National Conference on Innovative Trends in Science and Engineering (NC-ITSE'16) ISSN: 2321-8169
Volume: 4 Issue: 7 155 - 158

Experimental Investigation of Two Stroke SI Engine on Carburetor and Injection Mode

Prof. Swapnil Kamalkishor Agrawal
Mechanical Engineering Department
Mauli College of Engineering & Technology,
Shegaon – 444203, Maharashtra, India
Email: swapnilagrawal89@gmail.com

Prof. Rahul M. Jetwani
Department of Applied Science & Humanities
Mauli College of Engineering & Technology,
Shegaon – 444203, Maharashtra, India
Email:rahul.jetwani@gmail.com

Abstract – In Asian countries, it is came know that, the use of 2 stroke engine is increased very rapidly. This is because of its advantages like low weight, minimum cost and simple in operation. As 2 stroke engines are mainly known for high power out including some major drawback of carburetor and high exhaust emission. There for this paper state the used of injector to overcome this drawback. Also we are studding the performance evaluation of single cylinder 2 stroke SI engine on carburetor and injection mode

This paper states the experimental investigation of 2stroke SI engine on Carburetor and Injection mode. This investigation is regarding the reduction in fuel consumption and emission of harmful gasses like NOx, HC and CO.

Keywords – *Fuel Consumption, Carburattor, Fuel Injector, New Design.*

*****

I. Introduction

Air pollution in many cities is increasing due to the proliferation of vehicles powered by simple two-stroke cycle engines. These engines produce high levels of carbon monoxide, unburned hydrocarbons, and particulates.[1] The principal cause of high emissions is the simple scavenging process that allows 35%+ of the engines fuel to escape unburned from the engine.[2] Two-stroke cycle engines (“2-strokes”) are utilized due to their rugged construction, low cost, and high power / weight ratio.[3]

A recent estimate in India calculates that 80% of the 2-wheelers are powered by two-stroke engines; three-wheelers with two-stroke cycle engines were reported to account for 70% of the total unburned hydrocarbons (HC) and 46% of the carbon monoxide (CO) emissions in India and were a significant contributor to particulate emissions.[4]

Two-stroke engine has fewer components than four-stroke engine typically because two-stroke engine uses no valves. The piston of the two-stroke reciprocating engine takes over any valve functions in order to obtain a power stroke each revolution of the crankshaft.[5] The air and mixture flow in and out of the combustion chamber through several ports on the cylinder walls. The piston movement will cover and uncover the ports at correct time for maximum fluid exchange inside the combustion chamber.[6]

II. LITERATURE VIEW

AIM: Improving the performance of two strokes spark ignition engine by port fuel injection.

OBJECTIVE: Performance evaluation of 150cc, 2-stroke SI engine in carburettor and injection mode using two stroke engine test rig.

- Exhaust gas analysis of the engine in carburettor and injection mode.

METHODOLOGY:

Step1: Performance evaluation of two-stroke SI engine in carburetor mode.

- Calculation of BP, mf, BSFC, Brake thermal efficiency.
- Preparation of heat balance sheet.

Step2: Performance evaluation of two-stroke SI engine in Injection mode.

- Calculation of BP, mf, BSFC, Brake thermal efficiency.
- Preparation of heat balance sheet.

Step3. Comparative evaluation of SI engine with Injection and Carburetor mode.

Step4. Exhaust gas analysis of the engine in injection and carburetor mode.

CONCLUDING REMARK:

This chapter gives the details regarding aims and objectives. A brief look of plan of research work is also included in this chapter.

III. COMPONENTS OF INJECTION SYSTEM:

1. Fuel Injector
2. Fuel Pump
3. Common Rail
4. Electronic Control Unit(ECU)

1. Fuel Injector:

Fuel injectors are electromechanical valves, usually one per cylinder, situated so that they deliver fuel either directly into the engine’s combustion chamber (direct injection) or into the intake plenum port (indirect port injection). In either case, on command from the engine’s onboard computer, each injector opens and delivers a fine and precisely metered spray of fuel.

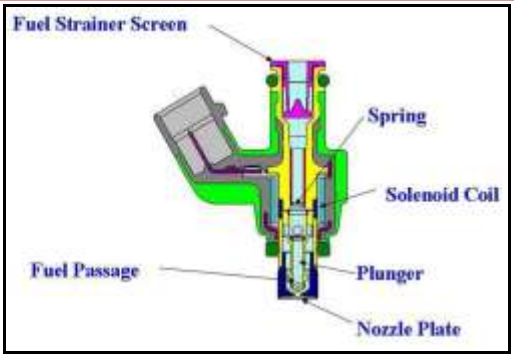

Figure 1: Fuel Injector

2. Fuel Pump:

To avoid float spot during acceleration, a separate membrane pump is provided which delivers spurts of extra needed fuel for acceleration. Pump lever is connected to accelerator pedal so when the same is pressed, the lever moves to left thrust pressing the membrane towards left and forcing petrol into main jet circuit.[7] When the pedal is left free, the lever moves the membrane back towards right creating vacuum toward left which opens the ball valve provided and thus admits the petrol from chamber into a pump.[8]

3. Common Rail:

In common rail system injector is fitted. It has gasket pipe which supply fuel from fuel tank to injector where required quantity of fuel is injected depending upon engine loading condition and remaining quantity of fuel is return back to fuel tank.

Figure 2: Common Rail

4. **Electronic Control Unit:**

An electronic control unit (ECU) or the computer receives electrical signals in the form of current or voltage from various sensors. It then uses the stored data to operate the injectors, ignition system and other engine related devices. As a result less unburned fuel leaves the engine as emission, and the vehicle gives better mileage.

Figure 3: Electronic Control Unit

IV. DESIGN PROCEDURE

The fuel injector generally used for 4 stroke Engine having specification as follows:

1. Flow rate:
   - Normal Reading = 80 – 85 ml / min.
   - Actual Reading = 70 ml /min.
2. Injector Fuel Volume :
   - 35 - 37 cc / 15 sec. (Model – F8B)
   - 38 - 40 cc / 15 sec(Model – F8D)

3. Fuel Pressure:
   - For an operation and engine stop _
     2.7 – 3.1 Kg / cm^2 ($Kg/cm^2 = 1x10^5$ Pa)
   - In Idle Condition _
     2 – 2.4 Kg / cm^2 ($Kg/cm^2 = 1x10^5$ Pa)

The modification in design of Fuel Injector for 2 strokes SI Engine is-

Duty cycle: Duty cycle is the percent of time that the injector is actually open (pulse width) Vs. Total time between firing events.

Fuel requirement in lbs /hr = (Max HP x BSFC) / (number of injectors x duty cycle);

Let calculate the injector size for the 150 cc 2-stroke SI engine 8 HP (5 KW)

BSFC= 0.35 Kg/ KW-hr

Basically the Duty cycle is ranges in between **0.8 – 0.85.** But, for safety purpose we have taken the duty cycle as 0.8

Fuel injector size = (8× 0.35) / (1×0.8)
= 3.5 lbs / hr.
= (3.5 × 60) / (6.177)
= 33.997 ml / min

Design of Fuel Pump:

Pump Specification:

- Voltage = 12 V,
- Current = 3.5–3.9 Amp,
- Pressure= 200 - 210 KPa

V. ENGINE SPECIFICATION

Stroke (Ls) = 5.8 cm
Bore dia (D) = 5.7 cm
Swept Volume = 148 cc
Clearance Volume = 22 cc
Compression Ratio = (Vs+Vc)/ Vc
= 7.727 say 8

Performance		
Peak power	8.0 hp at 2500rpm	Highest power amongst2-stroke scooters
Peak torque	1.35 Kg-m at 2500 rpm	Instantaneous pick-up
Engine		
Type	5-portsingle cylinder,2-stroke with reed valve induction	Advanced engine for superior performance
Transmission	4-speed gear box	Smooth easy shifting
Clutch	Wet multi-disc type	
Operating cycle	Two-stroke spark ignition, 150 cc engine	
CR ratio	8	
Bore	0.057 m	
L/D ratio	0.058m	
Max ratd BMEP	3.17 bar	
Appr. Best Bsfc	350 (gm/kw hr)	

Table 1: Engine Specification

VI. ENGINE PERFORMANCE

Experimental investigation of fuel consumption in Carburettor and Injector mode are tabulated as below:

Load (Kg)	Speed (rpm)	Carburettor (ml/hr)	Injector (ml/hr)
0	1500	876	828
	2000	900	852
	2500	930	882
2	1500	900	858
	2000	924	882
	2500	954	912
4	1500	942	906
	2000	960	924
	2500	984	951
6	1500	960	924
	2000	1002	969
	2500	1044	1014

Table 2: Comparative Performance of Petrol Consumption Between Carburetor and Port Injection Mode at No Load Condition.

Brake Power by using Carburetor and Injector Mode at no load condition:

$$B.P. = \frac{2\pi NT}{60}$$

$$B.P._1 = \frac{2\times\pi\times1500\times12\times9.81\times0.141}{1000\times60}$$

$$= 2.607 \text{ kW}$$

$$B.P._2 = \frac{2\times\pi\times2000\times12\times9.81\times0.141}{1000\times60}$$

$$= 3.477 \text{ kW}$$

$$B.P._3 = \frac{2\times\pi\times2500\times12\times9.81\times0.141}{1000\times60}$$

$$= 4.497 \text{ kW}$$

$$BMEP = \frac{BP}{\frac{\pi}{4}\times d^2\times l\times N}$$

$$BMEP_1 = \frac{2.607}{\left[\frac{\pi}{4}\times0.057^2\times.058\times\left(\frac{1500}{60}\right)\right]}$$

$= 704.459$ kN/m^2

= 7.04 bar

$$BMEP_2 = \frac{3.477}{\left[\frac{\pi}{4}\times0.057^2\times.058\times\left(\frac{2000}{60}\right)\right]}$$

$= 715.192$ kN/m^2

= 7.15 bar

$$BMEP_3 = \frac{4.497}{\left[\frac{\pi}{4}\times0.057^2\times.058\times\left(\frac{2500}{60}\right)\right]}$$

= 729.233 kN/m2

= 7.29 bar

1. Brake thermal efficiency by using Carburetor Mode at 6 kg load condition:

$$\eta_{bth} = \frac{B.P.}{mf \text{ x } Cv}$$

$$\eta_{bth\ 1} = \frac{2.607}{2.5641 \text{ x } 10^{-4} \text{ x } 43900}$$

= 23.16 %

$$\eta_{bth\ 2} = \frac{3.477}{2.6748 \text{ x } 10^{-4} \text{ x } 43900}$$

= 29.61 %

$$\eta_{bth\ 3} = \frac{4.497}{2.7869 \text{ x } 10^{-4} \text{ x } 43900}$$

= 36.75 %

2.Brake thermal efficiency by using Injector Mode at 6 kg load condition:

$$\eta_{bth} = \frac{B.P.}{mf \times Cv}$$

$$\eta_{bth\ 1} = \frac{2.607}{2.4665 \times 10^{-4} \times 43900}$$

$$= 24.076\ \%$$

$$\eta_{bth\ 2} = \frac{3.477}{2.5867 \times 10^{-4} \times 43900}$$

$$= 30.83\ \%$$

$$\eta_{bth\ 3} = \frac{4.497}{2.7068 \times 10^{-4} \times 43900}$$

$$= 37.84\ \%$$

Percentage increase in Brake Thermal Efficiency:

$$= \frac{37.84-36.75}{36.75}$$

$$= 2.96\ \%$$

VII. RESULT AND DICUSSION

The performance of 2-stroke SI engine in port injection mode with its advantages over carburetor mode using petrol as fuel is represented below.

Fuel Consumption: It is seen from the experiments that the mass of fuel consumed by the 2 stroke SI engine in port injection mode using petrol as fuel, the consumption rate is estimated to be reduced up to **3.91%** approx **4%** as compared to carburetor mode.

Brake Thermal Efficiency:

It is seen from the experiments that the brake thermal efficiency of 2 stroke SI engine in port injection mode may be increased up to 2.96 % as compared to carburetor mode at 6 Kg load condition.

DISCUSSION:

From the overall experimental setup it has revealed that the effect of port fuel injection using petrol as fuel improves the engine performance. Although there could be a problem of slight experimental error as not having highly precise equipments for measurements. From results it is almost clear that port fuel injection using petrol as fuel requires less fuel for the same power output as compared to conventional carburetor mode.

VIII. CONCLUSION

1. The engine can be successfully operated with the modification having port fuel injection with petrol as fuel up to 2500 rpm.
2. Improvement in fuel efficiency and more complete combustion of the modified engine were observed as compared to conventional carbureted engine.

REFERENCES

[1] Kumarappa S., Prabhukumar G.P. "Improving the Performance of Two Stroke Spark Ignition Engine by Direct Electronic CNG Injection", ISSN 1995-6665.

[2] Shawcross D., Pumphery C., Arnall D. "A five-million kilometer, 100-Vehicle Fleet Trial of an air assist direct fuel injected, automotive two stroke engine", 2000-01-0898.

[3] Kurniawan W.H., Abdullah S., Shamsudeen A., "A Computational Fluid DynamicsStudy Of Cold Flow Analysis For Mixture Preparation In A Motored Four Stroke Direct Injection Engine" ,UKM Bangi 43600.

[4] Barsotti S., Carmignani L., Matteucci L. "Optimization Of A Two-stroke Engine Scavenging Process By A CFD Analysis In Order To Reduce The Raw Pollutant Emissions", SAE 2005-32-0113.

[5] Franco A., Martorano L., Stan C., Eichert H. "Numerical Analysis Of The Performance Of A Small Two-stroke Engine With A Direct Injection", SAE-960362.

[6] Dr. Willson B. "Direct Injection as a Retrofit Strategy for Reducing Emissions from 2-Stroke Cycle Engines in Asia", 2002 HONG KONG SAR.

[7] Willson B., Mick J., Mick S., "Development of an Externally-Scavenged Direct-Injected Two-Stroke Cycle Engine", SAE 2000-01-2555.

[8] Sweeney M.E.G., Kenny R.G., Swann G.B.G., Blair G.P., "Single Cycle Gas Testing Method For Two-stroke Engine Scavenging", SAE-850178.