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IMPACT OF HCCI ENGINE PERFORMANCE AND CHARACTERISTICS ON IAA BLENDS

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Abstract

Various alternative fuels, such as alcohol, have a high octane rating and produce lower emissions. In general, resources are used wisely, yet fuel consumption is higher in light and heavy-duty engines. Isoamyl alcohol is abundant in unwanted waste material from sugar mills. This paper will give you more knowledge about the engine performance and characteristics like BP,IP,FP, and their efficiencies of alcoholic fuel in HCCI engines. Earlier studies were carried out. Several experimental research on primary alcohol gasoline blends on SI engines were conducted, raising awareness about the possible benefits.

Keywords: Primary alcohol, IAA , SI Engine, Blends, HCCI, Performance.

I. Introduction

Energy research is still an important concern. During the past 90 years, fuel appears to have been the most important source of scientific activity in fuel science. The focus is broad, covering a wide range of topics of rising importance, such as environmental challenges and pollution. CNG, H2, LPG, and alcoholic fuels are examples of alternative fuels for SI engines, whereas biodiesel, DME, and jet propellent-8 are examples of alternative fuels for Compression Ignite engines.

HCCI technology has shown a strong potential for drastically lowering fuel consumption and NOx emissions when compared to conventional spark-ignition engines. To achieve HCCI combustion in a port fuel injection gasoline engine, optimized kinetic process technology is used[1].

At a constant inlet air temperature of 60 °C, the test engine was able to run in HCCI mode between 800 and 2000 rpm and with a lambda value range of λ=1.61– λ =2.93. As test fuels, pure n-heptane and naphtha, as well as N25, N50, and N75 fuel mixes, were employed. Experiments revealed that when lambda increased, the propensity to knock decreased. Similarly, the inclusion of naphtha into n-heptane resulted in more stable combustion due to the higher octane number. When the naphtha proportion in the test fuels was raised, the combustion of HCCI was delayed[2].

Features of Primary Alcoholic Fuels: Either low - molecular - weight alcohols as well as molecular weights alcohols can be produced using domestic energy assets. Burning in spark-ignition engines gives out high performance. Combustion of alcohol in ICE produces more ignition pressure with lower knocks. With lower and appetitive tendency specific consumption is achievable with high octane value. Negotiable release of ash content[3]**Significance and Aspects of Alcoholic Fuels:**

seeking long-term growth by expanding the usage of sustainable energy and decreasing concerns about the depletion of energy from fossil resources. Engine performance and emission levels by taking use of alternative gasoline superior chemical characteristics over conventional fuels. Reducing the imbalanced use of traditional petroleum-based fossil fuels[4-6].

Operation of Alcohol Material Rates

To get a number of desirable properties and performance, and also trustworthy machine operation, ethanol power packages should follow to the world's accessible criteria[7-9].Various alternative fuels, such as alcohol, have a high octane rating and produce fewer emissions. In fact, resources are utilised efficiently, yet fuel consumption is higher in light and heavy-duty engines. Unwanted waste from sugar mills includes a high concentration of isoamyl alcohol[10-13].

II. Methodology

Selecting a Research Engine test setup single cylinder, 4 stroke, Multi-fuel, RCCI Engine. The concept is about investigating the performance characteristics of Petrol, IAA and hydrogen by choosing RCCI research engine with wire throttle method in the following manner.

1. By changing the blend ratio starting from B 0 to B 20 against the Load ranging from 0 to 18kg at constant speed 1500rpm.
2. In each case the objective of research is to find out the best performance characteristics against blend and speed.

➢ Total Number of Observations = CR x RPM x Load x Blend = 1 x 1 x 5 x 4 = 20

III. Experimental Procedure

In this experimentation HCCI is the ultimate combustion approach for attaining both CO_2 reduction and clean exhaust through the use of auto-ignition of gasoline, similar to that used in diesel engines. Homogeneous Charge Compression Ignition (HCCI) engines, which have low NOx and soot emissions and great volumetric efficiency, are a possible option. HCCI combustion may be produced in an IC engine by premixing the air-fuel mixture (either in the manifold or by early Direct Injection (DI) – as in a SI engine) and compressing it until the temperature is high enough for auto ignition to occur (like in a CI engine). HCCI engines have a limited operating range in which the rates of heat release and pressure rise increase at high loads and speeds, resulting in banging, and misfire may occur at low loads.

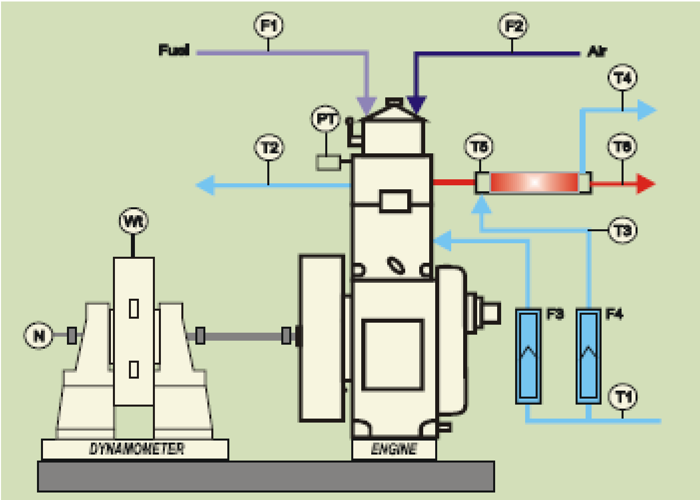


Fig.1.Schematic Diagram of Engine

In this experimentation the base fuel is used as a Diesel and the remaining fuel is primary alcohol such as Isoamyl alcohol. By using wire throttling method it varies load in HCCI single cylinder four stoke research engine. Different proportions are B0 , B5, B10, B20 & B30 with variable speeds are used in this research engine.

Apex Innovations Pvt. Ltd. created EngineSoft, a Lab view-based software suite for engine performance monitoring.

EngineSoft can meet the majority of engine testing application requirements, such as monitoring, reporting, data entering, and data logging.

The details of experiment were recorded and Experimentation was conducted at Apex Laboratories and it was located at Kanchipuram , Tamilnadu. To plot the graphs in this experiment IC Engine soft and Origin is used.

Fig.2. Engine Setup.

Table .1 Details of Experimental Setup

Manufacturing ID	224	Stroke (mm)	110
Make	Kirloskar	Bore (mm)	87.5
Type	TV1	CC	661
No. Cylinders	1	CR	17.5
No of Strokes	4	Dynamometer	EC
Engine Cooling Type	Water	PS	Capacity 5000 PSI
Maximum Power (Kilowatt)	5.2 @ 1500 revolutions per minute	CAS	Rev 10 with 5500 RPM
TS	RTD	Thermocouple	Type K
LI	Digital	Range (Kg)	0 to 50
Load sensor	LC	Type	SG
Range (Kg)	0 to 50	No. of Valves	Two
Fuel flow transmitter	DP	Range (mm)	0 to 500
Air flow transmitter	Pressure based	Range (mm)	250
Rota meter Capacity (LPH)	40 to 400	Calorimeter Capacity (LPH)	25 to 250

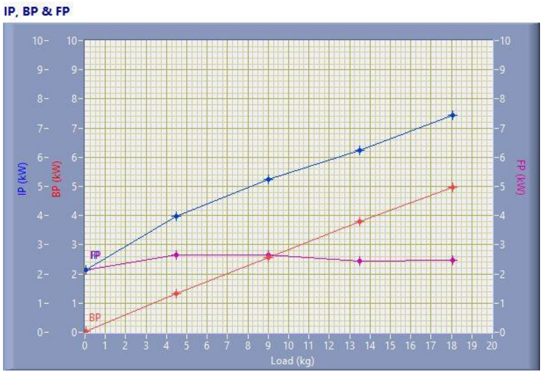
Table.2 Range/Accuracy/Resolution

Capacity	Range	Retention	Speed	Temperature of the Oil
	0 to 100 Percentage	0 to (1/10) m	400 to 6000 (1/min)	0 to 150degrees
Precession & Repeatability	±1% of full measuring range	Better than ± (1/10) m	±10	±2degrees
Accuracy	0.1 percentage	(1/1000) m	±1	±1 degrees

IV. Results and Discussion

The Performance of this experiments are recorded and it was generated and simulated by using IC Engine soft.

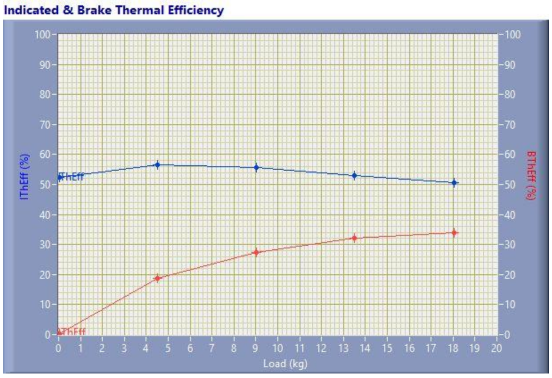
Graph 1 represents the Blend 0 (100%Diesel) , loads (0 to 18kg) and IP,BP& FP are recorded as shown. Here the load at 18kg IP,BP were increased and FP is decreased. lowest values are recorded at 0 & 2kg load. Graph 2 represents the Blend 0 (100%Diesel) , loads(0 to 18kg) and IMEP,BMEP& FMEP are recorded as shown. IMEP and BMEP were increased at a load of 18kg with constant speed of 1500r.p.m and FMEP is decreased. Lower values are recorded at 0 & 2.5kg.

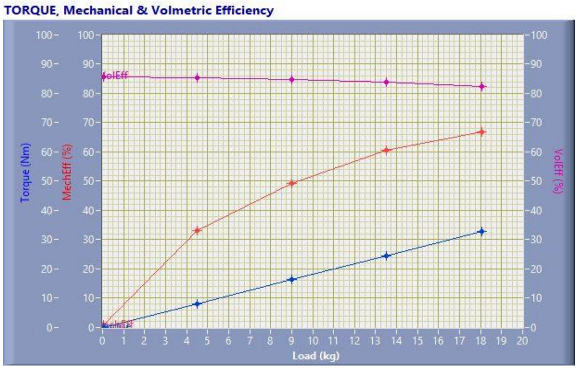


Graph 1 B0 - 100%Diesel

Graph 2 B0 - 100%Diesel

Graph 3 represents the Blend 0 (100%Diesel), loads (0 to 18kg) and Indicated and Brake Thermal Efficiency are recorded as shown. Brake Thermal Efficiency were increased at 18kgload and indicated Thermal Efficiency is decreasing. Graph 4 represents the Blend 0 (100%Diesel), load (0 to 18kg) and Mechanical and Volumetric efficiency are recorded as shown. At 18kg load Torque and Mechanical efficiency were increased and Volumetric efficiency is decreasing.



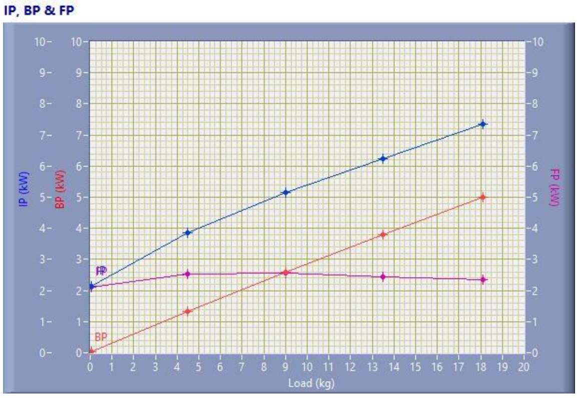


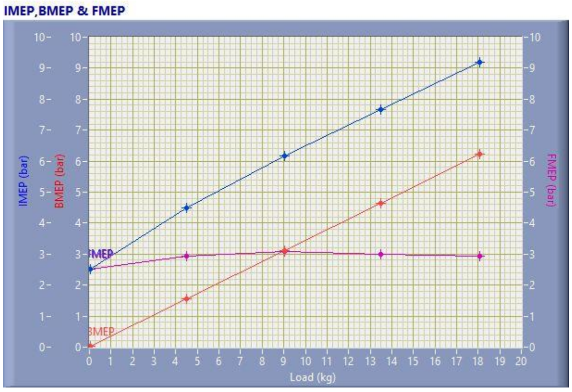
Graph 3 B0 - 100%Diesel

Graph 4 B0 - 100%Diesel

Graph 5 represents the Blend 10 (90%Diesel and 10% IAA) , loads (0 to 18kg) and IP,BP& FP are recorded as shown. Here the load at 18kg with a constant speed of 1500rpm IP,BP were increased and FP is decreased.

Graph 6 represents the Blend 10 (90%Diesel and 10% IAA), loads (0 to 18kg) and IMEP,BMEP& FMEP are recorded as shown. IMEP and BMEP were increased at a load of 18kg with constant speed of 1500r.p.m and FMEP is decreased. Lower values are recorded at 0 & 2kg.

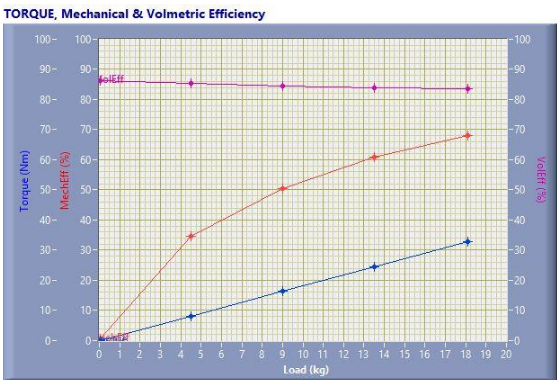




Graph 5 B10 -90% Diesel

Graph 6 B10 -90% Diesel

Graph 7 represents the Blend 10 (90%Diesel and 10% IAA), loads (0 to 18kg) and Indicated and Brake Thermal Efficiency are recorded as shown. Loads at 18kg Brake Thermal Efficiency were increased and indicated Thermal Efficiency is decreasing. Graph 8 represents the Blend 10 (90%Diesel and 10% IAA), load (0 to 18kg) and Mechanical and Volumetric efficiency are recorded as shown. load at 18kg Torque and Mechanical efficiency were increased and Volumetric efficiency is decreasing.

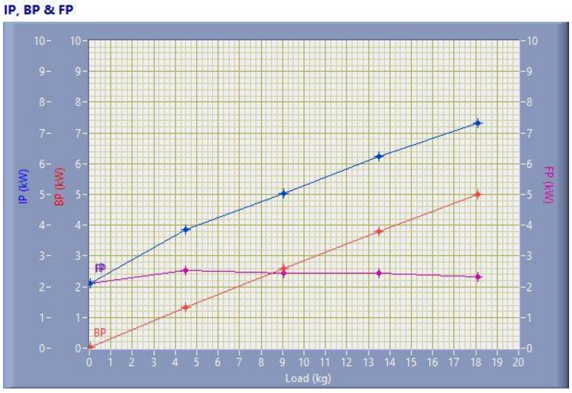


Graph 7 B10 -90% Diesel

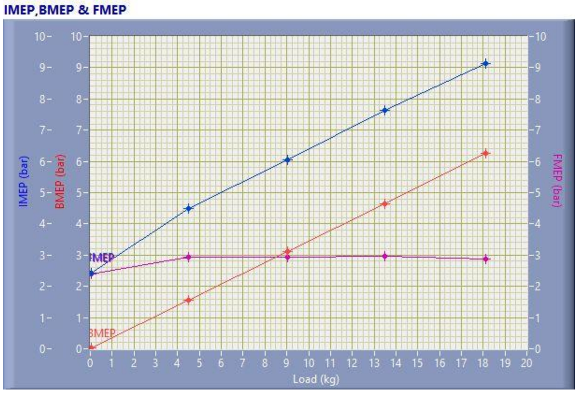
Graph 8 B10 -90% Diesel

Graph 9 represents the Blend 20 (80%Diesel and 20% IAA) , loads (0 to 18kg) and IP,BP& FP are recorded as shown. Here the load at 18kg with a constant speed of 1500rpm IP,BP were increased and FP is decreased.

Graph 10 represents the Blend 20 (80%Diesel and 20% IAA), loads (0 to 18kg) and IMEP,BMEP& FMEP are recorded as shown. IMEP and BMEP were increased at a load of 18kg with constant speed of 1500r.p.m and FMEP is decreased. Lower values are recorded at 0 & 2kg.

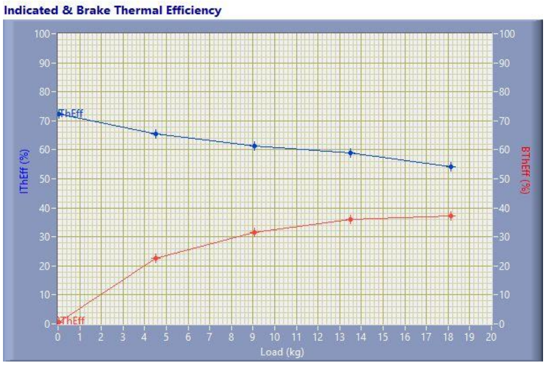


Graph 9 B20 -80% Diesel

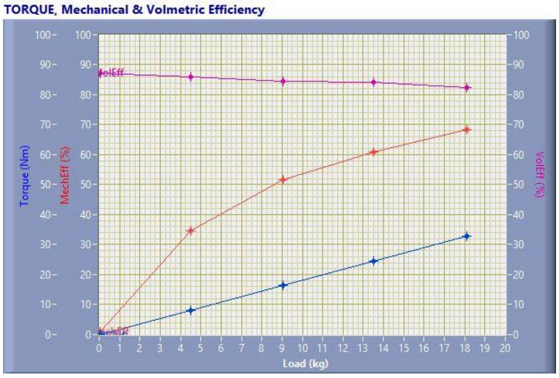


Graph 10 B20 -80% Diesel

Graph 11 represents the Blend 20 (80%Diesel and 20% IAA), loads (0 to 18kg) and Indicated and Brake Thermal Efficiency are recorded as shown. Loads at 18kg Brake Thermal Efficiency were increased and indicated Thermal Efficiency is decreasing. Graph 12 represents the Blend 20 (80%Diesel and 20% IAA), load (0 to 18kg) and Mechanical and Volumetric efficiency are recorded as shown. load at 18kg Torque and Mechanical efficiency were increased and Volumetric efficiency is decreasing.



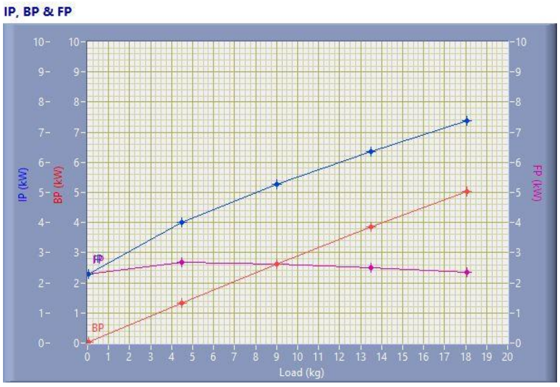
Graph 11 B20 -80% Diesel



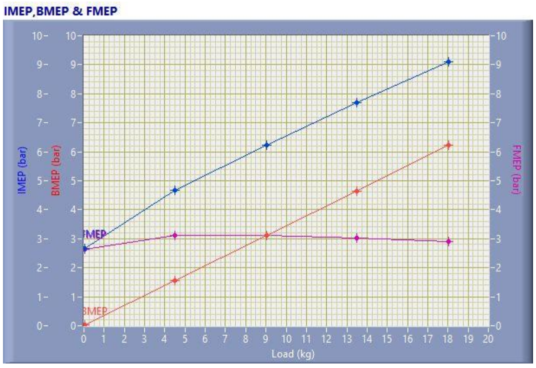
Graph 12 B20 -80% Diesel

Graph 13 represents the Blend 30 (70%Diesel and 30% IAA) , loads (0 to 18kg) and IP,BP& FP are recorded as shown. Here the load at 18kg with a constant speed of 1500rpm IP,BP were increased and FP is decreased.

Graph 14 represents the Blend 30 (70%Diesel and 30% IAA), loads (0 to 18kg) and IMEP,BMEP& FMEP are recorded as shown. IMEP and BMEP were increased at a load of 18kg with constant speed of 1500r.p.m and FMEP is decreased. Lower values are recorded at 0 & 2kg.



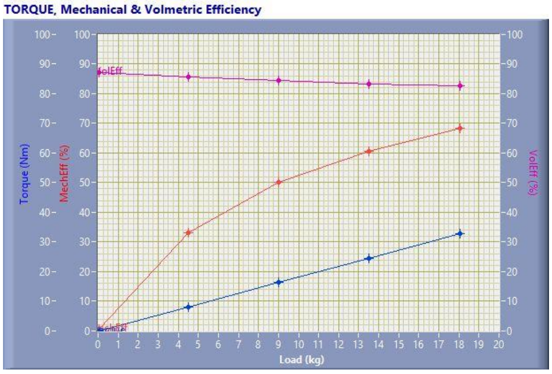
Graph 13 B30 -70% Diesel



Graph14 B30 -70% Diesel

Graph 15 represents the Blend 30 (70%Diesel and 30% IAA), loads (0 to 18kg) and Indicated and Brake Thermal Efficiency are recorded as shown. Loads at 18kg Brake Thermal Efficiency were increased and indicated Thermal Efficiency is decreasing. Graph 16 represents the Blend 30 (70%Diesel and 30% IAA), load (0 to 18kg) and Mechanical and Volumetric efficiency are recorded as shown. load at 18kg Torque and Mechanical efficiency were increased and Volumetric efficiency is decreasing.

Graph 15 B30 -70% Diesel



Graph 16 B30 -70% Diesel

V. Conclusions

In this experimentation , It is concluded that Impact of IAA Proportions on HCCI Engine to Analyse Performance Characteristics

- It is observed that Maximum BP is obtained at B30 blend achieved highest value of 5.03kW due to Maximum torque of 32.89 Nm where as the minimum value of 0.02kw is obtained in all cases(B0,B10 & B20).
- It is also observed that for Maximum IP is obtained at B30 blend with a highest value of 7.38 kW due the calorific value of 243.2 J/K /MOLE, where as the minimum value of 2.12 kw is obtained at B20.
- It is observed that Maximum Mech. efficiency is occurred at 68.38% B20 against maximum load of 18 kg and lower occurred at 0.70% at B30.
- It is observed that Maximum Brake Thermal efficiency (38.92%) is occurred B30 against a load 18 kg where as the lowest value (0.41%) against B0.
- It is observed that Maximum Indicated Brake Thermal Efficiency (38.92 %) against B30, where as the lowest value (0.41%) at maximum load of 0kg.

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