IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 16-22

Performance And Emission Of Jatropha And Palm Oil Mixed Biodiesel Blends In Ci Engine

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Abstract: *Economic developed in developing countries has led to huge increase in the energy demand. In India, the energy demand is increasing at a rate of 6.5% per annum. Diesel is one of the main transport fuel used in all sectors. Recent concerns over the environment, increasing fuel prices and shortage of its supply have promoted the interest in development of the alternative sources for petroleum fuels. Biodiesel, as an ecofriendly and renewable fuel substitute for diesel has been getting the attention of researches all over the world.Considerable amount work had been taken in the account of biodiesel preparation.In our project we deals with combination two proven bio additives for investingation.the project exposis the trans-esterification of jatropha and palm oil by alcohol in presence of potassium hydroxide catalyst at less than 65°C. The study encourages the production of biodiesel from jatropha and palm seed oil and blends of jatropha and palm seed oil with commercially available diesel. The study reveals that jatropha and palm fuel found to be good alternative fuel for IC engine.the important properties of biodiesel such as viscosity, density,flash point, calorific value, cetane value of jatropha and palm biodiesel was measured. The aim of the present stray is to evaluate the performances and emission analysis of pure biodiesel and its blends.The end results reviewed that D60J20P20 (diesel 60%, jatropha biodiesel 20%, palm biodiesel 20%) this combination could prove the performances and emission characteristics.*

I. Introduction

Overview

Energy consumption is constantly increasing all over the world in spite of the rationalization measures that have been undertaken. Liquid fossil fuels are the main and most frequently used fuels for mobile machinery. Considering the factthat the entire development of mobile machinery is based on the useof liquid fossilfuel, itisdifficult to expect shift from this trend to a mass development and use of new engine construction that would be suitable for some other type of fuel.

Biodiesel

Biodiesel refers to a vegetable oil – or animal fat-based diesel fuel consisting of long-chain alkyl (methyl, ethyl, or propyl) esters. Biodiesel is typically made by chemically reacting lipids (e.g., vegetable oil, soybean oil, animal fat with an alcohol producing fatty acid esters. Biodiesel is meant to be used in standard diesel engines and is thus distinct from the vegetable and waste oils used to fuel converted diesel engines. Biodiesel can be used alone, or blended with petrol, diesel in any proportions. Biodiesel blends can also be used as heating oil.

Need Of Biodiesel

For more than two decades, the world has relied heavily on non-renewable crude oil derived (fossil) liquid fuels out of which 90% is estimated to be consumed for energy generation and transportation.

It is also known that emission from the combustion of these fuels is the principal causes of global warming. With population increasing rapidly and many developing countries expanding their industrial base and output, worldwide energy demand is bound to increase on the other hand crude oil reserves could be depleted in less than 50 years at the present rate of consumption.

This situation initiated the interest in identifying and channeling renewable raw material into the manufacture of liquid fuel alternatives because development of such biomass based power would ensure that newtechnologies are available to keep pace with society need for new renewable alternative power for future.

Biodiesel As An Alternate Fuel:

Bio diesel is the name of clean burning fuel, produced from domestic renewable resources. It contains no petroleum but it can be blended with petroleum diesel at any level forming biodiesel blends. It can be used in CI DI engine with no major modifications. It is simple to use, bio degradable, non-toxic and essentially free of Sulphur and aromatics. It has low long term storage capacity.

Jatropha Overview

Jatrophacurcas is the species of flowering plant in the spurge family, Euphorbiaceae, that is native to the American tropics, most likely Mexico and Central America. It is cultivated in tropical and subtropical regions around the world, becoming naturalized in some areas.The specific epithet, "curcas", was first used by Portuguese doctor Garcia de Orta more than 400 years ago and is of uncertain origin.Commonnames include Barbados nut, purging nut, physic nut, or JCL (abbreviation of Jatrophacurcas Linnaeus).

J. curcas is a poisonous, semi-evergreen shrub or small tree, reaching a height of 6 m (20 ft). It is resistant to a high degree of aridity, allowing it to be grown in deserts.

The seeds contain 27-40% oil (average: 34.4%) that can be processed to produce a high-quality biodiesel fuel, usable in a standard diesel engine. The seeds are also a source of the highly poisonous toxalbumin curcin or jatrophin.

Uses Of Jatropha

- Interest exists in producing animal feed from the bio-waste once the oil is expressed, as in the case with Haiti, where Jatrophacurcas grows prolifically and animal feed is in very short supply.
- Similarly, Metsiyen in the Haitian culture dates back as a medicinal crop - thus the name "metsiyen"/"medsiyen". Some suggest it "calms the stomach".
- Also used as a contraceptive in South Sudan.

Palm Overview

Palm oil is naturally reddish in color because of a high beta-carotene content. It is not to be confused with palm kernel oil derived from the kernel of the same fruit, or coconut oil derived from the kernel of the coconut palm (Cocosnucifera). The differences are in color (raw palm kernel oil lacks carotenoids and is not red), and in saturated fat content: palm mesocarp oil is 49% saturated, while palm kernel oil and coconut oil are 81% and 86% saturated fats, respectively.

Along with coconut oil, palm oil is one of the few highly saturated vegetable fats and is semisolid at room temperature.

Palm oil is a common cooking ingredient in the tropical belt of Africa. South east Asia and parts of Brazil. Its use in the commercial food industry in other parts of the world is widespread because of its lower cost and the high oxidative stability (saturation) of the refined product when used for fryin.

Uses Of Palm

- The use of palm oil in food products has attracted the concern of environmental activist groups; the high oil yield of the trees has encouraged wider cultivation, leading to the clearing of forests in parts of Indonesia and Malaysia to make space for oil-palm monoculture.
- This has resulted in significant acreage losses of the natural habitat of the orangutan, of which both species are endangered; one species in particular, the Sumatran orangutan, has been listed as critically endangered.
- In 2004, an industry group called the Roundtable on Sustainable Palm Oil was formed to work with the palm oil industry to address these concerns.

II. Literature Review

The following literature survey related to analysis of biodiesel produced from various seeds like jatropha seed oil, palm seed oil. The previous works carried out by various authors has been discussed here.

Hussan et al., (2013).explained that Modern civilization and transport systemsare very dependent on fossil fuels which are non-renewable in nature. The rapidly growing demand for transport fuel and industrialization has caused serious threats to the environment and energy security of the world

According to the International EnergyAgency IEA (2011),The sustainability of biofuels is progressively promoting its acceptance and market demand will rise in the near future. Around 27% of transport fuel will be completely replaced by biofuels by 2050.

Atabani et al., (2012).explained that the crude vegetable oils are incompatible with engines due to their high viscosity and low volatility, transesterified vegetable oils blended with diesel at up to 20% of total volume can certainly be considered in view of energy, environ-mental and economic concerns.

Atabaniet al., (2013).Reported that the transesterification is the chemical reaction which yields biodiesel and glycerol from crude vegetable oil. Biodiesels and their blends with diesel fuel have similar properties to diesel fuel and meet the standard specification of the ASTM and EN test methods.

deVries, (2008).reviewed that among all the conventional edible biodiesel feedstock, palm is one of the most productive and economically suitable as an alter-native biodiesel source. Average oil yield froma palm tree is3e4 times higher than any other conventional biodiesel feedstock like rapeseed or sunflower. Besides, palm oil production needs less N-fertilizers and the energy needed in palm mills is provided by the combustion of palm fibers and shells, which reduces the carbon footprint.

Kalam et al., (2012). By contrast, jatropha is a potential non-edible feed-stock and the jatropha plant can be grown almost anywhere, even on gravel, sandy and saline soils. Its water requirement is extremely low. Hence, the use of jatropha seed oil is no threat to existing cultivable land and the food chain, unlike some other conventional edible feedstock. The plant itself can improve soil quality so that it can be used for other crops in the future. Extraction of biodiesel from jatropha seeds is simple and jatropha biodiesel exhibits more useful fuel properties than any other second-generation biodiesel feedstock. Jatropha oil is favored over palm oil due to its cold filter plugging point (CFPP) value, which makes it a better option for use in cold climates.

Rakeshsarin et al.,(2006). Review that jatropha palm biodiesel blends: An optimum mix for Asia, they concluded jatropha biodiesel, blended with palm methyl ester leads to a composition having efficient and improved low temperature property as well as good oxidation stability. Jatropha biodiesel has poor oxidation stability with good low temperature properties. On the other hand, palm biodiesel has good oxidative stability, but poor low temperature properties. The combination of jatropha and palm give an additive effect on these two critical properties of biodiesel.

Techniques To Reduce The Viscosity Of Oil

Among themany different types of alternate fuels, vegetable oilsand their esters come across as good choices. Theyare renewable, as the carbon released by the burningof vegetable oils is used when the oil crops undergophotosynthesis. An intensive research isbeing conducted in developing Diesel engine fuelsand lubricants based on vegetable oils. Because of thehigh viscosity of vegetable oils, they hinder fuel jetpenetration and atomization, result in higher fuelconsumption and leave gummy deposits on theengine components upon combustion. Therefore,vegetable oils cannot be used directly in dieselengines at room temperatures. In order to reduce the viscosity of the vegetable oils, various methods are

1. Blending
2. Transesterification,
3. Micro emulsion,
4. Pyrolysis or thermal cracking
5. Preheating.

Experimental Set Up

The experimental set up is shown in figure 1. A 2000 ml three necked round –bottom flask was used as a reactor. The flask was placed in heating mantle whose temperature could be controlled within 2 0˚C. One of the two side necks was equipped with a condenser and the other was used as a thermo well. A thermometer was placed in the thermo well containing little glycerol for temperature measurement inside the reactor. A blade stirrer was passed through the central neck, which was connected to a motor along with speed regulator for adjusting and controlling the stirrer speed.

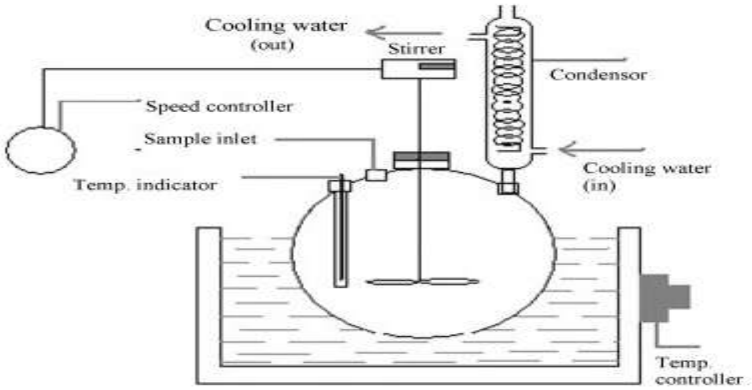

Figure 4.1 Experimental setup

Comparison of diesel vs biodiesel values

S.no	Fuel properties	Diesel	Jatropha oil	Jatropha biodiesel	Palm oil	Palm biodiesel
1.	Net calorific value (MJ/kg)	42	36.01	37.1	36.76	37.12
2.	Flash point (˚C)	60-80	242	192	198	135
3.	Viscosity (cSt,30˚C)	2.6	51	5.3	45	4.98
4.	Cetane value	47.8	51	58.4	48.2	54.6
5.	Density(kg/m³@15˚C)	841	932	887	918	83

Comparison of diesel vs blended biodiesel values

S.no	Fuel properties	diesel	Blend A	Blend B	Blend C	Blend D	Blend E
1.	Net calorific value (MJ/kg)	42	41.02	40.04	39.06	3808	37.11
2.	Flash point (˚C)	60-80	84.7	117.9	124.1	157.3	163.5
3.	Viscosity (cSt,30˚C)	2.6	3.108	3.616	4.124	4.632	5.14

III. Result And Discussion

Performances Charateristics:

Brake Thermal Efficiency: (Bte)

It is the ratio of energy in the brake power to the input fuel energy in appropriate units.

B.T.E $=\frac{B.P*3600}{BSFC*C.V}$

Where

C.V= calorific value in kJ/kg.

For all fuel blend. BTE value is reduced except blend B

The value of BTE for blend B is almost equal to D100

Because of mixed biodiesel in diesel decreases thermal efficiency due to poor combustion characteristics of blends owing to their relatively high viscosity and poor volatility

For 100% LOAD B-A 12.86%, B-B 0.30%,B-C 12.20%, B-D 20.47, B-E 28.4

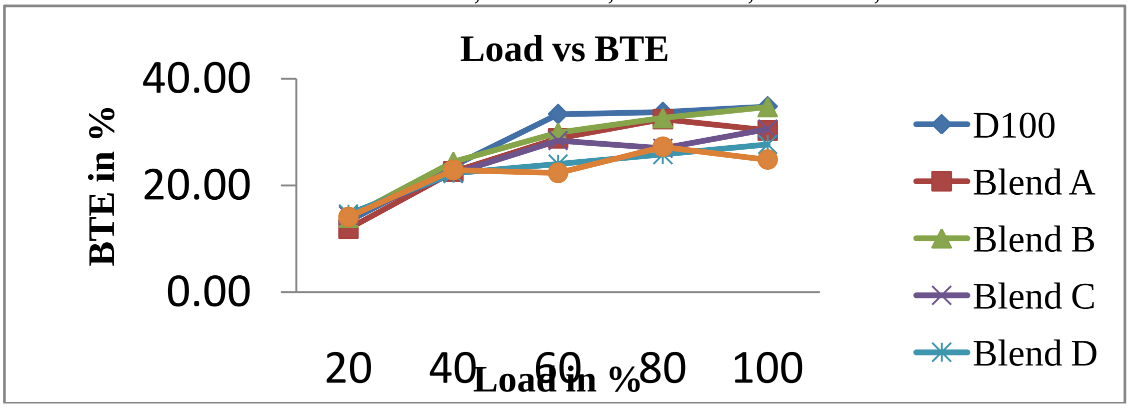

Figure 7.1 Load vs BTE

Brake Specific Fuel Consumption (Bsfc)

The fuel consumption characteristics of an engine are generally in terms of Specific fuel consumption in kilograms of fuel per kilometer. It is defined as the ratio of fuel consumption per unit time to power.

B.S.F.C= $\frac{T.F.C}{B.P}$(kg/KWhr)

TFC =(time consumption/time)*(specific gravity of fuel / 1000)

BSFC is reduced when increasing the load.

for all blends, high viscosity ,high density leads to improper fuel injection that result higher BSFC

For all blends, the net calorific value is reduced, that leads to consume more amount of fuel to produce the same power

The BSFC value increased by B-A 16.42%,B-B 13.24% ,B-C 18.19%, B-D 37.32%, B-E 50.64% to compare diesel in higher load

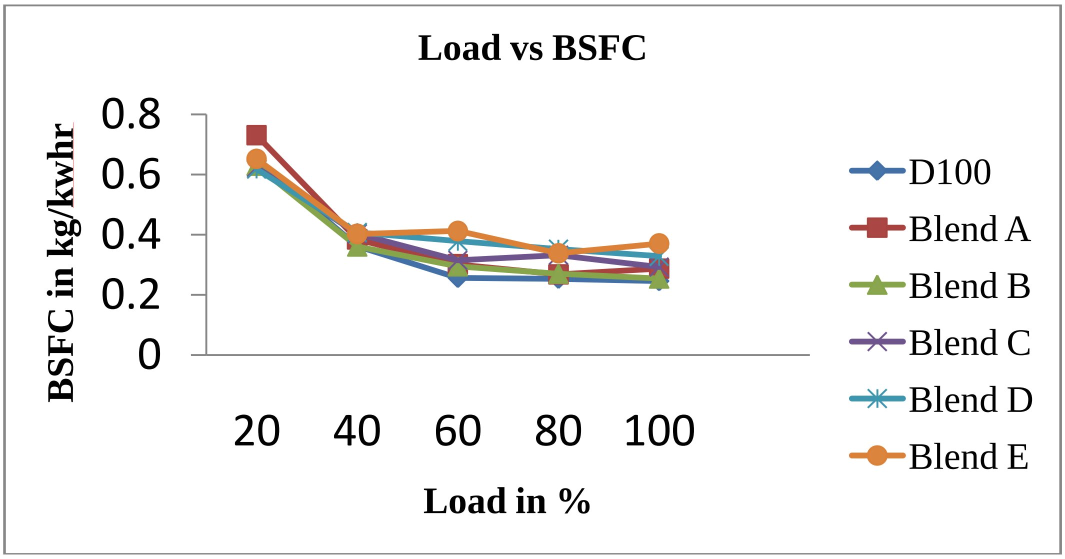

Figure 7.2 Load vs BSFC

Emission Characteristics
Smoke

Soot emissions from a diesel engine are manifested as visible black smoke. Smoke is nothing but the carbon particles suspended in the exhaust gases. Engine smoke is normally visible at the tail pipe, when the engine is accelerated or decelerated. Smoke emission increase with increase in engine load due to overall richer fuel air ratio, longer duration of diffusion combustion phase and reduced oxygen concentration.

Smoke reducing leads to biodiesel containO_2 .

Better combustion it will produce the lesser smoke.

For all bends B-A 18.36%, B-B 22.03 %, B-C 11.83%, increasing B-D 4% ,B-E 24% to compare diesel in loads.

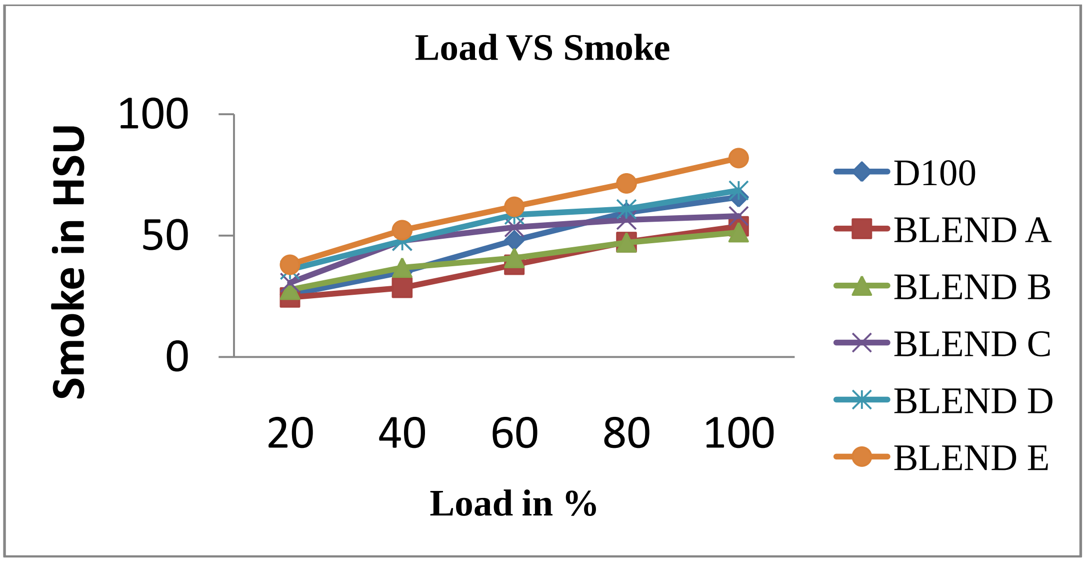

Figure 7.3 Load VS Smoke

Oxides Of Nitrogen

Among the gaseous pollutants emitted by diesel engine the oxides of nitrogen are the most significant. The formation of oxide, which is a major component of the oxides of nitrogen depend on a number of operating condition of the diesel engine. The main factors that control the formation of oxide are the amount of oxygen available, the peak temperature of zones with sufficient oxygen and residence temperature above 2000 K.

When fuel temperature is increases NO_X will be increasing

Oxygen content enhance the combustion temperature will be increase

For all blends B-A 5.32%, B-B 21.3%, B-C 26.4% , B-D 31.2%, B-E 80.4% to compare the diesel in higher loads.

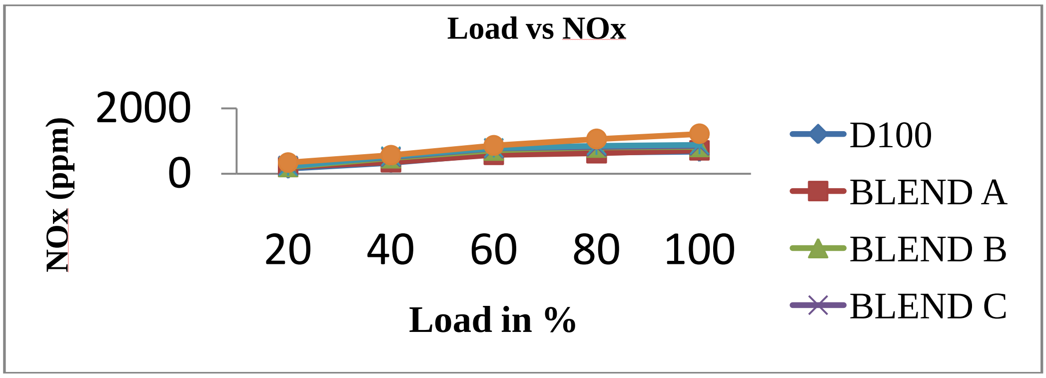

Figure 7.4 Load vsNOx

Hydrocarbon

The unburned hydrocarbon emission level from diesel engine is considerably lower than that from spark ignition engines. In the case of diesel engines, however, low exhaust gas temperature prevents the reduction of emission by catalyst. Furthermore, hydrocarbons emitted from diesel engines in the gases phase being absorbed on soot, makes the after treatment of soot difficult. Therefore, reduction of hydrogen emission remains one of the most important problems for both CI and DI diesel engines.

The dual biodiesel and blends generally exhibit lower HC emission at lower engine and higher HC emission at higher engine . This is because less oxygenavailable for the reaction when more fuel is injection at higher load . The lower calorific value and the higher viscosity of biodiesel oil result in the highest HC emission.

For all blends B-A 83.5%, B-B 49.2 %, B-C 20. 6%,B-D 3.17%, B-E 36.5% for diesel in higher loads.

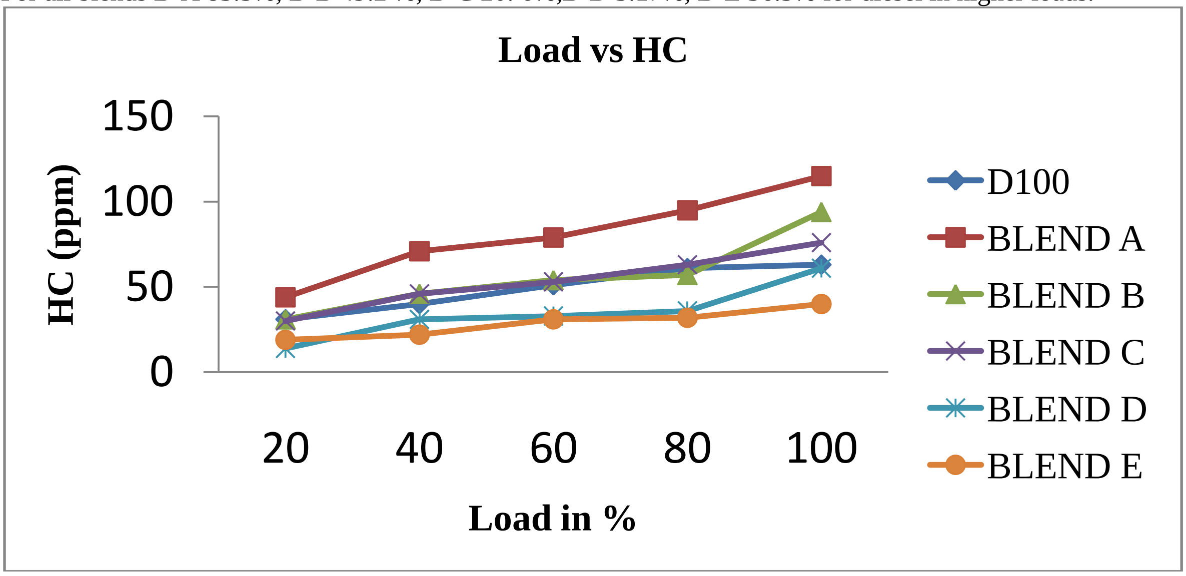

Figure 7.5 Load vs HC

Carbonmonoxide

It is a colorless and odorless but a poisonous gas. It is generated in an engine when it is operated with a fuel rich equivalence ratio. When there is not enough oxygen to convert to all carbon to carbon dioxide .some fuel does not get burned and some carbon ends up as carbon monoxide. Poor mixing, local rich region, incomplete combustion will also be the source of CO emission.

The dual biodiesel and blends generally exhibit lower CO emission at lower engine and higher CO emission at higher engine. This is because less oxygen available for the reaction when more fuel is injection at higher load. The lower calorific value and the higher viscosity of biodiesel oil result in the highest CO emission

For all blends B-A, B-B, B-C, B-D is increasing B-E 12.5 % to compare the diesel in higher loads.

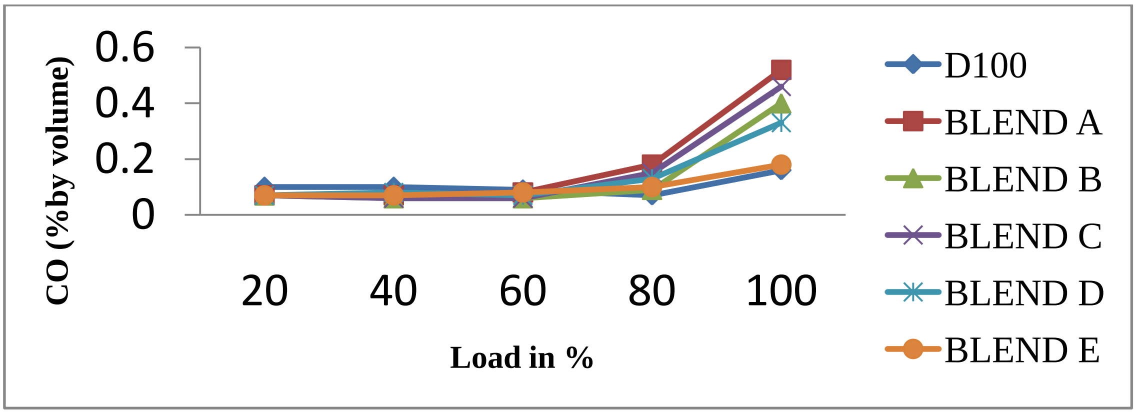

Figure 7.6 Load vs CO

IV. Conclusion

From the experimental investigation we have noticed that DIESEL 60% JATROPHA 20% PALM 20% (BLEND B) blend DI CI diesel engine could perform better and equivalent to diesel.
The results were tabulated below:

Table 8.1 Result

S.NO	Performance and emission	D100	BLEND B
1.	BSFC	0.24	0.25
2.	BTE	34.81	34.70
3.	SMOKE (HSU)	65.9	51.4
4.	NOx (ppm)	676	820
5.	HC (ppm)	63	94
6.	CO (%by vol)	0.16	0.40

1) BTE and BSFC value is almost equal to D100
2) Smoke is reduced
3) HC,CO, NO_X value is increased in D100

Future Scope:

We can add catalytic converter to reduce the exhaust parameter.