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Performance Characteristics of a Diesel Engine Fueled with Diesel & Turmeric leaf oil blends

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Abstract - *Experimental investigations were carried out on C.I. Engine with Bio Diesel blends of Turmeric leaf oil. The engine used for the experiments was single cylinder four stroke air cooled, constant speed diesel engine. Turmeric leaf oil is derived through transesterification process and parameters of transesterification were optimized. The blends of various proportions of the turmeric leaf oil with diesel were prepared, analyzed and compared with diesel fuel, and comparison was made to suggest the better option among the bio diesel combinations. Various tests have been carried out to examine properties, performance of different blends (TL5, TL15, TL25 and TL35) and compared with diesel. The leaf oil and diesel blends showed improved efficiencies. From the experimental results it is observed that turmeric leaf oil has better performance as compared to pure diesel.*

Key Words*: *Diesel Engine, Alternative fuel, Turmeric leaf oil, performance, emissions

1. INTRODUCTION

Diesel engines are being used as one of the vital prime movers for generating power and electricity in many industrial and agricultural applications. Reports emanating from research studies an alternate, renewable fuel unanimously predict an unprecedented demand for petroleum fuels by 2030 and the repercussions of this have been already felt by the sudden surge in petroleum prices. In addition to this petroleum fuel demand, its use is also associated with increased environmental problems. Considering the future energy security, sustainability and environmental damage, the study on various alternate, clean and renewable sources of fuel has grabbed the interest and attention of many researchers. Among which, biodiesel is one of the most commonly used alternative fuel for diesel engine. Biodiesel is normally produced from vegetable oil or animal fats through transesterification in the presence of catalyst at elevated temperature, while higher fatty acid oil even demands double stage Transesterification process. The conversion of ethyl esters, through the transesterification process, reduces the molecular weight to one-third that of the triglyceride and also reduces the viscosity by a factor of about eight, with a marginal increase in volatility. Thus, after trans-esterification process, the properties of the biodiesel are so conducive for its use in diesel engine. Recent studies on engine performance using biodiesel have shown significant improvements when compared to that of diesel. Furthermore, emissions such as smoke, HC (hydrocarbon), CO (carbon monoxide) and CO2 (carbon dioxide) were also found to be less at the expense of slight increment in NOx (oxides of nitrogen). The development of clean and alternate fuel in IC engines is still prior for the present research team, since the need of high performance and less emission fuel is very much crucial for this generation. Research in alcoholic fuel has already started a decade ago. As the part of literature survey is done on the area under bio-diesels used as alternate fuel in Compression Ignition Engines blended with diesel fuel of many research papers, conference papers, books and some of the research articles are referred. The details are discussed in below article. F. Karaosmanogi lu et al[1]. Studied the diesel fuel and sunflower oil properties in duel fuel mode. The performance and emissions was determined existing diesel engine without any modification. The engine tests were conducted at a speed of 1600 rpm single-cylinder direct injection, air cooled diesel engine, having a bore/stroke ratio of 108:110 mm. Ismet Çelikten et al [2]. Studied the four-cylinder, four-stroke, 46 KW, direct injection diesel engine were carried out with 4 different fuel that 100% diesel SD), 50% rapeseed oil methyl ester and 50% diesel (B1), 50% hazelnut oil methyl ester and %50 diesel (B2), 25% rapeseed oil methyl ester, 25%rapeseed oil methyl ester and 50% diesel (B3) blends engine performance and emission tests. Alireza Shirneshan et al [3]. Studied the 4-cylinder direct-injection diesel engine using biodiesel as an alternative fuel and their blends to investigate the emission characteristics of the engine under four engine loads at an engine speed of 1800 rpm. A test was applied in which an engine was fueled with diesel and four different blends of diesel/biodiesel (B20, B40, B60 and B80) made from waste frying oil. A.M. Liaquat et al[4] studied the engine performance parameters and emissions characteristics for direct injection diesel engine using coconut biodiesel blends D100, CB5,CB15.

N.R. Banapurmath et al [5] studied the four-stroke single cylinder direct injection diesel engine operated on dual fuel mode with producer gas as inducted fuel and diesel and neat Honge oil and its methyl ester (HOME) as injected fuels available biomass, up to 500kW of electric power. Hence, bio-derived gas and vegetable liquids appear more attractive in view of their friendly environmental nature.

2. Materials and Methods

2.1 Introduction to turmeric leaf oil:

In this project we tried to investigate the potential use of Turmeric leaf oil, various experiments were conducted on Turmeric leaf oil and the results were recorded. Turmeric leaf oil is one of the major feed stocks for biodiesel production. This amount of oil is a promising source for biodiesel production from a natural and environmentally friendly agricultural waste product.

2.2 Production of turmeric leaf oil

The following steps are involved in production of turmeric leaf oil

- Transesterification.
- Settling and Separation of esters and glycerine.
- Washing of bio-fuel heating.

The following blends are prepared (TL5, TL15, TL25, and TL35) in the performance and analysis criteria

Table 1: Blending Percentage of Fuel

Notation	Fuel Quantity (liter)	Bio-Diesel Quantity (ml)	Diesel Quantity (ml)
DIESEL	1	-	1000
TL5	1	50	950
TL15	1	150	850
TL25	1	250	750
TL35	1	350	650

2.3 Flash and Fire Points:

The flash and fire points of pure diesel and pure turmeric leaf oil and blend (TL5, TL15, TL25, and TL35) are measured.

Table 2: Flash and Fire points

S.No	Oil	Flash Point(°C)	Fire Point(°C)
1	D100	58	62
2	TL100	70	75
3	TL5	45	49
4	TL15	65	70
5	TL25	57	65
6	TL35	60	67

2.4 Experimental setup:

The diesel engine setup is shown in Fig 2. It is a 4 stroke, vertical, single cylinder, Air cooled, constant speed diesel engine which is coupled to electrical lighting load arrangement to absorb the power produced. The engine is started without load and when the engine run in stable condition the loads are applied by means of electrical lights having a power of each 1000W (4 No.s=4*1000 Watts). The loads are applied one after another until a maximum load of 4000 Watts. A measuring system for fuel consumption consisting of a fuel tank, burette, and a 3- way cock mounted on stand and a stop watch is used to record the time. Air intake is measured using an air tank fitted with an orifice meter and U- tube differential manometer filled with water. A governor is provided to maintain the constant speed.

Fig 1: Turmeric leaf biodiesel blends

The engine was first operated on diesel fuel with no load for few minutes at rated speed of 1500 rpm. The same speed is maintained throughout the experiments with all the fuel modes. The baseline parameters were obtained at the rated speed at various loads varying 0 to 100% of load. The diesel fuel was replaced with the turmeric leaf oil biodiesel; the test was conducted with the blend of 95% diesel and 5% biodiesel (TL5) and all the parameters were recorded at various loads. The experiment is repeated at various loads with different blends viz TL15, TL25 and TL35. The directly blended fuel does not require any modifications to diesel engines. Hence direct blending method was used in this test. The tests were conducted with these four blends by varying the load on the engine. The brake power was measured by using an electrical lighting loading. The mass of the fuel consumption was measured by using a fuel tank fitted with a burette and a stop watch.

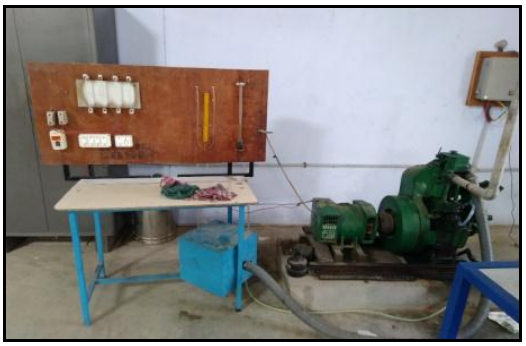

Fig 2: experimental setup

3. Results & Discussions

The performance parameters such as brake power, mass of fuel consumption, brake thermal efficiency, brake specific

fuel consumption; indicated specific fuel consumption, mechanical efficiency and indicated thermal efficiency were calculated from the recorded data. The variation of performance parameters are discussed with respect to diesel fuel, biodiesel blends and obtained optimum blend are discussed in below article.

Brake thermal efficiency:

The variation of brake thermal efficiency with respect to load for diesel and blends as shown in Fig:3. It can be observed that the brake thermal efficiency is increases with load up to 4000W. The power increment and reduction in heat loss with respect to load may be the reason for increase in brake thermal efficiency. From the results it is observed that the engine fuelled with TL5, TL15, TL25, TL35 and diesel gives brake thermal efficiency of 19.47%, 21.26%, 21.47%, 22.28% and 21.36% respectively at peak load. From the above observation TL35 showing maximum efficiency and hence TL35 is considered as optimum blend. The percentage of brake thermal efficiency increased for T35 as compared to pure diesel is 4.12%. The reason may be the correct substitution of Turmeric oil which gave the increased brake thermal efficiency from no load to full load

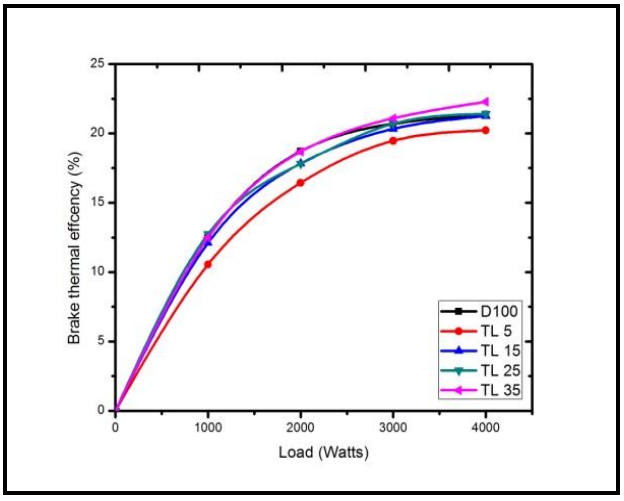

Fig 3: Load Vs Brake thermal efficiency

Mechanical efficiency:

The variation of mechanical efficiency with respect to load for diesel and blends were shown in Fig: 4. It can be observed from the figure that the diesel blends gave higher mechanical efficiency as compared to diesel efficiency for the entre load range. It can be observed that the engine fueled with TL5, TL15, TL25, TL35 and diesel gives mechanical efficiency of 75.77%, 73.32%, 78.39%, 81.93% and 69.31% respectively at 4000W load. By observing the entire efficiencies TL35 showing improved efficiency and therefore it is considered as optimum blend. The higher mechanical efficiency may be due to less friction power as the addition of high viscous Turmeric oil to the diesel.

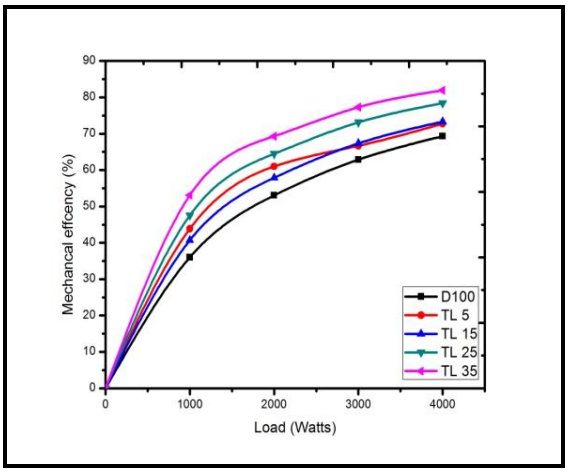

Fig 4: Load Vs Mechanical efficiency

Indicated thermal efficiency:

The variation of indicated thermal efficiency with respect to load for diesel and blends was shown in FIG:5 It can be observed that the indicated thermal efficiency is increases with load upto3000W and decreases at load 4000W.It is observed that the engine fueled with TL5, TL15, TL25, TL35 and diesel gives indicated thermal efficiency of 29.55% 29.007% 28.7% 27.20% and 30.82% respectively at 4000W load. From the above analysis the indicated thermal efficiency is gradually decreasing as the percentage of turmeric oil addition is increased. The reason may be due to lower calorific value of turmeric oil as compared to diesel.

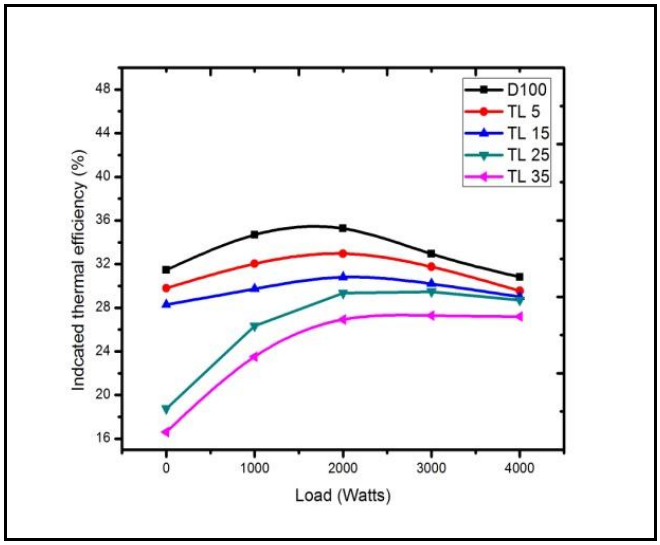

Fig 5: Load Vs Indicated thermal efficiency

Indicated mean effective pressure (IMEP):

Fig 6 Depicts the relation between loads and indicated mean effective pressure for pure diesel and various volumes of turmeric oil and diesel. All the curves following the same trend viz indicated mean effective pressure increases at every load increment. The addition of turmeric oil to diesel reduces the mean effective pressure for the entre load range. At

maximum load the indicated mean effective pressure for diesel, TL 5, TL 15, TL 25, and TL 35 are 552.81, 504.71, 521.59, 487.83 and 466.73 Kn/Mt2 respectively. The percentage reduction for TL 35 is 15.57% as compared to diesel without any addition of turmeric oil. The addition of turmeric oil reduces the calorific value and cetane number which increases the fuel supply causes to lower indicated mean effective pressure.

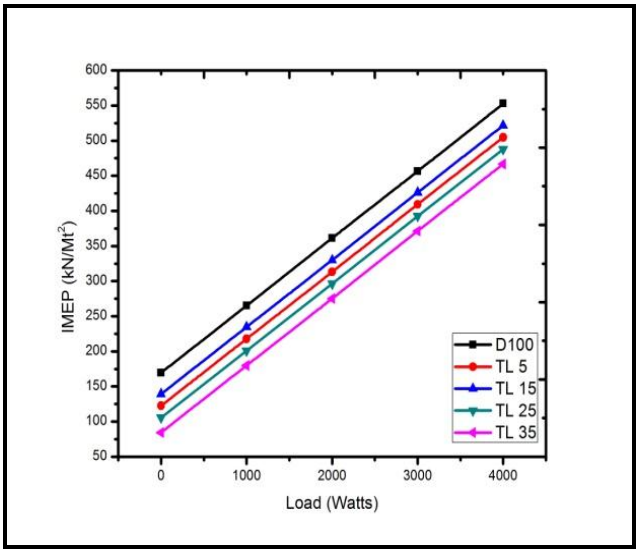

Fig 6: Load Vs IMEP

Brake Power (BP):

Fig 7 depicts the relation between load and Brake Power for pure diesel and various volumes of turmeric oil & diesel. All the curves following the same nature of behavior viz Brake Power increases at every load increment. The addition of turmeric oil to diesel reduces Brake Power for the entre load range. As the percentage of turmeric oil increases the brake power gradually decreasing. The highest brake power recorded for diesel operation as compared to TL 5, TL 15, TL 25 and TL 35. The brake power at peak load for diesel, TL 5, TL 15, TL 25 and TL 35 are 4570, 4426, 4315, 4211 and 4100 watts respectively. The reason for that may be the addition of turmeric oil increases the ignition delay which reduces the power. The overall reduction in the power due to the addition of 35% turmeric oil to the diesel is 10.28%.

Mass of fuel consumption:

The figure 8 describes the rate of change of mass of fuel with respect to load for diesel and various blends of diesel and turmeric oil at different proportions. The mass of fuel consumption TL 5 is higher than for all compositions even including diesel. The TL 35 combination has very less consumption of fuel. The mass of fuel consumption at 1, 2, 3, 4kw are 0.76, 1.02, 1.39, 1.80 kg/kwh. For TL 35 the mass of fuel consumption at 1, 2, 3 and 4 kw are 0.77, 1.03, 1.37, 1.70 kg/kwh respectively. At peak load the reduction in mass of fuel consumption for TL 35 is 5.5% as compared to only diesel. The TL 35 can be considered as optimum combination.

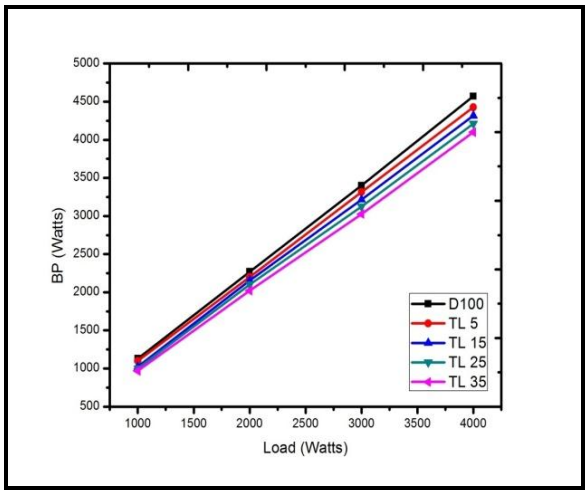

Fig 7: Load Vs BP

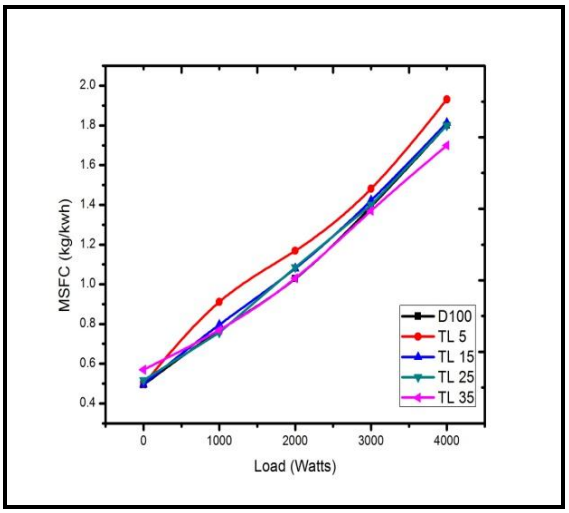

Fig 8: Load Vs MSFC

4. CONCLUSIONS

Following are the conclusions based on the experimental results obtained while operating single cylinder air cooled diesel engine fueled with diesel and Turmeric leaf oil blends.

- Brake thermal efficiency of the tested diesel engine is 0.92% improved when it is fueled with TL35 blend on average at all loads.
- Indicated thermal efficiency of TL 35 blend is reduced by 3.62% in comparison diesel operation
- Mechanical efficiency of the TL 35 blend is improved by 12.62% at peak loads.
- The combination of turmeric oil and diesel reduces the indicated mean effective pressure and Brake power.
- The mass of fuel consumption for TL 35 is low as compared to only diesel operation.

REFERENCES

[1] F. KaraosmanogÏ lua, G. Kurta, T. OE zaktas Long term CI engine test of sun flower oil Renewable Energy 19 (2000) 219±221.

[2] Ismet Çelikten, Emre Mutlu, Hamit Solmaz a Variation of performance and emission characteristics of a diesel engine fuelled with diesel, rapeseed oil and hazelnut oil methyl ester blends Renewable Energy 48 (2012) 122e126.

[3] Alireza Shirneshan HC, CO, CO2 and NOx Emission evaluation of a diesel engine fuelled with waste frying oil methyl ester Procedia- Social and Behavioral Sciences 75 (2013) 292 – 297.

[4] A.M. Liaquat*, H.H. Masjuki, M.A. Kalam, I.M. Rizwanul Fattah, M.A. Hazrat, M. Varman, M. Mofijur, M. Shahabuddin Effect of coconut biodiesel blended fuels on engine performance and emission characteristics Procedia Engineering 56 (2013) 583 – 590.

[5] N.R. Banapurmath, P.G. Tewari, R.S. Hosmath Experimental investigations of a four-stroke single cylinder direct injection diesel engine operated on dual fuel mode with producer gas as inducted fuel and Honge oil and its methyl ester (HOME) as injected fuels Renewable Energy 33 (2008) 2007–2018.

[6] B. Deepanraj, G. Sankaranarayanan, N. Senthilkumar & M. Pugazhvadivu (2016): Influence of Dimethoxymethane addition on performance, emission and combustion characteristics of diesel engine, International Journal of Ambient Energy, DOI: 10.1080/01430750.2016.1181568

[7] Lakshmipathi Anantha Raman, Sappani Rajakumar, Balakrishnan Deepanraj, and Lokesh Paradeshi "study on performance and emission characteristics of a single cylinder diesel engine using exhaust gas recirculation Thermal Science, Year 2017, Vol. 21, Suppl. 2, pp. S435-S441

[8] M. Kannan, R. Karthikeyan, B. Deepanraj and R. Baskaran "Feasibility and performance study of turpentine fueled DI diesel engine operated under HCCI combustion mode" Journal of Mechanical Science and Technology 28 (2) (2014) 729~737.