EXPERIMENTAL STUDY OF B20 BLEND HONNE OIL AND DIESEL FUEL WITH CuO NANO ADDITIVES

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Abstract - *Worldwide energy demand has been growing steadily during the past five decades and most experts believe that this trend will continue to rise. The amount of energy consumption and exhaust gas emissions increases day by day. This increase has forced many countries to take various precautions, and various solutions on emitted emissions for better country. The biodiesel is produced from the raw Honne oil by standard Transesterification process and blends are prepared as B10, B20, B30 and B40. Along with this B20 blend sample [80% diesel + 20% biodiesel] copper oxide (CuO) nanoparticles were added as additive in mass fractions of 25 ppm (CuO 25), 50 ppm (CuO 50) and 75 ppm (CuO 75) with the help of a mechanical Homogenizer and an ultrasonicator. Experiments were conducted to determine engine performance, exhaust emissions and combustion characteristics of a 3.7 Kw single cylinder, four stroke diesel engine using diesel with 20 percentage of Honne oil methyl ester (HnOME) blended fuel and nano additive blended fuel. The results revealed a considerable enhancement in the brake thermal efficiency and marginal reduction in the harmful emissions for the nanoparticles blended biodiesel fuels compared to those of neat biodiesel fuel. It was observed that Copper oxide nanoparticles blended fuel exhibits a significant reduction in specific fuel consumption and exhaust emissions at all operating loads. And also it shows improvement in peak pressure and heat release rate due to the influence of copper oxide nanoparticles addition in biodiesel–diesel blend. From experimental investigation shown that there is increment in BTE and reduction BSFC, Nox emissions with operation HnOME-B20+CuO +75nano blend.*

Keywords: Honne oil, Blending, Performance, Emissions, Combustion, Diesel engine

1. INRODUCTION

Biodiesel is increasingly gaining recognition in the market as an environmentally friendly fuel and the demand is expected to increase sharply as an alternative renewable energy source in the near future. Biodiesel fuel is mono alkyl ester derived from vegetable or animal and it can be blended with diesel fuel which has characteristics similar to diesel fuel and has lower exhaust emissions. On the other hand, the main drawbacks of vegetable oil have to overcome due to the high viscosity and low volatility which will cause a poor combustion in diesel engines. Trans esterification is the process successfully employed to reduce the viscosity of biodiesel and improve the other characteristic. Currently, more than 95% of the world biodiesel is produced from edible oil which is easily available on a large scale from the agricultural industry. However, competition of edible oil sources as food with fuel makes edible oil not an ideal feedstock for biodiesel production. Therefore, much effort is required to focus in this area to produce biodiesel from non-edible seeds like Jatrophacurcas, Pongamiapinnata, Calophylluminophyllum, etc. to become feasible feedstock for biodiesel. Biodiesel seems to be a realistic alternative renewable fuel in the near future and this review is focus on the possibilities of using palm oil, Jatrophacurcas, Calophylluminophyllum and biodiesel in diesel engine. Besides, the fuel characteristics, processes available, production, performance and emission analysis of biodiesel are discussed by making a comparison on these three different types of biodiesel fuel.

B.K.Venkanna et al (2015) [1].In this paper the worked have been carried out on non-edible oil which is known as hone oil. The honne oil is one of the new alternative fuels which may be referred as possible fuel for the diesel engine. The mostimportant parameter is to be considering when plant oil is used as ansubstitute energy for diesel engine is its viscosity and in most of the vegitable oils have higher viscosity.In this paper the viscosity of honne oil can be reduced by mixing with the diesel fuel.In this work the honne oil and diesel fuel are blended in range of H10 to H50 and experiments are conducted on diesel engine used in agricultural sector and evaluate performance ,emission and combustion features. After experiments the blend H20 are found to be better performance and less emissions compared to other mixtures and diesel fuel.

Harish Venu et al (2016) [2].Most of the research work are absorbed on the enhancing the performance of diesel engine with biodiesel mixtures. This is due to scarcity of the diesel fuel. In this work it is it is also absorbed on the enhancing the performance of the mixtures of diesel fuel and vegetable oils. In this work two types of blends are used one is Ethanol blend diesel (EBD) and second one is the Methanol blend diesel (MBD). They also used the Diethyl ether as a nano additive for improving the performance of the engine. They use 5% of diethyl ether with EBD and 10% of diethyl ether with EBD and similarly 5% and 10 % with the MBD and the experiments were conducted. The investigational outcomes show that addition of DEE in EBD increases the combustion duration, cylinder pressure and BSFC and also reduces the NO_x, Particulate matter and the smoke emission. On the other hand addition of DEE in MBD increases PM, CO_2 and the smoke emission and decreases the BSFC, Cylinder pressure.

Harish Venu et al (2017) [17].Most of the research works are going to improve the performance of the biodiesel blends and to protect the environment from the global warming. One of the recent developments to enhancing the performance of mixtures of biodiesel with addition of nano particle additives. In this work experiments are conceded out to observe the performance of the engine by the usage of biodiesel blended with Nano additives and also to evaluate the factors that are affecting the engine performance and the emission. In this work they were studied on biodiesel ethanol blend in a CI engine and they used two types of Nano additives i.e. Titanium Oxide (TiO_2) and Zr Oxide (ZrO_2) in addition also DEE additives are used. Experiments are conducted on a diesel engine fueled by test fuel i.e. 80% of diesel and 20% of ethanol and a blend of 25 ppm of TiO_2 and ZrO_2 and 50 ml of DEE. Experimental results reveal that addition of titanium oxide decreases the BSFC and CO emission and also increases the NO_x, HC and smoke. On the other hand addition of Zirconium oxide lowers the CO, CO_2, and smoke emission with increase in the BSFC and HC emissions. Simultaneously addition of DEE lowers the BSFC, NO_x and smoke with increase in HC, CO emissions and heat release rate.

H.C.Ong et al (2011) [4].Due to global warming and scarcity of the fossil fuel it is necessary to protect the environment and also to find the alternative sources for the fossil fuel. Biodiesel is the alternative sources for the fossil fuel. Biodiesel is the one of the best alternative fuel. However edible oil is not an ideal feedstock for the fuel due to competition between the sources as food and as fuel. In this paper comparison has been made between some of the biodiesel such as palm oil, Jatropacurcas and Calophylluminophyllum. Since palm oil is the edible oil hence concentration has been made on non-edible oils like jatrophacurcas and calophylluminophyllum. Compared to palm oil and jatropha, calophylluminophyllum is still in nascent state hence works are going to make it as alternative fuel in future. The experiments results reveal that rise in CO_2, NOx and decrease in HC, CO and smoke capacity.

C. Syed Aalam et al (2015) [18].Burning attributes of a solitary barrel, regular rail coordinate infusion (CRDI) framework helped diesel motor utilizing diesel with 25 rate of zizipus jujube methyl ester mixed fuel (ZJME25). Alongside this ZJME25 aluminum oxide nanoparticles were included as added substance in mass divisions of 25 ppm (AONP 25) and 50 ppm (AONP 50) with the assistance of a mechanical Homogenizer and an ultrasonicator. It was watched that aluminum oxide nanoparticles mixed fuel displays a critical lessening in particular fuel utilization and fumesemanations at allworking burdens. At the full stack, the greatness of HC and smoke emanation for the ZJME25 before the expansion of aluminum oxide nanoparticles was 13.459 g/kW h and 79 HSU, while it was 8.599 g/kW h and 49 HSU for the AONP 50 mixed ZJME25 fuel separately. The outcomes additionally demonstrated a significant improvement in brake warm proficiency and warmth discharge rate because of the impact of aluminum oxide nanoparticles expansion in biodiesel–diesel mix.

2.MATERIALS AND METHODS

2.1 History of Honne oil

It is a one kind of option fuel. It‟s logical name is "Calophylluminophyllum" It is produced using the completely develop organic products [Yellow or Red-brown]. In that organic products, seeds can be pound then "unrefined calophyllum oil [Thick dim Green]"is removed. After pretreatment [Esterification and Transesterification] the oil is utilized. Basic names for Honne oil in various dialects are Nagachampa, panchkesara, punnaga(inSanskrit), sharpen tree(in Kannada), poona or puna(in Telugu) [4].

Fig 2.1: Premature fruit bunch

It is wide leaved evergreen tree happening as a littoral speciesalong the shoreline peaks, albeit once in a while happening inland 9 and adjoining swamp woods. It has been generally established all through the tropics and is naturalized in the fundamental Hawaiian Islands. The tree is esteemed of its solidness, excellence as a fancy tree. Oil from the nuts has been generally utilized of medication, makeup then is today being delivered monetarily in the South Pacific. The tree develops best in direct daylight, however develops gradually. Trees start to manage fundamentally following 4-5 years. The nut bit contains 50-70% oil and the develop tree may deliver 1-10 kg of oil for every year relying on profitability of the tree and the proficiency of extraction process [1].

In spite of the fact that wildings happen, it can be respectably hard to engender. Its moderate development and substantial seeds make it far-fetched that the tree will turn into an obtrusive weed if brought into new regions. Tree develops stature of 8-20m at times coming up to 35cm (11ft). Shade width is regularly more noteworthy than the tree's stature when the tree is developed in open area. It has a wide spreading crown frequently by vast, twisted, flat divisions. The light dim bay indicates profound crevices rotating with level edges [19].

Table 2.1: Physico-chemical Properties of Calophylluminophyllum oil

Property	Unit	Value
Color	-	Reddish brown
Odor	-	Unpleasant
Density at 15ºC	Kg/m^3	910
Kinematic viscosity at 40ºC	Cst	38.17
Free fatty acid	mgKOH/g	28.15
Moisture	%	11%
Saponification value	-	204
Calorific value	MJ/KG	31.50
Specific gravity	-	0.906
Flash point	ºC	223
Fire point	ºC	252

2.2 Preparation of Biodiesel

The seeds of honne oil are collected from costal region in India. The seeds are collected and damaged seeds are discarded. This depends on the conditions. The seeds are de shelled, dried and proceed for the extraction of oil. The extraction of oil is done through mechanical expeller at room temperature.

Since the water content in oil is more and it is critical parameter, so the raw oil is kept in oven and maintained at a temperature to remove the moisture content. After the removal of moisture content detoxification is carried out by the addition of 1% of HCL solution. This helps in removal of traces of carbon, unsafonicable material and fiber etc.

Since the callophyllum oil contains about 19.58% of free fatty acids. The transesterification process is usually carried out in two steps. In the first step the free fatty acids are reduced by the acid esterification process. In the first stage the callophyllum oil, methanol and sulpuric acid are placed in closed reactor vessel and maintained at a temperature. The oil is heated up to 52ºC then 0.75% of sulfuric acid is added and methyl alcohol is about 1:6 molar ratio is added. The reaction is continues with stirring and maintained at temperature 55-57ºC about 90 minutes. When the FFA is reduced up to 0.99% the reaction is stopped.

In second stage of transesterification process the the esterified oil is poured in a flask and heated up to 60ºC. In another beaker by using 0.5% of sodium hydroxide pallets and methanol, a solution of potassium methoxide was prepared. This solution was stirred continuously till the potassium hydroxide pallets are completely dissolved. Then this solution was mixed with the heated honne oil and stirred continuously. Finally FFA was checked and the mixture was leave in separating funnel for 24 hours. After that two layer are separated the upper layer contains the biodiesel and lower layer contains the glycerol and soap. Hot water is used to wash it and leave in separating funnel until the clear water was seen.

Fig 2.2 Dried CallophyllumInophyllum seeds

2.3 Blending of biodiesel and Nano additives

The blending of biofuel with diesel is carried with proportion of 80% diesel fuel and 20% honne oil. In this present study we use copper oxide nano additives which helps in improving the performance and reduction in emissions. In this work copper oxide nano additives is used in proportion of 25ppm, 50ppm and 75ppm. In blending nano additives i.e. 25 ppm is added to B20. Similarly 50ppm and 75ppm is added to all the proportions of biodiesel. To prepare the biodiesel and nano additives mixture firstly the nanoadditves is added to the diesel and then a surfactant called as cetyltrimethyl ammonium bromide (CETAB) is added which helps in maintain the stability of nano additives in diesel fuel. After that prepared mixture is placed in a ultrasonicator which stir the mixture well to disperse the nano additives completely in the fuel. Hence a blends of biodiesel with fraction of B20 is prepared with addition of 25ppm, 50ppm and 75ppm of CuOnano additives.

3. EXPERIMENTAL SETUP

The test motor to be utilized is the Kirloskar, single barrel four-stroke water cooled diesel motor creating 5.2 kW at 1500 rpm. This motor was coupled to a vortex current dynamometer with a control framework. The chamber weight was measured by a piezoelectric weight transducer fitted on the motor barrel head and a wrench edge encoder fitted on the flywheel. Both the weight transducer and encoder flag wereassociated with the charge enhancer toconditionthe signs for ignition investigation utilizing SeS motor burning analyzer. The motor ignition analyzer is utilized to assess and decide control chamber ignition qualities, for example, start delay, begin of ignition, evaluated end of ignition, mass division consumed, warm discharge rate and weight and volume varieties regarding wrench edge. Five Gas Analyzer is utilized to test the discharges of the motor.

Experiment test was conducted on the single cylinder four stroke engines. The engine was computerized set up which measures indicated power, brake power, brake thermal efficiency, BSFC, volumetric efficiency. The experiments were conducted out after the installment of the engine. The engine pressure and the speed were set to constant. The test was conducted from no load condition to full1load condition. After the engine was run on the biodiesel and the results were tabulated with 20% increment in the load. Then the experiment was repeated for various loads and different blends of biodiesel and nano additives added biodiesel.

Fig 3.1 Experimental Set up

4. RESULTS AND DISCUSSION

4.1 Performance Analysis

4.1.1 Brake Thermal Efficiency (BTE)

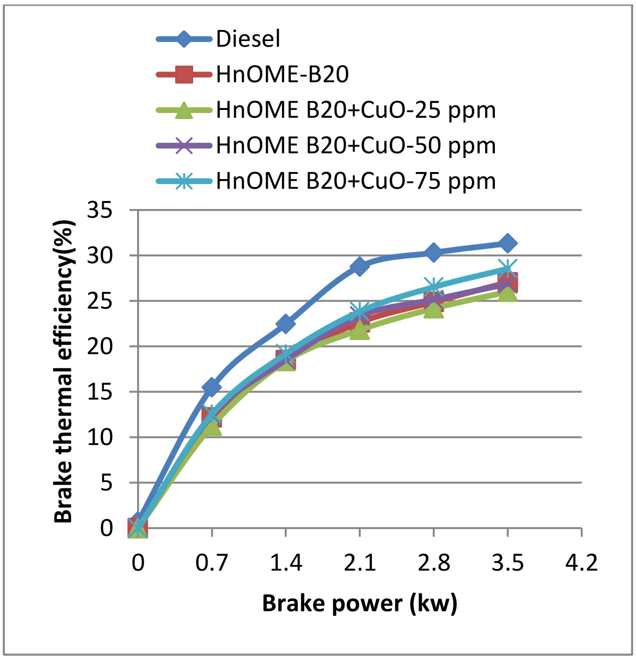

Fig 4.1: Brake thermal efficiency v/s Brake Power

Fig 4.1 show variation of brake thermal efficiency at various engine load conditions for neat diesel fuel the biodiesel blended with CuOnano additives. After the experiment it was found that B20 blends shows the better results and it is near to the values of diesel fuel so the nano additives are added to the B20 biodiesel in the proportion of 25ppm, 50ppm, 75pm. From the graph it is observed that B20 blend with 75ppm nano additives shows the good results and it is near to the diesel fuel. From plot it is observed that BTE for B20 is 27.04% after the addition of CuOnano additives it is increased to 28.54% at the proportion of 75ppm.

4.1.2Brake Specific Fuel Consumption (BSFC)

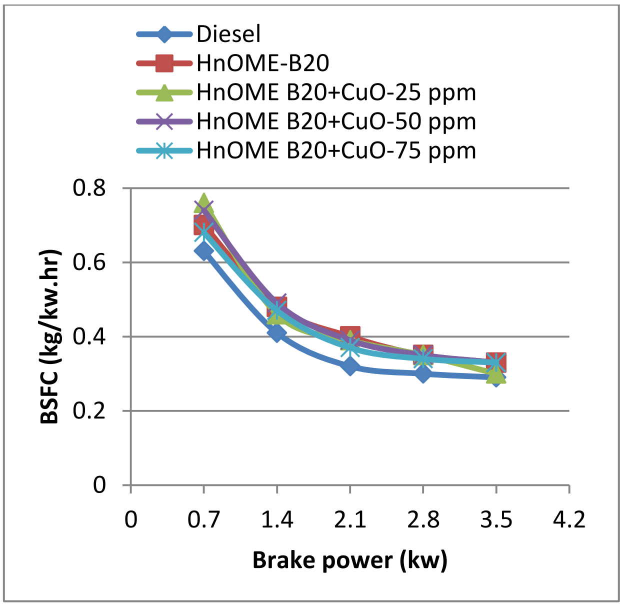

Fig 4.2: Brake Specific Fuel Consumption v/s Brake Power

Fig 4.2 shows the variation BSFC for diesel and nano additives added biodiesel at various loads. Plot shows that BSFC gradually decreases from no load condition to full load condition. From the graph we observed that BSFC for B20 biodiesel at maximum load condition is 0.33(kg/ kw.hr) whereas BSFC after the addition of CuOnano additives was found that there is 7% decrease in the fuel consumption. From the graph it observed that B20 blend with 75ppm nano additives show the good result.

4.1.3 Volumetric Efficiency

Fig 4.3 shows the volumetric efficiency of a diesel engine at various engine load conditions run on diesel fuel and the nano additives added honne biodiesel. From the graph it is observed that the volumetric efficiency decreases as the load increases. Graph shows that B20 blend with 75ppm nano additives shows the better volumetric efficiency compared to diesel fuel.

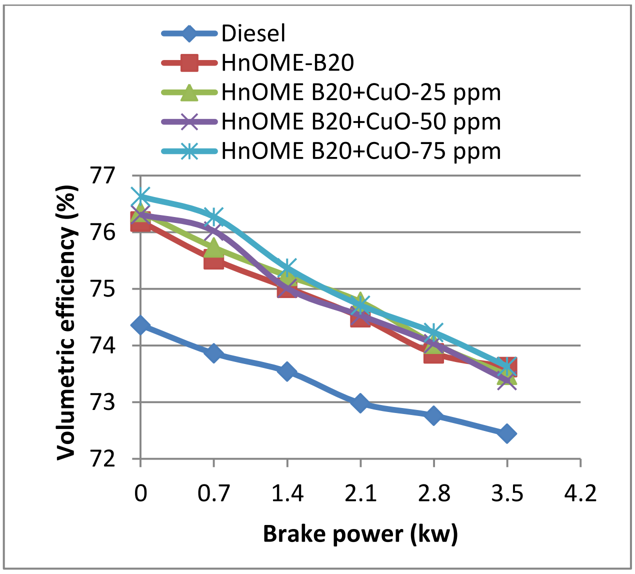

Fig 4.3: Volumetric Efficiency v/s Brake Power

4.2 Emission Analysis

4.2.1 HC Emissions

Fig 4.4 shows that effect of HC emissionsof diesel fuel and nano additives added biodiesel under various load conditions. From the graph it is observed that diesel fuel had highest HC emissions compared to biodiesel. The biodiesel with 25ppm nano additives show the least HC emissions this is due to nano additives supplies more oxygen for the oxidation of hydrocarbons during the combustion.

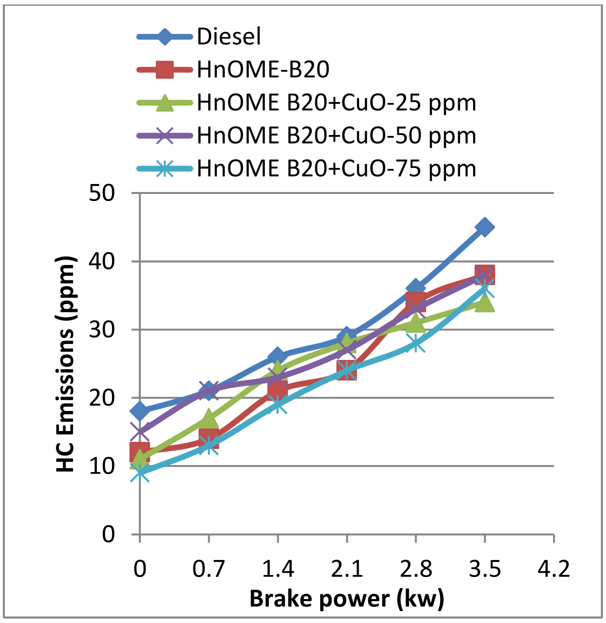

Fig 4.4: HC Emissions v/s Brake power

4.2.2 CO Emissions

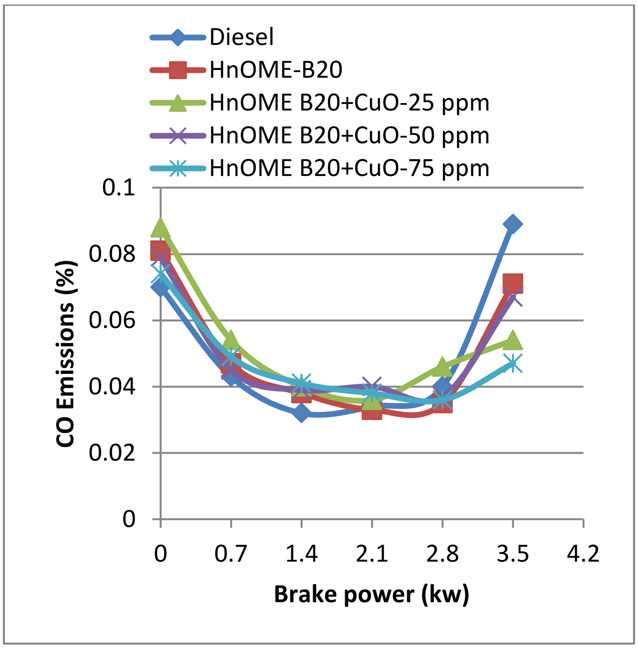

Fig 4.5: CO Emissions v/s Brake Power

Fig 4.5 shows the effect of CuOnano additives on CO emissions under various load conditions. The CuOnano additives had major influence on the CO emissions because it had large surface contact area which reduces the delay period. From the graphe it is observed that diesel fuel had highest CO emissions. By the use of nano additives at proportion of 75ppm it would reduce up to 52% of CO emissions.

4.2.3 NOx Emissions

Fig 4.6 show the effect of NOx emissions by the addition CuOnano additive under various engine load conditions. Usually by shortening delay period increases the combustion efficiency but the NOx emissions increases. The CuOnanoadditives provides more oxygen due to this heat release rate will be more hence the NOxemissions also increases. From the graph it is observed that NOx emission increases as the load increases and it is less for diesel fuel compared to nano additives added biodiesel.

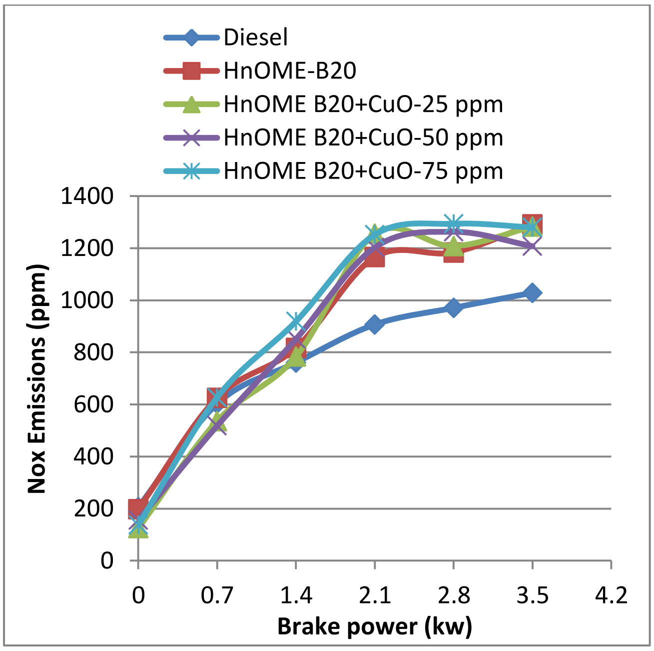

Fig 4.6: Oxides of Nitrogen v/s Brake Power

4.3 Combustion Analysis

4.3.1 Peak Pressure

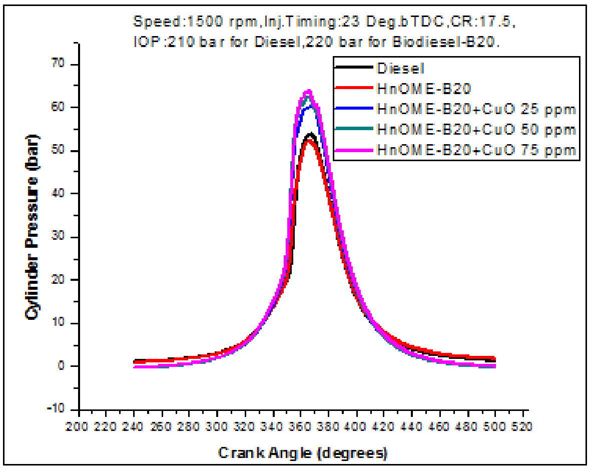

Fig 4.7: Cylinder Pressure v/s Crank Angle

Fig 4.7 shows that variation of cylinder pressure with respect to crank angle. The pressure in the cylinder is increased due to the addition of CuOnano additives this is because of high contact surface of the nano additives. From the graph it is observed the cylinder pressure increases before TDC and reaches maximum pressure and again decreases after TDC. From the graph the peak pressure is 53.63 bar for honne B20 and for honneB20+75ppm CuO is 63.66 bar at full load condition this due to addition of nano additives.

4.3.2 Heat Release Rate

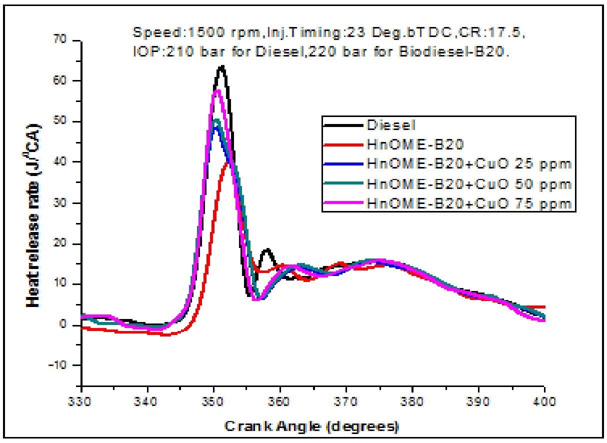

Fig 4.8: Heat Release rate v/s Crank Angle

Fig 4.8 shows the heat release rate of diesel fuel and nano additives added honne biodiesel for various crank angle. From the graph observed that heat release rate increases before TDC and attain peak heat release rate and again decreases. Heat release rate for diesel is more compared to biodiesel.

5. CONCLUSION

The performance, emission, and combustion characteristics of honne biodiesel fuel and nanoparticles blended Honne biodiesel fuels are investigated for a single cylinder constant speed direct injection diesel engine. Based on the results, improvement in BTE was observed with CuO added blends and EGR application in diesel engine are compared with neat diesel and B20 at full load operating condition The conclusions of this investigation are as follows:

1.The brake thermal efficiency and the brake specific fuel consumption of nanoparticles blended Honne biodiesel fuels are significantly improved compared to those of Honne biodiesel fuel. The maximum brake thermal efficiency for diesel, HnOME- B20+CuO 25 ppm, HnOME-B20+CuO 50 ppm, HnOME- B20+CuO 75 ppm are 31.32%, 27.04%, 26%, and 28.54% respectively. From this it is Observed is 28.54 % for HnOME- B20+CuO 75 ppm, whereas it is27.04 %for HnOME-B20 at the full load, respectively. Hence there is increment in BTE of 1.5 % with CuO 75 ppm.

2.The HC,CO and smoke emission are reduced for nanoparticles blended Honne biodiesel fuels compared to those of Honne biodiesel fuel it is attributed more oxygen supplement hence cause complete combustion. The CO, HC, and NOx emissions for the HnOME-B20+Cuo75ppm nanoparticles blends are lower compared to B20

3.The peak pressure and heat release rate are low for the nanoparticles blended Honne biodiesel fuels compared to those of Honne biodiesel fuel. The cylinder peak pressure for the HnOME at the full load observed is 53.63 bar compared to 63.66 bar for HnOME-B20+CuO 75 ppm. The maximum heat release rate observed at the full load, the release rate for HnOME-B20+CuO +75 ppm is greater compare to the HnOME-B20.

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