PERFORMANCE STUDY OF METHANOL – PERTOL BLEND IN THREE CYLINDER FOUR STROKE SI ENGINE TEST RIG

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Abstract—*This study discusses the performance parameter of a test rig (3-Cylinder 4-Stroke Maruti 800 model) fueled with low content alcohol (methanol) blends and pure petrol. In this study experiment is done to measure performance parameter, exhaust emission and exhaust gas temperature for 4-stroke SI engine one by one using different ratio of methanol-petrol blends. The engine is tested at different load at different rpm and varying blending percentage. It is found that increasing blending percentage increases break power and break thermal efficiency due to higher cylinder temperature. The results show that use of 15% of methanol with commercial petrol in Test Rig improves performance parameter and is good option for replacing any other additives and also methanol is good candidate in all alternative fuels.*

1. INTRODUCTION

Since energy crisis and environmental pollution is one of the major problem faced by present world population. Internal combustion engine is used transform energy from chemical to mechanical by motor shaft to operate various devices (cars, trucks, dynamo, etc. [1]. IC engine are used from more than a century and between these periods it got tremendous changes in design, material and performance characteristics. In past few years, researchers focus on largely on spark ignition engine aiming in reducing pollutant emission without affecting performance and fuel economy. Another effort is done to replace fossil fuel by non-conventional fuels due to rapid depletion rate of fossil fuels [2].

The higher-octane rating and higher heat of evaporation makes alcohols (ethanol, methanol, and butanol) as one of the appropriate fuel for high CR with high powers. High octane value can permit increase in CR and high heat of evaporation cools down the incoming fuel-air charge and make it denser to promote the power output [3]. As compared to conventional fuels which have high auto ignition temperature are ignited at higher temperature, alcohols auto ignition than those of gasoline which makes it safer for transportation and storage. [4]

Heat of evaporation of alcohol is 3-5 times higher than gasoline, which make lower temperature in intake manifold and increases volumetric efficiency. Higher laminar flame speed also increases thermal efficiency by completing combustion earlier due to which heat loss decrease though cylinder. Gasoline-methanol blend is more oxygenated due to the structure of methanol molecule, which contains oxygen. Methanol is an alternative fuel which can be produced from natural gas, biomass, municipal solid waste and sewage [5-7].

Several studies have been conducted on the use of methanol-gasoline blends as a fuel in SI engine and results shows that there is increase in thermal and volumetric efficiency, brake power, torque and fuel consumption. While decrease in brake specific fuel consumption and equivalence air fuel ratio [8-9]. The 15% methanol in fuel blend gave best results for all measured parameter at all engine speed.

2. STATEMENT OF PROBLEM

As the four-stroke engine are using different types of fuel like petrol, diesel, gas etc. in current day engines are facing many problems like cold start, vapor lock, reduce in performance parameter and emission of harm full gases, maximum fuel consumption less efficient and limited amount of fossil fuel. To overcome these difficulties methanol is used an additive with petrol to increase performance of engine, minimize fuel consumption and replace conventional sources with non-conventional.

3. OBJECTIVE

The objective of study is to analyze the performance parameter four stroke 3-cylinder SI engine test rig by different blends of methanol-gasoline to overcome above difficulties.

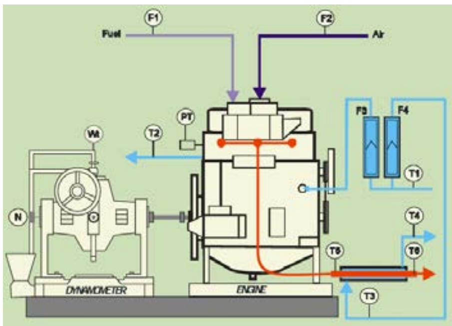
4. SCOPE OF STUDY

To increase the performance of 4-stroke, 3-cylinder engine test setup by using different blends of methanol-petrol. The readings obtained from conducted test have been evaluated and results and graph were compared.

5. EXPERIMENTAL SETUP & PROCEDURE

The Engine setup includes three cylinder, four stroke, petrol (MPFI) engine connected to Hydraulic type dynamometer for loading. It is provided with necessary instruments for combustion pressure and crank angle measurement. These signals are interfaced to computer through engine indicator for p-v diagram. The provision is also made for interfacing airflow, temperature, fuel flow, and load measurement.

The set has stand-alone panel box, fuel tank manometer, fuel measuring unit, box consist of air box, transmitters for air and fuel flow measurements, process indicator, load indicator and engine indicator. Rotameters are provided for cooling water and calorimeter water flow measurement. This setup enables study of performance for brake power, Thermal efficiency, volumetric efficiency and specific fuel consumption, A/F ratio and heat balance. Engine software is provided for performance evaluation.



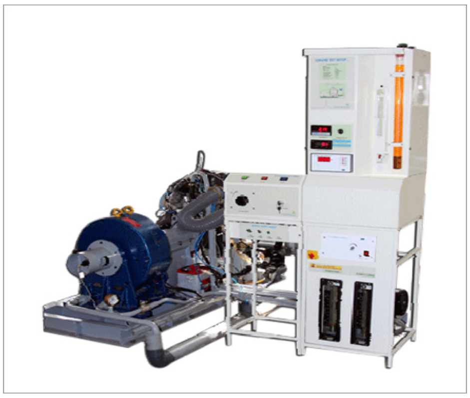


Fig.1 Engine Setup

These setup is connected to the computer in which "Engine soft" is installed by running that software we can get the result for the required performance and through which performance evaluation is done.

Table-1 Engine Specification

Product	Engine test setup 3 cylinder, 4 stroke, Petrol (Computerized)
Product code	230H
Engine	Make Maruti, Model Maruti 800, Type 3 Cylinder, 4 Stroke, Petrol (MPFI), water cooled
Bore Dia.	66.5mm
Stroke length	72mm
B. P	27.6Kw
Max. Speed	5000 rpm
Cubic Cap.	796cc
Software	"Engine soft" Engine performance analysis software

Specification of fluid used in experiment	
Density of petrol	720 Kg/m^3
Density of water	1000Kg/m^3
Calorific value of petrol	48000KJ/Kg
Calorific value of methanol	22700 KJ/Kg

Initially engine was stared and allowed to warm up for 15-20 min without blending to reach steady condition. The engine ones reached to steady state condition the engine rpm is set and the time taken for consuming a known volume of fuel is measured. Now methanol is blended with petrol contains 10%, 15%, 20% By volume (M10, M15, M20). The result for each blend is noted step by step at different speed and different load.

After getting the result for particular blend at different rpm, the remaining fuel is drain out and again filled with other percentage of blends. Engine is again run for few minute until the steady state reached and also remaining fuel of previous blend in valve is burned and reading is taken. Repeating this process, the given data is noted and result is displayed on the screen of computer. Temperature is displayed on digital screen and calculation of performance parameter is done automatically by the sensors placed at every point of engine test rig.

6. EXPERIMENTAL DATA

Engine speed (rpm)	Load (kg)	Brake Power	BMEP (bar)	Torque (Nm)	BSFC kg/kWh	B. Th eff (%)	Air flow (kg/hr)	Vol. eff (%)
1550	0.6	0.54	0.4	0.5	0.95	7.83	11.9	23.8
1905	0.9	0.69	0.5	2	0.91	8.87	12.2	25.8
2420	1.5	0.75	0.6	2.7	0.85	13.26	18.2	27.6
2952	2.4	0.86	0.9	4	0.97	12.21	23.4	26.3

Table-2 Result for Pure petrol

Engine speed (rpm)	Load (kg)	Brake Power	BMEP (bar)	Torque (Nm)	BSFC kg/kWh	B. Th eff (%)	Air flow (kg/hr)	Vol. eff (%)
1565	0.5	0.55	0.3	0.5	0.96	7.89	11.7	21.2
1923	0.9	0.74	0.5	1.9	0.89	9.14	12.1	23.9
2473	1.5	0.77	0.7	2.8	0.84	13.41	16.6	25.9
2965	2.4	0.87	0.8	4.7	0.98	12.25	19.9	24.2

Table-3 result for 10% Methanol (M10)

Engine speed (rpm)	Load (kg)	Brake Power	BMEP (bar)	Torque (Nm)	BSFC kg/kWh	B. Th eff (%)	Air flow (kg/hr)	Vol. eff (%)
1450	0.6	0.54	0.19	0.8	1.11	7.95	11.9	32.6
1921	0.9	0.71	0.37	2	0.98	9.41	12.4	25.2
2488	1.5	0.81	0.53	3.1	0.86	13.65	18.4	27.9
2963	2.4	0.88	0.66	5.1	1.05	12.15	21.6	29.6

Table-4 Result for15% methanol (M15)

Engine speed (rpm)	Load (kg)	Brake Power	BMEP (bar)	Torque (Nm)	BSFC kg/kWh	B. Th eff (%)	Air flow (kg/hr)	Vol. eff (%)
1440	0.6	0.51	0.17	0.9	1.35	7.84	12.2	31.5
2020	0.9	0.65	0.31	1.9	1.19	9.25	13.4	25.1
2503	1.5	0.67	0.47	3	0.72	13.31	18.1	27.3
2890	2.4	0.73	0.54	4.9	1.25	11.97	20.8	29.4

Table-5 Result for 20% methanol (M20)

7. COMPARISON OF RESULTS

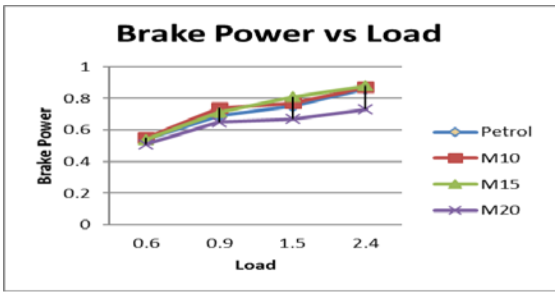


Fig .2 Brake Power vs Load

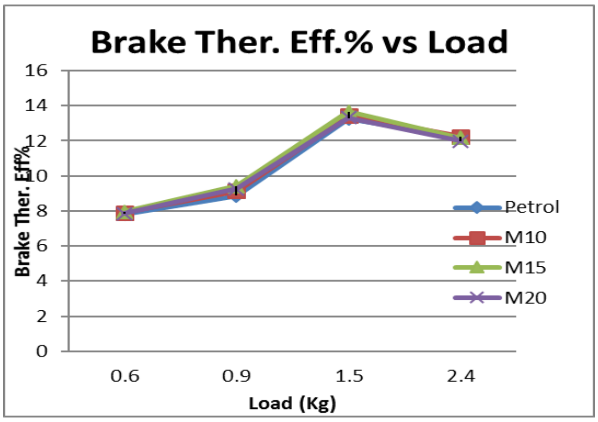


Fig.3 Brake Thermal Efficiency vs Load

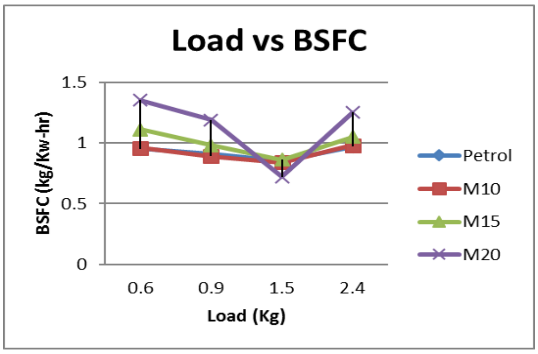


Fig. 4 BSFC vs LOAD

8. RESULT AND DISCUSSION

The experimental results of the methanol blends on performance parameter of spark ignition engine have been presented and discussed. It is clear that methanol blending is based on volume ratio replacement ratio. The methanol blending range is from 10-20%. Figure (2 to 4) shows the effect of load at different methanol blending percentage on brake power, break thermal efficiency and specific fuel consumption respectively.

There is increase in brake power for given load as the ratio of methanol in blend is increased, this is due to the higher combustion efficiency. Due to improvement of combustion process the break thermal efficiency increases as the methanol percentage is increased in methanol-petrol blends. The break thermal efficiency is totally dependent brake power and calorific value of engine; it increases as the methanol percentage is increased.

As the Percentage of methanol concentration in petrol is increased the specific fuel consumption decreases. The blends of methanol show lower SFC compared to gasoline because methanol contains more oxygen molecules as compare to gasoline, due to which complete combustion takes place in chamber. SFC is inversely proportional to thermal efficiency of engine and it decrease with increase in loads.

1. The blending ratio of 15% by volume of methanol gives maximum improvements in engine efficiency.
2. Brake power increase increases as the methanol blending is increased.
3. Combustion process is improved by increase in methanol percentage.
4. SFC shows the lower value at 20% blending of methanol-petrol.

ACKNOWLEDGMENT

I would like to express my sincere thanks to Head of Department of mechanical Engineering, Assistant for his entire assistance. I wish to express my deep sense of gratitude to student of H.P.T 2013 batch. Finally, I would like to thank all authorities of LNCT Bhopal.

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