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INVESTIGATION ON EFFECT OF EGR ON CI ENGINE FUELLED WITH KARANJA BIODIESEL:A REVIEW

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ABSTRACT

Internal combustion engine, mainly diesel engine play important role for transportation purpose, off road heavy duty works, in passenger vehicles and mechanized agricultural works. Looking towards continuous decrements of fossil fuels and stringent emission norms lead to have use of alternate fuel so as to control emission due to stringent emission norms as well to enhance life and performance of engine. Use of biodiesel is now developing interest towards use of alternative fuel. As in India biodiesel production mainly from jatropha seed, karanja plant, neem oil etc. Karanja oil properties is same as that of diesel recommended that transesterification process need to followed by proper catalyst. By literature survey it is found that Biodiesel blend of karanja oil with diesel say KBD30+EGR10% shows good properties as thermal efficiency is get improves as well NO emission get reduced by 25% ,HC by 15% and significant reduction in CO too [7]. Main reason behind EGR is to reduced cylinder pressure and temperature so as to reduce NO emission

KEYWORDS:-EGR(Exhaust Gas Recirculation),KBD-Karanja Biodiesel,NOx,Transesterification etc.

INTRODUCTION

Due to higher value of diesel, more interest are getting developed in making biodiesel from various plant available in India mostly jatropha, karanja, neem oil etc. Due to natural vegetable oil viscosity is more as that of diesel so as to match up with diesel it is mandatory to catalyst the reaction with methanol or ethanol or methyl ester, ethyl esters as a fuel additives to enhance quality of fuel. It is found that heating value is more as compared to diesel. In case of biodiesel amount of oxygen molecule is more due to which cylinder temperature increase due to complete combustion of fuel as compare to plane diesel so as to reduce temperature of cylinder cold EGR can be used. Looking towards stringent norms more interest are getting developed towards after treatment devices and external EGR technique. EGR is recirculation partial exhaust gases from EGR cooler so to cool it near atm temperature and allow to mix it with inlet fresh air via EGR valve. Due to EGR Peak pressure and temperature of cylinder can be maintained and NO emission can be reduced. [8,9,13]

By literature survey it is found that for single, double, multiple cylinder biodiesel can use direct with diesel in following proportions with EGR Proportion so as to achieve emission and performance of engine.

(1)KBD15+EGR5%, (2)KBD20+EGR8%, (3)KBD25+EGR10%, (4)KBD30+EGR12% etc. So all parameter can be checked at rated speed and different load. Some author enlisted below in list of survey found that during low EGR thermal efficiency get increases and NO emission reduction takes place also HC, CO significantly decreases. But at High EGR in case of mode (4), thermal efficiency reduced by little amount and NO drastically falls down by 45% likewise HC formation will be there with some white smoke particle emissions. Some of author conducted Experiment of plane diesel and varying EGR rate and compared with karanja biodiesel with varying EGR at different load and found that there was somewhat more emission reduction with improved thermal efficiency takes place. [7]

LITERATURE SURVEY AND REVIEW

Barnwal B.K. et al(2005) explained an importance of Biodiesel production from vegetable oil in india. Also explained its development, availability, uses and its effect on engine life and performance emission characteristics likewise.

Nitin shrivastava et al(2012) explained and carried experiment on single cylinder diesel engine fuelled with jatropa oil and found that due to use of jatropa increases NO_x emission at low EGR condition and further decreases significantly at High EGR said 20%. HC emission reduction can be seen at 15% EGR afterwards increased due to high EGR rate.[9]

M.K.Duraisamy et al(2011) carried test on CI engine fuelled with jatropa Biodiesel for NO reduction and found that for 15% EGR and JBD25+D75 composition NO get reduced and thermal efficiency is increased by 1.12%.[12]

S.A.Ransing et al(2015) reviewed the critical effects of EGR rates and various BD(Biodiesel)blend with varying diesel composition. He found that number of author working on BD with varying diesel composition for checking which one is better than other. Some of them apply EGR kit to it for more emission reduction. By EGR application and BD blend with diesel, emission get reduced by 15% more as compared to pure BD+Diesel composition.[10]

V.V.Pratibha bharati et al(2012) carried experiment on effect of EGR with karanja biodiesel. She observed CO emission reduced by 2.95%, HC by 5.4%, and NO by 13%, some improvement in brake specific fuel consumption is about 2.9%, BTE(Brake Thermal Efficiency) is increased by about 7.4% .[7]

H.H.Masjuki et al(2006) carried experiment on unmodified engine fuelled with biodiesel and fuel additives, they found that palm diesel with additives(B20X) produces higher brake power and lower SFC as compared to BD10 and BD20 fuel. Use of palm diesel with additive(B20X) reduces NO_x and CO and HC emissions.[3]

Gagandip singh bhuye et al(2015) carried out research work on twin cylinder CI engine and found with use of biodiesel karanja, NO and HC significantly decreases. with use of KBD25+75D give 20% reduction in NO emission and sharply thermal efficiency is get improved.[15]

S.V.Kale et al(2008)carried out experiment on CI engine fuelled with pongamia oil methyl ester with diesel fuel.he found maximum brake thermal efficiency of 27.13% achieved for BD20.While on diesel was 28.10% for same power for BD20 is more by 6.2% at 4.25 kW load and 24% at full load.[14]

T.Pushpraj et al(2012) studied different blends of biodiesel fuel with conventional diesel fuel. Exhaust emission were studied at 3000 RPM.Brake thermal efficiency is higher compared to conventional fuel.CO and CO₂ marginally lower than that of diesel.[4]

Wail M.Adaileh et al(2009) studied flammable qualities with biodiesel fuel blend.HC,CO,NO decreases at higher speed.The level of NO formation will be more when utilizing B5 and B20 rather than conventional diesel fuel.

Bobade S.N.et al(2012) studied properties of karanja oil.he used soxhelt method for oil extraction. it was observed that oil content 35%(by soxhelt extraction),24% by mechanical expeller. In transesterification process reaction of triglycerides (Fat/oil) with an alcohol in form of alkyl esters that is biodiesel and glycerol.[17]

Venkata Ramesh Mamilla et al(2011) studied biodiesel can be prepared from the karanja oil since acid content of this oil was more than 3ppm.So it can be changed over to biodiesel by esterification process.soxhlet apparatus is used to extract it.[6]

EGR TECHNIQUE

EGR is mostly used to reduce NO formation in high duty diesel engines.EGR method involve recirculation part fraction of exhaust gases say 10 to 15% back to suction inlet before combustion[13].So it will dilute the charge inside cylinder tend to reduce overall cylinder temperature. As in review we have seen use of Biodiesel fuel,cylinder temperature will increase due to complete combustion of fuel due to more availability of oxygen molecules. So to reduce that error we can imply EGR in some partially cooled condition back to suction inlet before combustion. This will dilute the mixture and overall cylinder temperature will be maintained. This will help to reduce NO emission and HC too.[11-13]

V.Pradeep et al(2007) investigate effect of hot EGR along with JBD100 on emission parameters. Smoke opacity was found out to be high on both 20% and 25% EGR at high load. For both fuel at high load NO emission found to be under reduction zone.[17]

Pratik G.sapre et al(2014) investigate performance and emissions parameters with cold EGR and Hot EGR and observed that thermal efficiency increases with lower EGR Rate and get lower by 0.9%.At 20% EGR at 45N-M torque. But in case of Cold EGR NO_x formation get reduced by 64% but thermal efficiency decreases by 1.12% also increases at high load and High EGR say 15%.[13]

Objective of this review is to check effect of biodiesel alone and EGR alone on emission parameter and together with on the same.[13]

$$\text{EGR Ratio (\%)} = \frac{\text{Volume of Exhaust gases recirculated}}{\text{Volume of fresh charge incomming}} \times 100$$

Parameter is to be study for KBD30+EGR10% is following:-

- Brake Thermal efficiency
- Specific Fuel consumption
- Brake specific fuel consumption
- Brake mean effective pressure
- NOx,CO,HC,CO₂, Smoke opacity etc

TRANSESTERIFICATION

It is also called as alcoholysis.It is the displacement of alcohol from esters by another alcohol in process similar to hydrolysis, except than a alcohol is used instead of water.



If methanol is used in above equation it is termed as methanolysis.the reaction of triglyceride with methanol represented by general equations.[6]

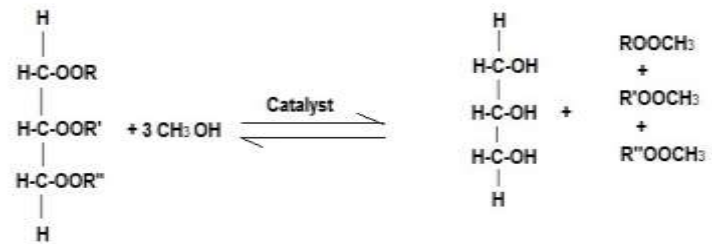


Fig:-Transesterification reaction with methanol

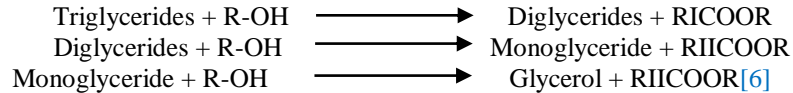


Fig 2:- seeds of karanja[6]



Fig 3:- oil expelled from seeds of karanja.[6]

PROPERTIES OF METHYL ESTERS

The properties of methyl esters produced were measured using respective standard techniques. It was found that the properties of the methyl esters satisfy Indian standards (IS 15607:2005) for Biodiesels. Properties of methyl esters and diesel according to ISI standars given in table 1 and 2.[6]

Property	Karanja oil
Density(Kg/m ²)	991
Kinematic viscosity c.stockes	69.6
Flash point(°C)	241
Fire Point(°C)	253
Heating Value KJ/Kg	34000
Specific Gravity	0.912

Table 1:- properties of oil before esterification [6]

Property	Karanja Methyl esters	Diesel	IS for biodiesel
Density(Kg/m ²)	855	836	860-900
Kinematic viscosity c.stockes	5.60	3.8	2.5-6
Flash Point(°C)	217	56	120
Fire point(°C)	233	63	130
Heating Value KJ/Kg	36120	42800	37270
Specific gravity	0.876	0.85	0.86-0.90

*Table 2:- properties of oil after esterification[6]***ADVANTAGES OF BODIESEL**

- Biodiesel can be run on any conventional, unmodified diesel engine without any modification.
- It can be store at any place as that of diesel at atm.pressure and temperature.
- It reduces carbon dioxide emission because as it can extract from plant.
- Biodiesel is more lubricating agent than diesel fuel. it increases the engine life and it can be used to replace sulphur.
- Due to more availability of oxygen combustion will be in complete form produces more power result in higher thermal efficiency.
- It can have low smoke and PM ,NO, emissions as compared to plane diesel fuel.[8]

CONCLUSION

- Many research takes place on Biodiesel like Karanja oil with varying rate say KBD15,KBD20,KBD25 individually checked with plain diesel fuel.
- Due to more availability of oxygen atom in biodiesel more heat is get developed so as to remove and maintain the temperature of cylinder EGR can be applied.
- With Biodiesel at lower rate NO formation is more as compared to plane diesel and HC, CO Smoke and Particulate matter also side by.
- Brake thermal efficiency by use of biodiesel get improved by little amount also life of engine can be improved because inbuilt property of biodiesel.
- Exhaust Gas temperature is increases as time passes EGR temperature can be managed by EGR cooler so that optimum characteristics we can compare with existing one.

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