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# Experimental Study of Performance Parameters of Newly Commissioned I. C. Engine

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***Abstract :** This paper reports the findings of an experimental study pertaining to the Performance parameters of newly commissioned internal combustion, single cylinder, diesel engine. All performance parameter studied are indicated horse power, brake horse, friction horse power, air fuel ratio and specific fuel consumption. These parameters were measured when engine rpm maintained at 1500. Results obtained are within limits.*

**Keywords:** *Diesel engine, efficiency, horse power and specific fuel consumption.*

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## 1. INTRODUCTION

There are continuous efforts made to develop internal combustion engine (ICE) technologies that consume less fuel and more environmentally. The basic step in developing efficient and environmentally ICEs is to ensure that the parameters affecting the combustion in-cylinder. There are many paramount parameters like fuel consumption, emissions and noise, and performance parameters. In this study the factorial design method of optimization which examines the parameters, engine speed, load, and fuel temperature. It has been found that the engine speed, load, and fuel temperature significantly influence ignition delay in different sizes [1]. Experimentally measured, analyzed the performance and emissions of an internal combustion engine (ICE). Engine fuelled with two different bio-diesels. An experiment performed according to ISO 8178 standard and results compared with that of the petroleum diesel. This study indicates that the two major pollutant gas emissions are generally reduced when using bio-diesel, therefore bio-diesel can be considered to be a more environmentally friendly [2]. The relationship between frequency information of vibration acceleration and characteristics parameters of combustion like peak combustion pressure and peak pressure rise rate was analyzed based on the results of the single-cylinder diesel engine. It was concluded that there existed a good linear relationship between the summation of frequency amplitude in the selected frequency range and the characteristics parameters. [3]. Biodiesel (20%)-methanol (5%)-diesel (75%), biodiesel (20%)-methanol (10%)-diesel (70%), biodiesel (20%)- diesel (80%), and standard mineral diesel as a baseline fuel are tested in a multi-cylinder diesel engine. Those biodiesel-alcohol low proportion blends are investigated under the same operating conditions at 20%, 40% and 60% of engine loads to determine the engine performance and emission of the diesel engine. As methanol proportions in blends increase, NO emissions increase, while CO emissions are reduced [4]. In this work, authors investigated the engine performance parameters and emissions characteristics for direct injection diesel engine using coconut biodiesel blends without any engine modifications using three fuel sample. A decrease in torque and brake power, while the increase in specific fuel consumption has been observed for biodiesel blended fuels over the entire speed range compared to net diesel fuel [5]. An engine combustion model was developed using computational fluid dynamics (CFD) software, AVL Fire, which can predict the engine performance and emission characteristics for second generation biodiesel produced from Australian native beauty leaf seed (BLS). The simulation results revealed that overall B10 biodiesel provides better performance and efficiency, and significantly reduced engine emissions [6]. The aim of this review paper was to discuss the effect of mixed blends of biodiesel alcohol and diesel on engine performance and emission parameters of a diesel engine. Most of the researchers reported that adding ethanol into biodiesel-diesel blend in diesel engines significantly reduce HC, PM, NOx and smoke emissions but slightly increase fuel consumption [7, 19]. Authors developed a novel fuel blend by adding carbon coated aluminium into diesel. Nanoparticles are blended with diesel in terms of different mass ratios, which are used for optimal selection. Thermo-physical properties of fuel blends are investigated at different testing temperatures. Series of experimental tests are conducted by using a heavy duty engine at 1810 rpm speed, brake specific fuel consumption is in the range from 0.1 kg·kWh−1 to 0.41 kg·kWh−1. The maximum emission reduction by using novel fuel blend could reach 16.7%, 48.8% and 33.5% in terms of nitrogen oxides, hydrocarbon compound and carbon monoxide. [8, 14]. Authors produced

Castor Methyl Ester (CME) Egyptian by using Castor raw oil to biodiesel by trans esterification-ultrasonic process. CME was blended with the conventional diesel fuel for improving sooting tendency and fuel viscosity. Thermal analysis showed that CME has comparable end-boiling temperature and fuel-air mixing of the diesel fuel. The results conclude that the 20% blending ratio is recommended to keep high engine efficiency without environmental deterioration [9, 13]. Researchers focused on to provide a comprehensive understanding of back pressure effects on marine diesel engine performance, and to identify limits of acceptable back pressure along with methods to tackle high back pressure. They tested a pulse turbocharged, medium speed, diesel engine, at different loads and engine speeds; against different values of static back pressure. A combination of pulse turbocharger systems and small valve overlap showed to significantly improve back pressure handling capabilities of engines [10]. Researchers investigated effects of hydrogen addition on a diesel engine in terms of engine performance and emissions for four cylinders, water cooled diesel engine. Hydrogen effects on the diesel engine were investigated with different amount at different engine load and the constant speed, 1800 rpm. Results shown when hydrogen amount is increased for all engine loads, an increase in brake specific fuel consumption and brake thermal efficiency due to mixture formation and higher flame speed of hydrogen gas. For the 0.80 lpm hydrogen addition, exhaust temperature and NOx increased at higher loads. CO, UHC and SOOT emissions significantly decreased for hydrogen gas as additional fuel at all loads. [11, 15].

The present investigation evaluates Mahua oil, Rape seed oil, Mange seed oil blended with Ethanol as a fuel in C I engine. A Twin cylinder C I engine was used to study the brake thermal efficiency, brake specific energy consumption, and emissions with the fuel of Mahua oil, Rape seed oil, Mange seed oil blended with Ethanol. Experimental results of Mahua oil, Rape seed oil, Mange seed oil blended with Ethanol and Diesel fuel are also compared [12, 16-18]

## 2. PERFORMANCE PARAMETERS:

*Performance Parameters are as Follows*:

Brake power (BP), Frictional power (FP), Torque, Brake mean effective pressure (BMEP), Frictional mean effective pressure (FMEP) , Brake thermal efficiency (BTEF), Indicated thermal efficiency (ITEF), Frictional thermal efficiency (FTEF), Mechanical Efficiency (MEF), Volumetric Efficiency (VEF), Air Flow, Fuel Flow, Brake specific fuel consumption (BSFC), Air Fuel Ratio (AFR), Heat Equivalent to Brake Power (HBP), Heat in Jacket Cooling Water (H JW), Heat in Exhaust Gas (H Gas), Heat to Radiation (H Rad).

## 3. INTERNAL COMBUSTION ENGINE SETUP DETAILS:

Type of Engine: Diesel Engine
Power: 3.50 kW
Speed: 1500 rpm. (Constant speed)
No. of cylinder: 1 Cylinder,
No. Strokes: Four,
Cylinder Bore: 87.50(mm),
Stroke Length 110.00(mm),
Compression Ratio 18.00,

## 4. RESULT AND DISCUSSIONS:

4.1 Data pertaining to IP, BP & FP obtained has been tabulated as in the following table 1 and plotted in the following graphs (Figure 1) :

Table: 1

| Speed (rpm) | Load (kg) | IP (kW) | BP (kW) | FP (kW) |
|---|---|---|---|---|
| 1499.00 | 1.37 | 3.25 | 0.39 | 2.86 |
| 1503.00 | 2.86 | 3.61 | 0.82 | 2.80 |
| 1504.00 | 3.32 | 3.62 | 0.95 | 2.67 |

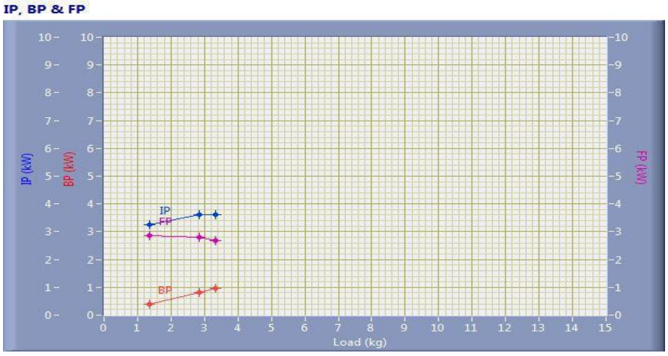

Fig. 1 IP, BP, and FP

4.2 Data pertaining to IMEP, BMEP & FMEP obtained has been tabulated as in the following table 2 and plotted in the following graphs (figure 2) :

Table: 2

| Speed (rpm) | Load (kg) | IMEP (bar) | BMEP(bar) | FMEP (bar) |
|---|---|---|---|---|
| 1499.00 | 1.37 | 3.93 | 0.47 | 3.46 |
| 1503.00 | 2.86 | 4.36 | 0.98 | 3.38 |
| 1504.00 | 3.32 | 4.36 | 1.15 | 3.22 |

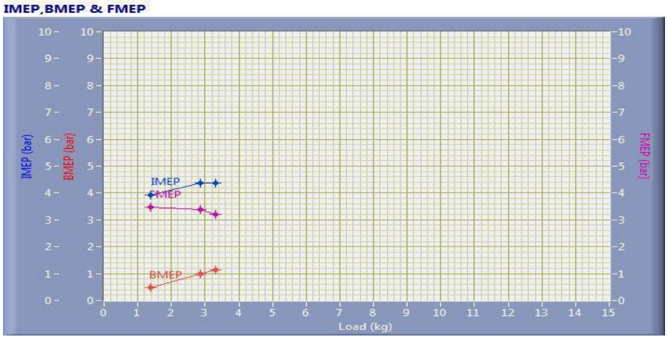

Fig. 2 IMEP,BMEP & FMEP

4.3 Data pertaining to Air & Fuel Flow obtained has been tabulated as in the following table 3 and plotted in the following graphs (figure 3):

Table: 3

| Speed(rpm) | Load (kg) | Air (mm WC) | Fuel (cc/min) |
|---|---|---|---|
| 1499.00 | 1.37 | 69.85 | 10.00 |
| 1503.00 | 2.86 | 68.90 | 12.00 |
| 1504.00 | 3.32 | 68.77 | 0.00 |

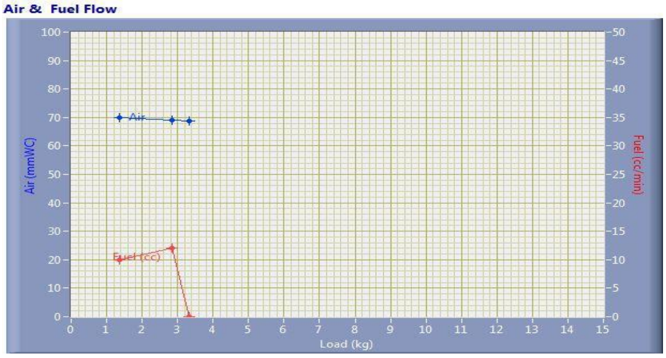

Fig. 3 Air & Fuel Flow

4.4 Data pertaining to Indicated & Brake Thermal Efficiency obtained has been tabulated as in the following table 4 and plotted in the following graphs (Figure 4):

Table: 4

| Speed (rpm) | Load (kg) | ITh Eff (%) | BTh Eff (%) |
|---|---|---|---|
| 1499.00 | 1.37 | 55.95 | 6.70 |
| 1503.00 | 2.86 | 51.83 | 11.70 |
| 1504.00 | 3.32 | 0.00 | 0.00 |

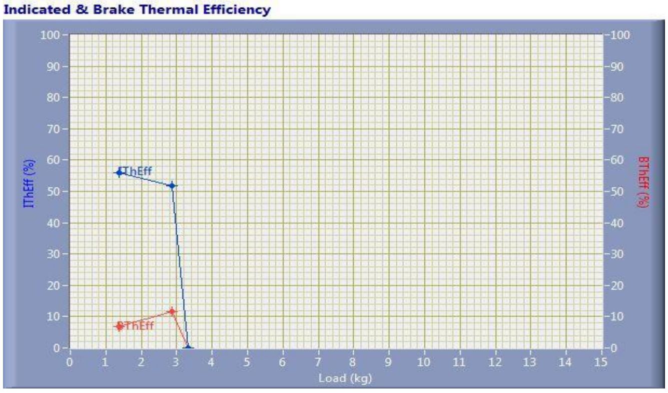

Fig. 4 Indicated and Brake thermal efficiency

4.5 Data pertaining to SFC & Fuel consumption obtained has been tabulated as in the following table 5 and plotted in the following graphs (Figure 5):

Table: 5

| Speed (rpm) | Load (kg) | SFC (kg/kWh) | Fuel (kg/h) |
|---|---|---|---|
| 1499.00 | 1.37 | 1.28 | 0.50 |
| 1503.00 | 2.86 | 0.73 | 0.60 |
| 1504.00 | 3.32 | 0.00 | 0.00 |

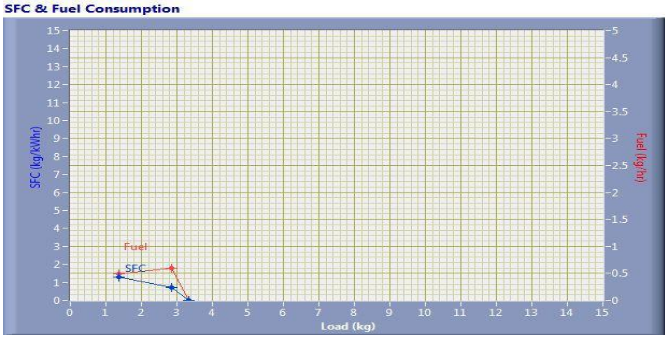

Fig. 5 SFC and Fuel Consumption

## 5. RESULT DATA:

| Torque (Nm) | BP (kW) | FP (kW) | IP (kW) | BMEP (bar) | IMEP (bar) | BTHE (%) | ITHE (%) | Mech Eff. (%) |
|---|---|---|---|---|---|---|---|---|
| 2.48 | 0.39 | 2.86 | 3.25 | 0.47 | 3.93 | 6.70 | 55.95 | 11.98 |
| 5.18 | 0.82 | 2.80 | 3.61 | 0.98 | 4.36 | 11.70 | 51.83 | 22.58 |
| 6.03 | 0.95 | 2.67 | 3.62 | 1.15 | 4.36 | 0.00 | 0.00 | 26.27 |

| Air Flow (kg/h) | Fuel Flow (kg/h) | SFC (kg/kWh) | Vol Eff. (%) | A/F Ratio | HBP (%) | H JW (%) | H Gas (%) | HRad (%) |
|---|---|---|---|---|---|---|---|---|
| 27.22 | 0.50 | 1.28 | 77.95 | 54.65 | 6.70 | 40.05 | 24.91 | 28.34 |
| 27.03 | 0.60 | 0.73 | 77.21 | 45.24 | 11.70 | 38.29 | 23.65 | 26.35 |
| 27.01 | 0.00 | 0.00 | 77.08 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |

## 6. CONCLUSION

It is concluded that indicated power and brake power increases with an increase in load when operating almost at constant rpm. But friction power decreases with increasing load when operating almost at constant rpm.

It is concluded that indicated mean effective pressure and brake mean effective pressure increases with an increase in load when operating almost at constant rpm.

But friction means effective pressure decreases with increasing load when operating almost at constant rpm.

It is concluded that Air flow decreases with increase in load when operating almost at constant rpm. Fuel flow increases with increase in load when operating almost at constant rpm.

It is concluded that indicated thermal efficiency decreases with the increase in load when operating almost at constant rpm. Brake thermal efficiency increases with increase in load when operating almost at constant rpm.

It is concluded that specific fuel consumption decreases with increase in load when operating almost at constant rpm. Fuel in kg/h increases with increase in load when operating almost at constant rpm.

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