

## Performance Analysis of Petrol - HHO Engine

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**Abstract:** Brown's gas (HHO) has recently been introduced to the auto industry as a new source of energy. The present work proposes the design of a new device attached to the engine to integrate an HHO production system with the gasoline engine. The proposed HHO generating device is compact and can be installed in the engine compartment. This auxiliary device was integrated and tested on a gasoline engine. Pulsar DTSi 150cc four stroke single cylinder engine was procured for the project. Belt rope dynamometer, mounting frames and experiment setup were designed and fabricated. HHO gas kit was installed with engine. Performance analysis and emission analysis has been done by using Petrol and Petrol-HHO separately on engine. It has been found that around 20% reduction in fuel consumption is achieved by using petrol-HHO and appreciable amount of reduction in emission of pollutants such as CO, unburned hydro carbons and CO<sub>2</sub> particularly during the idle condition.

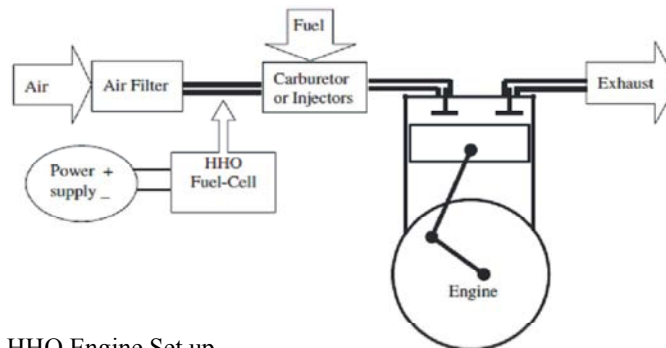
### Key words:

### Description of Petrol-HHO Engine

#### Main Parts of the Experimental Setup:

- |   |                     |                    |
|---|---------------------|--------------------|
| 1. Four stroke Pulsar 150 cc DTSi, single cylinder engine | 6. Brake drum       | 11. Spring balance |
| 2. HHO gas kit  | 7. Shaft            | 12. Petrol tank    |
| 3. Engine legs  | 8. Inverted V frame | 13. Burette        |
| 4. Royal Enfield (breaker) DC 12 volt battery             | 9. Bush bearings    | 14. Airfilter      |
| 5. Frame  | 10. Belt            | 15. Hose pipe      |
|   |                     | 16. Hand wheel     |

**Construction:** Petrol-HHO engine set up consists of four stroke pulsar 150-CC, single cylinder engine. The engine is attached to the bed of the Petrol-HHO engine set up by the help of fasteners. A 12 volt DC battery is fixed in the frame and the power from the battery is used to self start and to power HHO gas kit. The output of HHO gas is connected to hose pipe after the air filter and before the carburetor.



Simple Layout of Petrol-HHO Engine Set up

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Fuel is supplied from the petrol tank to burette with the help of valves and the fuel from the burette is supplied to the carburetor, from the carburetor the intake of petrol + HHO + air is supplied to the engine cylinder during the suction stroke.

During power stroke the crank shaft is driven by the piston and the crank shaft is coupled to the gear box by the help of clutch. A sprocket is attached at the output of the gear shaft.

With the help of chain drive brake drum is driven by the gear shaft sprocket. Brake drum and sprocket is mounted on the shaft which is made up of EN 8. The shaft is simply supported at the two ends by bush bearings. The bush bearings are mounted on the inverted V frame, top face of V frame slots are made for adjustment of bush bearings in case of chain sprocket centre distance is to be changed. One end of shaft is centre drilled and the purpose of centre drill is to take speed of output shaft by the help of tachometer.

The flat belt is attached to the brake drum to apply the load by to and fro motion of lead screw while rotating the hand wheel. The applied load is shown in the spring balance. Two spring balances are attached to the belt one at the tight side and another at the slack side and tangential to the brake drum.

**HHO Gas Kit:** HHO gas kit is a device especially designed for the producing HHO gas by supplying 12 volts DC current. 12 volts DC current is supplied from the battery which has been already integrated with the vehicle this gas kit contains

- HHO cell
- Pulse with modulator electronic circuit as shown in above figure.



**HHO Cell:** Two stainless steel electrodes are placed in the HHO cell and are connected with pulse with modulator circuit by external wiring. HHO cell is filled with electrolyte solution which contains mixture of water and electrolyte. The electrolytes used in the electrolytic solution are sodium hydroxide, potassium hydroxide and baking soda. Electrodes are dipped in the solution for passing the current.

**Pulse with Modulator:** This electronic device is used to regulate the fluctuation of current and to protect the wires from the undesirable heat.

Engine specification:



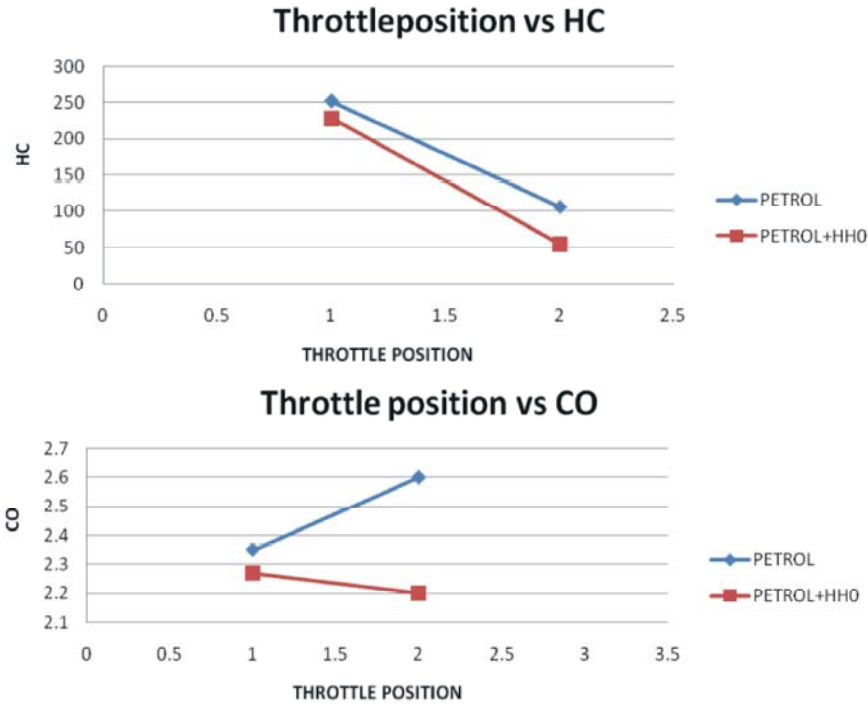
Pulsar 150 CC four stroke single cylinder DTSi engine

Engine manufacturer	Bajaj
Type	Pulsar 150 cc DTSi engine
Capacity	149.09 cc
Max power (KW @ rpm)	10.363 KW @ 8500
Max torque (N-m @ rpm)	12.76 @ 6500
Sprocket ratio	2.8:1
Gear ratio	1 <sup>st</sup> gear 2.76
	2 <sup>nd</sup> gear 1.88
	3 <sup>rd</sup> gear 1.38
	4 <sup>th</sup> gear 1.08
	5 <sup>th</sup> gear 0.92



**Exhaust Gas Emission Analysis:** We conduct emission analysis on Petrol-HHO engine with the help exhaust analyzer by supplying petrol and Petrol+HHO fuels respectively. The analysis is carried out on kanchipuram emission testing centre, Chennai. Results from this emission test shows that an appreciable amount of pollutants are reduced by using HHO gas as a supplemental fuel with petrol. The reading and graphs are shown below in the table and figure.

Tested fuels	CO (% by vol)	HC ( PPM)	CO <sub>2</sub> ( % by vol)	Throttle Position
Petrol	2.35	252	2.79	1(neutral gear)
Petrol HHO	2.27	229	2.6	1 (neutral gear)
Petrol	2.6	107	6.68	2 (neutral gear)
Petrol HHO	2.2	55	5.7	2 (neutral gear)



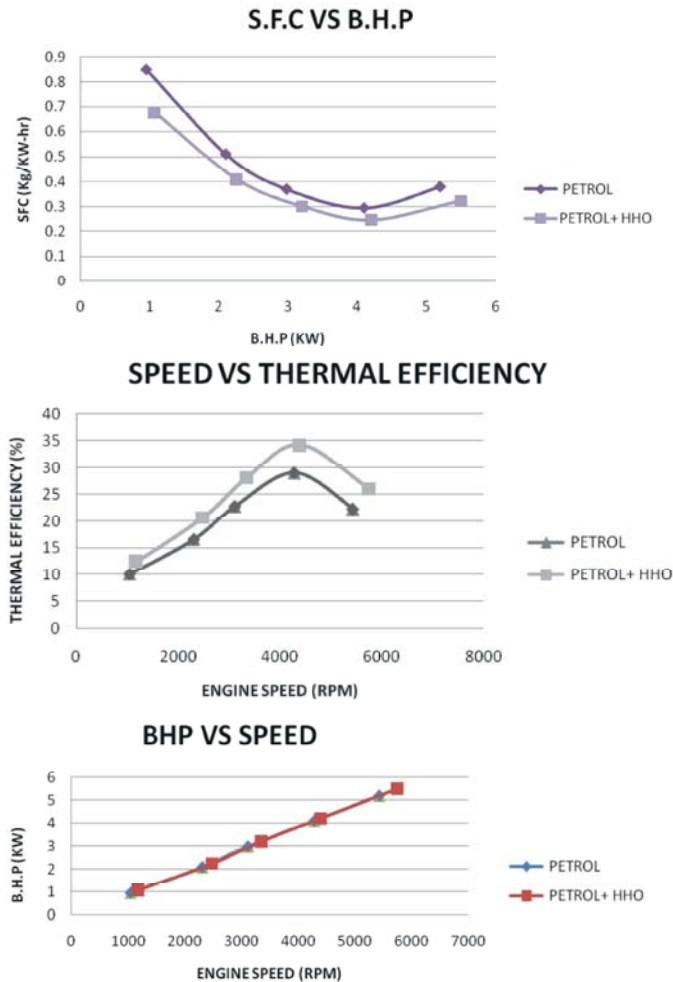
**Performance Analysis:** We conduct performance analysis on Petrol-HHO engine by supplying petrol and Petrol+HHO fuels respectively. After analysis it has been found that the specific fuel consumption, brake power and the thermal efficiencies are increased with the Petrol+HHO fuel. The reading and graphs are shown below table and figure.

Observation Petrol engine

Throttle position	Load (Kg)			Drum Speed (rpm)	Engine speed	Time taken for 10cc			
	S1	S2	S1-S2			fuel consumed (sec)	BP (KW)	$\eta_{th}$ (%)	SFC (Kg/KW-hr)
1/8	25	6	19	271	1045	32	0.95	10.11	0.848
1/4	25	6	19	598	2310	25	2.10	16.60	0.510
1/2	25	5	20	806	3116	23	2.98	22.80	0.370
3/4	25	5	20	1109	4287	22	4.10	29.00	0.295
1	25	5	20	1406	5435	13	5.20	22.30	0.380

Observation Petrol- HHO engine

Throttle position	Load (Kg)			Drum Speed (rpm)	Engine speed	Time taken for 10cc			
	S1	S2	S1-S2			fuel consumed (sec)	BP (KW)	$\eta_{th}$ (%)	SFC (Kg/KW-hr)
1/8	25	6	19	302	1168	36	1.06	12.41	0.678
1/4	25	6	19	641	2478	28	2.25	20.62	0.410
1/2	25	5	20	866	3348	27	3.20	28.10	0.301
3/4	25	5	20	1136	4392	25	4.20	34.30	0.245
1	25	5	20	1487	5752	15	5.50	26.04	0.323



**CONCLUSION**

The Petrol HHO engine performance and emission analysis are conducted with Petrol + HHO and petrol respectively. Thus the performance and emission analysis results are compared after conducting the tests with petrol + HHO and petrol respectively.

The following conclusions are observed as follows.

- The use of HHO in gasoline engines enhances combustion efficiencies, consequently reducing the fuel consumption by 20%.
- Use of HHO in gasoline engines leads to reduction in emission of harmful pollutants such as carbon monoxide and unburnt hydrocarbons.
- Use of HHO in gasoline engine increases the power output of the engine around 5.7%.
- The HHO gas kit can be easily constructed and easily integrated with existing engines at low cost.

- Thermal Efficiency increases around 5%

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