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A Study of Performances and Emission Analysis of Duck Fat oil as Bio-Diesel

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Abstract: ***The universal energy consumption is expected to grow in a quicker rate than the population growth. By 2030, a rise of 53% of worldwide energy consumption and 39% of conservatory smokes emissions from fossil fuels is anticipated. Therefore, it becomes a universal agenda to develop clean alternate fuels which are domestically accessible, environmentally acceptable and technically feasible. Energy consumption is constantly growing all over the world in spite of the justification measures that have been accepted. Liquid fossil fuels are the main and most regularly used fuels for automobile and mobile machinery. The studies have been focused on realizing the fuel that would be adaptable to the prevailing engine constructions and that would meet the measures regarding renewability. ecology and reliability of use. Through the last decade biodiesel has developed the most collective renewable liquid fuel. As an alternative fuel, biodiesel appears as one of the best choices among other foundations due to its environment friendly behavior and similar functional assets with diesel. Nowadays, manufacture of biodiesel from Animal Fat oil is gaining more consideration to replace diesel fuel. Biodiesel, a clean renewable fuel, has freshly been measured as the best for a diesel fuel replacement since it can be used in any compression ignition engine deprived of any modification.***

He foremost objective of this work is to discuss the stimulus of biodiesel from Duck fat oil. In this study, the consequence of bio-diesel from Duckfat oil and its combinations on a single cylinder Kirloskar TV-1 diesel engine were investigated. In this work, the concert and emission examination were directed. The test fuel were prepared in the ratio of B25, B50, B75 and B100, which represent the blend ratio of Duck fat oil biodiesel and the rest diesel fuel. The goal of this examination was to reformulate the fuel to consume the biodiesel and its mixture to growth the fuels performance, characteristic and to decrease the contamination from the engine. The investigation aloud comes reveal a marginal decrease in brake thermal efficiency when equated to that of sole fuel. In this Brief study, the emission trial were conducted with the help of AVL Di gas analyzer, in which CO, HC and smoke density are peripheral enlarged on the other hand CO_2, O_2 ***and NOx are substantially reduced when compared to that of sole fuel. Cylinder pressure and H.R.R. were also performed with help of AVL Di Gas Analyzer.***

Key words: ***Duck fat oil, Transesterification, Ultrasonic Assisted Transesterification Biodiesel, Oxides of nitrogen, Smoke.***

NOMENCLATURE

BP	Brake power, kW
BTE	Brake thermal efficiency in %
SFC	Specific Fuel Consumption, kg/kW h
CO	Carbon monoxide, % vol.
HC	Hydrocarbon, ppm
NO*x*	Oxides of Nitrogen, ppm

Transesterification Process.
Diesel – 100%
DTB 25 - 75%diesel +25% Duck fat oil
DTB 50 – 50%diesel+50% Duck fat oil
DTB 75 – 25%diesel+75% Duck fat oil
DTB 100 – 100% Duck fat oil.
Ultrasonic Assisted Trasesterification Process.
Diesel – 100%
DUB 25 - 75%diesel +25% Duck fat oil
DUB 50 – 50%diesel+50% Duck fat oil
DUB 75 – 25%diesel+75% Duck fat oil
DUB 100 – 100% Duck fat oil.

I. INTRODUCTION

Biodiesel is well-defined as fatty acid methyl or ethyl esters from animal fats or vegetable oils or as an alternate fuel of diesel. It is renewable, green environmental, non toxic and oxygenated fuel [1,2]. Even though many researches pointed out that it might help to decrease green house gas emissions, improve income distribution and promote sustainable rural development [3-6]. The major cause is being underprovided in of new information about the impact of biodiesel on diesel engines. For instance, the reduction of engine power, as well as the development of fuel consumption for biodiesel, is not as a excessive amount as estimated; the early research assumptions need been earmarked, it is more prone to oxidation aimed at biodiesel which can out come in mysterious exudates and residues that can plug fuel filter, and therefore it will encouragement engine durability [7,8]. In the self-propelled sector, the high oxides of nitrogen (NOx) and HC emission from the diesel engine are its highest problems with respect to air pollution. In this insight, the reductions in HC and CO emissions from the engine container be added by use of biodiesel. But, NOx emissions are slightly amplified for the biodiesel blended diesel fuel [9-13].High viscosity, external tension and density of biodiesel encouragement atomization by growing the mean fuel droplet size which in turn escalations the spray tip saturation. Many scholars have establish that viscosity and density are distress the atomization, whereas density is the lowermost on mean droplet magnitude and consequently to grow superior fuel atomization viscosity must be the first alternative of a fuel’s physical property to be decreased [4,5]. The above declared problem can be answered by blending biodiesel with diesel fuel which will decrease the viscosity of fuel. Introduce some poetry review correlated to animal fat oil – biodiesel and also performances and emission analyzer.

II. BIODIESEL PRODUCTION AND PROPERTY ANALYSIS

A. Ransesterification

The response instrument for alkali catalyzed transesterification was expressed as three steps. Transesterification is the method of adaptation of the triglyceride through an alcohol in the frequency of a catalyst to form esters and glycerol. Animal fat oil is exposed to chemical responses with alcohol like methanol or ethanol in the attendance of a catalyst. After the response is adjustable, excess methanol is required to lessen the instigation energy, thereby shifting the steadiness to the product side[10]. The triglyceride present in the animal fat oil is converted into biodiesel. Among the alcohols used for the transesterification reaction are methanol and ethanol. However, when methanol is processed, methyl esters are formed, whereas ethanol produces ethyl esters. Both these compounds are biodiesel fuels in different chemical combinations[12]. The mechanism of transesterification reaction scheme is illustrated by Figure 1.Transesterification of Duck fat oil produces ester whose properties are comparable with those of diesel fuels. Schematic diagram of biodiesel plant is shown in Figure 2. The properties of the diesel fuel and the Duck Fat oil biodiesel are summarized in Table 1.

Table 1 Properties of diesel and biodiesel blends

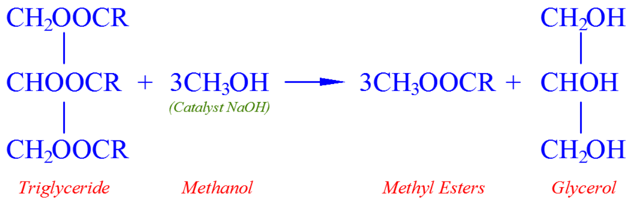


Figure 1 Mechanism of transesterification process

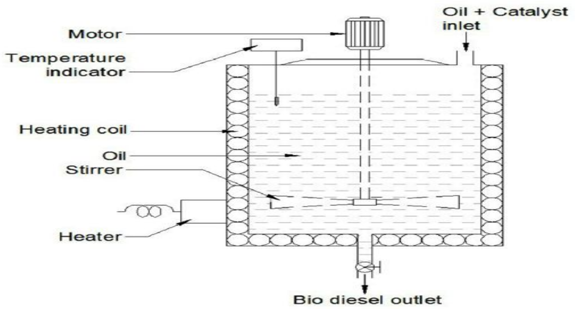


Figure 2 Schematic diagram of Biodiesel Plant

Sample Name	Specific gravity	Density kg/m^3	Calorific values kJ/ kg
Diesel	*0.8350*	835	*44640*
DTB 25	0.8642	864	43435
DTB 50	0.8648	865	43035
DTB 75	0.8654	865	42530
DTB 100	0.8660	866	42150

Figure 1 Transesterification process of converting Duck fat oil to biodiesel

B. Ultrasonic Assisted Transesterification Process

A mixture of methanol and potassium hydroxide (KOH) was agitated using a magnetic stirrer agitator for 5-10 min to form the methoxide and water. Then, Sheep fat oils were mixed separately with the previously pre pared potassium methoxide in a conical flask. Afterward, the mixture was transferred to the ultrasonic reaction chamber to be subjected to ultrasound waves. The ultrasonic amplitude and reaction time were adjusted by a PC controller. The schematic diagram of ultrasonicator is shown in Figure 1 and the properties of biodiesel extracted using this method is tabulated in
Table 2.

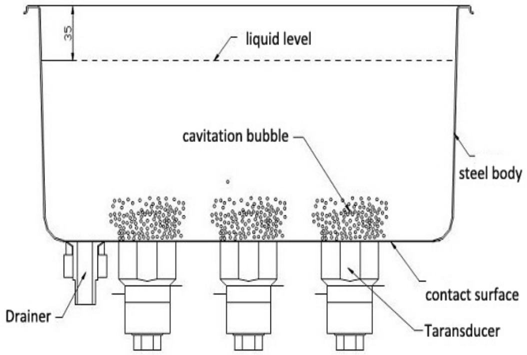


Figure 2 Schematic diagram of ultrasonicator assisted Transesterification process

Sample Name	Specific gravity	Density kg/m^3	Calorific values kJ/ kg
Diesel	*0.8350*	835	*44640*
DUB 25	0.8642	864	43150
DUB 50	0.8678	868	42950
DUB 75	0.8735	874	42875
DUB 100	0.8770	877	41860

Table 2 Properties of Diesel and Biodiesel.

III. EXPERIMENTAL SETUP

The diesel engine used for research is Kirloskar TV1, single cylinder, water cooled engine coupled to eddy current dynamometer with computer boundary. The detailed specification of the engine is shown in Table 2. A data acquisition system is used to gather and analyze the combustion records like in-cylinder pressure and heat release rate during the research by using AVL transducer. The exams are conducted at the rated speed of 1500 rpm. In every test, exhaust emission such as nitrogen oxides (NOx), hydrocarbon (HC), carbon monoxide (CO) and smoke are measured. From the initial measurement, brake thermal efficiency (BTE) and specific fuel consumption (SFC) with respect to brake power (BP) for different blends are calculated. The blends of biodiesel and diesel used were B25 and B50. B75 and B100 means 25 % biodiesel fuel and 100% of diesel fuel by volume. In order to study the effect of biodiesel blends on the engine combustion and emission characteristics, the injection timing was kept constant at 23° TDC. The effect of biodiesel blends was studied and results were compared with sole fuel diesel.

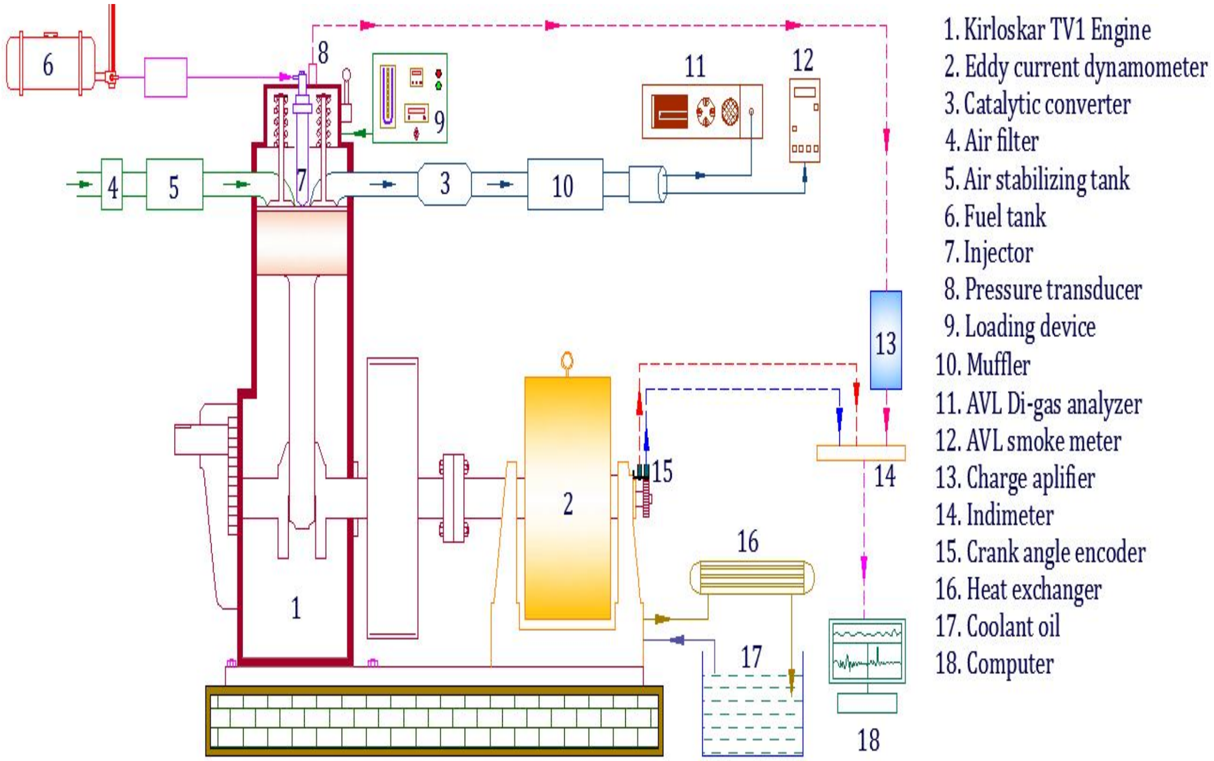


Figure 5Schematic diagram of the experimental setup

Type	Vertical, Water cooled, Four stroke
Number of cylinder	One
Bore	87.5 mm
Stroke	110 mm
Compression ratio	17.5:1
Maximum power	5.2 kW
Speed	1500 rev/min
Dynamometer	Eddy current
Injection timing	23° before TDC
Injection pressure	220kg/cm^2
Ignition timing	23° before TDC
Ignition system	Compression Ignition

Table 2Specification of test engine

IV. RESULT AND DISCUSSION

A. Brake Thermal Eficiency

The effect of Duckfat oil Biodiesel mixture on brake thermal efficiency is exposed in Figure 6. It can be seen from the figure that Brake thermal efficiency in overall reduced with the increasing quantity of biodiesel in the test fuels[11]. The brake thermal efficiency for all the samples was less than that of sole fuel by about approximately 0.8% to 2.5% for all the samples in the maximum load of 5.2 kW. This is due to the effect of biodiesel blend in both the processes respectively.

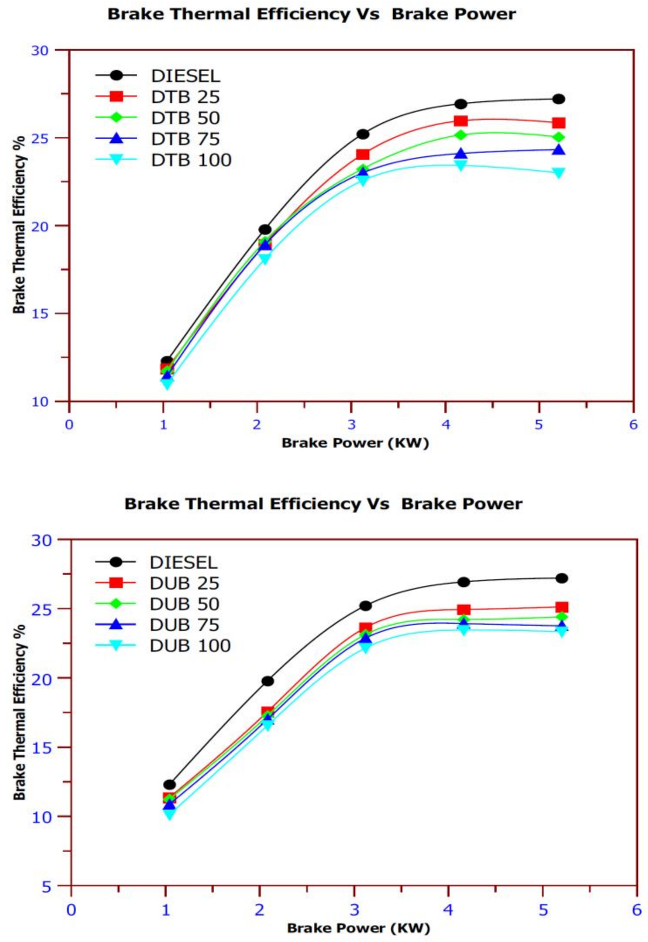
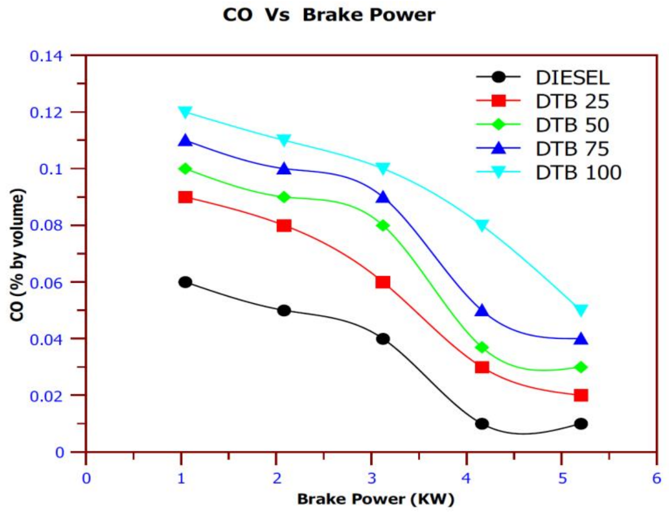


Figure 6 Brake thermal efficiency against brake power

B. Co Emission

The effect of the Duck fat oil biodiesel blend on the % CO emission is shown in Figure 7. for the biodiesel and its mixtures, the % CO emissions where greater than that of lone fuel. The least %CO emissions have been obtained for the BTB 25& BUB 25 with the higher value of 0.13% by volume at 100% load. The decrease of CO emission is due to the oxygen contented on the biodiesel mixture in both the methods respectively.



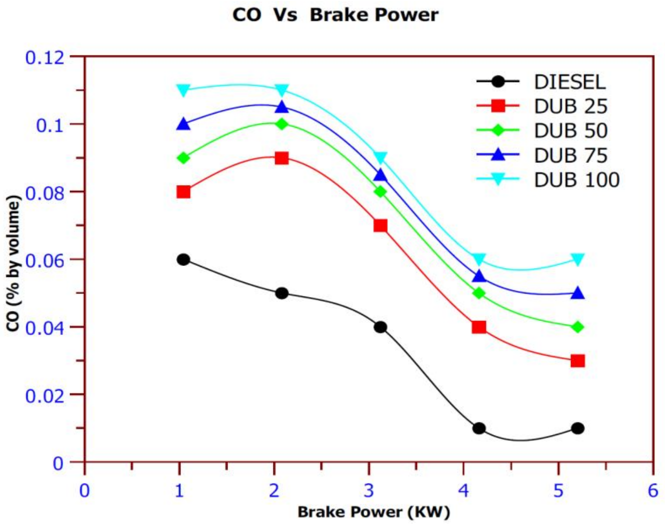


Figure 7. % CO emission against Brake power

C. Hc Emissions

The result of Biodiesel on hydrocarbon emission is exposed in Figure 8. It is observed that the HC emission is minimum for sole fuel with a value of 16 ppm at maximum load. The HC emission is greaterwhen matched to that of the sole fuel for all the samples. There is marginal decrease of HC emission for all the samples. But for the BTB 100 & BUB 100 HC emission is increased effectively when compared to other samples. This may be due to the oxygen comfortable of the biodiesel mixtures in both processes respectively.

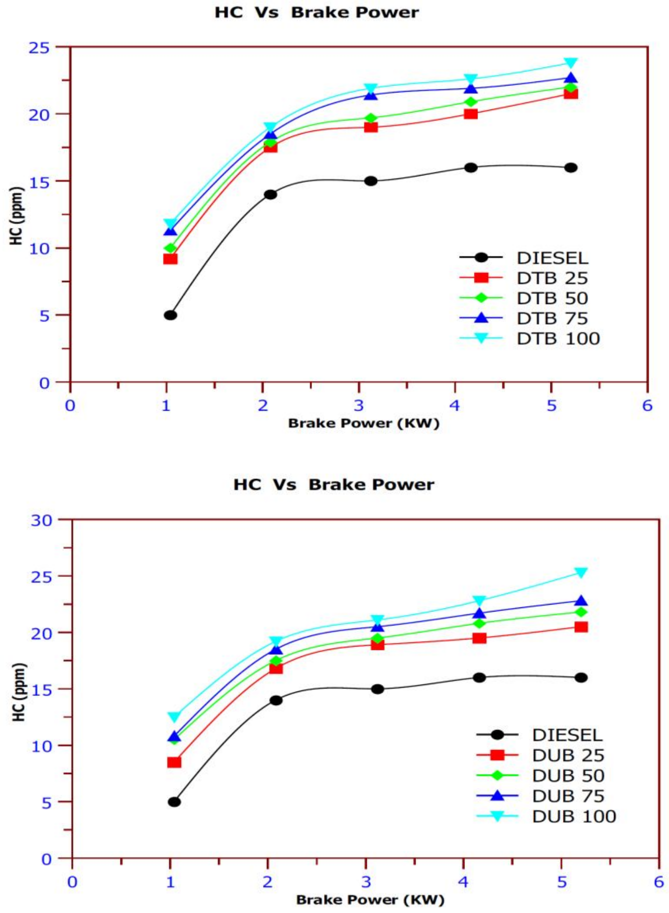
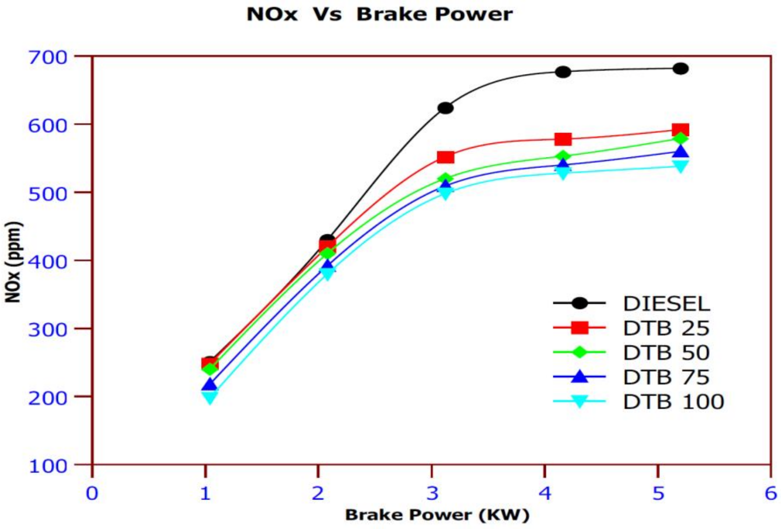


Figure 8. Hydrocarbon emission against brake power

C. Nox Emission

The result of biodiesel on NOx emission is exposed in Figure 9.for the biodiesel and its mixture the NOx emission where minus than that of sole fuel. The NOx emission is minimum for BTB 100& BUB 100 with a value of 592 ppm& 600 at 25%. Similarly for BTB 100& BUB 100 at maximum load is 538ppm & 540 ppm which is less when compared to all other samples at maximum load. This is due to the result of oxygen contented in the biodiesel mixture in both the processes.



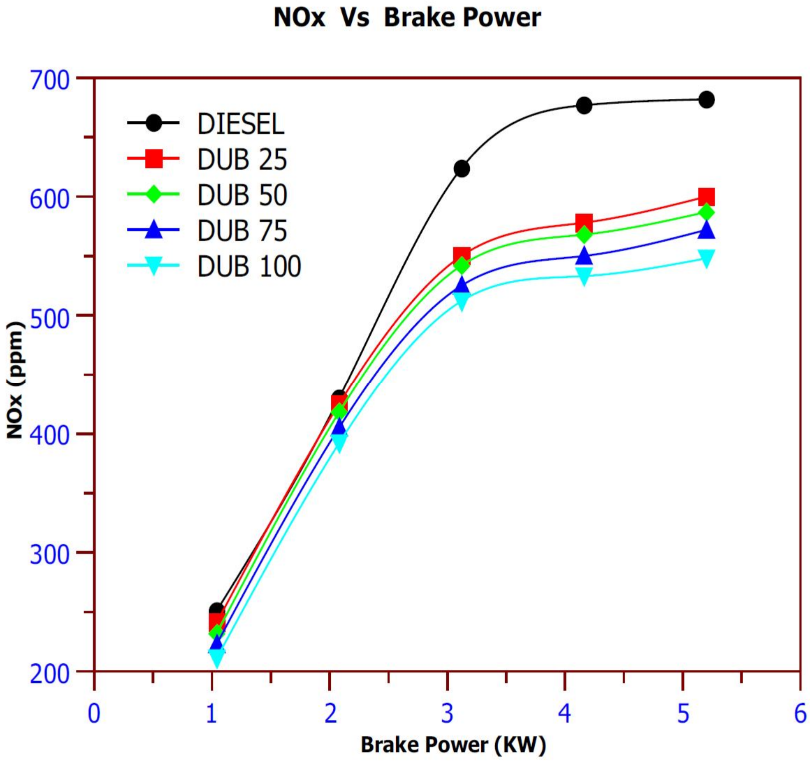


Figure 9. Carbon-monoxide emission against brake power

D. Smoke Emission

The effect of biodiesel on smoke emission is exposed in Figure 10.for the biodiesel and its mixtures the smoke emission is higher when compared to the sole fuel. It is observed for all the examples the smoke emission is greater than that of sole fuel. The maximum smoke value is 54.2 HSU&56.2 HSU for BTB 100& BUB 100 at maximum load blend in both the processes.

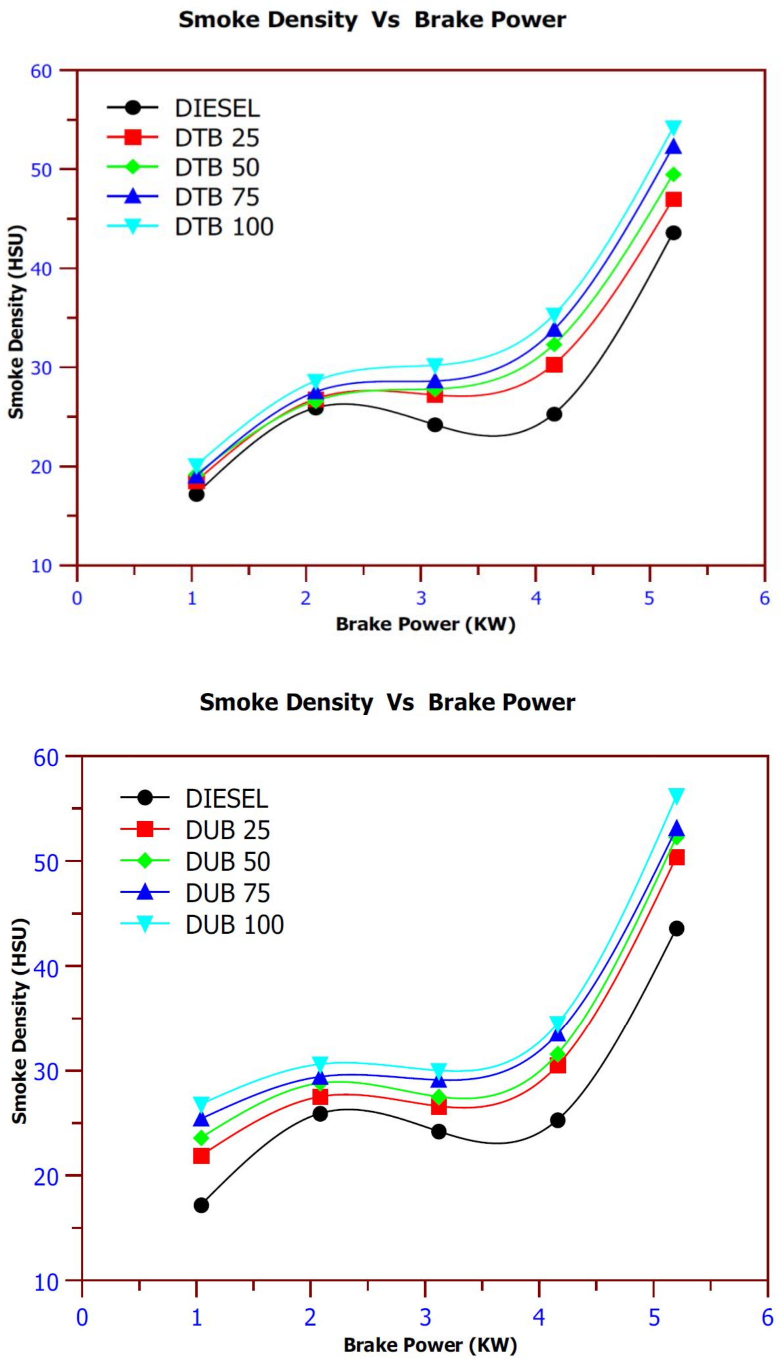


Figure 10. Smoke density against brake power

E. *Combustion Characteristics*

1) *Cylinder Pressure* :The difference in-cylinder pressure beside crank angle is exposed in Figure 11. The topmost pressure for the Duck Fat oil biodiesel and its blends is lesser than that of the diesel fuel due to the poor atomization, which decelerates the combustion and cause for the lower cylinder gas pressure. However, the variation between the BTB 25& BUB 25 and diesel fuel is marginal. It is experimental that the occurrence of topmost pressure is advanced with the accumulation of Duck fat oil biodiesel, which supplies oxygen and promotes the complete combustion of fuel. The maximum in-cylinder pressure of 59.9476 kg/kW-hr & 59.3533 kg/kW-hr was found in the case of diesel fuel and it was 61.241 kg/kW-hrfor BTB 100 & BUB 100 fuel.

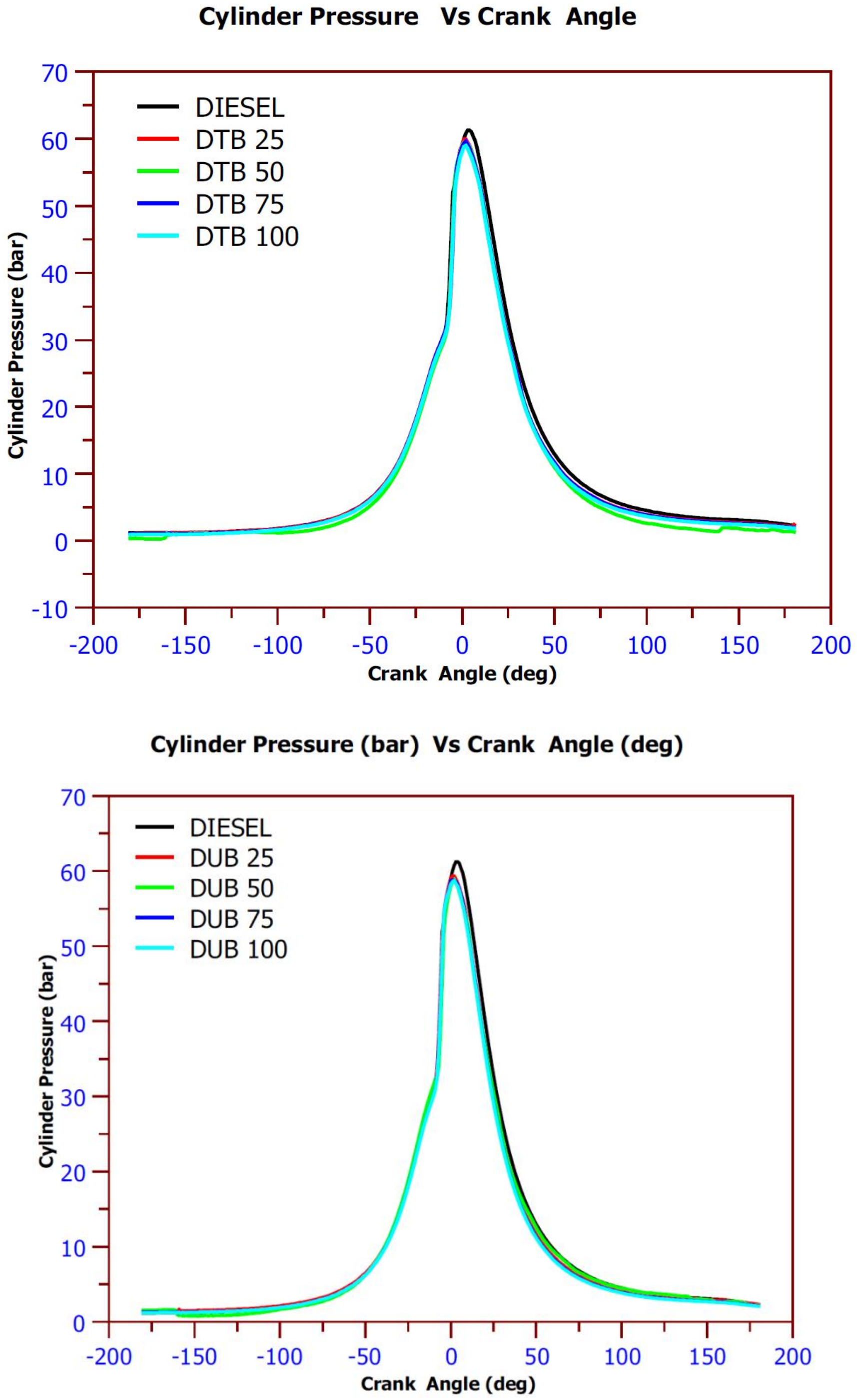


Figure 11.In-cylinder pressure against crank angle

2) Heat Release Rate

The adding of Duckfat oil biodiesel blend advances the happening of the peak heat release rate when comparing with the diesel fuel and the variation of heat release rate through the crank angle is shown in Figure 12. After the combustion starts, the heat release rate growths and reaches to the extreme value. The addition of DuckFat oil biodiesel reductions the ignition delay and accelerates previous start of combustion, which results in the lower heat release rate and progression of the peak heat release rate. The maximum heat release rate is observed as 117.233 kJ/m^{3}deg&119.235 kJ/m^{3}deg for the diesel fuel, whereas it is 123.752kJ/m^{3}deg for the BTB 100 & BUB 100.

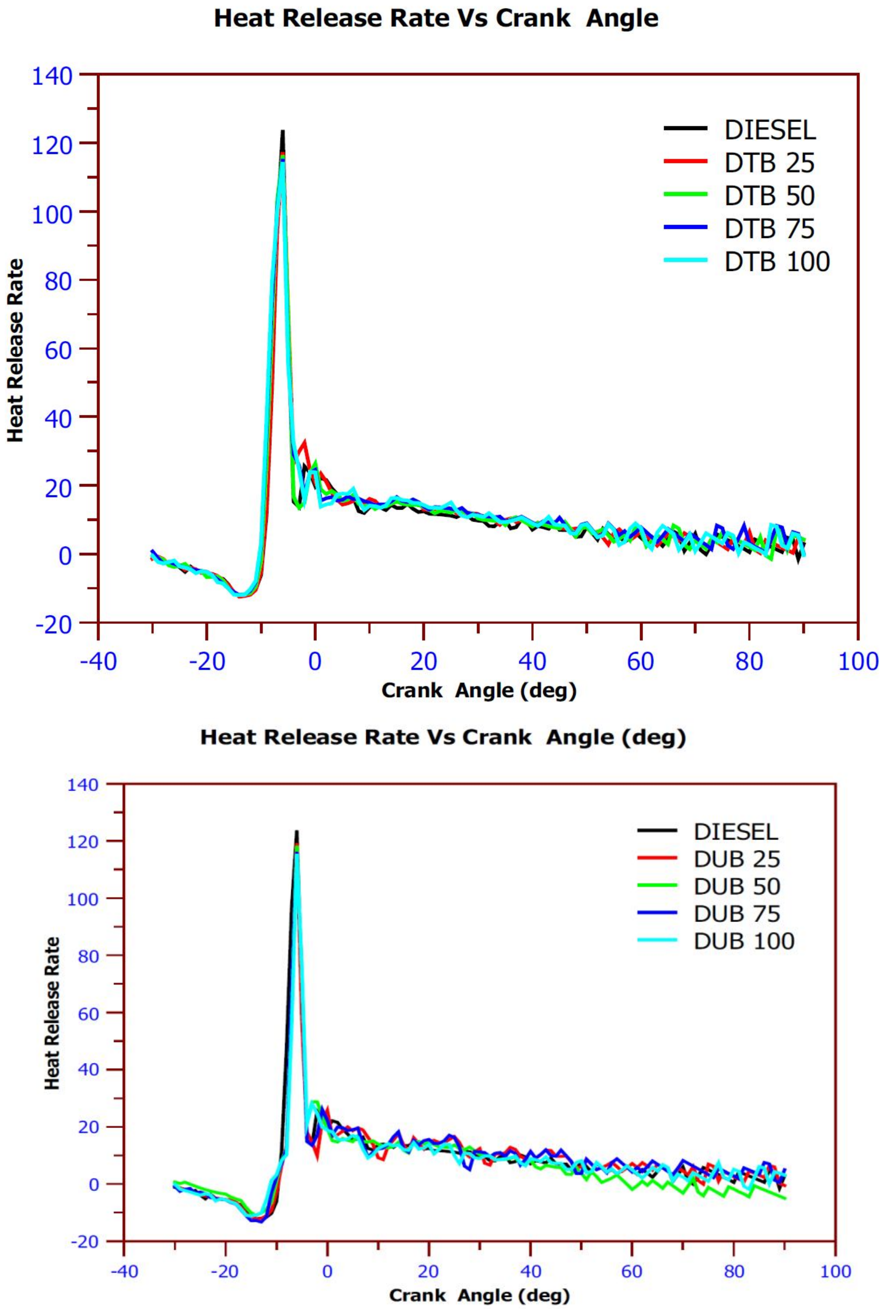


Figure 12. Heat release rate against crank angle

V. CONCLUSIONS

The Duckfat oil biodiesel (B25) and its blends with sole fuel, B50, B75 and B100 were investigated and the results were compared with diesel and reported in this project.

The brake thermal efficiency is marginally decreased for the biodiesel and its blend in both the processes respectovely.

A. The exhaust gas temperature is lesser for BUB 25 is 311°C & 322°C at maximum load in both the processes respectively.
B. The emission analysis for the biodiesel and its blend gave the best result when compared to the sole fuel in both the processes respectively.
C. The CO emission is increased by 0.12%&0.11% by volume at 20% of load for BTB 25& BUB 25
D. The CO_2 emission is increased by 4.3 % & 3.9% by volume at 100% of load for BTB 25& BUB 25

E. The HC emission is reduced by 23.8 ppm &25.3 ppm at 100 % of load for BTB 100& BUB 100
F. The O_2 emission is increased by 12.04% & 10.07% by volume at 100% of load for BTB 100& BUB 100 respectively.
G. The NOx emission is reduced by 538 ppm& 548 ppm at 100% of load for BTB 100& BUB 100 respectively.
H. Smoke density is increased by 54.2 HSU &56.2 HSU at 100% of load for BTB 100& BUB 100 respectively.
I. Cylinder Pressure

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