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A Study on Performance and Noise Analysis of 4 Stroke 4 Cylinder Diesel Engine

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ABSTRACT

In our modern world, rapidly growing environment one of the developing problems is that of "Noise". This has lead to overcrowded or jammed roads and noise pollution. Engine noise is one of the major sources of noise in vehicles. So, it is necessary to study noise generated by four stroke four cylinder diesel engine at different loads. First the sound pressure level is measure in dB(A) near the engine at four different locations at distance of 1.5m from centre of each side of an engine to find out that location where sound pressure level is maximum. Sound power is calculated using rectangular parallelepiped at different loads. Frequency spectrum analysis is done to measure sound pressure level in 1-1 octave band.

Keywords : Specific Fuel, Specific Energy, Noise, Four Stroke Four Cylinder Diesel Engine

I. INTRODUCTION

1.1 Introduction

In our modern world, rapidly expanding environment one of the developing problems is that of noise. Apart from the pure annoyance factor of noise, exposure to an intense sound field over a long period of time presents the risk of permanent damage of hearing. This particular problem is becoming a source of serious concern to industrial corporations, trade unions and companies.

The object of this part is to discuss the concept of noise, problems of noise and its effect on man and environment both as annoyance and as a danger to health.

Noise: Noise is conveniently and concisely defined as "unwanted sound".

Sound: Sound waves are pressure variations produced as a result of mechanical Disturbance in a material medium.

Decibel: Decibel is the logarithm of a ratio of two quantities and therefore has no units. Decibel is defined by expression as $10 \log_{10} (P/P_O)^2$ P is the sound pressure amplitude of the measured sound
P0 is a reference pressure, 20μPa.

1.1.1Sources of Noise

Sources of noise may be either natural are manmade. Natural sources include thunderstorm, volcanic eruption, earthquake, etc. but the main sources of noise which lead to noise pollution are manmade sources. they include noise from automobiles, such as cars, buses, trucks, fire engines, trains, aeroplanes, noise from factories industries, noise from constructional equipments, and noise from domestic application such as food mixers, washing machines, exhaust fans, vacuum cleaner, dish washers, T.V., radio, musical instruments etc.

These sources can be divided into following categories

(a) Traffic noise
(b) Industrial noise
(c) Noise due to constructional equipments
(d) Noise due to domestic application

(a). Traffic Noise

This includes noise from automobiles rail and aircrafts. Noise from these sources includes noise produced by their engines, exhaust, horns and sirens. Traffic noise, actually is the main menace of noise.

(b). Industrial Noise

In industries, noise is the by product of energy conversion. High intensity noise produced by many machines which man has invented during his technological advancements.

(c). Noise Due to constructional Equipments

Heavy constructional Equipments used for building construction and infrastructure development produced heavy noise. They include welding generators, tower cranes, compressors, etc.

(d). Noise Due to Domestic Application

A number of domestic appliances are noise producers. A variety of appliances, e.g. food mixers, whistling kettles, electric drill, hand operated lawn mowers, vacuum cleaners are capable for generating noise levels to the tune of 77-91 db.

Out of above three parameters, the source that affects the most is Traffic noise. In traffic noise, almost 70% of noise is contributing by vehicle noise. Vehicle noise, mainly, arises from two parameters i.e. Engine noise and Tire noise. The major traffic noise is includes

1. Road Traffic Noise
2. Rail Traffic Noise
3. Air craft Noise

Road Traffic Noise

The noise generated from road traffic is the measure source of air pollution. Various source of noise pollution. Various sources of noise in a vehicle are its engine, transmission system, exhaust, horn, and sirens. The volume of traffic noise increases with the increase in traffic speed. For example a sports car produced 30 times more intense than a small passenger car. Traffic noise also depend upon the traffic density and the type and condition of vehicles. Heavy diesel vehicle such as trucks, busses, etc. are the noisiest vehicle on the road.

Rail Traffic Noise

Noise from rail traffic is not a serious as other traffic noises. The noise produced of lower frequency as compared to that of road traffic. Further the most of the railway tracks run through rural areas. The introduction of electric locomotive has also reduced rail traffic noise to great extent. The maximum impact of noise produced by train is felt by the buildings nearby the railway tracks. Hooting of train can rise noise level up to 130db which is much more higher than the permissible limits.

Aircraft Noise

Aircraft noise is causing much more discomfort than that from road traffic noise. The source of noise has been increased during recent year, especially closed to the international airports. Noise produced by aircraft is intermittent as compared to continuous noise from road traffic it is much more disturbing and harmful.

Further, advanced jet planes produced more intrinsic sound which can also damage hearing ability permanently.

1.2 Sound Sources

A distinction is made between three different types of sound sources:

1. Point source
2. Line source
3. Plane source

II. METHODS AND MATERIAL

2. C.I. ENGINE NOISE AND FUELS

2.1.1Performance Parameter of CI Engine

2.1.1 Indicated Thermal Efficiency

Indicated Thermal Efficiency is the ratio of energy in the indicated power ip , to the input fuel energy in appropriate units.

η_{ith} = indicated power[KJ/s] / energy in fuel per second [KJ/s]

= I P / (mass of fuel/s x calorific value of fuel)

= I P / (m_f x CV)

2.1.2 Brake Thermal Efficiency

Brake Thermal Efficiency is the ratio of energy in the brake power bp , to the input fuel energy in appropriate units.

η_{bth} = brake power [KJ/s] / energy in fuel per second [KJ/s]

= B P / (mass of fuel/s x calorific value of fuel)

= B P / (m_f x CV)

2.1.3. Mechanical Efficiency

Mechanical Efficiency is define as the ratio of brake power (delivered power) to the indicated power (power provided to the piston)

η_m = brake power / indicated power

= BP / (BP + FP)

Fractional power FP = IP - BP

It can also be defined as the ratio of the brake thermal efficiency to the indicated thermal efficiency.

η_m = brake thermal efficiency / indicated thermal efficiency

2.1.4. Volumetric efficiency

This isthe most important parameters which decides the performance of four stroke engines. Four stroke engine having distinct suction stroke and therefore the volumetric efficiency indicates the breathing ability of the engine. it is noted that the utilization of the air is what going to determine the power output f engine. Hence, an engine must able to take in as much air as possible.

Volumetric efficiency is defined as the volume flow rate of air into the intake system divided by the rate at which the volume is displaced by the system.

$\eta_v = m_a / (\rho_a V_{disp} N/2)$

where ρ_a is the inlet density

The normal range of volumetric efficiency for CI engine is between 85 to 90%.

2.1.5. Relative Efficiency or Efficiency Ratio (η_{rel})

Relative efficiency or efficiency ratio is the ratio of thermal efficiency of actual cycle to that of the ideal cycle. The efficiency ratio is a very useful criterion which indicates the degree of development of the engine.

η_{rel} = actual thermal efficiency / Air standard efficiency

2.1.6. Mean Effective Pressure (p_m)

Mean effective pressure is the average pressure inside the cylinder of an internal combustion engine based on the calculated or measured power output. It increases as manifold pressure increases. For an particular engine, operating at a given speed and power output, there will be a specific indicated mean effective pressure , imep, and corresponding brake mean effective pressure, bmep. They are derived from the indicated and brake power respectively. Indicated power can be define as

$IP = p_{im} L A n K / (60 x 1000)$

Then the indicated mean effective pressure can be written as

$p_{im} = 60000 x IP / (LAnK)$

Similarly the brake mean effective pressure can be given by

$p_{bm} = 60000 x BP / (LAnK)$

Another way of specifying the indicated mean effective pressure p_{im} is from the knowledge of engine indicator diagram (p-V diagram). In this case, p_{im} may defined as

p_{im} =Area of indicator diagram / length of the indicator diagram

where the length of indicator diagram is given by the difference between the total volume and the clearance volume.

2.1.7. Mean Piston Speed

An important parameter in engine application is the mean piston speed, S_p. it is define as

$S_p = 2LN$

where the L is the stroke and N is the rotational speed of the crankshaft in rpm. It may be noted that S_p is often a more appropriated parameter than crank rotational speed for correlating engine behavior as a function of speeds.

2.1.8. Specific Fuel Consumption (s f c)

The fuel consumption characteristics of an engine are generally expressed in terms of Specific Fuel Consumption in kilograms of fuel per kilowatt-hour. It is important parameter that reflect how good the engine performance is. It is inversely proportional to the thermal efficiency of the engine.

Sfc = fuel consumed per unit time / power

Brake Specific Fuel Consumption and indicated Specific Fuel Consumption, abbreviated as bsfc and isfc , are the Specific Fuel Consumption on the basis of BP and IP respectively.

2.1.8.1 Brake specific fuel consumption

Brake specific fuel consumption is defined as ratio of fuel consumed per unit time per unit brake power

bsfc = fuel consumed per unit time / brake power

2.1.8.2 Indicated specific fuel consumption

Indicated specific fuel consumption is defined as ratio of fuel consumed per unit time per unit indicated power

isfc = fuel consumed per unit time / power

2.1.9. Calorific Value (CV)

Calorific Value of the fuel is the thermal energy released per unit quantity of the fuel when the fuel is burned completely and products of combustion are cooled back to the initial temperature of the combustible mixture. Other terms used for the calorific value are heating value and heat of combustion.

When the products of combustion are cooled to 25 ° C practically al the water vapour resulting from the combustion process is condensed. The heating value so obtained is called the higher value or gross calorific value of fuel. The lower or net calorific value is the heat released when the water vapour in the products of combustion is not condensed and remains in the vapour form

2.1.10. Specific Power Output

Specific Power Output of an engine is defined as the power output per unit piston area and is a measure of the engine designer success in using the available piston area regardless of cylinder size. The specific power can be shown to be proportional to the mean effective pressure and mean piston speed.

Specific power output, P_s = BP / A = constant x p_{bm} x S_p

As can be seen the specific power output consist of two elements viz., the force available to work and the speed with which it is working. Thus the same piston displacement and bmep, an engine running at higher speed will give a higher specific output. It is clear that the output of an engine can be increased by increasing either the speed or the bmep. Increasing the speed involves increasing the mechanical stresses of various engine components. For increasing the bmep better heat release from the fuel is required and this will be involve more thermal load on engine cylinder.

2.2 Engine Noise

An engine is a mechanical device that produces some form of output from a given input. An engine whose purpose is to produce kinetic energy output from a fuel source is called a prime mover, alternatively, a motor is a device which produces kinetic energy from a preprocessed "fuel" (such as electricity, a flow of hydraulic fluid or compressed air). The various factors that contribute to the noise in engine are:

2.2.1 Combustion Noise

Combustion noise is produced because of unsteady combustion of fluid and is of two types: turbulent combustion noise and periodic combustion oscillation. The turbulent combustion noise or combustion roar has no specific frequency but is composed of broad-band frequency spectrum. This noise is amplified if the flame is enclosed with the system resonance frequencies dominating. The requirements for reduction of this noise tend to be opposition to those for efficient combustion.

Combustion oscillations involve a feedback cycle that converts chemical energy into oscillatory energy in the gas flow to the combustion region. The mechanism is such that the pressure waves generated are so phased to the velocity fluctuations.

The noise spectrum involves one specific frequency and its harmonics and that frequency is related to the resonant modes of the combustion chamber. Some of the possible cures are:

1. Modification of combustion chamber geometry
2. Change of air-fuel ratio, burner type etc.
3. Change of burning rate It should be noted that combustion roar in reciprocating engines which has frequency of the firing rate is not related to the combustion noise, but is due to the gross fluctuation in the flow rate produced by periodic action.

2.2.2 Mechanical Noise

Mechanical noise is the noise which is generated by various impacts between the engine parts. This noise source is more important in the higher frequency range rather than in lower frequency range where combustion noise is important. There are lots of moving parts, for example, gear, valves, and rocker arms, piston and cylinder liner. Some are as follows:

2.2.2.1 Engine clicking noise:

A clicking or tapping noise that gets louder when you rev the engine is probably "tappet" or upper valve-train noise caused by one of several things: low oil pressure, excessive valve lash, or worn or damaged parts.

2.2.2.2 Collapsed lifter noise:

Worn, leaky or dirty lifters can also cause valve-train noise. If oil delivery is restricted to the lifters (plugged oil galley or low oil pressure), the lifters won't "pump up" to take up the normal slack in the valve-train. A "collapsed lifter will then allow excessive valve lash and noise.

2.2.2.3 Valve lash noise:

Too much space between the tips of the rocker arms and valve stems can make the valve-train noisy, and possibly cause accelerated wear of both parts.

2.2.2.4 Damaged engine parts noise:

Excessive wear on the ends of the rocker arms, cam followers (overhead cam
engines) and/or valve stems can open up the valve lash and cause noise.

2.2.2.5 Rapping or deep knocking engine noise:

A deep rapping noise from the engine is usually "rods knock" a condition brought on by extreme bearing wear or damage. If the rod bearings are worn or loose enough to make a dull, hammering noise.

2.2.3 Piston Slap Noise

Piston slap noise is generated by the sudden impact of the piston to the cylinder wall is considered to be predominant due to the higher amount of energy released. In the compression stroke, the connecting rod pushes the piston upwards overcoming the gas force. The force acting on the piston has a lateral component and the piston slides upwards on the minor thrust side of the cylinder wall. Thus, as the crank pin passes through the cylinder center line, the lateral component of force on the piston pin changes direction, causing the piston to accelerate through the clearance and slap against the major thrust side of the cylinder wall.

There are at least two piston slaps per revolution, but the major impact occurs at T.D.C. before the power stroke. These simple models do not take into account others factors which may affect. the piston motion such as:

1. Piston pin offset.
2. Rocking motion of piston.
3. Frictions at piston pin as well as piston's outer surface.
4. Piston configuration, especially under operation.
5. Pressure distribution around piston due to the squeezing motion of oil film.
6. Compliance of cylinder liner wall.

2.2.4 Bearing Noise

Crankshaft bearings are always replaced when rebuilding an engine because they are a wear component. Heat, pressure, chemical attack, abrasion and loss of lubrication can all contribute to deterioration of the bearings. The above features
give rise to the noise.

Some of the factors that cause bearing noise are as follows:

2.2.4.1 Dirt:

Dirt contamination often causes premature bearing failure. When dirt or other abrasives find their way between the crankshaft journal and bearing, it can become embedded in the soft bearing material. The softer the bearing material, the greater the embed ability, which may or may not be a good thing depending on the size of the abrasive particles and the thickness of the bearing material.

2.2.4.2 Heat:

Heat is another factor that accelerates bearing wear and may lead to failure if the bearings get hot enough. Bearings are primarily cooled by oil flow between the bearing and journal. Anything that disrupts or reduces the flow of oil not only raises bearing temperatures but also increases the risk of scoring or wiping the bearing.

2.2.4.3 Misalignment:

Misalignment is another condition that can accelerate bearing wear. If the center main bearings are worn more than the ones towards either end of the crankshaft, the crankshaft may be bent or the main bores may be out of alignment.

2.2.4.4 Disassembly:

Disassembly can be another cause of premature bearing failure. Common mistakes include installing the wrong sized bearings, installing the wrong half of a split bearing as an upper, getting too much or not enough crush because main and/or rod caps are too tight or loose, forgetting to tighten a main cap or rod bolt to specs failing to clean parts thoroughly and getting dirt behind the bearing shell when the bearing is installed.

2.2.4.5 Corrosion:

Corrosion can also play a role in bearing failure. Corrosion results when acids accumulate in the crankcase and attack the bearings causing pitting in the bearing surface. This is more of a problem with heavy-duty diesel engines that use high sulphur fuel rather than gasoline engines, but it can also happen in gasoline engines if the oil is not changed often enough and acids are allowed to accumulate in the crankcase.

III. LITERATURE REVIEW

Scarth Philip and Ortiz Diego [1] studied the idling noise of medium and heavy I.C. engines have become an important noise assessment criterion in the commercial vehicle sector. Starting and low idle noise is often the first impression a potential customer gains of the vehicle. A quiet and pleasant low idle noise is critical in giving the desired impression. In urban environments, with heavy traffic and consequently large amounts of non-moving vehicles, high levels of idle noise are a disturbance to the general public.

Kaminski T. and Wendeker M. [2] studied cycle to cycle variation of internal cylinder pressure. Combustion process in spark ignition engines is widely known as a nonlinear and noisy process. Instabilities, which are occurring as cycle-to-cycle variations of internal cylinder pressure, affect directly the power output. Examination of these variations can lead to better understanding of their sources and help in their elimination in a future engine control procedure.

Alt Norbert, Sonntag Hans-Dieter, Heuer Stefan and Thiele Rainer [3] studied the cold start noise behavior of modern I.C. engines. The overall improved noise and vibration behavior of modern I.C. engines has also contributed to this trend. Despite overall improvements in I.C. engine noise and vibration, certain aspects of I.C. engines continue to present significant challenges. One such issue is the presence of I.C. knocking that is prevalent during cold start and warm-up conditions.

Torregrosa A.J., Broatch A., Climent H. and Andres I. [4] estimated the flow of noise emission from rear mufflers in IC engine exhaust systems, through the analysis of measurements performed in a steady cold flow bench. First, the net acoustic power transmitted along the outlet pipe is obtained from in-duct pressure measurements.

Shrivastava A. and Dang M. [5] studied a novel setup for measuring sound power emitted by an automobile engine has been designed and fabricated in this study. Sound pressure levels have been measured to compute sound power level as per IS Standard 3744. A microphone traversing system has been designed and fabricated to measure sound pressure at various points on a spatial grid.

Higgs Benjamin and Rupke Ryan [6] designed the muffler. The primary goal of this project is to develop a muffler system to meet the demanding needs of a Formula SAE prototype race car.

Yong Hao Zhi, Yan Jin and Chen Yang [7] studied the total noise emission using continuous wavelet transform. Noise emission from Petrol engine is a complicated acoustic signal with many different components mainly caused by combustion and mechanism operations. The rapid rise of pressure in the cylinder caused by combustion of fuel near the top dead center (TDC) transmits to the engine structure surface and forms an important part of the total noise emission. The combustion can also cause the vibration of cylinder head, connection rods and crankshaft, with the vibration being also an important source of engine noise.

Litak rzegGorz, Kaminski Tomasz, Czarnigowski Jacek, Zukowski Dariusz and Wendeker Mirosław [8] studied the fluctuations of combustion using experimental time series of internal pressure in one of four cylinders in a spark ignition engine. Employing standard statistical methods like histograms and return maps, cycle-tocycle variations of heat release were analyzed. A substantial difference in system behavior corresponding to quality of combustion was observed with a changing spark advance angle. Examining recurrence plots for a higher spark advance angle formation of specific patterns of vertical lines characteristic to intermittent behavior was found.

3.1 Experimental Set-up

To study the noise generated by an engine, the parameters like sound pressure Level are required to study in different conditions like speed and load. Experimental set up of four stroke four cylinder diesel

3.2 Methods

Engine testing setup consisted of a stationary, four stroke four cylinder Loading was done using an mechanical load. Engine cooling was done by means of water. Figure 1 shows the schematic of experimental test rig whose technical specifications are given . This set up is used for investigating performance and SPL. SPL analysis is carried Sound Level Meter (SLM) which was used as a measurement system This combination of SLM with Filer set was used to measure SPL under various operating conditions of the engine when run on various blends of diesel fuels. These measurements are recorded in decibels (dB). Measurements were performed at 1.5m distance from the engine by placing SLM on the same horizontal plane of the engine. It was ensured that low environment noise was recorded during experiments.

4.1. Procedure of SPL Measurements

1. To start the engine.
2. Check the digital switch, if it is on than ok otherwise on the digital switch.
3. Set the speed rpm on the engine (N=1500 rpm).
4. Check load changing wheel.
5. Set the load on the engine.
6. Set the instrument (Sound Level Meter) at medium range of frequency band.
7. After some time starting the engine take the reading of sound pressure level (SPL) on the digitally on the instrument (Sound Level Meter).
8. Change the load through loading wheel the values of (SPL) is taken at different loading condition.
9. Stops the engine
10. Changing the fuel and removing the air in the diesel engine by using fuel pump.
11. Start the engine and run ideally after some time from engine start
12. Change the load and various value of SPL is calculated. This process is repeated

After taking all reading (diesel and Biodiesel fuel). Stop the engine. 3.1 Experimental Set-up

To study the noise generated by an engine, the parameters like sound pressure Level are required to study in different conditions like speed and load. Experimental set up of four stroke four cylinder diesel engine is shown in fig. 4.1

The specifications of an engine are as follows:

Table 4.1 Specifications of an C.I. Engine

Engine	Diesel
Cylinder	Four
Stroke	Four
Rated power (H.P.)	27
Rated Speed (rpm)	2200
Bore (mm)	78
Stroke Length (mm)	95
Compression Ratio	18.6:1

Fig.4.1 Four Stroke Four Cylinder diesel engine

4.2 Methods

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4.3 Measurements

Measurements procedure of different noise parameters contain calculation of sound power, measurement of sound pressure level at different locations and measurement of sound pressure level for frequency spectrum in 1-1 octave band are discussed below:

Fig 4.2. Sound level meter

SPECIFICATIONS of SLM

Display	18 mm (0.7") LCD (Liquid Crystal Display), 3 ½ digits.
Measurement Rang	35 to 130 db, 3 ranges : Range 1 - 35 to 80 db, Range 2 - 50 to 100 db, Range 3- 80 to 1300 db, * Each range with warning indicator for over & under load.
Resolution	0.1 db
Measurement frequency	31.5 Hz to 8000 Hz.
Frequency weighting	Characteristics of " A " frequency weighting Network. * The "A weighting " Human Ear Listing " response.

4.3.1 Procedure of SPL Measurements

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9. Stops the engine

Changing the fuel and removing the air in the diesel engine by using fuel pump.

10. Start the engine and run ideally after some time from engine start
11. Change the load and various value of SPL is calculated. This process is repeated
12. After taking all reading (diesel and Biodiesel fuel). Stop the engine.

IV. RESULTS AND DISCUSSION

5.1 Fuel Consumption

Figure 4.1 shows the variation in fuel consumption for diesel B20 and B100 when various blends are used in diesel engine. As the loads are increased the diesel engine consumed more fuel in comparison to diesel fuel. The fuel consumption (FC) of B20 and B 100 was increased around 4.4% and 10.5% than that of diesel. It is observed that at the same brake load engine consumed more fuel (B20 & B100) in comparison to conventional diesel fuel. During testing of diesel engine fuelled with Karanja oil engine consumed approximately 5.11% more fuel than that of the diesel for same

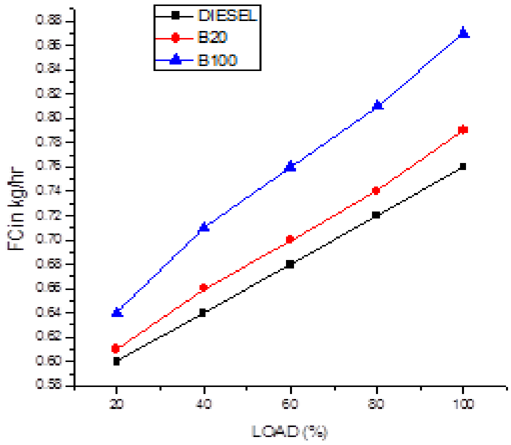

Fig 5.1. Variation in Fuel Consumption with Varying Load for Diesel, B20 &B100 blends

5.2 Brake Specific Fuel Consumption

Figure 5.2 shows the variation in brake specific fuel consumption (BSFC) with varying load for diesel, B20 & B100 blends. It was resulted that the brake specific fuel consumption (BSFC) is higher than that of diesel when the B20 and B100 blends were used in diesel engine. The BSFC of diesel engine was slightly decreased as the engine brake load increased. The BSFC of diesel engine fuelled with B20 and B100 blends were 4.4% and 10.5% more brake specific fuel consumption than that of diesel fuel at 1500 rpm engine speed and 100% brake load. The brake specific fuel consumption is an essential parameter by which compare the engines and determine the fuel efficiency of engines.

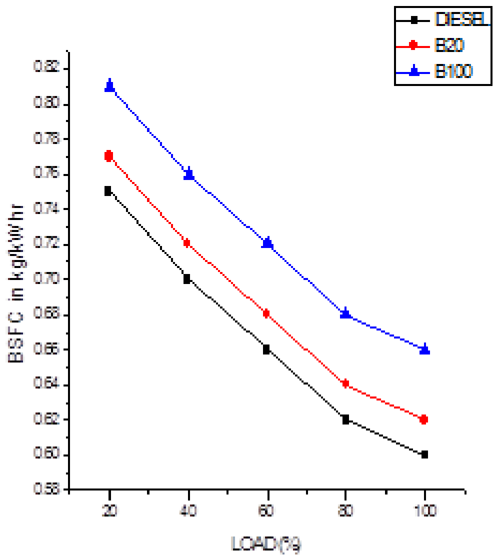

Fig 5.2 : Variation in Brake Specific Energy Consumption with Varying Load for Diesel, B20, B100 blends.

5.3 Brake Specific Energy Consumption

Figure 5.3 shows variation in brake specific energy consumption (BSEC) with varying load for diesel, B20 and B100 blends. It was resulted that the BSEC of diesel engine has higher energy consumption that of diesel when the blends were used 20% and 100%. The BSEC of diesel engine was slightly decreased as the engine brake loads were increased. The BSEC of B20 and B100 blends were increased more energy as compared to diesel fuel when engine runs at constant speed of 1500 rpm and 100% engine load.

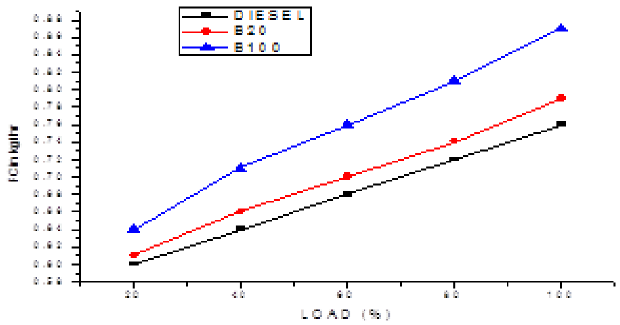

Fig 5.3 : Variation in Brake Specific Energy Consumption with Varying Load for Diesel, B20& B100 blends

I. fuel consumption= ux sp. Gravity of fuel x 60

5.4 Brake Thermal Efficiency

Figure 5.4 shows the variation in the brake thermal efficiency (BTE) of diesel engine fuelled with diesel, B20 and B100 blends at various load. The brake thermal efficiency (BTE) of B20 and B100 is decreased as the blends were increased. The brake thermal efficiency of B20 and B100 is less than that of diesel fuel at 1500 rpm constant engine speed and 100% brake load. It is observed that the brake thermal efficiency of B100 was decreased in comparison to diesel.

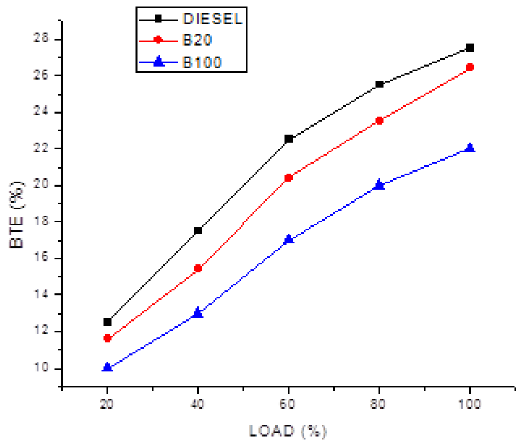

Fig 5.4 : Variation in Brake Thermal Efficiency with Varying Load for Diesel, B20 & B100 blends

5.5 Sound Pressure Level

Figure 5.5 shows variation in Sound Pressure Level (SPL) with varying load for diesel, B20 and B100 blends. It was resulted that the SPL of diesel engine has higher noise generation that of diesel when the blends were used 20% and 100%. The SPL of diesel engine was slightly increasing as the engine brake loads were increased. The SPL of B20 and B100 blends were generate less noise as compared to diesel fuel when engine runs at constant speed of 1500 rpm and 100% engine load.

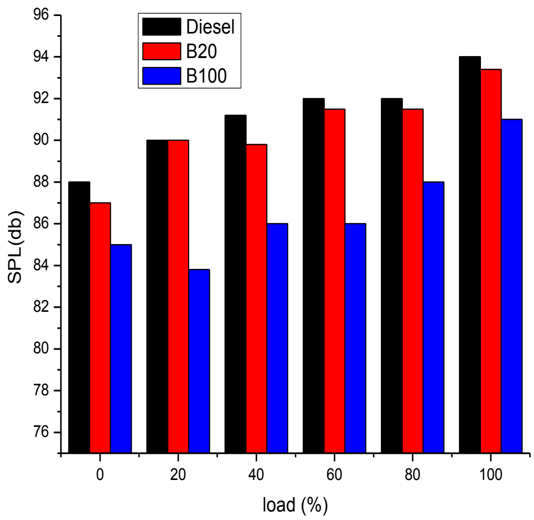

Fig 5.5 : Variation in Sound Pressure level with Varying Load for Diesel, B20& B100 blends

5.6 Sound Power Level

Figure 5.6 shows variation in Sound Power Level (SWL) with varying load for diesel, B20 and B100 blends. It was resulted that the SWL of diesel engine has higher noise generation that of diesel when the blends were used 20% and 100%. The SWL of diesel engine was slightly increasing as the engine brake loads were increased. The SPL of B20 and B100 blends were generate less noise as compared to diesel fuel when engine runs at constant speed of 1500 rpm and 100% engine load.

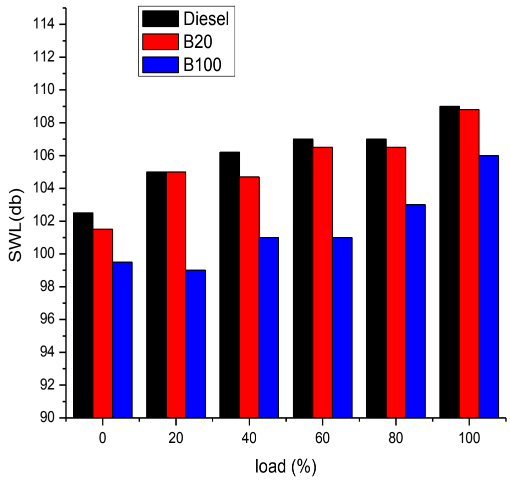

Fig 5.6: Variation in Sound Power Level with Varying Load for Diesel, B20& B100 blends

V. CONCLUSION

Important findings of this experimental endeavor are summarized as follows:

- A considerable amount of the fuel consumption (FC) of B20 and B 100 was increased around 4.4% and 10.5% than that of diesel.
- Average The BSFC of diesel engine fuelled with B20 and B100 blends were more brake specific fuel consumption than that of diesel fuel
- The brake thermal efficiency of B20 and B100 is less than that of diesel fuel.
- The BSEC of B20 and B100 blends were increased consumed more energy as compared to diesel fuel.
- The SPL of B20 and B100 blends were generate less noise as compared to diesel fuel.
- The SWL of B20 and B100 blends were generate less noise as compared to diesel fuel

This experimental study supports the use of palm and jatropha combined biodiesel-diesel blends in diesel engine without any substantial engine modification.

VI. REFERENCES

[1]. Scarth Philip and Ortiz Diego, "Idle Noise Reduction of Light, Medium andHeavy Duty I.C. Engines", THIESEL Conference on Thermal and Fluid Dynamic Processes in I.C. Engines (2004).

[2]. Kaminski T. and Wendeker M., "Combustion process in a spark ignition engine: Dynamics and noise level estimation", American Institute of Physics,Vol. 14, No. 2 (2004).

[3]. Alt Norbert, Sonntag Hans-Dieter, Heuer Stefan and Thiele Rainer, "I.C.engine cold start noise improvement", In: SAE 01-2490 (2005).

[4]. Torregrosa A.J., Broatch A., Climent H. and Andres I., "A note on the Strouhal number dependence of the relative importance of internal and external flow noise sources in IC

engine exhaust systems", Journal of Sound and Vibration , Vol. 282 , pp. 1255–1263 (2005).

[5]. Shrivastava A., Dang M., "A novel Setup for Sound Power Level Measurement", IE(1), Journal-MC, Vol. 87 (2006).

[6]. Higgs Benjamin and Rupke Ryan, "Noise reduction and automotive muffler design", MME-419, April (2007).

[7]. Yong Hao Zhi, Yan Jin and Chen Yang, "Study of engine noise based on independent component analysis", School of Mechanical and Energy Engineering, Zhejiang University, Hangzhou, Vol. 8(5), pp. 772-777 (2007).

[8]. Litak Grzegorz, Kaminski Tomasz, Czarnigowski Jacek, Zukowski Dariusz and Wendeker Mirosław, "Cycle-to-cycle oscillations of heat release in a spark ignition engine", Meccanica, Vol. 42, pp. 423–433 (2007).

[9]. Tempest W, "Noise handbook", Academic Press New York, Second edition,(1988).

[10]. White R.G. and Walker J.G., "Handbook on Noise and Vibration", Ellis

[11]. Horwood New York, Third edition, (1991).

[12]. Shastri Satish Trivedi and Manjoo Bala, "Handbook on Noise pollution: it's

[13]. Scientific and legal Perspective", Divyajyoti Prakashan Jodhpur, Second edition, (1994).

[14]. Cyril M.Harris, "Handbook of Acoustical measurements and Noise Control',Mc-Graw Hills, (1991).

[15]. Nigam S.P., "Introduction to Noise", Noise control programme, Thapar University, Patiala, (2008).

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