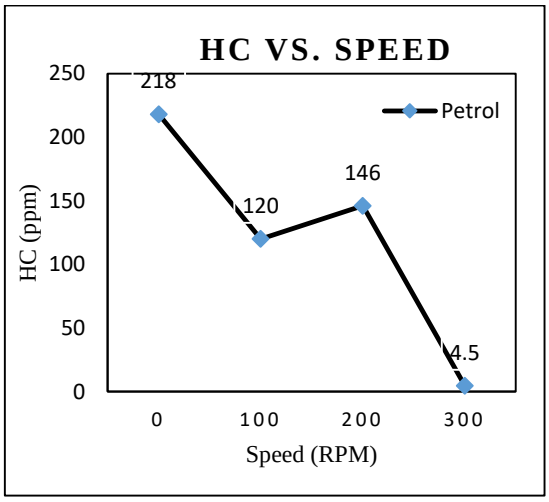

Fig No.-6

4.3. Mileage test:

Volume for a single CNG tank-

$$V = \frac{\pi}{4} \times d^2 \times h + 2\left[\frac{1}{2} \times \frac{4}{3} \times r^3\right]$$

Where, d = 160mm; h = 320mm; r = 75mm

$$V = \frac{\pi}{4} \times 160^2 \times 320 + 2[0.5 \times 1.33 \times 75^2]$$

$= 6996481.755\text{mm}^3 = 0.00699\text{m}^3 \sim \underline{0.007\text{m}^3}$

For volume of CNG tanks = 0.014m^3 and for varying pressure ranging from 3000 psi to 1000 psi, the density of CNG for each reading was calculated. Now by using both the pressure and density values, the mass of gas consumed was determined.

For CNG-

Table no-4

Sr. No.	Distance (Km)	Mass consumed (Kg)	Mileage (Km/kg)	Cost of fuel (₹)
1.	0	0	0	0
2.	38	0.442	87.6	19.02
3.	72	0.886	81.26	38.09
4.	110	1.32	83.33	56.76
5.	140	1.77	88	76.11

For Petrol-

Table no-5

Sr. No.	Distance (Km)	Mass consumed (Litres)	Mileage (Km/Lit)	Cost of fuel (₹)
1.	0	0	0	0
2.	38	0.9	42.22	72
3.	72	1.8	40	144
4.	110	2.5	44	200
5.	140	3.3	42	264

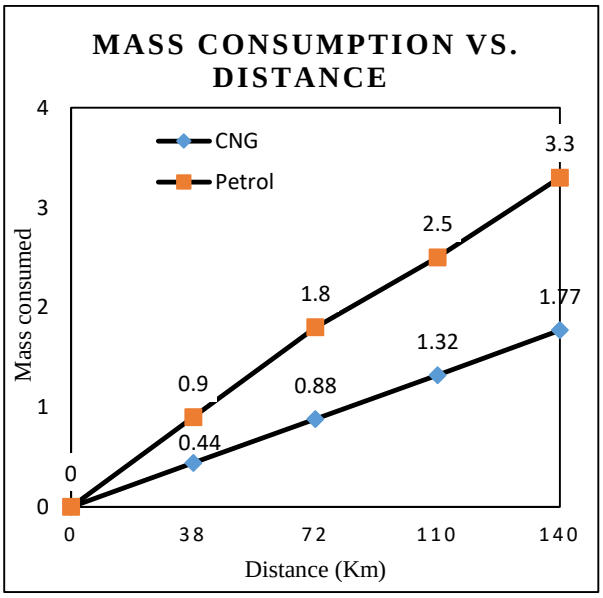

Fig No.-7

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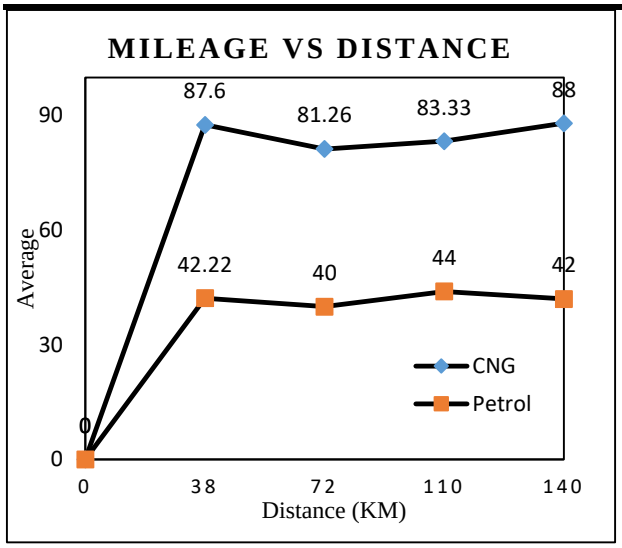

Fig No.-8

4.4 Noise test :

The motorcycle engine must be at normal running temperature during the test. The motorcycle must be in neutral gear during the test. The measurements between two verifications are valid if an adjustment of less than 0.5 dB_A is required. The microphone must be placed behind the exhaust pipe at a distance of 50 cm ±2 cm from the reference point of the exhaust pipe at the same height as the reference point ±2 cm. Perform the test with constant engine rpm measured with the help of an optical tachometer.

Table no-6

Sr. No.	Speed (RPM)	Exhaust sound CNG (dB_A)	Exhaust Sound Petrol (dB_A)
1.	0	60	65
2.	140	73	70
3.	250	76	74.2
4.	400	80	77.8

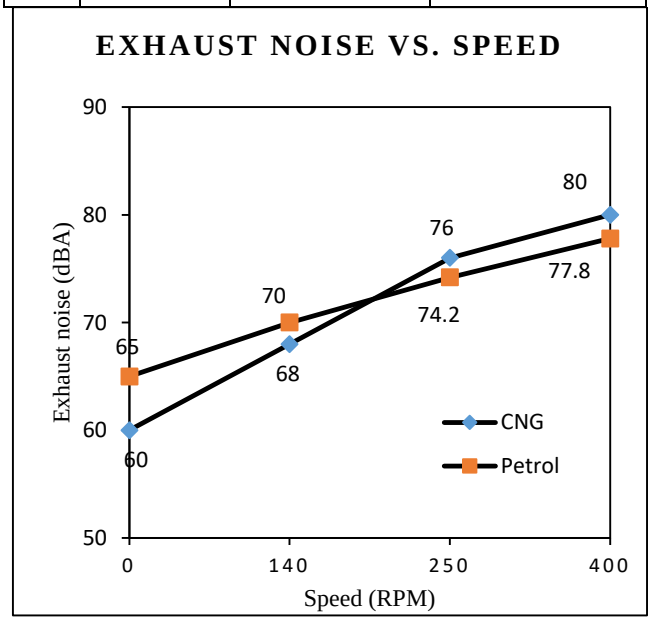

Fig No.-9

V. RESULT

- In acceleration test, time required to accelerate from 0-40 km/hr. during maximum load, CNG takes around 21.30 sec whereas petrol takes 11.50 sec to reach 40 km/hr.
- In emission test, CNG produce less CO, CO_2 gases as compared to the petrol and also HC is absent in CNG.
- In mileage test, the two-wheeler is driven for maximum distance of 140 Km where the mileage given by the CNG fuelled engine is 88 Km/Kg and for petrol fuelled engine for the same distance it is 42 Km/lit.
- In noise test, during idling CNG produces up to 60 dB_A but at 400 rpm the noise level rises to 80 dB_A and for petrol it is slight lower to 77.8 dB_A.

VI. CONCLUSION

From the results obtained it can be concluded that a bi-fuel (CNG) operated two-wheeler is more beneficial, economical and environment friendly as compared to the petrol operated two-wheeler.

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