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PERFORMANCE EVALUATION OF FOUR STROKE CI ENGINE USING COCONUT BASED BIO-DIESEL

S. Raju Ph.D Research scholars, Department of Mechanical Engineering, Chaitanya Deemed to be university, kishanpur, Hanamkonda, Telangana, 506001.
Dr. M. Srinivasnaik Associate professor, Department of Mechanical Engineering, Chaitanya Deemed to beuniversity, kishanpur, Hanamkonda, Telangana,506001.

Abstract:
As the world's need for fossil fuels rises, pollution levels are rising quickly. The amount of greenhouse gases and other hazardous pollutants that can be released into the environment as a result of using fossil fuels has peaked. The previous few decades have seen a global search for a secure, environmentally sustainable alternative energy source. Green bio-diesel is a popular alternative energy source.
Biofuel is an alternative fuel that can be used directly in in diesel engine as pure or blended with diesel fuel. The current project is the Making biodiesel from used edible (coconut) oil through a transesterification process and methyl alcohol Glycerol and potassium hydroxide serves as a catalyst. The density, viscosity, calorific valve, flash, and fire of her were tested. Performance test is done on 4-stroke water-cooled diesel engine.

Key words: coconut oil, 4-stroke engine, bio-fuel.

1. Introduction:

The world's demand for energy is rising quickly. The number of cars has significantly increased recently, which has increased demand for petroleum-based products. Alternative energy sources are receiving more attention as a result of rising energy demand, declining petroleum-based fuel reserves, rising pollution produced by them, and rising fuel costs.
There has been a vigorous quest for alternative fuels because crude oil stocks are only expected to endure for a few decades. Today, alternative fuels like bio alcohols, hydrogen, natural gas, and biodiesel are all in use. The most potential substitute for petroleum-based diesel fuel (PBDF) among the several alternative fuels under investigation is biodiesel made from vegetable oils for the following reasons (Ramadhas et al., 2004).
1. Biodiesel is made entirely from vegetable sources.
2. Biodiesel is an oxygenated and non-flammable fuel
3. Emissions of carbon monoxide (CO) and soot tend to be reduced
4. Use of biodiesel does not contribute to global warming.
5. Biodiesel improves energy security and economy independence.

The goal of every researcher is to improve an engine's performance and efficiency while reducing exhaust pollutants. Both human life and the environment are harmed by exhaust pollutants. The uses of alternative fuels, catalytic converters, and the addition of chemicals to the fuels, among other emission reduction strategies, are employed in the engines to address these issues. Most commonly, compression ignition engines emit exhaust pollutants such as hydrocarbons (HC), carbon monoxide (CO), and nitrous oxide (NOx). Alternative fuels can be added and blended in various ratios to reduce exhaust emissions. Numerous studies have been conducted on various alternative fuels. Vegetable oil has a high viscosity and moderate volatility, which prevents combustion in diesel engines. Transesterification is the process of eliminating glycerides and combining vegetable oil esters with alcohol so that the viscosity is comparable to diesel and high heating is maintained. by enhancing the performance characteristics of a diesel engine, such as fuel relative to petroleum diesel fuel, value and cetane number. The various fuels' chemical compositions and structures result in variations in engine operations, which in turn produce variations in engine parameters (such as combustion, performance and emission) biofuel is made from the esters of vegetable oils fuel viscosity reduction fuel viscosity through transesterification.

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1.1Transesterification:

The fatty acid triglycerides are esters of fatty acids, and transesterification is the chemical splitting up of the heavy molecules to produce simpler esters. For a set period of time, the triglycerides are reacted with a suitable alcohol in the presence of a catalyst at a controlled temperature. Alkyl esters and glycerine are the end products. The main component is the alkyl ester, which has favourable properties as a fuel for use in CI engines.

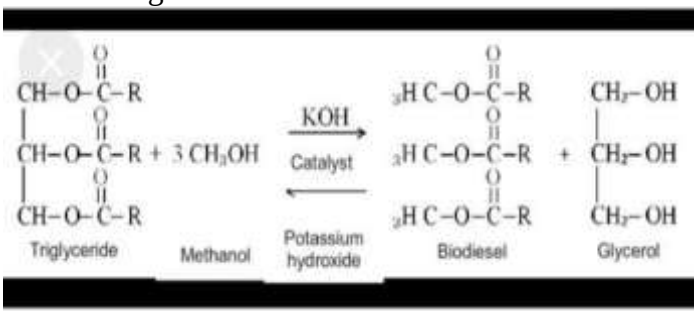

Fig1: chemical reaction of biofuel and catalyst

2. PRODUCTION OF BIODIESEL:

Vegetable oils are fatty acid esters that are chemically complex. These are known as fatty acid tri-glycosides. These triglycerides would have a molecular weight of 800 or higher. Because of their high molecular weights, these fats have a high viscosity, which causes major issues when used as fuel in CI engines. These molecules must be broken down into simpler molecules in order to have viscosity and other properties comparable to the PBDF. Vegetable oils can be modified in a variety of ways. Some of them are pyrolysis, micro emulsification, dilution, and transesterification. Among these, transesterification is the most widely used commercial process for producing clean, environmentally friendly fuel known as biodiesel.

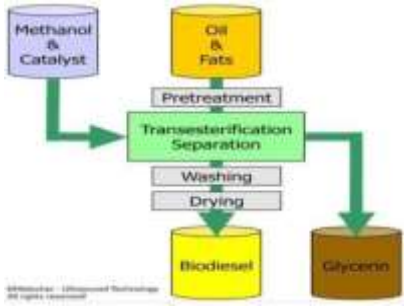

Fig2: bio-fuel preparation

Fuel Properties of Raw Oil, Biodiesel And PBDF:

Properties	Raw Oil	Bio-Fuel	PBDF
Specific gravity	17.19		
Density (kg/lit)	0.8	0.5	810
Viscosity at 53°C	39.46	10.5	2
Flash point (°C)	256	170	52
Fire point (°C	285	195	60
Boilingpoint (°C)	240	145	45
Mass (Kg)	0.048	0.04	0.03

Fig 3: flash and fire point apparatus

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Fig 4: Red Wood Viscometer

3. EXPERIMENTAL ANALYSIS:

For the research, a single-cylinder, 4-stroke, water-cooled diesel engine with a rated power of 5 HP at 1500 rpm was used. To absorb the power generated, the engine is coupled to a rope-pulley brake arrangement. The volumetric flow rate of fuel is measured with a burette and a stopwatch. The engine and exhaust gas temperatures were measured using thermocouples and a digital temperature indicator. An M.S. tank filled with a blended bio-diesel orifice and a U-tube manometer that measures the pressure inside the tank are used to measure air consumption.

Fig 5: Experimental Setup

Engine specification:

Engine	Kirloskar Diesel engine
Speed	1500 rpm
Number of cylinders	1
Compression ratio	16.5:1
Orifice meter	20mm
MaxmiumH.p	5 H.P
Stroke	110 mm
Bore	80 mm
Type	Water cooled
Method of loading	Rope brake

4. Experimental Producer:

Determine the maximum load that an engine should be subjected to. Verify the fuel supply, water flow in the pipes, and lubricant in the oil sump. Ensure that there is no load. For a few minutes, the engine was allowed to run at its ideal speed after starting. By using a mechanical brake, the engine is gradually loaded while the speed is kept constant. Ensure that the brake drum is receiving the cooling Water supply. Engine load should be applied in increments of 0%, 25%, 50%, 75%, and 100% of the maximum load. Take note of the corresponding engine speed, hanger weight, spring balance, fuel consumption (time for 10 CC), and manometer reading. Unload the engine after taking the readings, let it run for a little while, and then turn it off.

5. RESULTS AND DISCUSSIONS:

For a single cylinder, 4-stroke, 5 HP diesel engine, experiments have been carried out, and experimental data has been collected, evaluated, and analysed using various blends of coconut oil.

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Engine performance calculations are generated by utilising various mixtures. The majority of talks focus on comparing the engine performance of coconut, diesel oils using various blends at minimum and maximum loads at average engine speed (1500rpm). The mass flow rate of fuel, air flow rate for lambda (to obtain engine performance), speed, and oil temperature of the engine are studied during continuous operation of a single-cylinder, four-stroke, 5 HP diesel engine for the specified time period, and through this the overall performance of the engine has been demonstrated. The outcomes appeared to vary.

5.1Mechanical efficiency

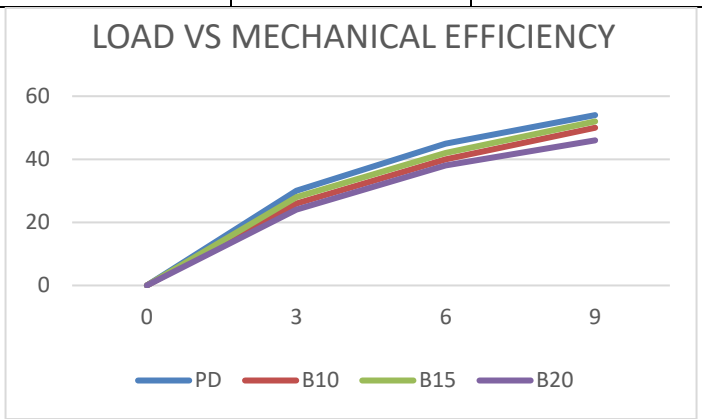
Load (KG)	PD	B10	B15	B20
0	0	0	0	0
3	30	26	28	24
6	45	40	42	38
9	54	50	52	46

5.2Brake Thermal Efficiency

Load (KG)	PD	B10	B15	B20
0	0	0	0	0
3	15	11.70	11.74	11.58
6	29	22	20	19
9	40	3.95	29.72	27

5.3Indicated Thermal Efficiency

Load (KG)	PD	B10	B15	B20
0	40	45	33	44
3	51.65	42	40	46
6	60	52	46	50
9	74	60	52	57



The engine's mechanical efficiency under varied loads is shown in Fig5This might be because the oi l has better lubricating properties, which cutsdown on frictional losses.When compared to other blen ds, mechanical efficiency is higher at B15 at maximum load.

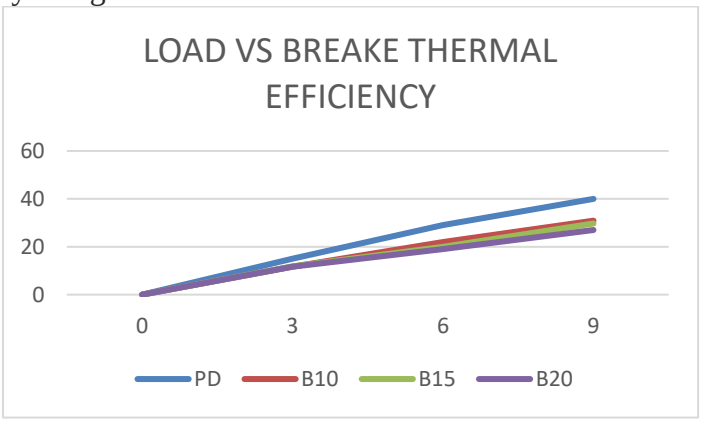


Fig7. shows the variation of Brake thermal efficiency withvariation of loads. It can be seen from graph that Brakethermal efficiency in all cases it increased with increased

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inload.ThemaximumBrakethermalefficiencywasobtainedatB10 coconut oil which are higher thanotherblends.

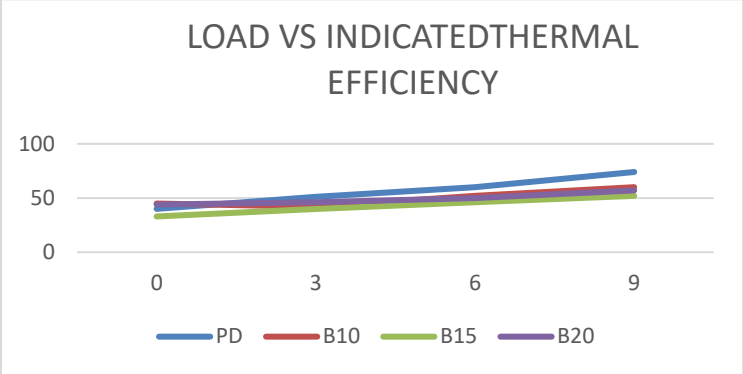

Fig8. It can see from graph that Indicated Thermal Efficiency is higher than that of B10 coconut oil at maximum load to compare other fuels and different blends

6. Conclusion:

Different coconut oil mixes were the subject of an experimental inquiry, and the performance of each was assessed and contrasted with diesel.Methyl esters made from coconuts that are used as biodiesel can be usedin diesel engines directly.Coconut oilmixed separately with diesel hasbeen used to test th e engine.

When coconut oil is added to an engine, the thermal efficiencyof the engine is noticeably higher and is enhanced by 40%.In terms of engine performance, it was foundthatthe B10 coconut oil blend outp erformed the other blends by a significant margin.eventhough coconut oil has a low viscosity and is c ost-effective.The coconut oil mixture (B10) is recommended when taking thermal efficiency into consideration.

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