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IMPACT OF HCCI ENGINE EFFECT ON SOYABEAN OIL BLENDS TO ANALYZE PERFORMANCE AND EMISSIONS CHARACTERSTICS WITH EGR

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ABSTRACT
The technology's objective is to deliver comfort and usefulness while inflicting no harm to the environment or the user. Fossil fuels have afforded us with comfort and usefulness in a number of sectors for many years, but they also produce environmental concerns that endanger natural and human life. The work is done with a single cylinder four stroke C.I engine at CS and altering loads with varied amounts of blends (B5, B10, B15, B20). An eddy current dynamometer is fitted to the engine. Several tests were undertaken in order to enhance the performance of an engine.As a result, engine performance metrics were enhanced in various proportions, while emissions were lowered in various proportions. The results agreed quite well with the known theoretical and experimental values of other investigators.

Keywords: SBO, HCCI, Proportions, Emissions, CI engines.

1. Introduction

Now a days Oil reserves are depleting very fast because of population increases then consumption of fuel increases but the problem with fossil fuels is detrimental effect of exhaust fumes causes human health and the environment, to eliminate this majority researchers concentrate on renewable energy resources. The ongoing GHG emissions of fossil fuels into the environment have a huge impact on global warming. The depletion times of different FF are set on the high reducing rates that occur in FF it has been projected that oil deposits will be exhausted in around 34 years. According to these characteristics, researchers began looking for alternative fuels that are more convenient, affordable, and ecologically acceptable than existing fossil liquid fuels. Biodiesel fuel seems attractive for the future because of their resemblance to diesel fuel. BD is the generic term for fatty acid methyl esterswith some of the vegetable or animal oils. Biodiesel fuelsqualities arezero toxicity, superior lubrication qualities, lesser pollutants than diesel engine exhaust fumes. Biodiesel fuel reduces Carbon monoxide and Hydrocarbons emissions.There have been several research published on the effects of BD fuel blends derived from variousVO and animal oils on performance and combustion in CI engines.

Because of their biodegradability and non-toxicity, biofuels are alcohols and BD have been recommended as replacements to IC engine DO. These fuels have gotten a lot of interest since they dramatically decrease exhaust fumes when used as fuel.Oil costs have quadrupled, resulting in a global energy catastrophe. As a result, the prices of various commercial energy sources increased, resulting in worldwide inflation. As a result, the quest for alternative renewable fuels is necessary. Because their properties are comparable to those of normal diesel oil, the most acceptable alternative types of fuel for DE may be chosen VOor animal fat. A variety of plants produce oils that may be utilized in IC engines. SBO is a vegetable oil derived from soya bean seeds.Processed SBO is used as a foundation for oil paintings as a drying oil. The fossil fuels very hazardous to environment and human health these fuels are releases dangerous emissions these increases the temperature of the globe for this reason humans cannot live in the earth and also pollute the water and soil also spoiled because of these fumes. To eliminate these types of problems now a days the best fuels are Biodiesels. These fuels are release very less pollutants then we overcome the global warming. The Soyabean oil along with diesel is selected and used as a BD fuel in DE with a constant speed by changing the blends.

2 .Literature Survey

R.J et al. (2005) conducted an experimental study on a CI Engine powered by Biodiesels. This study demonstrated the availability and combustion qualities of sunflower oil and maize oil. Sunflower and maize methyl esters have been discovered to be an extremely successful means of removing virtually all of the unwanted combustion characteristics of vegetable oils. SFO Methyl Esters and MO Methyl Esters were created, with less viscosity, high heat content, and density similar to DO.

Tamil et al investigated the performance, emission, and combustion characteristics of a one-cylindersteady speed, direct injection DE with a methyl ester of SFO blend as an AF and compared the findings to regular DO operation.

Mustafa et al analyse the effects of BD derived from high free fatty acid feed stocks on engine performance and emissions. Two types of biodiesels were created: one from animal fat-based yellow grease with 9 percent free fatty acids and one from SBO.

Nomenclature

AFR	Air fuel ratio	IC	Internal Combustion
SBO	Soyabean Oil	SFC	Specific Fuel Consumption
FF	Fossil Fuel	ME	Mechanical efficiency
ITE	Indicated Thermal Efficiency	VE	Volumetric efficiency
CO_2	Carbon dioxide	IP	Injection Pressure
AIT	Air Intake Temperature	MFG	Manufacturing
NO_x	Nitrogen Oxides	HCCI	HomogeneousCharge Compression Ignition
O_2	Oxygen	BTE	Brake Thermal Efficiency
EC	Eddy Current	HC	Hydro Carbons
EGR	Exhaust gas recirculation	SI	Spark Ignition
HB	Heat Balance	FC	Fuel Consumption
DE	Diesel Engine	BD	Bio Diesel
CI	Compression Ignition	DO	Diesel Oil
AF	Alternative Fuel	SFO	Sun Flower Oil
MO	Maize Oil	VO	Vegetable Oil
CS	Constant Speed	ECD	Eddy Current Dynamometer

3. Methodology

Choosing a Research Engine test configuration Homogeneous Charge Compression Ignition engine, one cylinder, 4 stroke, multi-fuel.

The idea is to examine the performance and emissions of SOYABEAN OIL (SBO)taking the following HCCI research engine.

Objective 1- The fuels used in this investigation are diesel, Soybean and nano additive as a Al_2O_3. Engine Make Kirloskar $TV_1$is a research engine which is used to test the various blends on different fuel mixtures, to reduce the emissions.

Objective 2- By changing the blend ratio, Compression ratio, Constant speed (RPM), changing loads from (20%, 40%, 60%, 80% and 100%) finding the emissions and performance Characteristic's from range of Blends (B5, B10, B15 and B20).

Objective 3- Each and every finding from each blend is to reduce the NO_x and Co emissions, at the same time the best performance and combustion characteristics has been found and friction power has been reduced in this investigation.

Objective 4- Total Number of Observations = CR x Blend x RPM x Load = (1 X 4 X 1 X 5) = 20.

4. Experimental Procedure

For this experiment, a Kirloskar TV1 diesel engine is used in this method and HCCI mode is preferred. Engine Control Unit helps in different manner like variation of loads and also different proportions of blends to the engine.

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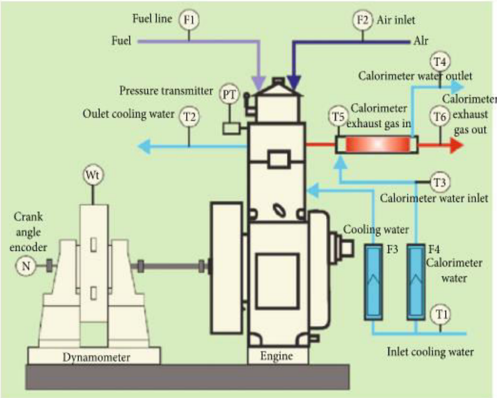

Fig 1 Engine Configuration Diagram

Fig 2 Engine test setup

Experiment information were documented, and the experiment was carried out at Apex Laboratories in Kanchipuram, Tamil Nadu.

Table 1Experiment Setup Specifications

MFG 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 With5500 RPM
TS	RTD	Thermocouple	K Type
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

The aim of fuel properties is to measure in SBO and diesel displays fuel features in a variety of ways.

Table 2 Fuel Properties

Properties	**Diesel**	**Soyabean Biodiesel**
Specific Gravity	0.825	0.78
Kinematic Viscosity at 40^{o}C	4.35	5.16
Flash Point (degree celsius)	42.5	166.5
Low Heating Value (Mj/Kg)	42	38.89
Acid Value (mgKOH/g of oil)	0.04	1.9
Fire Point (degree celsius)	67	193
Cetane Index	46	47.5

The current information is recorded based on our experiments and it is required to determine the capacity, range, speed, and oil temp.

Table 3 Range/Accuracy/Resolution

	OPACITY	ABSORPTION	RPM	OIL TEMP
Measuring range	0-100%	0-99.99 1/m	400-6000 1/min	0-150^{o}C
Accuracy & Repeatability	±1% of full scale	Better than ± 0.10 1/m	±10	±2^{o}C
Resolution	0.1%	0.001 1/m	±1	±1^{o}C

5. Results and Discussion

The performance of these studies have been noted, and they were produced and simulated using the IC Engine soft.

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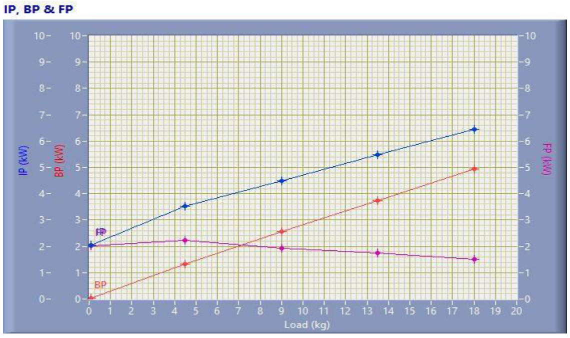
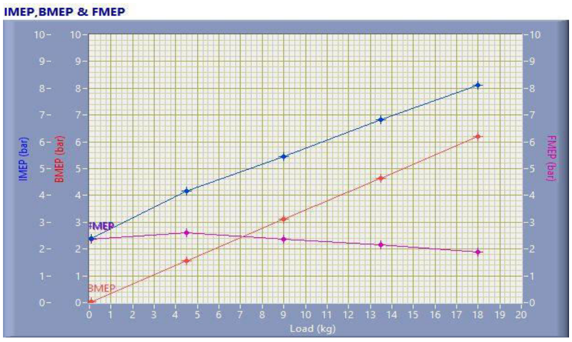


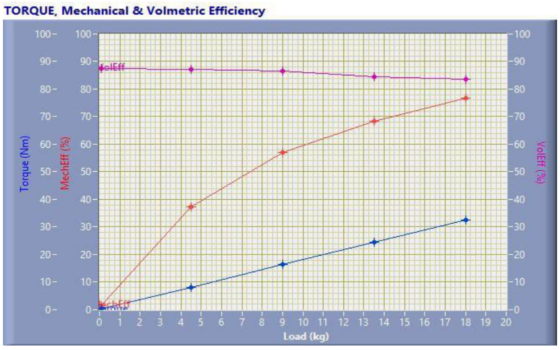
Graph 1 Load Vs IP, BP&FP



Graph 2 Load Vs IMEP, BMEP&FMEP

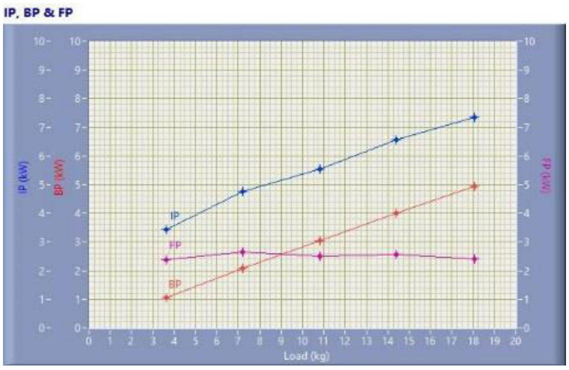
Graph 1 shows the B0 (100 percent Diesel), loads (0 to 18kg) and IP, BP, and FP readings. Here, the load is 3.6kg with a CS of 1500rpm, hence IP, BP are raised but FP is reduced. Graph 2 shows the B0 (100 percent Diesel), loads (0 to 18kg) and IMEP, BMEP, and FMEP readings. At a load of 3.6kg at a CS of 1500r.p.m, IMEP and BMEP were raised, but FMEP was lowered.

Graph 3Load Vs ITE&BTE

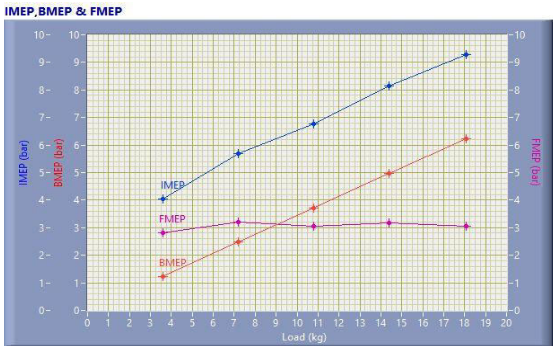


Graph 4 Load vs Torque, ME&VE

Graph 3 shows the B0 (100 percent Diesel), loads (0 to 18kg) and indicated and brake TE. With a steady speed of 1500r.p.m, ITE was raised to 3.6kg while BTE was reduced to 3.6kg.Graph 4 shows the B0 (100 percent Diesel), weights (0 to 18kg) and Torque, ME & VE. Torque and ME rise at a load of 18kg and a CS of 1500r.p.m, whereas Volumetric Efficiency dropped.

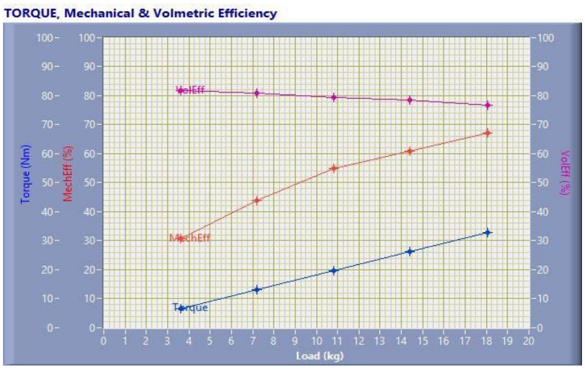


Load Vs IP, BP&FP

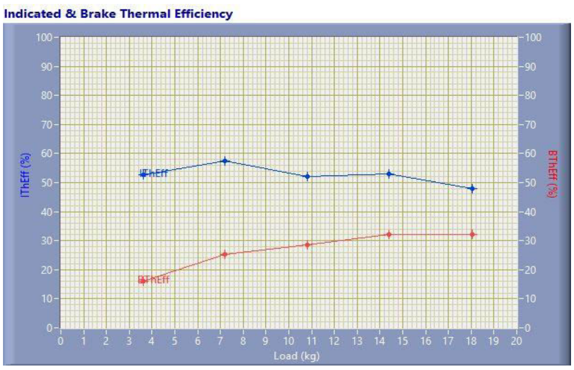


Graph 6 Load Vs IMEP, BMEP&FMEP

Graph 5 shows the Blend 5 (95 percent Diesel and 5 percent SBO), loads (0 to 18kg), and IP, BP, and FP readings. Here, the load is 3.6kg with a CS of 1500rpm, hence IP, BP are raised but FP is reduced.Graph 6 shows the Blend 5 (95 percent Diesel and 5 percent SBO), loads (0 to 18kg), and IMEP, BMEP, and FMEP readings. At a load of 3.6kg at a CS of 1500r.p.m, IMEP and BMEP were raised, but FMEP was lowered.

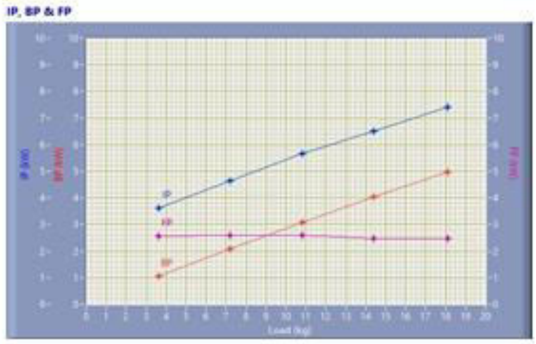


Graph 7 Load Vs ITE&BTE

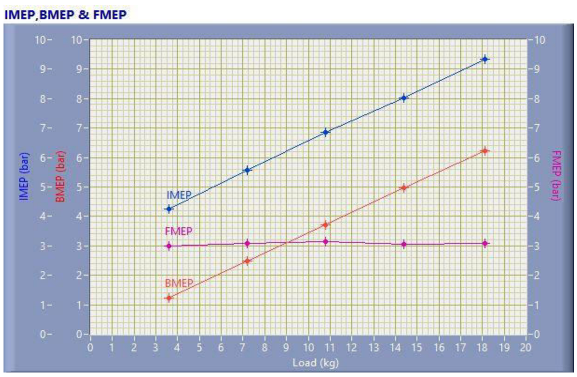


Graph 8 Load vs Torque, ME&VE

Graph 7 shows the Blend 5 (95 percent Diesel and 5 percent SBO), loads (0 to 18kg), and I&BTE. With a steady speed of 1500r.p.m., ITE was raised to 7.2kg while BTE was reduced to 3.6kg.Graph 8 shows the Blend 5 (95 percent Diesel and 5 percent SBO), weights (0 to 18kg), and Torque, Mechanical, and Volumetric Efficiency. Torque and Mechanical Efficiency rose at a load of 18kg and a constant speed of 1500r.p.m, whereas Volumetric Efficiency dropped.



Graph 9 Load Vs IP, BP&FP



Graph 10 Load Vs IMEP, BMEP&FMEP

Graph 9 shows the B10 (90 percent Diesel 10% SBO), loads (0 to 18kg), and IP, BP, and FP values. Here, the load is 18kg with a CS of 1500rpm, hence IP, BP, and FP are raised but FP is dropped.Graph 10 shows the B10 (90 percent Diesel and 10% SBO), loads (0 to 18kg), and IMEP, BMEP, and FMEP measurements. At a load of 3.6kg at a CS of

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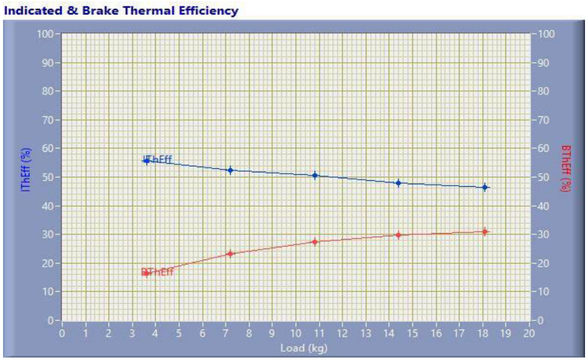
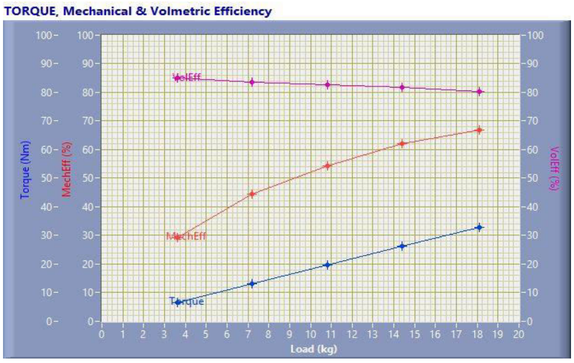
1500r.p.m, IMEP and BMEP were raised, but FMEP was lowered.

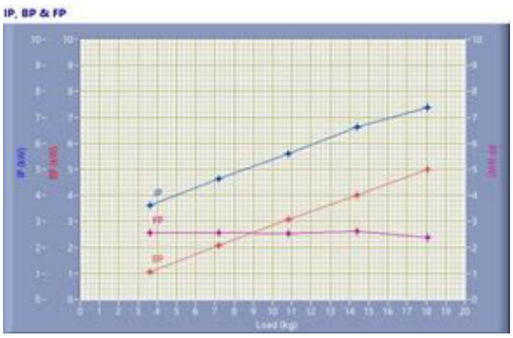


Graph 11 Load Vs ITE&BTE

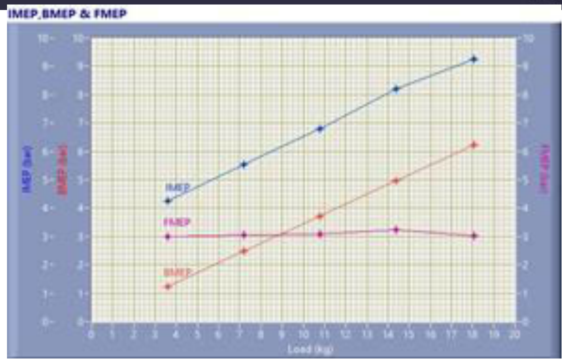


Graph 12 Load vs Torque, ME&VE

Graph 11 shows the B10 (90 percent Diesel and 10 percent SBO), loads (0 to 18kg), and indicated and brake TE. ITE was raised at 3.6kg load and BTE was lowered at 3.6kg load at a CS of 1500r.p.m.Graph 12 depicts the B10 (90 percent Diesel and 10percent SBO), weights (0 to 18kg), and Torque, ME & VE. Torque and Mechanical Efficiency raised at a load of 18kg and a CS of 1500r.p.m, whereas Volumetric Efficiency dropped.



Graph 13 Load Vs IP, BP&FP



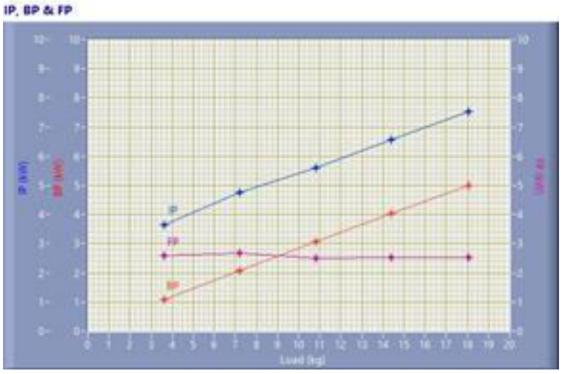
Graph 14 Load Vs IMEP, BMEP&FMEP

Graph 13 depicts the Blend 15 (85percent Diesel and 15percent SBO), loads (0 to 18kg), and IP, BP, and FP readings. Here, the load is 18kg with a CS of 1500rpm, therefore IP, BP are raised but FP is lowered. Graph 14 depicts the Blend 15 (85% Diesel and 15% SBO), loads (0 to 18kg), and IMEP, BMEP, and FMEP readings. At a load of 3.6kg at a CS of 1500r.p.m, IMEP and BMEP were raised, but FMEP was lowered.

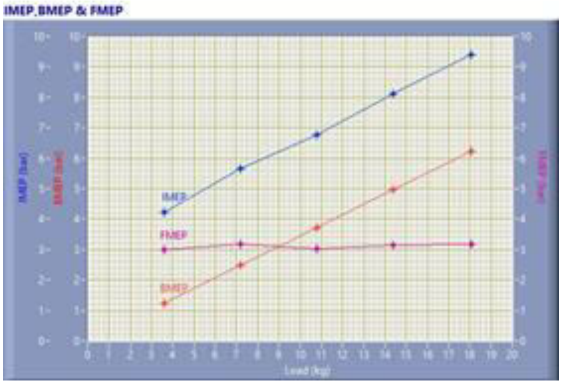
Graph 15 Load Vs ITE&BTE

Graph 16 Load vs Torque, ME&VE

Graph 15 shows the B15 (85 percent Diesel and 15 percent SBO), loads (0 to 18kg), and indicated and brake TE. ITE was raised with a load of 3.6kg, whereas BTE was lowered at a CS of 1500r.p.m.Graph 16 depicts the B15 (85 percent Diesel and 15 percent SBO), weights (0 to 18kg), and Torque, Mechanical, and Volumetric Efficiency. Torque and Mechanical Efficiency raised at a load of 18kg and a CS of 1500r.p.m, whereas Volumetric Efficiency reduced.



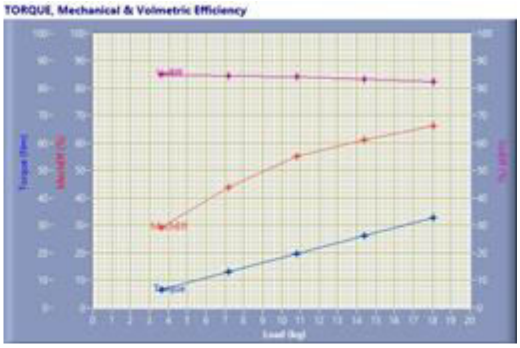
Graph 17 Load Vs IP, BP&FP



Graph 18 Load Vs IMEP, BMEP&FMEP

Graph 17 depicts the B20 (80percent Diesel and 20percent SBO), loads (0 to 18kg), and IP, BP, and FP readings. Here, the load is 10.8kg with a CS of 1500rpm, therefore IP, BP are raised but FP is lowered.Graph 18 depicts the B20 (80percentDiesel and 20percent SBO), loads (0 to 18kg), and IMEP, BMEP, and FMEP readings. At a load of 3.6kg at a CS of 1500r.p.m, IMEP and BMEP were raised, but FMEP was lowered.

Graph 19 Load Vs ITE&BTE



Graph 20 Load vs Torque, ME&VE

Graph 19 depicts the B20 (80 percent Diesel and 20 percent SBO), loads (0 to 18kg), and indicated and brake TE. ITE was raised with a load of 3.6kg, whereas BTE was lowered at a CS of 1500r.p.m.Graph 20 shows the B20 (80 percent Diesel and 20percent SBO), loads (0 to 18kg), and Torque, ME & VE. Torque and Mechanical Efficiency raised at a load of 18kg and a CS of 1500r.p.m, whereas Volumetric Efficiency dropped.

6. Conclusions

It is determined from this experiment that the Effect of SBO Proportions on HCCI Engine to Examine Performance Characteristics,

- As compare to B0, Maximum BP is reached at B20 with a Max. of 4.98 kW owing to Max. torque of 32.84 Nm at 18kg Load, whilst the Min. value of 1.05kw is attained in B5. Max. IP is acquired at B20 with a Max. of 7.52 kW, whereas the Min. value of 3.43 kw is attained in B5.

- Max. Mech.Efficiency is recorded at B5 over Max. load of 18 kg and Minimum at B10 is 29.29 % and Max. Vol.Efficiency is recorded at B5 over Min. load of 3.6kg and Min. at B10 is 80.19 % over 18kg load.
- Max. Brake Thermal Efficiency is found to be 32.29 % over a weight of 14.4 kg, with the lowest value 16.15 % against B5 at 3.6kg and Max. Indicated Brake Thermal Efficiency 57.46 % against a load of 7.2kg, with the lowest value 45.59 % against a load of 18kg.
- It is noticed that Fuel Consumption is Max. at B20 at load of 18kg is 1.43 whilst Min. at all blends is 0.56 and SFC is Max. at B5, B10, B15 at a load of 3.6kg is 0.53 whereas Min. at B5 at a load of 14.4kg is 0.26.

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