Performance Analysis of Single Cylinder Diesel Engine with Mango Seed Oil and Additive (Cerium Oxide)

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Abstract- *In the present work approach to reduce the viscosity of the bio diesel and in order to improve the calorific value of bio diesel extracted from the mango seed oil cerium oxide as been used as a fuel additive. The mango seed oil is prepared by employing transesterification process and blended with 10%,20%,30% of fuel and additives blended with bio diesel. The optimum blend ratio of fuel additives was identified and 20% of additives shows better performance than others. The experiment was conducted in a single cylinder DI diesel engine From the experimental investigation it is found that, viscosity has been reduced and it shows increase in calorific value. The brake thermal efficiency for 20% additive fuel is slightly increased. The scarcity and increase in the crude oil prices have forced everyone to think on the use of biodiesel as an alternative fuel source. Also, it is important that unlike the traditional fuels which emit green house gases and particulate matter.*

Keywords- Biodiesel, Blend, mango seed oil Biodiesel, additives

I. INTRODUCTION

Although diesel engines are generally more efficient than spark ignition engines, emissions from diesel engines are tupically higer. Biodiesel fuel is one of the alternate fuels for diesel fuel.Biodiesel can be used with diesel fuel at different proportions,as it has very similar characteristics but lower exhaust emissions.The burning of fossil fuels is connected with emission such as CO_2,CO,NO_X,SO_X and particulate matter,smoke,which are currently foremost global sources of emissions[1].

S.Savariraj et al [1] studied the "experimental investigation on DI Diesel engine powered with Raw Mango seed oil(MSO) and Mango seed bio diesel (MSBD)". The objective of the present work is on replacing the conventional diesel fuel with raw mango seed oil with diesel (B25,B50,B75 and B100) and methyl ester of mango seed oil (MSBD)with diesel (BD25,BD50,BD75, and BD100).The bio diesel of MSO was prepared by transesterfication process. The experimental results proved that SFC is less for MSBD than raw MSO and brake thermal efficiency is more for MSBD than raw MSO.S.Savariraj et al [2] Reported on "characterization of the DI diesel engine powered by mango seed oil methyl ester with fuel additive" In his work approach to reduce the viscosity of the bio diesel and in order to improve the calorific value of bio diesel extracted from the mango seed oil 1,4 dioxane has been used as a fuel additive. The methyl ester mango seed oil is prepared by employing transesterification process and blended with 2.5%,5%,7%,10% of fuel additives blended with bio diesel.The brake thermal efficiency for 10% additive fuel is slightly increased and significantly reduced NOx emission about 200ppm.

Musa umaru et al [3] studied on"production and characterization of bio diesel from Nigerian Mango seed oil" The bio diesel produced was characterized to ascertain its suitability for use as fuel. Results obtained showed that increase in temperature result in corresponding increase in the bio diesel yield .A yield of 83% wt was obtained at an optimum temperature of 60^0c.The result of biodiesel characterization shows that the fuel fulfills most of the ASTM and EN Standard so can be used as a possible candidate for replacement for petroleum diesel.

E.Muthamizhselvan et al [4] Reported on "prediction and reduction of NOx Emission Using bio fuel in multi cylinder diesel engine by injecting ammonia with SCR" injection of aqueous solutions of ammonia in the tail pipe of a diesel engine for the decrease of oxides of nitrogen (NOx) has been carried out in a four stroke multi cylinder,water cooled, constant speed diesel engine, four observation has been made for the exhaust emission NOx analysis of concentration of ammonia solution B25,B50,B75 and B100 by weight with different pressure of ammonia solution as reductant by fitting Marine ferromanganese nodule as SCR catalyst.

C.Syed Aalam et al[5]; studied on experimental investigation on a CRDI system assisted diesel engine fuel with aluminium oxdie nanoparticles blended with biodiesel. Experiments were conducted to determine engine performance ,exhaust emissions and combustion characteristics of a single cylinder,common rail direct injection system with 25% of zizipus jujube methyl ester blended fuel (ZJME25).The results also showed a considerable enhancement in brake thermal

efficiency and heat release due to the influence of aluminium oxide nonoparticles addition in biodiesel –diesel blend.

V.sajith et al[6] Reported on experimental investigation on the effect of cerium oxide nanoparticle fuel additives on biodiesel .comparisons of the performance of the fuel with and without the additive are also presented engine test modified bio diesel at different dosing levels (22 -80ppm) of the additive showed on improvement in the efficiency of the engine.emission levels of hydrocarbon and NO_x are appreciably reduced with the addition of cerium oxide nanoparticles.HE Liying et al [7] studied on Recent advances of cerium oxide nanoparticles in synthesis luminescence and biomedical studies a review . the CeO_2 nanoparicles can be synthesized by solution based methods including co –precipitation,hydrothermal , microemulsion process,sol-gel techniques combustion reaction and so on.nanostructured cerium oxide (CeO2) commonly known as nanoceria is a rare earth metal oxide, which plays a technologically important role due to its versatile applications as automobile exhaust catalysts. Dhiraj s. patil et al [8] Studied on "the effect of cerium oxide nanoparticle as fuel additives in diesel and bio diesel blends" the main objective paper is the need to reduce the emission which is major impulse to the developmemt of alternative fuel.it is found that the cerium oxide additive perform well in diesel ,diesel- bio diesel blends and improves the performance characteristics of CI Engine with improved brake thermal efficiency ,brake specific fuel consumption and reduce the engine emission without any physical modification in an engine.

From the literature survey the present work is planed Performance Analysis of Single Cylinder Diesel Engine with mango seed oil and additive (cerium oxide) The present work focused on fuel additives blendsed mango seed oil. The objective of the present work is focused on adding cerium oxide as a suitable additiveblended with mando seed oil to improve the fuel properties.

II. MATERIALS AND METHODS

Preparation of bio diesel Mango seed oil Is produced from mango seed which is commercially available in market . Generally it Is used in soap industry and cosmetic industry. The mango seed is dried in room temperature and the shell is removed and subject to crusher to crush the mango seed and finally oil is derived .Preparation of bio diesel from mango seed oil is done by transesterification. it is the process of using methanol (CH3OH) in the presence of catalyst (potassium KOH) to chemically brake the molecules of raw mango seed oil into ester and glycerol.This process reacts with the oil mixed with alcohol to remove the glycerin, a byproduct of bio diesel production. The methyl ester of mango seed oil id mixed well cerium oxide with help of a magnetic stirrer.

Properties of Diesel,Mango seed oil

Properties	Diesel	Mango seed oil	B20
Density(kg/m^3)	0.812	0.967	0.843
Calorific value(kcal/kg)	10047.850	9986.000	10035.48
KinematicViscosity(m^2/sec)	1*10^{-6}	2.98*10^{-6}	1.396*10^{-6}
Flash point (^{0}C)	38	150	60.4
Fire point (^{0}C)	45	170	70

Fig (1)

III. EXPERIMENTAL SET – UP

The Experimental investigation was carried out in single cylinder water cooled DI diesel engine with 80mm bore 110mm stroke and 16.5:1 compression ratio.The engine is started with no load condition The engine is allowed to work for at least 10 minutes to stabilize.Initially engine was run with the pure diesel from no load to full load condition with an increment of 25% of load in each run. After getting the steady state the parameters such as the Manometer reading, Time taken for 10cc fuel consumption, exhaust emissions NOx, HC, CO and Exhaust gas temperature etc.,

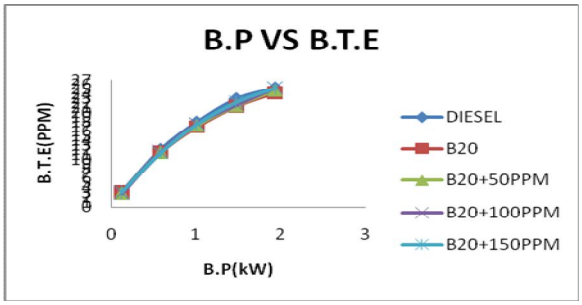
were taken as per the observation table. Engine was then run on blend of Mango seed biodiesel mixed in 20% by volume represented by B_{20}, respectively. Performance parameters are noted.The experiments are repeated for B20 blend with different mass fractions of nano particles and readings are noted.

Table Engine Specifications

Make	Kirlosker Model AV
Bore	80mm
Stroke	110
R.P.M	1500
B.H.P	5H.p(3.72k.w)
C.R	16.5:1
Fuel	H.S Diesel oil
Sp Gravity	0.8275
C.V	10300kcal/kg
Dia of orifice	30mm
Dia of Brake drum 'd1'	0.3m
Dia of rope 'd2'	0.015m
1kcal	4.188kj/kg

IV. RESULTS AND DISCUSSION

The experimental investigation consists of two phase of work the first phase of the work having without fuel additives, the second phase of the work is with fuel additives. The additives concentration varies from 50ppm ,100ppm,150ppm cerium oxide blended with mango seed oil.the influence of fuel additives in the bio diesel to analyze the performance and the emission and identify best concentration of fuel additives.



Graph -1 Brake power vs brake thermal efficiency

Graph (1) shows the influence of fuel additives concentration on 100%, B20, B20 + 50PPM, B20 + 100PPM, B20 + 150PPM. with respective brake power of the engine generally bio diesel have low unsaturated acid.The presence of cerium oxide fuel additive in the bio diesel influence the complete combustion of fuel during the combustion.Among the concentration 100ppm volume shows maximum brake thermal efficiency when compared to other. The brake thermal efficiency of mango seed oil with cerium oxide additive increases by 2.09% of B20+100PPM when compared to B20.

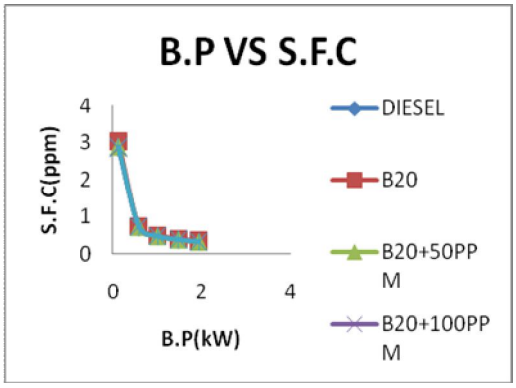


Fig (3) ; specific fuel consumption vs brake power Fig (3) shows the various of specific fuel consumption with brake power for bio diesel blend and modified bio diesel with different dosing levels of the cerium oxide nanoparticles. The specific fuel consumption is decreased by 7.14%B20+100PPM when compared to B20. But The Specific fuel consumption is increased by 3 %at B20 compared to diesel from the fig it is observed that the BSFC values of neat diesel fuel and 50ppm and 100ppm nearly same .

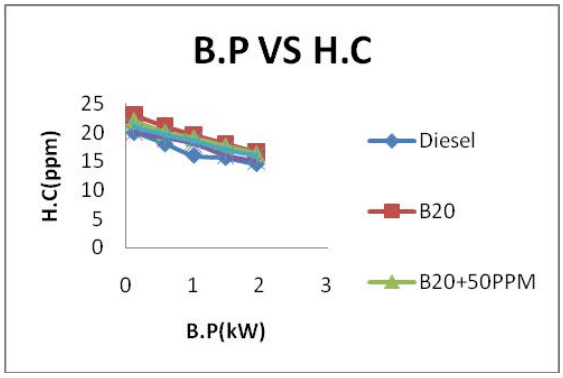


Fig (4) : hydrocarbon vs brake power

Fig (4) shows the variation of hydrocarbon emission for 50ppm, 100ppm,150ppm level of Ce_2O_3 in bio diesel blend. Addition of cerium oxide nanoparticles increase the level of oxygen content in the bio diesel blend. However oxygen content of fuel is the main reason for HC emission reduction and complete combustion.from the fig The HC emission was decreased by 9.09% of B20+100PPM when compared to B20. But The HC emissions was increased by 12.12% of B20 blend i.e (16.5ppm) when compared to diesel (14.5ppm).

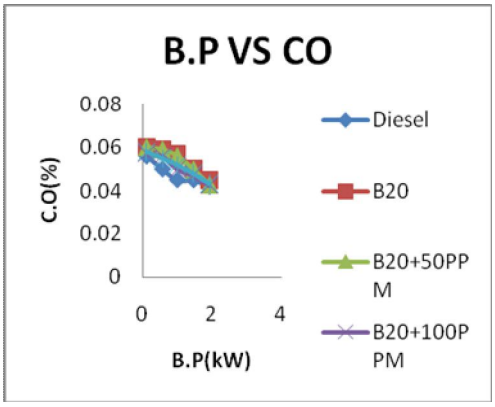


Fig (5) CO VS B.P

Fig(5) shows the influence of the cerium oxide nanoparticles addition to bio diesel on carbon monoxide emissions.non metal oxide particles as an oxidation catalyst lead to high carbon combustion activation and hence promote complete combustion. The nanoparticles blended fuels showed accelerated combustion due to the shortened ignition delay. due to shortened of ignition delay the degree of fuel air mixing and uniform burning could have enhanced. The CO emission was decreased by 5.55% of B20+100PPM when compared to B20.but In the present work the CO emissions are increased by 6.6%at B20 compared to diesel

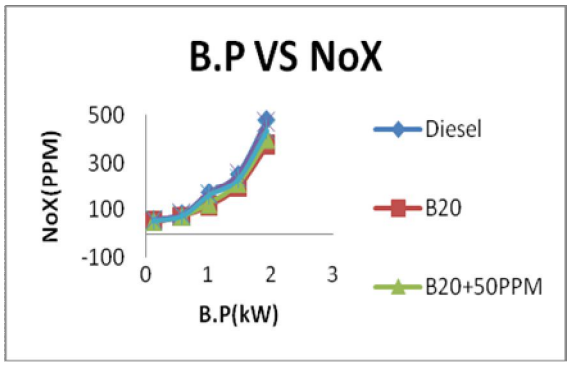


Fig (6) B.P VS NOx

Fig (6) shows NOx emission with and without the addition of nanoparticles on Ce_2O_3

NOx increase with addition of nanoparticles in all the cases. NOx emission is depended on temperature , the local concentration of oxygen and the duration of combustion during different combustion phases on the different combustion zones. By the addition of nanoparticles ,which increases the diffusion controlled combustion duration that increase the NOx emission. The NOx emission was increased by 20.12% of B20+100PPM when compared to B20. But In the present work the CO emissions are increased by 6.6%at B20 compared to diesel

V. CONCLUSION

The experiments were conducted with Mango seed oil biodiesel and Ce_2o_3 as a additive, have been studied and investigated the performance and emission characteristics. The experiments were conducted on a single cylinder four stroke diesel engine when engine fuelled with blending of Mango seed oil biodiesel and diesel along with Cerium oxide nano fluid as additive .

- The Brake thermal efficiency of mango seed oil blend B20 decreases by 4.2% when compared to diesel .due to its low calorific value of mango seed oil.
- The Specific fuel consumption is increased by 3 %at B20 compared to diesel
- The HC emissions was increased by 12.12% of B20 blend i.e (16.5ppm) when compared to diesel (14.5ppm).
- In the present work the CO emissions are increased by 6.6%at B20 compared to diesel
- In present work the NO_x emissions are decreased by 22%at B20 compareed to diesel
- The brake thermal efficiency of mango seed oil with cerium oxide additive increases by 2.09% of B20+100PPM when compared to B20.
- The specific fuel consumption is decreased by 7.14%B20+100PPM when compared to B20.
- The HC emission was decreased by 9.09% of B20+100PPM when compared to B20.
- The CO emission was decreased by 5.55% of B20+100PPM when compared to B20.
- The NOx emission was increased by 20.12% of B20+100PPM when compared to B20.

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