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Investigation on the Performance of Single Cylinder Diesel Engine using Tobacco-Diesel Blends

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ABSTRACT

In the present investigation tobacco-diesel blend was used as an alternate fuel for diesel engine. The properties of tobacco oil were determined. Crude tobacco oil is converted to tobacco seed methyl esters (TSOME) by esterification process. The performance and emissions parameters of single cylinder, stationary diesel engine were calculated with the blends (B5, B10, B20, B30, B40) prepared and with the standard diesel and graphs were plotted. The parameters obtained by the above tests were compared with the base line data obtained by using diesel and optimum tobacco seed oil blend B5 is obtained. The blend showed best performances increase in brake thermal efficiency, decrease in brake specific fuel consumption and reduction in emissions CO, HC and smoke density. Finally results shows that tobacco seed methyl esters can used as alternate fuel for compression ignition engines.

Keywords : TSOME (Tobacco Seed Methyl Esters), Esterification, Non-Edible Oil, Brake Power

I. INTRODUCTION

Diesel fuel has an essential function in the industrial economy of a developing country and used for transport of industrial and agricultural goods and operation of agricultural machines and pump sets in agricultural sector. The requirement of petro diesel in India is day to day increasing. The domestic supply of crude oil will satisfy only about 22% of the demand and the rest will have to be met from imported crude. This has stimulated recent interest in alternative source to replace petroleum-based fuels. Of the alternative fuels, bio-diesel obtained from non-edible vegetable oils which are also called as second generation feed stocks have became more attractive for bio-diesel production and also holds good promises as an eco friendly alternative to diesel fuel. Non-edible oils are renewable, from environmental friendly and can be produced in rural areas also. Some of the examples of non-edible oil seed crops are Mahua, Neem seed, Tobacco seed, Rubber seed, Castor etc.

Tobacco scientifically named as Nicotiana tabacum contains oil by 35-49% of oil to weight Annual yields about 15000 tons per year and grown in many countries like India ,Turkey, South America etc. Tobacco seed oil has low toxicity, and its smell is rather strong. It is burnt in lamps throughout India, and acts as good charcoal. The high calorific value of tobacco seed oil matches diesel. Its blend with diesel, substituting for nearly about 35% of the later, and has been suggested for use without any major engine modifications and any drop in engine efficiency.

II. MATERIALS AND METHODS

A sample of tobacco oil was collected from tobacco seeds by using oil extraction technique called as mechanical press. The produced crude oil is filtered by using the serigraphy papers (A1, A2) filtered oil is preheated by direct heating. The molar ratio 16:1 we mixed methanol and KOH by the titration up to dissolving the KOH completely. This solution is mixed with tobacco crude oil and heated further to separate glycerine and other fatty acids about 6 hours at constant temperature in between 60°c to 75°c. The mixture solution is cooled by using conical flask for about 1 day at atmospheric temperature. The obtained glycerine and bio-diesel is separated and blends we required were prepared. This entire process is called as esterification process. To determine the properties of the blends prepared different tests have been performed. For measuring flash point and fire point of blends we have used All's closed cup flash point and fire point setup, for measuring calorific value of oils equipment known as Bomb Calorimeter, For determining viscosity of blends Redwood Viscometer was used.

III. OIL EXTRACTION TECHNIQUES

There are so many investigations on oil extraction techniques for non-conventional feed stock of oils have done in last few years.

Mechanical Press

The technique of oil extraction by using mechanical press is most conventional one. But oil extracted by using these techniques needs further treatment of degumming and factorisation. One more problem associated with conventional mechanical press is their design is suitable for some particular seeds only and yields affected for other seeds.

Solvent Extraction Technique

It is a technique of removing one constituent of solid by means of a liquid solvent also called leaching. In this process, a chemical solvent such as n-hexane is used to saturate the crushed seed and pull out the oils. After completion of the extraction process the solvent is condensed and reclaimed. There are many factors influencing the rate of extraction like particle size, Temperature, Agitation of solvent, viscosity of solvent selected.

Steps in Production of Bio-Diesel

Transesterification or esterification

Settling and separation of esters and glycerine.
Washing of bio-fuel.

Heating.

The most common derivatives of agricultural oils for duels are methyl esters .These are formed by esterification of the oil with methanol in the presence of catalyst to give methyl esters and glycerol. Generally used catalysts are sodium hydroxide (NaOH), potassium hydroxide (KOH).

Properties of Tobacco Seed Oil

Some of the properties of diesel and tobacco seed oil were mentioned in the below tabular column.

Property	**Pure diesel**	**Tobacco seed oil**
Boiling point	180°-360°C	320°C
Specific gravity(gm/cm^3)	0.835	0.917
Flashpoint	58°C	210°c
Calorific value(KJ/Kg)	42500	38438
%of carbon residue	0.12	0.22
Dynamic Viscosity at 40°c(poise)	0.652	0.738
Transport information	hazardous	Non hazardous

IV. EXPERIMENTAL OBSERVATION

Specific Gravity-Results

Specific gravity is the relative measure of the density of the substance. It is defined as the ratio of density of the substance to the reference density. Digital balance is used to measure the specific gravity of the blends prepared and tabulated as shown below.

Table 1. Results of Specific Gravity for TSOME and Diesel

S. No	Oil	Blend	Specific gravity
1.	Diesel	D100	0.835
2.	Tobacco oil crude	B100	0.917
		B5	0.6859
3.	Tobacco Seed Oil Methyl Ester Blend with	B10	0.6988
	Bio-Diesel (TSOME)	B20	0.7111
		B30	0.7282
		B40	0.7454

Flash Point and Fire Point Results

Flash and Fire points are obtained by using pen sky rest. The apparatus consists of a brass cup and cover fitted with shutter mechanism and without shutter mechanism, test flame arrangement, hand stirrer, thermometer socket.

Table-2. Results of Flash Point and Fire Point for TSOME and Diesel

S. No	Oil	Blend	Flash point °C	Fire point °C
1.	**Diesel**	**D100**	**58**	**62**
2.	**Tobacco oil crude**	**B100**	**185**	**192**
3.	**TSOME**		**50**	**56**

Society Results

The resistance to flow, exhibited by fuel blends, is expressed in various unit of viscosity. It is the major factor of consequences in exhibiting their sustainability for mass transfer and metering requirements of engine operation. High value of viscosity results in incomplete combustion and ultimately carbon deposits on the injector nozzle as well as in the combustion chamber. Redwood viscometer is used to find out the viscosity of blends prepared.

Table-3. Results of Viscosity for TSOME and Diesel at 40°c.

S. No	Oil	Blend	Kinematic viscosity (Stokes)	Dynamic Viscosity (Poise)
1.	Diesel	D100	0.364	0.652
2.	Tobacco Oil Crude	B100	0.484	0.738
3.	TSOME		0.80	0.64

Carbon Percentage Result

The carbon residue property is a measure of the tendency of fuel to form carbonaceous deposits in the engine, which can lead to stress, corrosion or cracking of components. A destructive –distillation method for estimation of carbon residues in the fuels and lubricating oils called as Conrad son carbon test is used.

Table-4. Results of Carbon Residue for TSOME and Diesel

Oil		% of /carbon
Diesel	D100	0.12
Tobacco Seed Oil Methyl Ester Blends with Bio-Diesel(TSOME)	TSOME	0.22

Calorific Value Results

Calorific value of the fuel is the thermal energy released per unit quantity of fuel when the fuel is burned completely and the products of combustion are cooled back to initial stage temperature of the combustion mixture. A Bomb calorimeter is used to measure the calorific value of blends prepared.

Table-5. Results of Calorific Value in KJ/Kg for TSOME and Diesel.

Oil	Crude	B5	B10	B20	B30	B40
Tobacco seed oil (KJ/Kg)	38438	42181	41862	41224	40586	39948
Diesel(KJ/Kg)	42500	42500	42500	42500	42500	42500

Diesel Engine Experiment Setup

Experimental set up consists of water cooled single cylinder vertical diesel engine coupled to a rope brake arrangement shown in figure below To absorb the power produced necessary weights and spring balances are induced to apply load on the brake drum suitable cooling water arrangement for brake drum is provided. A fuel measuring system consists of fuel tank mounted on a stand, burette and a three-way cock. Air consumption is measured by using a mild steel tank, which is fitted with an orifice, and a U-tube manometer that measures the pressure inside the tank. For measuring emissions, gas analyser is connected to the exhaust flow.

Specifications Of The Dynamometer Were Shown In Table Below

Type	Rope brake
Diameter of brake drum	300mm
Diameter of rope	12 mm
Effective radius of brake drums	157.5mm

Engine Specifications

Brake horse power	5HP
Speed	1500 RPM
Bore	80mm
Stroke	110mm
Compression ratio	16.5:1
Method of start	Crank shaft
Orifice diameter	20mm
No of cylinders	1
Type of ignition	Compression ignition
Make	Kirloskar

Smoke Meter Specifications

Model name	NPM-SM-111B	Type of flow	Partial flow
Display indication	K % OPACITY	Display range	0 to 9.90/m-1
Linearity	0.1/m-1	Response time	0.3 seconds
Warm up time	3 minutes	Operating temperature	5 to 50 °c
Repeatability	0.1/m-1	Drift	0.00/m-1, span 0.1/m-1
Power requirement	230VAC, ±10%50hz, 250 VA	Weight	23 kgs
Rpm	100 to 9999(for Ripple sensor)	Scale resolution	0.01/m-1
Dimensions	W-47.5cm, D-47.5cm, H-26 cm	Oil temperature	0°c to 150°c
Remote display	Available	Computer controlled operation	Available via RS232 interface

Auto Exhaust Analyzer Specifications:

CO	0 to 9.99%vol. Res. 0.01%
HC	0 to 20000ppm. (propane) Res. 1ppm
Co2	0 to 20.00% vol. Res. 0.10%
O2	0 to 25% Res. 0.01%
Lambda	0.200 to 1.800% Res. 0.001%
Air/Fuel	0 to 30:1 Res.1

Fourstroke Single Cylinder Water Cooled Diesel Engine Coupled To Rope Brake Dynamometer.

Four stroke Diesel engine

Rope Brake Dynamometer

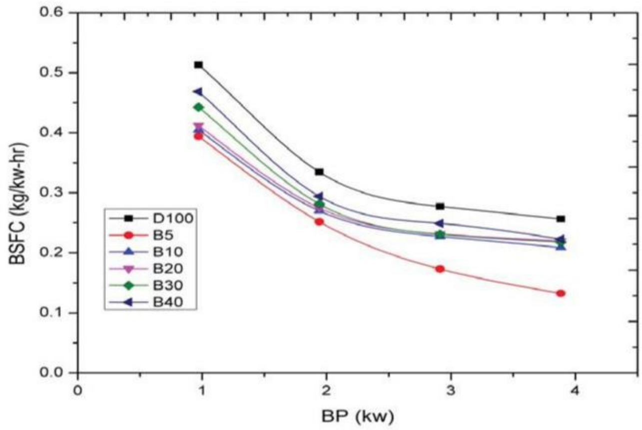
V. RESULTS AND DISCUSSIONS

The performance and emission characteristics of a conventional diesel, diesel and bio-diesel blends were investigated on single cylinder diesel engine at various loads from no load to full load were discussed as per the results obtained and graphs were plotted.

A. Brake Power Vs Brake Specific Fuel Consumption:

The variation of brake power Vs Brake specific fuel consumption was shown in graph below. The graph reveals that brake power increases with decrease in Brake specific consumption that means fuel consumption decreases.

Figure-1 Variation of brake specific fuel consumption with Brake power using TSOME Blends.



B. Brake Power Vs Brake Thermal Efficiency:

The variation of Brake power VS Brake Thermal Efficiency was plotted and shown in graph below. As the Brake power increases the Brake Thermal Efficiency also increased and blend B5 has showed maximum when compared to pure diesel.

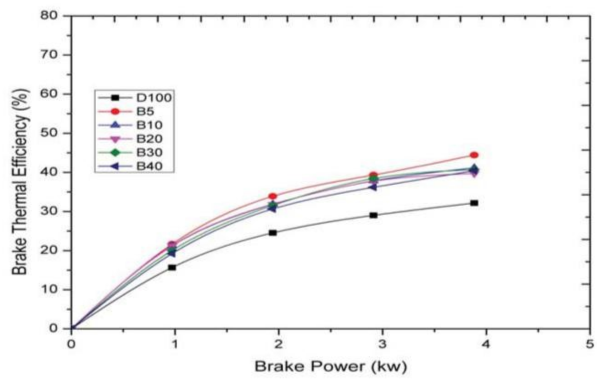


Figure-2 Variation of Brake power with Brake Thermal Efficiency using TSOME Blends.

C. Brake Power Vs Air Fuel Ratio:

The variation of Air Fuel Ratio with Brake power is shown in graph below. As the load increased the Air Fuel Ratio varies from zero load to full load differently for different blends. Air Fuel rate decreases for TSOME blends when compared to diesel.

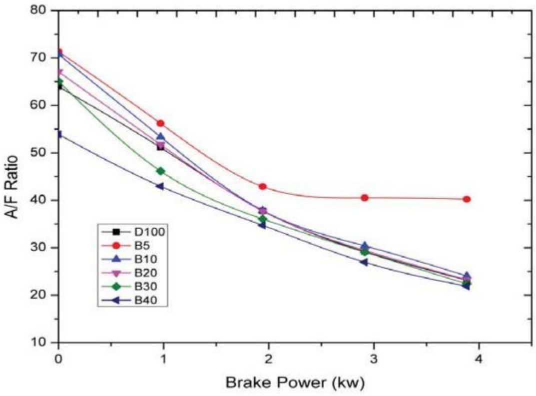


Figure-3 Variation of brake power VS Air Fuel Ratio using TSOME Blends.

D. Brake Power Vs Mechanical Efficiency

The variation of Brake power Vs Mechanical Efficiency is plotted and shown in graph below. The graph reveals that as Brake power increases Mechanical Efficiency also increases. The Mechanical Efficiency of a diesel engine was high while using tobacco seed oil blends when compared with diesel.

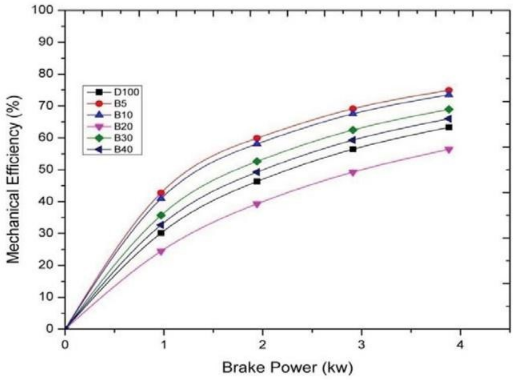


Figure-4. Variation of Brake power Vs Mechanical Efficiency using TSOME Blends.

E. Smoke Density Vs Brake power

The variation of smoke density Vs Brake power is determined and plotted in graph shown below. The density of the smoke gradually decreased in diesel engine when using tobacco seed oil blends when compared with normal diesel used.

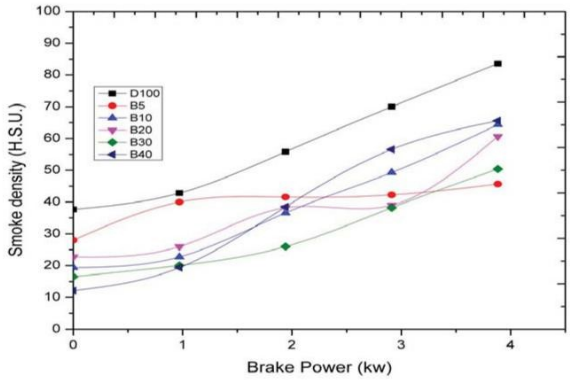


Figure-5. Variation of Smoke Density Vs Brake Power using TSOME Blends.

VI. XII.CONCLUSION:

The conclusion of this investigation when compared with diesel base line data at full load as follows

Maximum brake thermal efficiency for B5 (44.42%) was achieved which means there was an increase of 12.11% compared with diesel. In B5 fuel the Brake Specific Fuel Consumption is lower than diesel by 18.52%. As a C I Engine fuel, B5 Blend results in an average reduction of 21.53% of smoke densities from all the blends and 45.32% reductions when compared with diesel. Since B5 blend reduces the environmental pollution, high in thermal efficiency when compared with diesel it will be a promising energy source for sustaining the energy.

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VIII. REFERENCES

[1]. S. Ramadhas, S. Jayarag, C.Muraleedharan, Use of vegetable oils as I.C.Engine fuels A review, Renewable Energy 29(2004), pp 727-742.

[2]. B.Y.Mathur, P.M.Poonia and Jethoo A.S, “Economics Formulation Techniques and Properties of Biodiesel A Review” Universal Journal of Environmental Research and Technology, Volume1, 2011, Issue2: 124-134.

[3]. Dilip Kumar Bora, “Performance of single cylinder diesel engine with karabi seed biodiesel.”

Journal of Scientific & Industrial Research, Vol. 68, November 2009, pp 960-963.

[4]. Dutra, Teixeira, Colaco, Calderia and Leiroz, “Comparative Analysis of Performance and Emissions of an Engine Operating with Palm Oil ethyl Ester and their Blends with Diesel”,20 International Congress of Mechanical Engineering ,Gramado, RS, Brazil November 15-20,2009.

[5]. F.Karaomanoglu, G.Kurt, T.OE zaktas, Long term CI engine test of sunflower oil, Renewable Energy 29(2004), pp 219-221.

[6]. K.Pramani, Properties and use of jatropha curcas oil and diesel fuel blends in compression ignition engines, Renewable Energy 28(2003) pp 239-248.

[7]. L.Ranganathan, S.Sampath “A review on biodiesel production, combustion emissions ad performance” International journal of Advanced Scientific and Technical Research, Issue 1,Vol 1 October 2011 ISSN2249-9954.

[8]. L.Panwara, Hemant Y.Shrirama, N.S.Rathore, Sudhakar Jindal, A.K.Kurchania, Performance evaluation of a diesel engine fuelled with methyl ester of castor seed oil, Applied Thermal Engineering 30(2010), pp 245-249.

[9]. M. Pugazhvadivu and G. Sankaranarayanan, “Experimental studies on a diesel engine using mahua oil as fuel”, Indian Journal of Science and Technology, Vol. 3 no. 7(July 2010)ISSN:0974-6846.

[10]. S.Jaichandra and K. Annamalai, “The status of Biodiesel as an Alternative Fuel for Diesel Engine-An overview “Journal of Sustainable Energy& Environment 2(2011) pp 71-75.

[11]. S. Jindal “Effect of engine parameters on NOx emissions with Jatropha biodiesel as fuel.” International journal of energy and environment, Volume 1, Issue 5, 2010, pp 919-926.

[12]. S.S.Ragitha, S.K.Mohapatra and Kundu, “Comparative study of engine performance and exhaust emissions characteristics of a single cylinder 4-stroke CI engine operated on the esters of hemp oil and neem oil” Indian Journal of Engineering & Materials Sciences Vol. 18, June 2011, pp. 204-210.

[13]. S.Saravanan, G.Nagarajan, G.Lakshmi Narayana Rao, S.Sampath “Role of a biodiesel blend in sustaining the energy and environment as a CI Engine Fuel” International Journal of Energy and Environment, Volume 2, Issue1, 2011, pp 179-190.