EFFECT OF DI-CI ENGINE FUELLED WITH ETHANOL ADDITIVE IN WASTE VEGETABLE OIL METHYL ESTER

C. Srinidhi[#1], Srikant Tilekar[#2], Shylesha V Channapatna[#3], Dr. Madhusudhan.A[#4]

Abstract—A quest for renewable fuels in current diesel engines, the primitive objective is to reduce the reliance on petroleum /fossil fuels. Biodiesel and alcohols have been researched extensively in many countries all over the globe. The current paper is focused to derive experimentally the performance and exhaust emission characteristics of a DI-CI engine when fuelled with Waste vegetable oil biodiesel (B10, B20,B30) addition of ethanol (E5% and E10%) over the various loading conditions on the engine. The observations made is lesser CO emissions and Exhaust Gas temperatures reduced within increase of % addition of ethanol in Biodiesel and its blends

.

***Index Terms*—Waste Vegetable biodiesel ethanol blend, Biodiesel, performance, emissions.**

I. INTRODUCTION

The concept using Vegetable Oil as a fuel was introduced by Dr. Rudolf Diesel who developed the first Diesel Engine to run on Peanut Oil. But later due to problems like high viscosity, injection problems and atomization factor the use of vegetable oils reached to near extinct. [2]. The current date focuses on the use of alternates without heavy changes in engine design and here in comes biodiesel who faces challenges like high viscosity, high flash point etc which restricts the combustion scenario and fuel pump lines of automobile inspite of fact that Biodiesel have high the oxygen level in the blend. During the search of biodiesel which can be derived from edible and non edible oils. Using edible oils like sunflower oil, rice brain oil etc has raised a question for fuel versus food debate. But biodiesel excels in performance basis and fails in NOx emissions. In current paper the focus is brought on effects of addition of ethanol in biodiesel and its blends which usually results in lesser carbon monoxide emissions G. Venkata Subbaiah et al; [1] investigated that the highest brake thermal efficiency was observed with 15% ethanol in diesel-biodiesel-ethanol blends. The exhaust gas temperature from the engine reduced with the increase of ethanol percentage in diesel-biodiesel-ethanol blends. The Carbon monoxide and smoke emissions reduced significantly with higher percentage of ethanol in diesel-biodiesel-ethanol blends. The Hydrocarbons, Oxides of nitrogen and carbon dioxide emissions increased with the increase of ethanol percentage in diesel-biodiesel-ethanol blends but the hydrocarbon emissions were still lower than that of diesel fuel. As the brake thermal efficiency increased and carbon monoxide hydrocarbons and smoke were lower than that of diesel fuel with the diesel-biodiesel-ethanol blends, the rice bran oil biodiesel can be used as an additive to mix higher percentages of ethanol in diesel-ethanol blends to improve the performance and reduce the emissions of a diesel engine. Prommes Kwanchareon et al; [3] studied solubility of a diesel- biodiesel- ethanol blend, its properties and its emission characteristics from diesel engine. They found that the blended fuel properties were close to the standard diesel except flash point. It was also found that CO and HC emissions reduced significantly at high engine load, whereas NOx emissions increased compared to those of diesel. The above studies reveal that the diesel-biodiesel-ethanol blends reduce CO, HC, PM, Smoke emissions and increase NOx emissions compared with the diesel fuel. There is a little research on the use of rice bran oil biodiesel in diesel-biodiesel-ethanol blends for diesel engines. The performance and emission characteristics of the biodiesel blended up to 20% were close to that of diesel fuel [4, 5]. In the present investigation the performance and emission characteristics of a diesel engine were studied by using 10% rice bran oil biodiesel as an additive in the diesel-biodiesel-ethanol blends and compared with that of the diesel fuel.In actual both ethanol and mineral diesel fuel are immiscible in nature. Ethanol in addition affects properties such as calorific value lubricity, Cetane number, viscosity, and mainly, volatility and stability [6]. The phase separation is prevented by addition of an emulsifier and co-solvent, which lowered the surface tension and co-solvent which increased the power of solvency for the pure solvent. In practice, biodiesel premises increase of ethanol-blended fuel making the mixture more stable. Chemically addition of ethanol in blends of Waste vegetable biodiesel and diesel helps in improving of engine ignition as alcohols have lesser flash point in comparison.

Table no 1: Property Table

	Diesel fuel	B10	B10E5	B10E10	B20
Density(g/cm3)	0.86	0.865	0.860	0.855	0.870
Viscosity at 40OC (m2/s)	3.5	3.613	3.49835	3.3837	3.726
Flash Point (^{O}C)	69	78.6	75.67	72.74	88.2
Auto Ignition Temperature(^{O}C)	224	233.6	242.52	251.44	243.2
Pour Point(^{O}C)	1	1.2			1.4
Cetane Number	4.5	9.65	9.6675	9.685	14.8
Acid Value mgKOH/g	0.06	0.076	0.0722	0.0684	0.092
Net heating Value (MJ/kg)	43	42.573	41.789	41.005	42.145

***C.Srinidhi**, Asst Prof. Mechanical Dept. Suman Ramesh Tulsiani Technical Campus-Faculty of Engg 8390877727,*
***Srikant Tilekar**Asst Prof. Mechanical Dept. Suman Ramesh Tulsiani Technical Campus-Faculty of Engg, 9986662698*
***Shylesha V Channapatna**, Asst Professor, RSCOE, Tathewade.*
***Dr A Madhusudhan** Prof, Mechanical Department, NMIT, Bangalore.*

ISSN: 2278 – 7798

	B20E5	B20E10	B30	B30E5	B30E10
Density(g/cm3)	0.865	0.848	0.875	0.869	0.864
Viscosity at 40OC (m2/s)	3.6057	3.2448	3.839	3.71305	3.5871
Flash Point (^{O}C)	84.79	74.56	97.8	93.91	90.02
Auto Ignition Temperature(^{O}C)	251.64	276.96	252.8	260.76	268.72
Pour Point(^{O}C)			1.6		
Cetane Number	14.56	13.84	19.95	19.4525	18.955
Acid Value mgKOH/g	0.0874	0.0736	0.108	0.1026	0.0972
Net heating Value (MJ/kg)	41.383	39.096	41.718	40.977	40.236

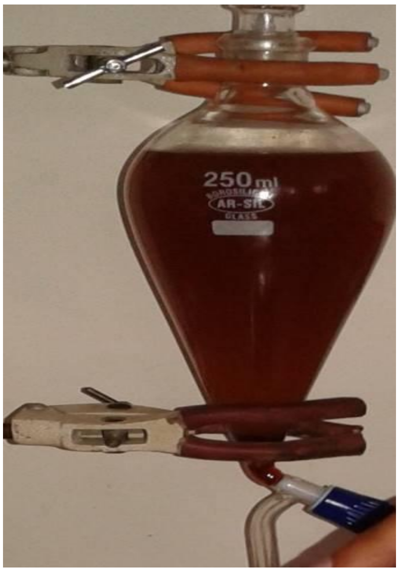


Figure no 1: Trans esterified Mixture

Figure No 2: Reaction of Mixture on Magnetic Stirrer

II. Experimental Setup and Procedure

The Performance and emission test was conducted on four stroke single cylinder Diesel Engine with Eddy current type dynamometer for various fuels. The specifications are mentioned in table mentioned. The engine used is a Direct Injection Compression Ignition engine. The operating compression ratio used in 17.5. The Output parameters like Thermal Performance parameters and Engine emissions were obtained from varying the input parameters for various loads and Blend of Bio diesel-ethanol-Diesel. The experimental readings which were recorded at a Compression ratio 17.5, injection pressure of 205 bars and injection timing of 23^{O}bTDC. The gas analyser used was 4-way in nature that can measure NOx, HC, CO and CO2.

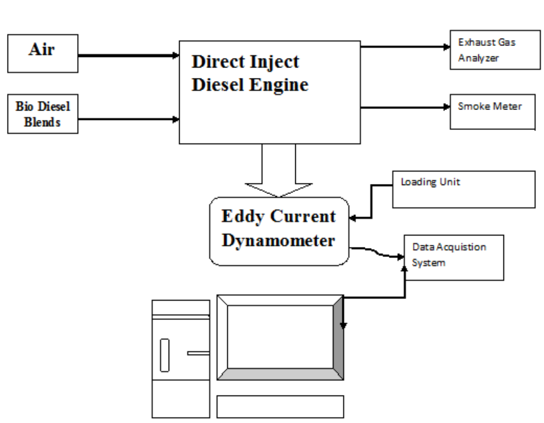


Fig 2: Experimental Setup

Make and Model	Kirloskar Oil Engine TV1
Type	4-stroke single cylinder, water Cooled
Bore and stroke	80mm and 110mm
Compression ratio	17.5:1
Maximum Speed	2000rpm
Exhaust Gas Analyzer Make	Numen
Measureable Gases	CO, CO2, NOx and HC

Table no 2: Specification of engine

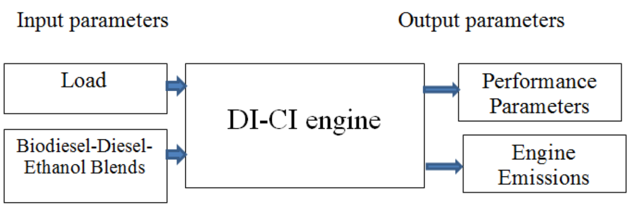
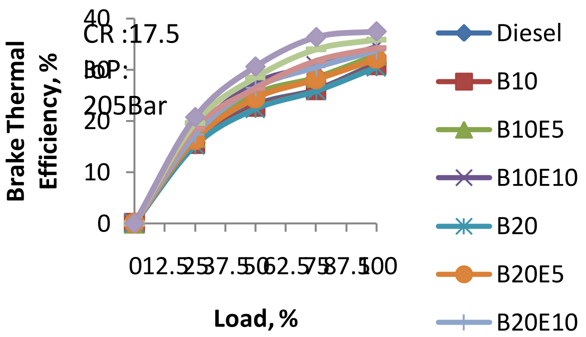


Figure no 3: Block diagram of Experimental Procedure

III. Results and Discussion

1. Variation of Brake Thermal Efficiency to load

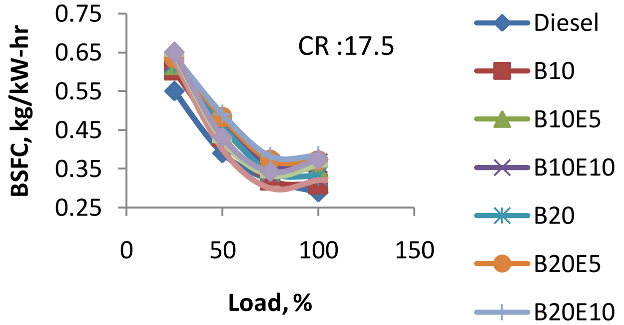


The graph is plotted for variation of load with respect to brake thermal efficiency. As the load increases the brake thermal efficiency also increases. The addition of ethanol increases the brake thermal efficiency. At full load, the rise in

ISSN: 2278 – 7798

brake thermal efficiency of B30E10 is 12% high in comparison of B 30. Also B20E10 yielded a better efficiency of 8.2% with respect of B20. The increase in efficiency is due to quick ignition of ethanol in comparison of Blends of biodiesel which acts as a catalyst which preheats the blends.

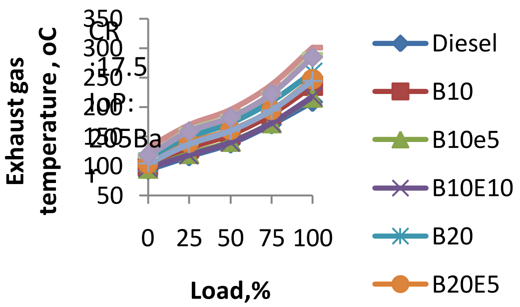
2. Variation of Brake Specific fuel consumption to load



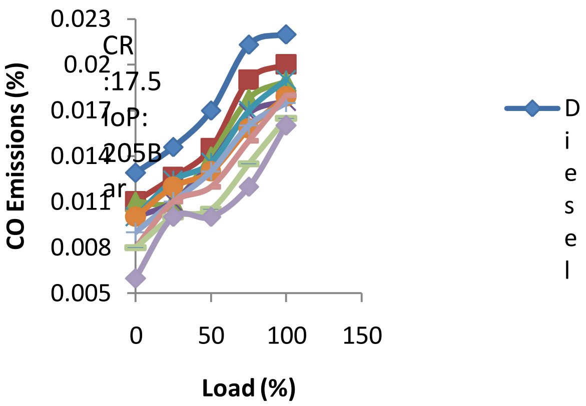
It is observed that with increase in loading fossil diesel and all blends provide lesser brake specific fuel consumption. Diesel leads in providing higher with respect to the fuel consumed for producing power required. As the blend percentage increases the bsfc values also increase remarkably. Addition of ethanol additive in blendshas costed more the brake specific fuel consumption for waste vegetable oil methyl ester and diesel (B10, B20, and B30). The increase in fuel consumption is about 9.7%, which might be due to lesser heating value of fuels in comparison with mineral diesel.

3. Variation of EGT with respect to load

The graph represents the study of variation of exhaust gas temperature from the engine to increasing load. It is observed that as the load increases the temperature of the exhaust gases also increases. Also if the blend percentile of Methyl ester increases the Exhaust gas temperature also increases. It is observed during the experimentation that B30 exhibits the maximum Exhaust gas temperatures. The addition of ethanol depreciates the exhaust gas temperature on a average of 8%

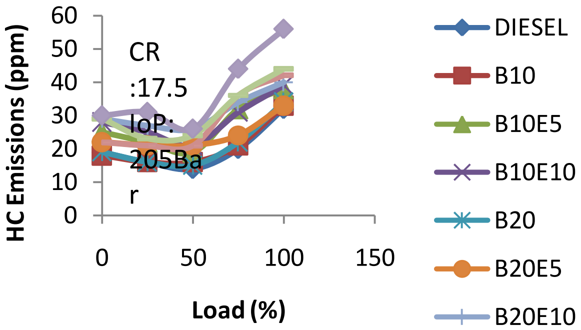


4. Variation of Carbon Monoxide emission to load



Carbon monoxide emissions occur basically due to incomplete combustion inside the combustion chamber. Also time for combustion plays an important role for CO emissions. During experimentation it was observed that diesel fuel combusted in the engine cylinder gave the maximum readings of CO emissions. The doping of Ethanol in the blends of Methyl ester and diesel reduced the CO emissions by about 11% on an average. The addition of alcohol/ethanol promoted the combustion and better preheating for the biodiesel to undergo combustion. Also the biodiesel has high oxygen content than that of mineral diesel

5. Variation of Hydrocarbon emission with respect to load

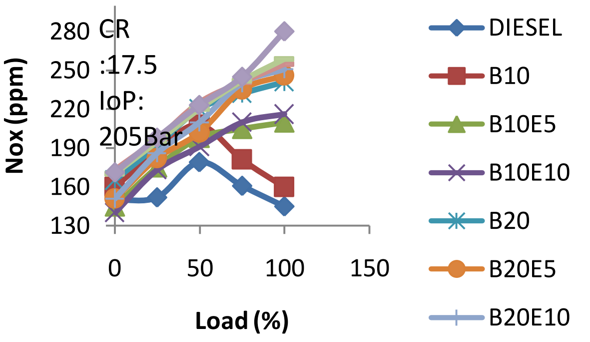


The graph describes to the fact that the hydrocarbon emissions for CI engines for the mentioned fuels are increasing with respect to load. The addition of ethanol increases the hydrocarbon emissions. Where as in comparison of mineral diesel and biodiesel the hydrocarbon emission lie on the same loci. Also the to the fact that as biodiesel have high oxygen content than that of diesel the hydrocarbon emission characteristics result in the same values

ISSN: 2278 – 7798

6. Variation of Nitrogen Oxide's emissions with respect to load

Nitrous Oxide emissions are a factor of temperature present in the engine. Higher temperatures promote drastically the formation of nitrous oxide emissions. During experimentation it was observed that the NOx emissions (in ppm) increased gradually as the load increased. The addition of ethanol which promoted the combustion for the blended diesel-biodiesel fuels, hence increasing the NOx by an approx. of 9%



IV. Conclusion

The addition of ethanol provides a better thermal efficiency with the regular blend of biodiesel and diesel where in almost a shift in increase of 12% was observed. The brake specific fuel consumption pushed up to higher, decreasing the mileage factor for engines under load conditions. Also the carbon monoxide emissions reduced on addition of ethanol in the blends. The use of biofuels increases the combustion efficiency and lowers CO, HC emissions but increase the cylinder combustions chamber temperature there by increasing the formation of nitrous oxides. Also bio fuels bear the authencity of the heating value being lesser as they contain chain of carbon-hydrogen atoms with oxygen which in due lower the heating value.

.

REFERENCES

[1] G. Venkata Subbaiah, K. Raja Gopal, Syed Altaf Hussain, B. Durga Prasad and K. Tirupathi Reddy, "RICE BRAN OIL BIODIESEL AS AN ADDITIVE IN DIESEL- ETHANOL BLENDS FOR DIESEL ENGINES" International Journal of Research and Reviews in Applied Sciences ISSN: 2076-734X, vol June 2010, pp 334-342

[2] C. Srinidhi , S. V. Channapattana, J.A. Hole, A.A Pawar and P.G Kamble, "Investigation On Performance and Emission Characteristics Of C.I. Engine Fuelled With Honne Oil Methyl Ester" "International Journal of Engineering Science Invention"Vol.3 Issue.5 (2014), pp. 59-66, May 2014.

[3] Prommes Kwanchareon, Apanee Luengnaruemitchai, and Samai Jai-In, "Solubility of a diesel-biodiesel ethanol blend, its properties and its emission characteristics from diesel engine", DOI: 10.1016/J. Fuel.2006.09.034.

[4] Jayant Singh, T. N. Mishra, T. K. Bhattacharya, and M. P. Singh, "Emission Characteristics of methyl ester of rice bran oil as fuel incompression ignition engine", World Academy of Science. Engineering and Technolog,y 3:6, 2007, pp. 198-202.

[5] B.K.Venkanna, C. Venkataramana Reddy, Swati B and Wadawadagi, "Performance, Emission and Combustion Characteristics of Direct Injection Diesel Engine Running on Rice Bran Oil / Diesel Fuel Blend", International Journal of Chemical and Biomolecular Engineering, 2:3, 2009, pp. 131-137

[6] Syed Altaf Hussain, G.Venkata subbaiah, and V,Pandurangadu, "Performance and emission characteristics of a supercharged direct injection diesel engine using rice bran oil", i-manager's Journal on Future Engineering & Technology, Vol. 4 l No. 4 l May - July 2009, pp.48-53

