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Experimental Investigation on Performance Characteristics of Four Stroke Single Cylinder Petrol Engine Using A Pre-Heating Set-Up And Fuel Blends

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Abstract-The humidness within the atmospheric air affects the gasoline vaporization within the carburetor. The aim of the project is to induce the performance characteristics of an inlet air is preheated for various fuel blends of methanol and ethanolwithgasolinein the 4-stroke S.I. engine. Heating inlet air makes the vaporization simple and successively complete combustion is achieved. We tend to fictional the set up and conducted experiments on that. Here engine operates with petrol-methanol blends of four different proportions and pure methanol (100%) similarly petrol-ethanol blends of four different proportions and pure ethyl alcohol (100%) within the experiment without preheating& with preheating conditions. Preheating the engine prior to cold starting has been reported as a good way to avoid any of these undesired effects. Therefore, the performance characteristics of the normal engine are compared with the developed engine. The results are therefore tabulated and analyzed accordingly.

Index Terms-PetrolEngine; methanol; ethanol; Cu tubes

1. INTRODUCTION

Generally, gasoline engines are also known as spark-ignition (S.I) engines. Petrol engine takes in a very ignitable mixture of air and gasoline that is ignited by a regular spark once the charge is compressed.The first four stroke spark-ignition engine was built in 1876 by Nicolas August Otto. A four-stroke spark-ignition is an Otto cycle, it consists of following four stroke like suction or intake stroke, compression stroke, expansion or power stroke, exhaust stroke as shown in fig 1.1.[11] Each stroke consists of 180^0 rotation of crank shaft and to complete cycle of four stroke engine through 720^0 of crank rotation. Therefore for one complete cycle there's only 1 power stroke whereas the crankshaft turns by 2 revolutions.

The different strokes of the single cylinder engine with the graphs depicting the piston displacement. Here we are considering a petrol engine of Bajaj pulsar capacity of 150cc.

Generally Performance is done on the engines to know about its effectiveness.Already so far several performance tests are done on diesel engines using preheating of air fuel mixture, we are performing tests on pulsar 150cc petrol engine by using pre heating setup such as Brake power, indicated power, brake specific fuel consumption(bsfc), mechanical efficiency, indicated thermal efficiency, break thermal efficiency. Adding alcohols such as ethanol and methanol to gasoline allows the fuels to combust more completely due to the presence of oxygen, which increases the combustion efficiency and reduces air pollution.

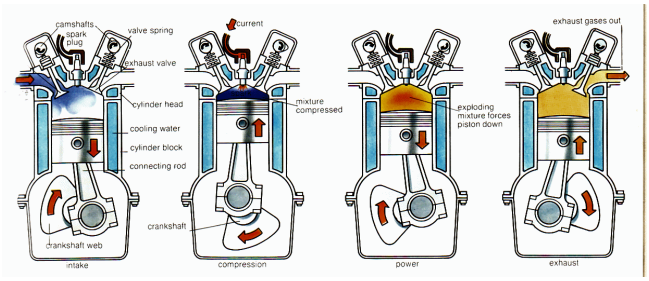


Fig. 1.1 Four Stroke Engine

Table 1.1 Pulsar 150cc Engine Specifications

Engine Type	4-Stroke DTS-I Air cooled single cylinder
Engine Displacement(cc)	149.01CC
Power (PS@rpm)	15.06PS
Torque (Nm@rpm)	12.5Nm
Bore	57
Stroke	56.4
No Of Cylinders	1
Drive Type	Chain Drive
Valves(per cylinder)	4

KrishnaPerumal – R, Manoj – R, was Reduction of hydrocarbon by preheating Air-Fuel Mixture by flue gas in S.I. Engines. In this air-fuel mixture is heated using the heat from the exhaust gases so as to reduce the hydrocarbons produced from a spark ignition

engine.A. Malaisamy, P. Balashanmugam, was fabrication of Efficiency Increaser byUsing Preheating Method. In this a heat exchanger was designed to pre heat the air intake by using the exhaust gases coming out of the exhaust manifold.AshrafElfasakhany, was investigations on the effects of ethanol-methanol-gasoline blends in a spark-ignition engine: Performance and emissions analysis from different blended fuels in types (ethanol, methanol and gasoline) and rates (3e10 vol. % methanol and/or ethanol in gasoline).GholamhassanNajafiisOptimization of performance and exhaust emission parameters of a SI engine with gasoline-ethanol blended fuels using response surface methodology. S. Phuangwongtrakula,Experimental study on SI engine performance for optimal mixing ratio of ethanol-gasoline blended fuels, experimentally determine the optimal blend in order to maximize brake thermal efficiency of a commercial SI engine.

The concept of air pre heating proved to be a several advantages include, helping the engine for a cold start, heating the atmospheric air will remove most of the vapour present in it which may lead to improper flame propagation. The fuel mixed with the heated air will burn completely in the combustion chamber thereby reducing the amount of unburnt particles.

2. EXPERIMENTAL SET UP

In the experimental setup it has to be fabricated so as to obtain the performance parameters. The performance test is conducted on the 4-stroke S.I. engine under both the conditions (normal and modified). Internal combustion (4-stroke spark ignition), Air filter, Carburettor, Fuel tank, Silencer, Angular rods, Brake drum, Transmission shaft, Chain and sprockets, Bearings , Rope brake dynamometer, Different weights .The additional equipment required for the modified engine is as follows: Copper pipes of different sizes, Insulation material – ceramic glass wool.

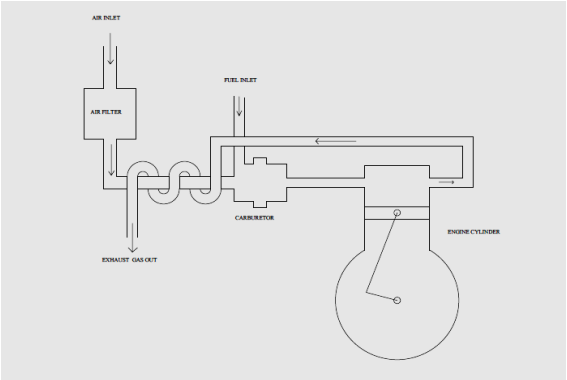


Fig.2.1 Schematic diagram of experimental set-up

The fabricated set up of the engine is shown below:

Fig. 2.2. Set up of normal engine

Fig.2.3. Modified engine experimental Set-up

A. Methanol & Ethanol blends with Petrol

We are using two different blended fuels. Methanol-petrol and ethanol-petrol blends. The methanol-petrol blend was first prepared at five different concentrations 10:90, 20:80, 40:60, 60:40, 80:20 and pure methanol 100% and Ethanol-petrol blend also prepared in the same concentrations. These 2 blends are employed in the normal engine and additionally used in modified engine then we have a tendency to compare the both results with initial gasoline results.

3. PERFORMANCE TEST ON FOUR STROKE SINGLE CYLINDER PETROL ENGINE

Table 3.2 Calculations for Normal engine

A. Normal Engine readings

S.No	Load (in kgs)	Speed (in rpm)	Time for 10cc fuel consumption
1	0	300	66
2	2	300	58
3	4	300	52
4	6	300	39
5	8	300	37

Table 3.1 Readings for Normal engine

Load (kgs)	BP (kw)	Heat Input (kj)	IP (kw)	BSFC (kg/kwh)	η_m (%)	η_{bth} (%)	η_{ith} (%)
0	0	5.23	0.52	0	0	0	10.02
2	0.73	5.95	1.25	0.61	58.2	12.2	21.06
4	1.46	6.64	1.98	0.34	73.5	21.9	29.89
6	2.19	8.86	2.71	0.30	80.6	24.7	30.67
8	2.92	9.34	3.44	0.23	84.7	31.3	36.92

B. Modified Engine readings

These are the readings which are obtained after attaching the pre-heating setup and we conducted test with different load conditions.

Table 3.3 Readings for Modified Engine

Load (In Kgs)	Speed (In Rpm)	Time For 10cc Fuel Consumption
0	300	69
2	300	61
4	300	54
6	300	40
8	300	39

Table 3.4 Calculations for Modified Engine

Load (kgs)	BP (kw)	Heat input (kj)	IP (kw)	BSFC (kg/kwh)	η_m (%)	η_{bth} (%)	η_{ith} (%)
0	0	5.008	0.5	0	0	0	9.98
2	0.73	5.665	1.23	0.581	59.3	12.9	21.7
4	1.46	6.398	1.96	0.328	74.5	22.8	30.6
6	2.19	8.640	2.69	0.295	81.4	25.3	31.1
8	2.92	8.860	3.42	0.227	85.3	33	38.6

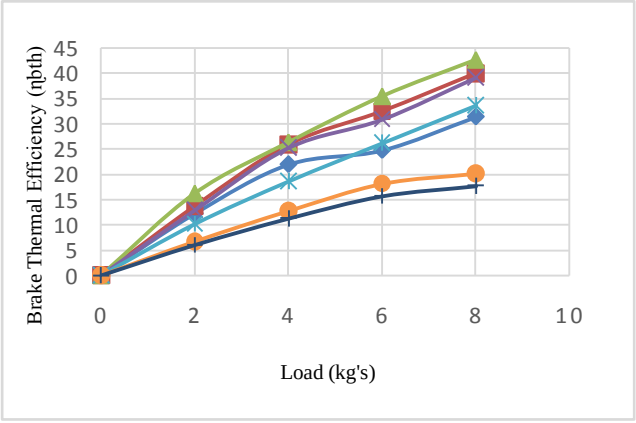
4. RESULTS AND DISCUSSION

In this we compare the results which are obtained from the normal engine (without preheating setup) and modified engine (with preheating setup) and methanol & ethanol blends.

Table 4.1 Comparison of Results

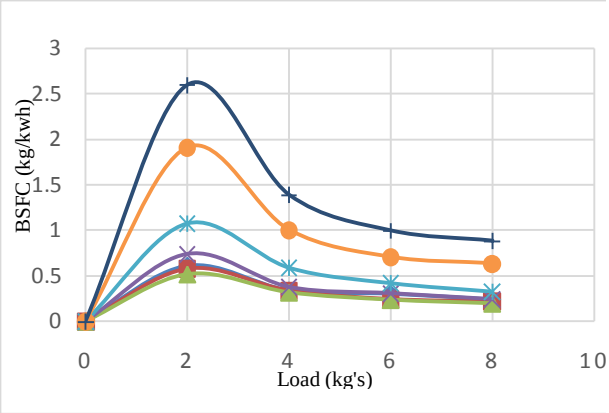
Fuels	Normal engine		Modified engine	
	BSFC	$\eta_{bth(\%)}$	BSFC	$\eta_{bth(\%)}$
Petrol	0.239	31.3	0.227	33
10% Methanol blend	0.218	40.1	0.203	42
20% Methanol blend	0.196	42.06	0.184	45.3
40% Methanol blend	0.242	39.07	0.230	41.12
60% Methanol blend	0.323	33.6	0.312	34.8
80% Methanol blend	0.637	20.16	0.597	21.51
100% Methanolblend	0.885	17.67	0.749	20.89
10% Ethanol blend	0.241	33.96	0.226	35.1
20% Ethanol blend	0.237	34.16	0.225	35.96
40% Ethanol blend	0.262	33.68	0.241	34.9
60% Ethanol blend	0.425	22.85	0.406	23.89
80% ethanol blend	0.793	13.59	0.802	15.86
100% ethanol	1.076	11.26	0.880	13.76

Graph for before preheating Methanol-Petrol blends:



Graph 4.1 Brake Thermal Efficiency vs Load

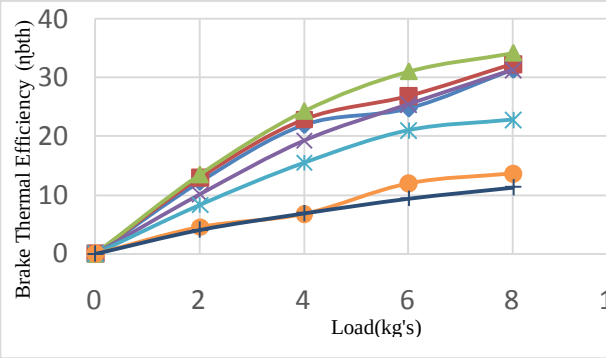
Graph for before preheating Methanol-Petrol blends:



Graph 4.2 BSFC vs Load

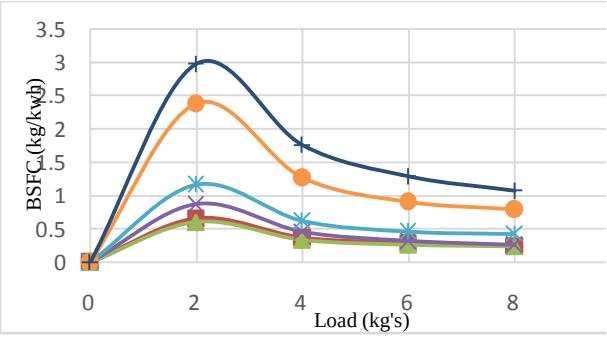
Graph 4.2 shows comparing the brake specific fuel consumption (BSFC) for pure petrol with preheating and without preheating of air drawn against load. We obtained better results with Methanol-petrol blend rather than petrol. 20% Methanol gives Maximum brake specific fuel consumption.

Graph for before preheating Ethanol-Petrol blends:



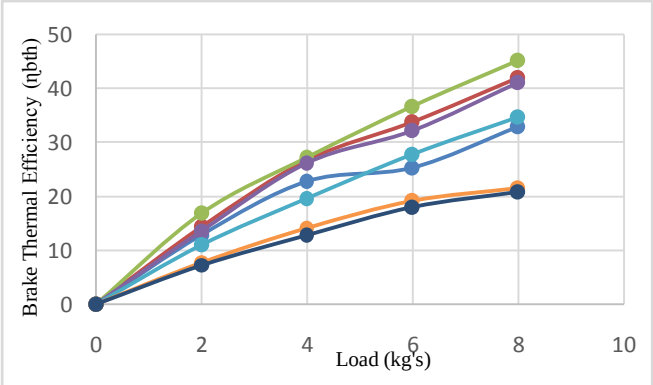
Graph 4.3Brake Thermal Efficiency vs Load

Graph for before preheating Ethanol-Petrol blends:



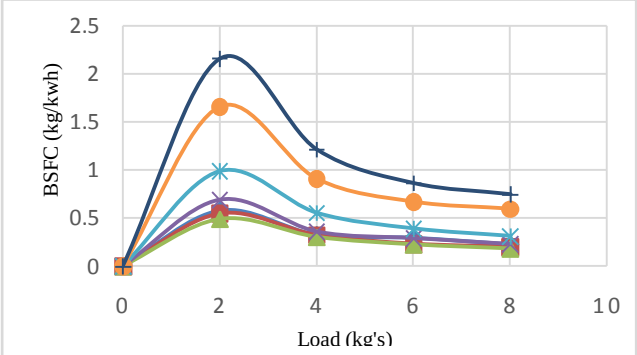
Graph 4.4 BSFC vs Load

Graph for after preheating Methanol-Petrol blends:



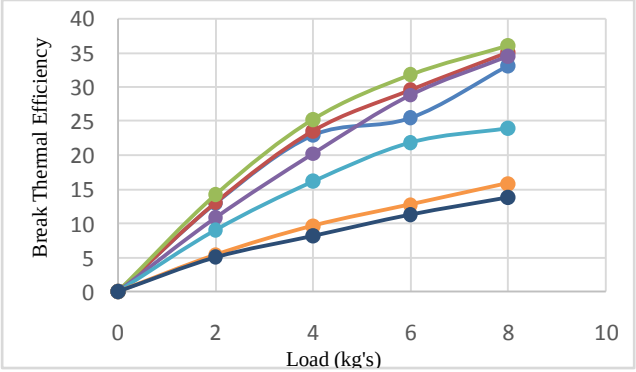
Graph 4.5 Brake Thermal Efficiency vs Load

Graph for after preheating Methanol-Petrol blends:



Graph 4.6 BSFC vs Load

Graph for after preheating Ethanol-Petrol blends:



Graph 4.7 Brake Thermal Efficiency vs Load

5. CONCLUSION

In this experimentation the performance of a four-stroke single cylinder S.I engine by using normal mode engine (unheated air) operation and modified engine (preheated air) was analyzed. And also, methanol- petrol, ethanol-petrol blends are used in both conditions, the results were compared.

On experimentation with normal mode engine, the results show the performance characteristics BSFC is

0.23956 and brake thermal efficiency is 31.3%. And the modified engine get BSFC is 0.2272 brake thermal efficiency is 33%. By using pre heating 5.4% improvement in BSFC is observed.

Blends of methanol - petrol and ethanol - petrol at different concentrations (10%, 20%, 40%, 60%, 80%, and 100% of methanol and ethanol with petrol) and conducted experiment on normal engine as well used in modified engine.

The BSFC of a normal engine for methanol 10% blend's is 0.2183 and brake thermal efficiency is 40.1.24%, 20% methanol blend gets 0.1949 and 42.6%,40% methanol blend 0.2424 and 39.07%, 60% methanol blend gets 0.3237 and 33.6%, 80% methanol blend gets 0.6375 and 20.16%, and 100% pure methanol gets 0.8853 and 17.67%.

The methanol blends for modified engine gets BSFC and brake thermal efficiency was 10% blends 0.2034, 43.2%, 20% methanol bend gets 0.1844, 45.3%, 40% methanol blend gets 0.23024, 41.12%, 60% methanol blend 0.31295, 34.8%, 80% methanol blend gets 0.5977, 21.51%, and 100% pure methanol gets 0.7491, 20.89%.

The BSFC of a normal engine for ethanol 10% blend's is 0.2417 and brake thermal efficiency is 33.9%, 20% blend gets 0.2376 and 34.16%,40% ethanol blend 0.2626 and 33.68%, 60% ethanol blend gets 0.4254 and 22.85%, 80% ethanol blend gets 0.7936 and 13.59%, and 100% pure ethanol gets 1.070 and 11.26%.

The ethanol blends for modified engine gets BSFC and brake thermal efficiency was 10% ethanol blends 0.2239, 35.1%, 20% ethanol bends 0.2257, 35.96, 40% ethanol blend gets 0.2419, 34.5%, 60% ethanol blend 0.4069, 23.89%, 80% ethanol blend gets 0.6802, 15.86%, and 100% pure ethanol gets 0.8808, 13.76%.

In modified engine BSFC results are decreased when comparing with normal engine performances. When compared with normal enginethe break thermal efficiency was increased in modified engine.Finally when compared to all these experiments 20% of methanol blend gives best results.

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