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Performance Evaluation On 4-Stroke Single cylinder C.I Engine using Various Volume Fractions of TSOME diesel Blend

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Abstract : The growing dependence on conventional fuels like petrol, diesel, and gasoline, coupled with the depletion of petroleum reserves, highlights the urgent need for alternative fuels to sustain global energy demands. In particular, the search for viable substitutes for compression ignition (C.I.) engines has shifted focus toward biofuels derived from biomass and biological waste. Among these, Tobacco Seed Oil (TSO) has emerged as a promising alternative fuel due to its abundant availability worldwide. TSO is extracted from tobacco seeds and has shown potential as a viable biofuel. This project aims to explore the use of TSO and its diesel blends (5%, 10%, 15%, 20%, 30%, and 40% by volume) in a 4-stroke single-cylinder diesel engine. The study will assess the fuel properties using standard testing methods, followed by experimental evaluation of the engine's performance and emission characteristics across various loading conditions. This research seeks to determine the potential of Tobacco Seed Oil as a sustainable and efficient alternative fuel for compression ignition engines.

Keywords: Tobacco Seed Oil (TSO), Biofuel, Compression Ignition (C.I.) engines, Emission characteristics, Sustainable energy

I. INTRODUCTION

With the socio-economic growth of the society, the energy requirement has increased multi fold globally as the consumption pattern in a particular country depends upon the availability of energy resources. The various sectors that require energy from some sources are industry, transport, agriculture, domestic etc. Different energy sources are wood, coal, petroleum products, nuclear power, solar, wind etc. Out of these, the world surface transport depends primarily on petroleum fuels. The overbearing dependence on petroleum products and related economic and environmental problems have created disquieting situation. The known petroleum reserves are not only limited but also concentrated in certain regions of the world. Further- more, petroleum reserves are depleting at breakneck pace. The critical situation has stimulated scientists and industries to search for and evaluate alternative fuels for petrol and diesel engines. The diesel engine is frequently used in transportation, power generation and many miscellaneous applications including Indus- trial and agricultural. The major pollutants from diesel engine are smoke, particulate matter (PM), carbon monoxide (CO), Nitrogen oxides (NOx) and un-burnt hydrocarbon (UBHC). Among different pollutants, the most significant are smoke and nitrogen oxides for achieving this goal, two methods have been followed; adaptation of the engine to the fuel and adaptation of the fuel to the engine. Considering the large numbers of existing engines, the second strategy seems to be more apropos. Hence, there is a need to explore a viable alternate fuel that can be used in compression ignition (CI) engines. Any such alternative should not only match the performance of diesel but also meet or exceed the current emission norms. Harvesting renewable energy has also become an important energy source worldwide]. The alternate fuel must be readily available, technically feasible, and economically viable and also meet the pollution norms after Trans esterification the mixture at the end is settle for at least 10 hours. The lower layer will be of glycerin and the upper layers methyl ester (bio-fuel). After settling we have to separate the methyl ester from the glycerin shown in fig.(1). The mixture is separated by using a separating flask.

Process of Separation bio-diesel and glyciren

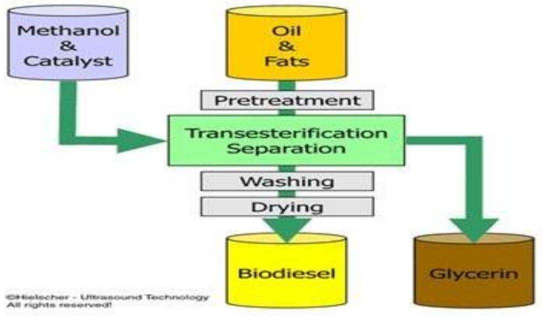
Fig:1. Process of Separation of bio-Diesel

II. PROCESS

Introduction:
In organic chemistry, process of exchanging the organic group R″ of an ester with the organic group R′ of an alcohol. These reactions are often catalyzed by the addition of an acid or base catalyst.[1] The reaction can also be accomplished with the help of enzymes (biocatalysts) particularly lipases.

Transesterification: alcohol + ester → different alcohol+ different ester

Strong acids catalyses the reaction by donating a proton to the carbonyl group, thus making it a more potent electrophile, whereas bases catalyses the reaction by removing a proton from the alcohol, thus making it more nucleophilic. Esters with larger alkoxy groups can be made from methyl or ethyl esters in high purity by heating the mixture of ester, acid/base, and large alcohol and evaporating the small alcohol to drive equilibrium.



Flowchart of Transesterification Process of TSOME

Purification of Oil:
The oil extracted as above can be purified by the following means:

Sedimentation:
This is the easiest way to get clear oil, but it takes about a week until the sediment is reduced to 20 - 25% of the raw oil volume.

Boiling with water:
The purification process can be accelerated tremendously by boiling the oil with about 20 % of water. The boiling should continue until the water has completely evaporated (no bubbles of water vapour anymore). After a few hours the oil then becomes clear Separation of ethyl-esters

Boiling with water

Filtration:
Filtration of raw oil is a very slow process and has no advantage in respect of sedimentation. It is not recommended. Oil extraction can be more effectively carried out by the improved expellers by the following methods:

Method 1:
Prepressing of seeds lightly can precede oil milling. This results in higher capacity; lower power consumption, lower wear & tear and maintenance. The oil recovery is lower in this case.

Bio-Diesel blends

Method 2: Here either in the same screw press – two-stage pressing is carried out or prepressed cake from first stage screw press in sent for second pressing to other screw press. Any kind of oil-bearing seed can be processed in oil mill, preparatory equipment's are recommended prior to expelling. Pressed cake can be sold after recovering the max. Oil Hence, double pressing system is recommended. cases. Engine test results, it has been established that up to 20% Tobacco seed oil can be substituted for diesel for use in a C.I. engine without any major operational difficulties

a) Diesel mixture in measuring jar

(b) Oil measuring jar

Blending Percentage of Fuel:

Notation	Fuel Quantity	Bio-Diesel Quantity	Diesel Quantity
B5	1 LITRE FUEL	50 ml	950ml
B10	1 LITRE FUEL	100 ml	900 ml
B20	1 LITRE FUEL	200 ml	800 ml
B30	1 LITRE FUEL	300ml	700ml
B40	1 LITRE FUEL	400ml	600ml

The corresponding temperatures were found to be 55–60 and 45 °C for 5%,10%,15% and 20% blends,whereas only at 35–40 °C did the viscosity of the 20:80 J/D blend become close to the specification range. Acceptable brake thermal efficiencies and SFCs were achieved with the blends containing up to 20%. Blends with a lower percentage of Tobacco seed oil showed slightly higher exhaust gas temperatures when compared to an engine running with diesel but they were much lower than the Tobacco seed oil in all

Tobacco seed Oil Blends (B5, B10, B20, B30, and B40)

Fuel Properties:

Specific gravity-Results of Specific Gravity for TSOME and Diesel:

S.No	Oil	Blend	Specific Gravity
1.	Diesel	D100	0.835
2.	Tobacco Oil Crude		0.917
3	Tobacco seed Oil Methyl Ester Blends With Bio- Diesel (TSOME)	B5	0.6859
		B10	0. 6988
		B20	0.7111

		B30	0.7282
		B40	0.7454

CARBON PERCENTAGES – 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 of Calorific Value in kJ/kg for TSOME and Diesel:

	Crude	B5	B10	B20	B30	B40
Tobaco seed oil kJ/kg	38438	42181	41862	41224	40586	39948
Diesel kJ/kg	42500	42500	42500	42500	42500	42500

VISCOSITY – Results of Viscosity for TSOME and Diesel at 40^0C:

S.NO	OIL		Kinematic Viscosity (stokes)	Dynamic Viscosity (Poise)
1	Diesel	D100	0.364	0.652
2.	Tobacco Oil Crude		0.484	0.738
3	Tobacco seed Oil Methyl Ester Blends with Bio-Diesel (TSOME)	TSOME	0.80	0.64

FLASH ANS FIRE POINTS –Results of Flash Point and Fire of TSOME and Diesel:

S.No	Oil		Flash Point 0C	Fire Point 0C
1.	Diesel	D100	58	62
2.	Tobacco Oil Crude	B100	185	192
3	Tobacco seed Oil Methyl Ester Blends With Bio-Diesel (TSOME)	TSOME	50	56

After find all properties of TSOME then next stage performance and emissions parameters are find with the help of 4-stroke single cylinder compression ignition diesel engine, gas analyzer and smoke meter

III. EXPERIMENTAL SETUP AND PROCEDURE

Introduction

Using TSOME oil tests are to be conducting on different equipment's, to be found some of the fuel properties. Later performance and emission tests were conducted on 4- stroke single cylinder water cooled diesel engine coupled with a rope brake dynamometer, with the help of Smoke meter and multigas analyzer

Fuel Property Measurement

The improvement in the performance of the CI engines, over the past century, has resulted from the complimentary refinement of the engine design and fuel properties. Calculate the fuel properties like flash point, fire point, specific gravity, calorific value for different oils for different blends using the suitable equipment.

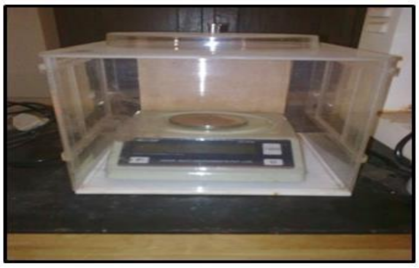
Some of the fuel properties include:

Flash point ,Fire point, Specific gravity, Calorific value, Viscosity, Carbon residue

To determine the kinematic viscosity and dynamic viscosity of a given sample of oil at different temperatures using REDWOOD-I viscometer similarly remaining properties also measured using various equipment's as shown in below Fig

REDWOOD-I Viscometer apparatus

Flash point & Fire point apparatus



Digital balances

(a) Porcelain crucible (b) Inner iron crucible (c) Outer iron crucible
(d) Experimental setup

Diesel Engine:

Experimental set up consists of a water cooled single cylinder vertical diesel engine coupled to a rope pulley brake arrangement it shown in plate 4.6, to absorb the power produced necessary weights and spring balances are induced to apply load on the brake drum suitable cooling water arrangement for the brake drum is provided. A fuel measuring system consists of a 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 water manometer that measures the pressures inside the tank. For measuring the emissions the gas analyser is connected to the exhaust flow

(a) (b)

(a) 4- Stroke diesel engine (b) Dynamometer

SMOKE METER:

Netel‟ssmoke meter Model NPM-SM-111B has been designed and developed to get an accurate reading of diesel engine smoke emissions, like smoke density (HSU), absorption co-efficient (K) obtain. It is shown in plate.

Smoke meter

IV. EXPERIMENTAL OBSERVATION

Introduction:

The engine was first operated on diesel fuel with no load for few minutes at rated speed of 1500 rpm until the cooling water and lubricating oil temperatures comes to certain temperature. The same temperatures were maintained throughout the experiments with all the fuel modes. The baseline parameters were obtained at the rated speed by varying 0 to 100% of load on the engine.

The diesel fuel was replaced with the Tobacco seed oil biodiesel (B5) and test was conducted with the blend of 95% diesel and 10% biodiesel by varying 0 to 100% of load on the engine with an increment of 20%. After the Tobacco seed oil biodiesel, the test was conducted with the blend of 90% diesel and 10% biodiesel (B10).
After the Tobacco seed oil biodiesel, the test was conducted with the blend of 80% diesel and 20% biodiesel (B20). After the Tobacco seed oil biodiesel, the test was conducted with the blend of 70% diesel and 30% biodiesel (B30) and after the Tobacco seed oil biodiesel, the test was conducted with the blend of 60% diesel and 40% biodiesel (B40). 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 three blends by varying the load on the engine. The brake power was measured by using an electrical dynamometer. The mass of the fuel consumption was measured by using a fuel tank fitted with a burette and a stop watch. The brake thermal efficiency and brake specific fuel consumption were calculated from the observed values. The exhaust gas temperature was measured by using an iron-constantan thermocouple. The exhaust emissions such as carbon monoxide, carbon dioxide, nitrogen oxides, hydrocarbons and unused oxygen were measured by exhaust an analyser and the smoke opacity by smoke meter.

The results from the engine with a blend of diesel and biodiesel and compared with the baseline parameters obtained during engine fuelled with diesel fuel at rated speed of 1500 rpm.Out of these three blends best blend is obtained on the basis of performance parameters. In this experiment B5 shows the best results. And compared with the baseline parameters obtained during engine fuelled with diesel fuel at rated speed of 1500 rpm.

V. FORMULAE

1. FUEL CONSUMPTION (M_F)
Where T=Time Taken For F.C Cc Of Fuel Consumption
Mass Of Fuel Consumption Per Min,
$M_F = \frac{20 \text{ x Sp.Gravity of Diesel}}{\text{T x 1000}} \text{ kg/sec}$

2. Power BP

B.P = $\frac{2\pi NT}{60 \times 1000}$ KW

WHERE T- TORQUE = 9.81 X W X RE N-M ACTUAL LOAD W = (W-S) KG

W= DEAD WEIGHT KG

S= SPRING BALANCE READING KG

RE = EFFECTIVE RADIUS OF ROPE BRAKE DRUM= 0.1575M

N = SPEED RPM

3. ACTUAL VOLUME FLOW RATE OF AIR,

Va= CD x A0 x √ (2xgxha) m3/s

Where

CD = Co-efficient of discharge of orifice meter = 0.62

A0 = Area of orifice = (π/4) d02 m2.

do= Orifice diameter, m = 0.020 m

g = Acceleration due to gravity = 9.8 m/s^2

ha = Pressure head in terms of „m" of air = $\rho_w h_w / \rho_a$ m_a

ρ_w = Density of water =1000 kg/m3

h_w=Difference of manometer readings= h1-h2

ρ_a = Density of atmosphere = Pa/RTa kg/m^3

p_a = Atmosphere pressure = 750 mm of Hg = 1x 105 N/m2

R= Gas constant of air= 287 J/kg 0k Ta = Atmosphere temperature ^{o}k

4. Mass flow rate of air

ma = Va x pa x 3600 kg/hr.

5.Swept volume of engine

= (π/4) D2 L m3 Theoretical volume flow rate of air,

Vs = (π/4) D2 L (N/2 x60) m3/s

Where D = cylinder bore = 0.08 m L= stroke = 0.011 m

6.Indicated power

IP = (BP + FP) kw

Where

FP = friction power from Willan"s line graph kw

7. BRAKE SPECIFIC FUEL CONSUMPTION

BSFC = $\frac{M_F}{B.P}$ x3600 KG/KW-HR

8.INDICATED SPECIFIC FUEL CONSUMPTION ISFC=

ISFC = $\frac{M_F}{I.P}$ x 3600 KG/KW-HR.

9.BRAKE THERMAL EFFICIENCY

ηBTE = $\frac{B.P}{M_f\ C_v}$ ×1000 .

WHERE CV = CALORIFIC VALUE OF THE FUEL

10.INDICATED THERMAL EFFICIENCY

ηITE = $\frac{B.P}{M_f\ C_v}\ x1000$.

11. MECHANICAL EFFICIENCY

= (BP / IP) X 100 %

12. VOLUMETRIC EFFICIENCY

= (VA/VS) X 100 %

13. AIR FUEL RATIO A/F

= MA/MF

VI. EXPERIMENTAL OBSERVATIONS FOR DIESEL

EXPERIMENTAL OBSERVATIONS FOR DIESEL (D100):

S.No.	Load				Spe ed (N) (rpm)	Time Taken for 20cc Fuel Consump tion (sec)	Manometer Reading		
	%	W (kg)	S (kg)	W-S (kg)			h_1 c m	h_2 c m	hw m
1	0	0	0	0	1500	155	4	2	0.06
2	25	4	0	4	1500	115	4	2	0.06
3	50	8	0	8	1500	90	4	2	0.06
4	75	12	0	12	1500	71	4	2	0.06
5	100	16	0	16	1500	59	4	2	0.06

EXPERIMENTAL RESULTS USING DIESEL D100:

S. No.	Load %	BP kW	FP kW	IP kW	ηMech %	Hbte %	ηite %	ηvol %	A/F	ISFC Kg/kW-hr	BSFC Kg/kW-hr
1	0	0	2.2	2.2	0	0	48.37	89.74	62.27	0.175	∞
2	25	0.96	2.2	3.161	30.41	15.67	51.55	89.74	49.88	0.164	0.540
3	50	1.92	2.2	4.123	46.64	24.53	52.60	89.74	39.03	0.161	0.345
4	75	2.88	2.2	5.084	56.75	29.02	51.16	89.74	30.78	0.165	0.291
5	100	3.84	2.2	6.046	63.61	32.16	50.57	89.74	25.59	0.167	0.263

EXPERIMENTAL OBSERVATIONS OF SMOKE DENSITY D100:

S.No.	Load %	Weight Kg	Absorption co-efficient K	Smokedensity H.S.U.
1	0	0	1.1	37.69
2	25	4	1.3	42.82
3	50	8	1.9	55.82
4	75	12	2.8	70.00
5	100	16	4.2	83.57

EXPERIMENTAL OBSERVATIONS FOR BLEND B5:

S.No.	Load				Speed(N) (rpm)	Time Taken for 20CC Fuel Consumption (sec)	Manometer Reading		
	%	W(kg)	S(kg)	W-S (kg)			h1 cm	h2 cm	hw m
1	0	0	0	0	1500	175	0	3.5	0.035
2	25	4	0	4	1500	129	1	3	0.04
3	50	8	0	8	1500	101	0.8	3	0.038
4	75	12	0	12	1500	98	0.7	2.9	0.036

5	100	16	0	16	1500	96	0.7	3	0.037

EXPERIMENTAL RESULTS USING BLEND B5:

S.No.	B P (k w)	F P (kW)	I P (kW)	ηmech %	ηBTE %	ηITE %	ηVol %	BS FC kg /k Wh r)	ISF C Kg/ K Whr)	A/F (kg of air/ kg of fuel)
1	0	1. 3	1. 3	0	0	39.31	67.41	∞	0.1411	71.32
2	0.9	1. 3	2. 27	42.75	21.64	50.62	72.06	0.3943	0.1288	56.20
3	1.9	1. 3	3. 24	59.9	33.89	56.58	70.24	0.2518	0.1240	42.89
4	2.9	1. 3	4. 21	69.13	39. 25	71.34	68.37	0.1730	0.1025	40.51
5	3.8	1. 3	5. 18	74.91	44.42	82.99	73.31	0.1324	0.0874	40.23

EXPERIMENTAL OBSERVATIONS OF EXHAUST SMOKE DENSITY USING B5:

S.No.	Load %	Weight kg	Speed Rpm	Absorption co-efficient K	Smoke density H.S.U.
1	0	0	1500	0.78	28
2	25	4	1500	1.19	40
3	50	8	1500	1.25	41.565
4	75	12	1500	1.38	42.238
5	100	16	1500	1.42	45.69

Experimental Observations for Using B10:

S.No.	Load				Spe ed (N) (rpm)	Time Taken for 20cc Fuel Consumption (sec)	Manometer Reading		
	%	W(kg)	S (kg)	W-S (kg)			h1 c m	h2 c m	hw m
1	0	0	0	0	1500	172	0.7	3	0.037
2	25	4	0	4	1500	128	0.8	3	0.038
3	50	8	0	8	1500	96	0.5	2.9	0.034
4	75	12	0	12	1500	76	0.5	3	0.035
5	100	16	0	16	1500	62	0.5	2.8	0.033

EXPERIMENTAL RESULTS USING BLENDB10:

S. No.	BP (kW)	F P (k W)	IP (k W)	ηmech %	ηBTE %	ηITE %	ηVol %	BS FC (kg /kWhr)	ISF C (kg/kWhr)	A/ F (kg of air/kg of fuel)
1	0	1.4	1.4	0	0	41.15	69.31	∞	0.20894	70.746
2	0.97	1.4	2.37	40.94	21.23	51.86	70.24	0.404	0.1658	53.355
3	1.94	1.4	3.34	58.10	31.85	54.83	66.43	0.269	0.15684	37.850
4	2.91	1.4	4.31	67.53	37.83	56.01	67.40	0.227	0.15352	30.402
5	3.88	1.4	5.28	73.50	41.15	55.98	65.45	0.208	0.1536	24.084

EXPERIMENTAL OBSERVATIONS OF EXHAUST SMOKE DENSITY USING B10:

S.No.	Load %	Weight kg	Speed Rpm	Absorption co-efficient K	Smoke density H.S.U.
1	0	0	1500	0.5	19.35
2	25	4	1500	0.60	22.74
3	50	8	1500	1.06	36.594
4	75	12	1500	1.58	49.298
5	100	16	1500	2.40	64.37

EXPERIMENTAL OBSERVATIONS USING BLENDB20

S.No.	Load				Spe ed (N) (rpm)	Time Taken for 20cc Fuel Consumptio (sec)	Manometer Reading		
	%	W(kg)	S(kg)	W-s (kg)			h1 cm	h2 cm	hw m
1	0	0	0	0	1500	166	0.7	3	0.037
2	25	4	0	4	1500	128	0.7	3	0.037
3	50	8	0	8	1500	96	0.5	3	0.035
4	75	12	0	12	1500	76	0.5	2.9	0.034
5	100	16	0	16	1500	60	0.5	2.9	0.034

EXPERIMENTAL RESULTS USING BLEND B20

S. No.	B P (k W)	F P (kW)	IP (kw)	ηmech %	ηBTE %	ηITE %	ηVol %	B SF C (k g/ k W hr)	ISF C (kg/k Wh r)	A/ F (kg of air /kg of fue l)
1	0	2	2	0	0	56.62	69.31	∞	0.1028	67.0958

2	0. 97	2	2.97	24.44	21.19	64.85	69.31	0.412	0.1007	51.7365
3	1. 9	2	3.94	39.2	31.7	64.5	67.4	0.274	0.1079	37.7393
4	2.91	1.4	4.31	67.53	37.83	56.01	67.40	0.227	0.15352	30.402
5	3.88	1.4	5.28	73.50	41.15	55.98	65.45	0.208	0.1536	24.084

EXPERIMENTAL OBSERVATIONS OF EXHAUST SMOKE DENSITY USING B20

S.No.	Load %	Weight kg	Speed Rpm	Absorption co-efficientK	Smoke density H.S.U.
1	0	0	1500	0.60	22.74
2	25	4	1500	0.70	25.99
3	50	8	1500	1.12	38.21
4	75	12	1500	1.15	39
5	100	16	1500	2.17	60.65

EXPERIMENTAL OBSERVATIONS USING BLENDB30

S. No.	Load				Speed (N) (rpm)	Time Taken for 20cc Fuel Consum ption (sec)	Manometer Reading		
	%	W(kg)	S(kg)	W-S (kg)			h1 cm	h2 cm	hw m
1	0	0	0	0	1500	172	0.5	2.9	0.034
2	25	4	0	4	1500	122	0.5	2.9	0.034
3	50	8	0	8	1500	96	0.6	2.8	0.034
4	75	12	0	12	1500	78	0.5	2.8	0.033
5	100	16	0	16	1500	62	0.5	2.6	0.031

EXPERIMENTAL RESULTS USING BLEND B30

S.No.	B P (k W)	F P (k W)	IP (k W)	ηmech %	ηBTE %	ηITE %	ηVol %	BS FC (kg/k Whr)	ISF C (kg/k Whr)	A/ F (kg of air /kg of fuel)
1	0	1.75	1.75	0	0	50.92	66.44	∞	0.17419	65.0776
2	0.97	1.75	2.72	35.68	20.03	56.15	66.43	0.4427	0.15796	46.1576

3	1.94	1.75	3.69	52.59	31.53	59.95	65.97	0.2813	0.14795	36.0677
4	2.91	1.75	4.66	62.46	38.42	61.52	65.45	0.2308	0.1448	29.0750
5	3.88	1.75	5.63	68.93	40.72	59.08	63.44	0.2177	0.15013	22.3995

EXPERIMENTAL OBSERVATIONS OF EXHAUST SMOKE DENSITY B30

S.No.	Load %	Weight kg	Speed Rpm	Absorption co-efficient K	Smoke density H.S.U.
1	0	0	1500	0.42	16.51
2	25	4	1500	0.52	20.028
3	50	8	1500	0.7	25.99
4	75	12	1500	1.12	38.219
5	100	16	1500	1.63	50.376

EXPERIMENTAL OBSERVATIONS FOR BLEND B40

S. No.	Load				Speed (N) (rpm)	Time Taken for20CC Fuel Consumption (sec)	Manometer Reading		
	%	W(kg)	S(kg)	W-S (kg)			h1 c m	h2 c m	hw m
1	0	0	0	0	1500	148	0.5	2.8	0.033
2	25	4	0	4	1500	118	0.5	2.8	0.033
3	50	8	0	8	1500	94	0.5	2.9	0.034
4	75	12	0	12	1500	74	0.4	2.9	0.033
5	100	16	0	16	1500	62	0.5	2.6	0.031

EXPERIMENTAL RESULTS USING B40

S.No.	B P (k W)	F P (k w))	IP (k W)	ηmech %	ηBTE %	ηITE %	ηVol %	BS FC (kg/k Whr)	ISF C (kg/k Wh r)	A/ F (kg of air/kg of fuel)
1	0	2.25	2	0	0	49.70	65.45	∞	0.18132	53.8925
2	0.97	2.25	2.97	32.67	19.23	58.86	65.45	0.4685	0.1531	42.9683
3	1.94	2.25	3.94	49.25	30.64	62.21	66.43	0.2940	0.14486	34.7427
4	2.91	2.25	4.91	5928	30.54	61.03	65.45	0.2490	0.14764	26.9474

5	3.88	2.25	5.88	66.04	33.02	61.24	63.44	0.2229	0.14714	21.8824

EXPERIMENTAL OBSERVATIONS OF EXHAUST SMOKE DENSITY B40

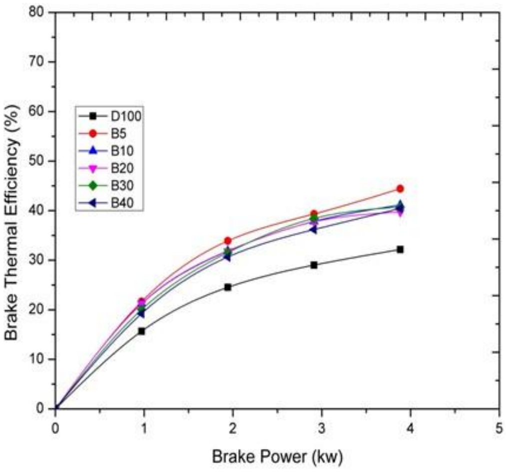
S.No.	Load %	Weigh kg	Speed Rpm	Absorption co-efficient K	Smoke density H.S.U.
1	0	0	1500	0.3	12.10
2	25	4	1500	0.5	19.35
3	50	8	1500	1.13	38.47
4	75	12	1500	1.94	56.56
5	100	16	1500	2.48	65.57

SUMMARY FROM EXPERIMENTAL OBSERVATION

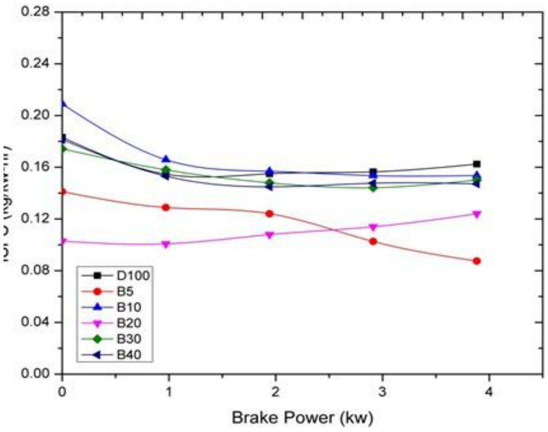
The performance and emission characteristics of conventional diesel, diesel and biodiesel blends were investigated on a single cylinder diesel engine. The conclusions of this investigation at full load are as follows:

- The brake thermal efficiency increases with increase biodiesel percentage. Out of all the blends B5 shows best performance and emissions parameters. The maximum brake thermal efficiency obtained is 44.42%with B5 blend.
- As a CI engine fuel, B5 blend results in an average reduction of 21.53% smoke densities.
- Since B5 blend reduces the environmental pollution, high in thermal efficiency when compared with diesel it will be a promising renewable energy source for sustaining the energy.

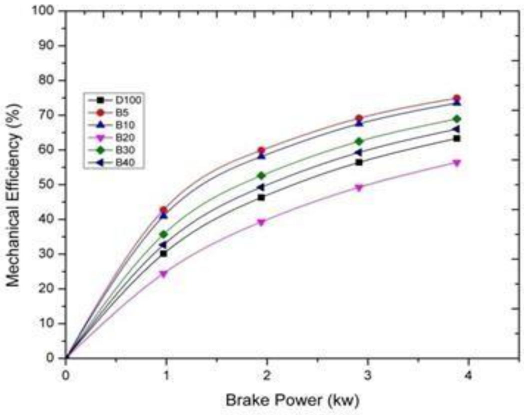
Graphs:



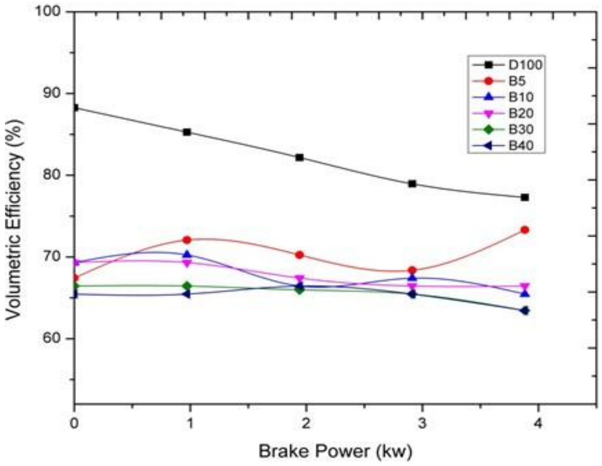
Variation of Brake Themral Efficiency with Brake power



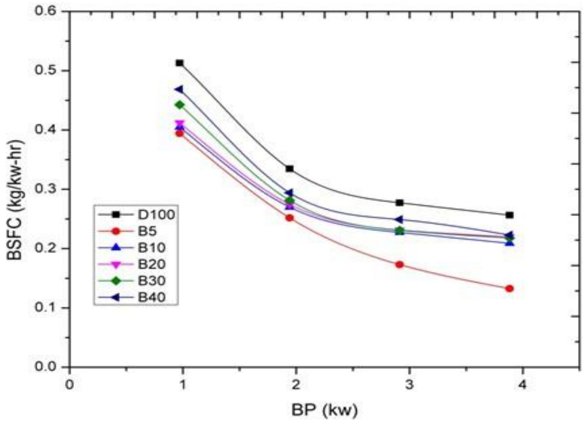
VariationofIndicated spacific fuel consumption with Brake Power usingTSOME Blends



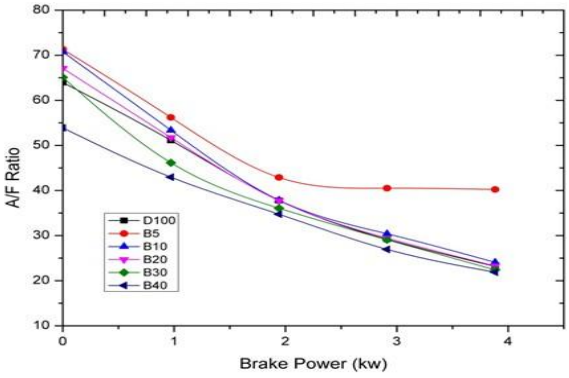
Variation of Mechanical Efficiency with Brake power using TSOME Blends



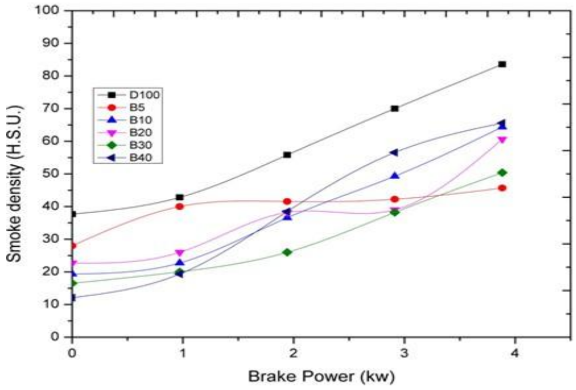
Variation of Volumetric Efficiency with Brake power



Variation of Brake spacific fuel conjumption with Brake Power using TSOME Blends



Variation of Air-Fuel Ratio with Brake Power using TSOME Blends



Variation Smoke deensity with Brake power using TSOME Blends

VII.CONCLUSION

In this investigation experiments are conducted on four stroke single cylinder water cooled diesel engine at constant speed using TSOME blends and determine how an engine will operate with an alternative fuel.

The physical and chemical properties of crude Tobacco seed oil not suitable to used directly as CI engine fuel due to higher viscosity and density which will result in low volatility and poor atomization of oil during oil injection in combustion chamber causing incomplete combustion and carbon deposits in combustion chamber.For this reasons crude Tobacco seed oil is converted to Tobacco seed oil methyl esters bytransesterification process. Transesterification process is a method to reduce viscosity of crude tobacco seed oil with low production cost.

In order to achieve maximum yield of Tobacco seed oil, transesterification of crude oil of this species was carried out at 65- 700C. It is observed base catalyst performs better results than acid catalyst.The fuel properties of obtained Tobacco seed oil that is, kinematic viscosity, specific gravity, flash point, fire point, calorific value and carbon residue were found

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