A Comparative Analysis of Performance Parameters of Four Stroke Single Cylinder Diesel Engine working on COEE20 Blend with ED20 and Neat Diesel

Ashish Kumar Dubey[1], Priyank Dixit[2], Abhishek Kumar[3], Akhand Pratap Singh[4]
[1]M.Tech Student, [2]Research Guide, [3]HOD, Department of Mechanical Engineering, KNP College of Science & Technology, Bhopal
[4]Industrial Training Institute Benibari, Anuppur

Abstract - In every developing country the crisis of fuel supply is rising day by day as the economy is rising. The rising fuel prices and decreasing Petroleum reserves have made necessary to start use of alternate fuels. In alternate fuels, the use of Biodiesel is increasing as they are harvested fuels and safe to transport. Because these are cultivated on wastelands, it avoids a possible conflict of fuel vs. food security. The methyl or ethyl esters of some vegetable oils are called the Biodiesel. For this experimental analysis the blends of Castor Oil Ethyl Ester and Diesel was prepared in the ratio of 20% (Castor Oil Ethyl Ester 20% and Neat Diesel 80%) which is called COEE20 and Ethanol-Diesel of 20% (Ethanol 20% and Neat Diesel 80%) which is called ED20, then both blends are tested with Neat Diesel in a Four Stroke Single Cylinder Direct Injection Diesel Engine for important parameters like Fuel consumption, Brake Specific Fuel Consumption, Brake Specific Energy Consumption and Brake Thermal Efficiency for different load condition and compared with each other. The analysis indicates that fuel consumption of COEE20 found 5-6% more compared to neat diesel while consumption was 2-5% more than ED20 blend as the load was increased from 0% to 50% in the interval of 12.5% in Engine. Analysis also concluded that the Brake Specific Fuel Consumption of COEE20 found 5-11% more compared to neat Diesel fuel, while COEE20 found only 5-7% more compared to ED20. The Brake Specific Energy Consumption of the COEE20 was more than by 4-9% compared to Diesel while more than by around 10% compared to ED20. The efficiency of the COEE20 was less than by 4-10% compared to diesel while less than by around 10-11% compared to ED20 in different load condition. However the ED20 blend found highest efficient fuel for Diesel Engine.

Keywords– COEE20, Castor Oil Ethyl Ester, Performance of Diesel Engine, ED20.

1. INTRODUCTION

The increasing fuel prices and environmental aspects in the world have created a need to develop alternative fuels from bio-origin such as vegetable oils, which can be obtain from forests and oil-bearing biomass materials [1]. By the use of Biomass or vegetables oils an alternative can be produced. These alternatives require more efforts in the field of research and development to produce the fuels from renewable resources. Actually this is a way to produce the Alkyl Esters which is also known as the Biodiesel [2]. A Biodiesel can be produce from any type of edible or non-edible, new or used vegetable oils and animal fats, which are non-toxic, biodegradable, renewable resources [3]. Because the crude vegetable oils have high viscosities, so they cannot be used directly as a fuel in Diesel engine, they also content a high percentage of ash too [4]. Basically we cannot use the raw vegetable oils in any diesel engine without any engine modification because it results a poor engine performance and leads to wear out the engine components [5]. Hence to reduce the viscosity of the oil there are many methods used in which, Transesterification process is commonly employed. The main objective of the Transesterification process is to reduce the viscosity of the biodiesel as well as to increase the Cetane Number of the Biodiesel [6]. In Transesterification process an Alcohol (Methanol, Ethanol or Butanol) is used with the vegetable oil in the presence of a catalyst, such as Sodium Hydroxide (NaOH) or potassium hydroxide (KOH) with some application of heat. Transesterification chemically breaks the Triglyceride of vegetable oil into Alkyl Ester and Glycerol obtained as a by-product. This process also increases the Cetane number of the biodiesel [7]. The non-edible Castor oil is a colorless to very pale yellow liquid with mild or no odour or taste. It is a triglyceride in which approximately 90% of fatty acid chains are Ricinoleic acid, Oleic and Linoleic acids are the other significant components [8]. Usually Biodiesels also have the flash point higher than the petroleum fuel (150^0C), which makes it less volatile and safer to transport or handle than petro- diesel fuel [9]. In short the clean burning of Biodiesel makes it good alternative fuel to Diesel. It also possesses many other attractive features like renewability, biodegradability, low emission and non-toxic [10].

2. EXPERIMENTAL SETUP

The experiments have been performed on a Single Cylinder Four Stroke Direct Injection Diesel Engine, which specification is given below:

Details	Parameters
Make	Kirlosker Engine
Model	SV1
Alignment	Vertical, Totally Enclosed.
Ignition	Compression Ignition
Stroke	Four Stroke
Cooling System	Water Cooled
No. of Cylinder	One
Bore Size	87.5 mm
Stroke Length	110 mm
Cubic Capacity	662 CC
Compression Ratio	16.5:1
Engine RPM	1500
Rated Power	8 hp

3. RESULTS & DISCUSSION

The following results have been analyzed through the experiments:

A. PROPERTIES OF FUELS

The basic properties of Neat Diesel, COEE and Ethanol are obtained by the help of IOCL and Department of Chemistry in KNP College of Science and Technology, Bhopal, Which are listed below:

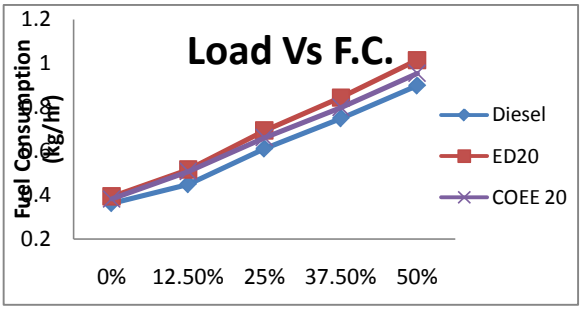
Properties	Diesel	COEE	Ethanol
Density (kg/m^3) at 40^{0}C	840	930	830
Relative Density at 40^{0}C	0.84	0.93	0.83
Viscosity (mm^2/s)	3.2	14.8	2.5
Flash point (^{0}C)	54	135	15
Fire Point (^{0}C)	62	145	26
Cloud Point (^{0}C)	7.5	-12	4
Pour Point (^{0}C)	-15	-30	-70
L.C.V. (kJ/kg)	42750	37900	26800

B. PERFORMANCE OF DIESEL ENGINE

All experiments have been performed in a Diesel engine at a constant speed of 1500 RPM by varying the brake load from 0% to 50%, with the interval of 12.5%. The result data obtained from the experiments is used to evaluate the performance characteristics of diesel engine:

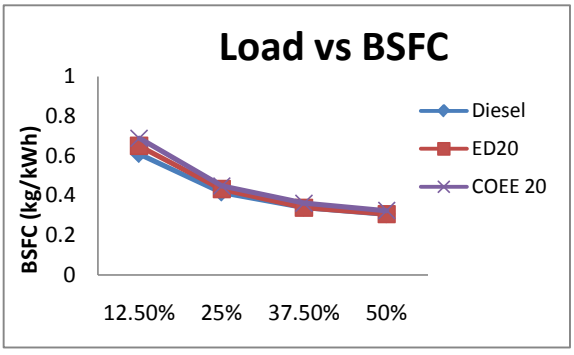
I. FUEL CONSUMPTION

The first graph has been plotted between Load in x-axis and Fuel consumption in y-axis. As the graph indicates that fuel consumption increases as the load increased. It is found that fuel consumption of COEE20 found 5-6% more compared to neat diesel while consumption was 2-5% more than ED20 blend as the load was increased. The fuel consumption of the ED20 blend was more compared to other fuels in high load condition.



II. BRAKE SPECIFIC FUEL CONSUMPTION

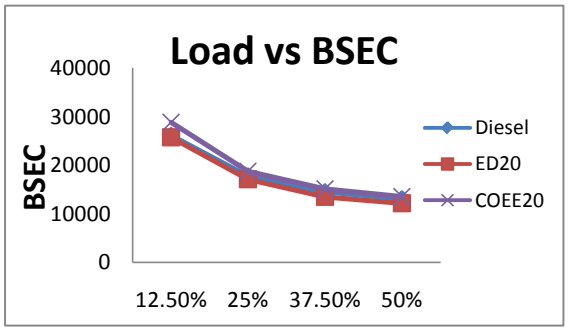
The second graph has been plotted between Load in X-axis and BSFC in y-axis, which indicates that Brake Specific Fuel Consumption of COEE20 found 5-11% more compared to neat Diesel fuel, while COEE20 found only 5-7% more compared to ED20. For BSFC the ED20 blends found the optimum performer.



III. BRAKE SPECIFIC ENERGY CONSUMPTION

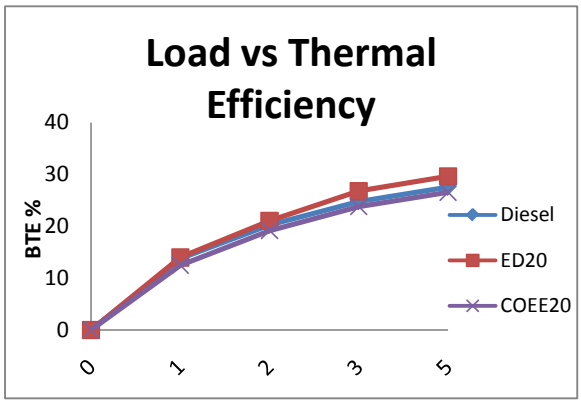
The third graph has been plotted between Load in X-axis and BSEC in y-axis, which indicates that Brake Specific Energy Consumption of the COEE20 was more than by 4-9%

compared to Diesel while more than by around 10% compared to ED20.



IV. BRAKE THERMAL EFFICIENCY

The third graph has been plotted between Load in X-axis and % Brake Thermal Efficiency in y-axis, which indicates that all the fuel performs efficiently in high load condition. The results also indicates that The efficiency of the COEE20 was less than by 4-10% compared to diesel while less than by around 10-11% compared to ED20 in different load condition.



4. CONCLUSION

It has been concluded based on the experiments that the use of Biodiesel blend (COEE20) slightly increases the (BSFC) in comparison to Diesel and ED20 fuels at the same load conditions. The Brake Thermal Efficiency of biodiesel (COEE20) fuel found close to Diesel fuel. The BSEC graph also indicates that the COEE20 consumes more BSEC than other fuels. Although the ED20 found the best alternative to the Diesel fuel but Castor Oil Ethyl Ester also found better fuel to be used as the alternative. In Short COEE 20 blend meets the expectation to be used as a Bio-fuel; however its performance is somewhat lower than ED20 blend.

7. FUTURE SCOPES

The prices of petroleum oil are increasing day by day; therefore the need to develop alternate fuels has become acute. COEE20 is renewable, Biodegradable, non-toxic and comparatively cheaper, than other Biodiesel fuels therefore it can be used as a substitute of Petroleum fuel. Also, the performance of Castor Biodiesel fuel is almost similar as to conventional diesel fuel and no extra engine modification required to use of biodiesel fuel in place of conventional Petroleum fuel.

REFERENCES

[1] S. Sivalakshmi & T. Balusamy, “Performance and emission characteristics of a diesel engine fuelled by neem oil blended with alcohols”, International Journal of Ambient Energy, 32:4(2011), 170-178.

[2] H. Fukuda, A. Kondo, H. Noda, “Biodiesel fuel production by transesterification of Oils”, J. Biosci. Bio-Engineering, (92) [2001], PP: 405–416.

[3] M. Balat, “Production of Biodiesel from Vegetable Oils: A Survey”, Energy Sources, (29), [2007], PP: 895-913.

[4] M. Karabektas, M. Hosoz, Performance and emission characteristics of a diesel engine using Iso-Butanol–Diesel fuel blends, Renewable Energy (34) 2009, PP: 1554-1559.

[5] Bari S., Yu C.W., Lim T.H., Performance deterioration and durability issues while running a diesel engine with crude palm oil, Proc. Institution Mechanical Engineers, Part (D), J Automobile Engineering (216), 2002, PP: 785–792.

[6] Sumedh S. Ingle, Vilas M. Nandedkar & Madhav V. Nagarhalli, “Prediction of Performance and Emission of castor Oil Bio-Diesel in Diesel Engine”, International Journal of Mechanical and Production Engineering, (Vol-1, Issue-1), [2013], PP: 16-18.

[7] D.P. Deshpande, Y.D. Urambkar and P.B. Thakare, “Production of Biodiesel from castor oil using acid and base catalyst” Research Journal of chemical science, vol. 2, no. 8, August 2012, pp. 51-56.

[8] M. H. Chakrabarti & Rafiq Ahmad, “Transesterification Studies on Castor oil as a first step towards its use in Biodiesel production”, Pak. J. Bot., 40(3), [2008], PP: 1153-1157.

[9] Devendra Vashisth & Mukhtar Ahmad, “A Comparative study of Castor Oil and Jatropa Oil source and its Methyl Ester Test on Diesel Engine, International Journal of Engineering Science

and Technology (IJEST)", Vol. 3, No. 6, June-2011, PP: 4765-4773.

[10] Akhand Pratap Singh and Mukesh Kumar Bunkar, "Experimental investigation of Performance Parameters of Four Stroke Single Cylinder Direct Injection Diesel Engine Operating on Ethanol and Waste Frying Oil Ethyl Ester blends with conventional Diesel Fuel" IJRMET, ISSN: 2349-4689 , Vol. 5, Issue 1, Nov 14 – Apr 15, PP: 2249-5762..