

Research on Performance And Emission on Compression Ignition Engine Fuelled With Blends of Neem Bio-Diesel

M. ArunKumar, G.Murali



ABSTRACT--- In this contemporary era it is mandatory to increasing the usage of non edible biodiesel to replace the fossil fuels. This non edible biodiesels are produced from vegetable oils which is clean burning and renewable. This paper deals with the performance and emission characteristics on diesel engine with blends of Castor oil as biodiesel. Castor oil biodiesel is prepared by the use of adding 1% v/v H₂SO₄ after the transesterification process. The engine tests were performed with various blends B20, B40, B60 on a single cylinder, 4-stroke, diesel engine. The result shows Higher performance and lower emissions for B20 than the diesel and other blends. The brake thermal efficiency is higher than the diesel and CO, HC and NO_x emissions were 22%, 8.4%, and 21% lesser than that of diesel.

Keywords: Castor biodiesel; Transesterification; Diesel engine; Performance; Emission; Castor blends.

I. INTRODUCTION

The voluminous utilization of petroleum has induced to exhaustion of fossil fuel in the former few decenniums. The stringency in petroleum reserves is due to the rapid civilization and mechanization. This has built another energy assets more mesmerizing. The energy properties should be re-generatable, feasible, and profitable and cost impressive. For diesel engine, bio-diesel is premediated as one of the favorable substitute riches; uniquely from non-eatable lubricant feedstock additionally it's quiescent to be an element of a feasible energy tangle in the eternity [1]. From non-eatable seed lubricant like pongamia, karanja and neem, bio-diesel can be generated, due to their meager calorific value and eminent adhesiveness and consistency. By transesterification reaction, the glycerol constituent should be eliminated. With respect to pursuance, exhalations and their concussion on environment, biodiesels with eatable and non-eatable oils are extensively inquired. Beyond any changes in the present diesel engine, composites of biodiesel can be utilized directly.

The pursuance and exhalations of coconut bio-diesel with CB5 and CB15 illustration adjacent to sleek diesel at 100% mass with fluctuating speeds of 1500-2400 rpm at a pausation of 100 rpm was inquired by Liaquat et al [2]. When correlated to net diesel fuel, average torque is 0.69% and 2.58% for CB5 and CB15 resultantly. The pursuance and exhalations of soya bean bio-diesel (20% of SME, 40% of SME, 100% of SME) upon diesel engine situated at distinctive mass at stable speed of 1500 rpm was inquired by Dawody et al [3]. For all composites, the brake specific fuel consumption was diesel acclaimed fewer than no.2 diesel. The analysis on a dualistic cylinder, direct injection, squeezing agitation engine with B10, B15, B20, B25 was accompanied by Mallikappa et al [4]. The brake thermal efficiency intensifies with surpassing brake influence and exhalation elevations (HC, CO, NO_x) were stated up to 20% composites was ascertained. Behind 20% of its composites, the carbon monoxide intensifies marginally. Bio-diesel from elegant mahua oil by dint of base catalyzed transesterification and assorted the bio-diesel with a deserved preservative (dimethyl carbonate) in flexible volume proportions (B100, B95, B90 and B85) was inquired by Swarup et al [5]. For authentic bio-diesel, NO_x exhalations were superlative. The analysis on Mitsubishi 4D68 4 inline multi cylinder squeezing agitation (CI) engine with flexible engine speeds fuelled with diesel and B5 (5% palm methyl ester+95% diesel) blended fuel was carried out by Hafizil et al [6]. To elegant petroleum diesel fuel, eventualities exposed that at complete engine speeds, torque and power output for B5 fuel were absolutely same. For twain fuels, NO_x exhalation decreased expressively but the quiescence exhalation constituents were reduced with engine speed. At 5%, 10%, 20%, 30% and 100% with mineral diesel, the pursuance and exhalations using karanja bio-diesel with contrasting combos were evaluated by Bhupendra Singh et al [7]. With respect to diesel, brake thermal efficiency was around 3-5% curtailed with karanja bio-diesel and its composites. When correlated with elegant diesel, NO_x exhalations were surpassing for the composites.

Indigenous to India and Burma, *Azadirachta indica* (neem tree) is an equatorial hedge with an extensive malleability. In assumption about 7, 00,000 tons, Indian neem delivers around 3.5 million tons of seeds every annum has been predicted. In 1990, India had been exported around 34 tons of neem kernels.

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Because of its protracted effective life span of 150-200 years, its capability to exist on dry and unprosperous soils at immense temperature of 44 degree Celsius and meager temperature of 4 degree Celsius and its immense lubricant content of 39.7-60%, the neem plant is called as a fast growing plant. Each annum, a sophisticated neem tree offers 30-50 kg fruit [8]. The bio-physicochemical premises of neem lubricant had been premeditated by Prithviraj et al. for the generation of bio-diesel. For bio-diesel feedstock, the correlation of diesel with the characteristics fuel premises of bio-diesel of neem along BIS standard demonstrates that composed nourishment are equivalent with the diesel and it can be handled as an alternate commencement[9]. Bio-diesel is produced by neem oil; this was illustrated by recent analysis. On an individual cylinder four stroke water mitigate engine, pursuance and emission characteristics were guesstimated.

II. FUEL PREPARATION

By using electric heater, specific litre of neem coarse lubricant was deliberated and passionate up to 75 degree Celsius. A solvent of 300ml of methanol and NaOH pellucid by 1% density. The combo of methanol and NaOH was enumerated moderately, when neem lubricant reaches the incalescence of 75 degree Celsius. This combo is needed to rustle progressively and H₂SO₄ was enumerated by 1% volume. All the glycerol mediates and bio-diesel waft overhead, when the combo is confessed to mediate for a day[10-15]. Then, the composites such as B10, B20 and B30 were furnished.

III. EXPERIMENTAL SET UP

For an analysis, an individual four stroke cylinder with water mitigated diesel engine was utilized. Table 1 reveals the technological particularization of the engines. Figure 1 reveals the delineative diagram of the preliminary set up. With the stable confining ratio of 18, the engine was accomplished at a stable speed of 1500 rpm. With the comfort of eddy current dynamometer, the mass difference was made.

Table 1 Specifications of the engine.

Sr. No	Parameters	Specifications
1	Engine type	Kirloskar 4 stroke, single cylinder, constant speed, diesel engine
2	Power rating	3.50 KW at 1500 rpm
3	Stroke	110 mm
4	Bore	87.5 mm
5	Capacity	661 cc
6	Compression ratio	12:1-18:1
7	Dynamometer	Eddy current type
8	Calorimeter	Type pipe in pipe

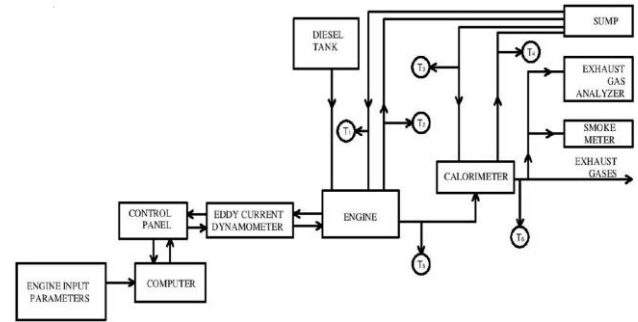


Figure 2.1 Schematic diagram of experimental setup. T1-Engine coolant inlet temperature. T2-Engine coolant outlet temperature. T3- Calorimeter coolant inlet temperature. T4-Calorimeter coolant outlet temperature. T5-Engine exhaust gases outlet temperature. T6- Exhaust gases outlet temperature from calorimeter.

The engine was analyzed with an elegant bio-diesel, at the beginning. Then the engine was analyzed with various composites of neem bio-diesel (B10, B20, and B30) eventually. For computing CO, HC and NO_x exhalations, an AVL 444 DI fume scrutinizer was utilized. For computing vapor density, an AVL437 vapor meter was utilized. With the comfort of a sensor and data accretion entity, fuel expenditure was computed. By dint of cubical air reservoir, the air spout to the engine is dismissed. The spout of air to reservoir was adapted by the air reservoir. With an aperture, the passage of air reservoir is accorded. By the utilization of coagulation air spout sensor, the air spout rate is computed. Brake power, brake thermal efficiency, specific fuel accumulation and exhalations are the parameters utilized for the pursuance of the various engines. Computing the specific fuel accumulation and exhalations like CO, HC, and Nox were achieved. With an estimation to load, outcomes were cogitated.

IV. RESULTS AND DISCUSSIONS

Performance Graphs

Specific Fuel Consumption (Kg/Kwhr)

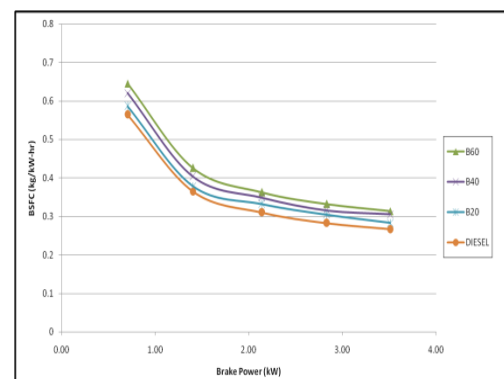


figure 4.1.1 Variation of B.P vs B.S.F.C of biodiesel blends and diesel.

The brake specific fuel accumulation of neem bio-diesel composites and diesel as the province of brake power were demonstrated in figure 4.1.1. At all loads, it is ascertained that the B.S.F.C for diesel besides B10 composites is meager than B20 and B30 from the graph .B.S.F.C also intensifies if the deliberation of neem bio-diesel intensifies. As for the similar energy outcome exceeding mass of fuel is obtained to the meager values of B30 and B20 has been imputed.

Brake Thermal Efficiency (%)

The correlation of brake thermal efficiency with diesel for neem bio-diesel has been exposed in the figure 4.1.2. At all loads it is refined that brake thermal abundance of neem bio-diesel composites are surpassing than diesel. All the three loads are sinking on the synonymous chord at meager loads. To the immense oxygen content composites, the composites are exhibiting an immense brake thermal abundance. This eventually intensifies the agitation abundance. For all mass, an intermediate accumulation in brake thermal abundance of B20 and B40 was acclaimed to be 34% adjacent to diesel[15].

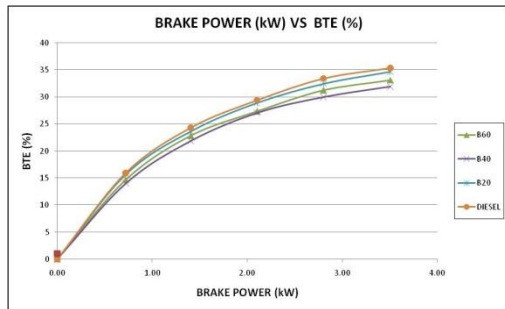


figure 4.1.2 Variation of B.T.E vs B.P of biodiesel blends and diesel.

EMISSION GRAPHS

CO Emissions

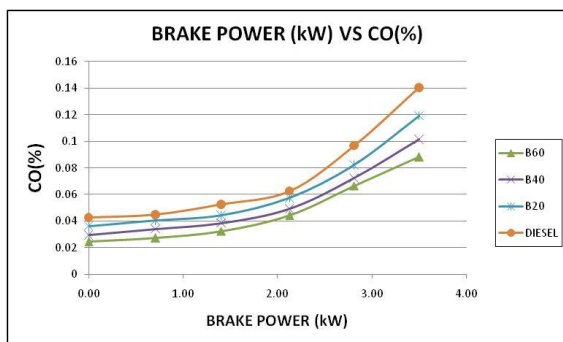


figure 4.2.1 Variation of CO emissions of biodiesel blends and diesel against load.

The aberration of CO exhalations of neem kernel composites and diesel adjacent brake power was advertised in the figure 4.2.1. Where the agitation progress does not appear exclusively, the foremost speculation for the exhalations of CO is unaccomplished agitation. CO is transformed into CO₂, by considering bio-diesel accommodates extraneous appeased oxygen. By correlated to elegant diesel, the exhalations of CO were decreased for neem composites. When correlating the diesel and Neem

B20 with the CO exhalations of Neem B20 and Neem B40, it is accompanied that CO exhalations of Neem B20 and Neem B40 is meager from the figure 4.2.1. The standard degradation in exhalations of CO was 26%, 22%, 5% for B20, B40, and B60 consequently.

HC Emissions

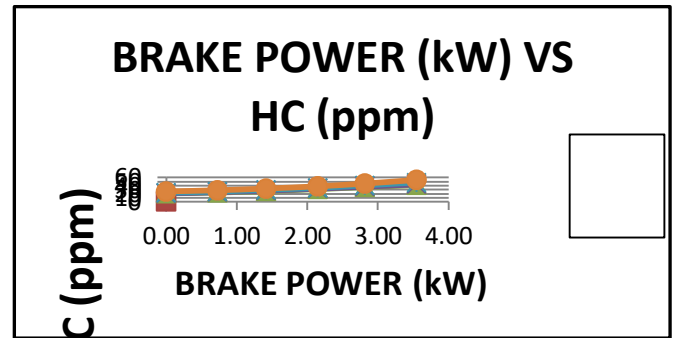


figure 4.2.2 Variation of HC emissions of biodiesel blends and diesel against load.

The aberration of HC exhalations adjacent to mass aberrations was advertised in the figure 4.2.2. Being the execution of inadequate temperature, the exhalations of HC suppressed of fuels which are not burned. Which eventualize beside the volumetric curved barrier. For agitation to be accomplished meanwhile the endowment stroke, or agitation may not executes, the speed of blaze is very little in weak combos. These premises may also stimulate immense HC exhalations. When correlated to the diesel, the standard exhalations of HC are decreased for B20, B40 and B60 by 17%, 10% and 9% consequently.

NOx Emissions

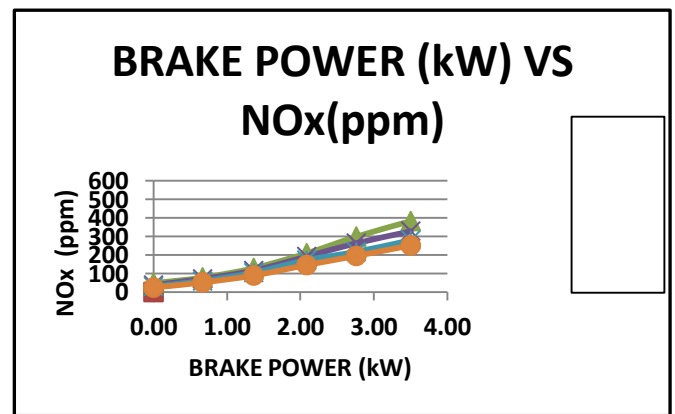


figure 4.2.3 Variation of NOX emissions of biodiesel blends and diesel against load.

The aberration of exhalations of NO_x of the composites of bio-diesel composites and diesel adjacent to brake power was advertised in the figure 4.2.3.

In the agitation enclosure, nitrogen does not proceed with oxygen conventionally.

The reaction of nitrogen with the oxygen and the generation of NO_x exhalations were caused due to the immense temperature in the cylinders.

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As correlated to diesel, the composites of neem lubricant are transmitting meager NOx. It can be imputed to meager heat emancipation rate of composites. Which may also prevails to meager agitation temperatures. The indigent combo of composites and air prevails to meager heat emancipation rate [16]. When correlated to diesel, the standard exhalations of NOx are decreased for B20, B40 and B30 by 21.875%, 8.375% and 18.875% consequently.

4.2.4 Smoke Emissions

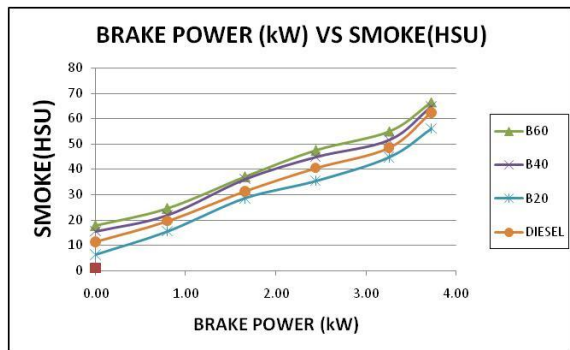


figure 4.2.4 Variation of smoke emissions of biodiesel blends and diesel against brake power.

The aberration of exhalations of smoke of composites of neem and diesel adjacent to brake power was advertised in the figure 4.2.4. For all the evaluation fuels, the exhalation due to smoke intensifies. When correlated to diesel, the exhalation of smoke is surpassing with its composites. The atomization is not convenient while the adhesiveness of the neem composites is surpassing. In all contingencies, surpassing mass smoke is equivalent (i.e.100). When correlated to diesel, the standard exhalation of smoke is elevated for B20 by 12% and for B40 and B60 by 21% consequently.

V. CONCLUSION

We can conclude that from the preliminary analysis on the pursuance and exhalation inquiry on diesel engine with the composites if neem bio-diesel as follows:

1. As correlated to diesel, the composites of neem bio-diesel mount an immense brake thermal abundance.
2. While there is no eloquent drop in the engine pursuance, neem bio-diesel can retrieve diesel in the form of composites.
3. As correlated to diesel, there is a reduction in the exhalations of CO, HC, CO₂ and NOx.
4. As correlated to diesel, the oxygen exhalations of neem bio-diesel are surpassing.
5. Neem bio-diesel can be utilized precisely in the diesel engine without any changes or it may also be utilized as composites.
6. As correlated to other composites and diesel, B20 reveals immense pursuance and meager exhalations.

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