ISSN: 2278-4632
Vol-11 Issue-02 2021

Experimentation in Improving the Efficiency of Twin Cylinder Tractor Engine with Biodiesel Using Cotton Seed Oil

Dilipram Deep[1], Debasish Das[2], Jyoti Prakash Behera[3]
[1]Asso. Professor, [2]Asst. Professor, [3]Student
Department of Mechanical Engineering
Einstein Academy of Technology and Management
Bhubaneswar, Khurdha
Odisha, India

ABSTRACT

Carbon fuel increases the air pollution in the atmosphere and also excessive oil costs leads for alternate sources which will be a substitute for carbon fuel that could increase the performance and efficiency of the vehicle. Biodiesel are the promising substitute for alternate fuel. To minimize the usage of carbon fuel the biodiesel blends are used. The biodiesel produced from cotton seed oil represents one of the most suitable options for use of conventional carbon fuel. Cotton seed oil is converted into cotton seed oil methyl ester known as biodiesel. This is prepared inthe presence of homogeneous acid catalyst. The properties of the cotton seed oil is discussed for preparation of biodiesel blend. The cotton seed biodiesel blend is initially a binary mixture of cotton seed biodiesel and diesel fuel. The work in this paper is aimed to reduce the emission and to increase the performance of the engine. The performance test is done on the twin cylinder tractor engine by using the biodiesel blend. The cotton seed curcas biodiesel is used up to 50% mixed with diesel fuel and the performance of the engine produces approximately 60% much less carbon emission and close to 80% much less sulfur dioxide. Biodiesel is more lubricating than diesel fuel, increasing the lifecycle of the engine. Air pollution prompted by means of the growing use of petroleumfuel, alternate clean burning gasoline must be explored.

Keywords: Diesel Engine, Performance, Emission, Cotton seed biodiesel blends.

1. INTRODUCTION

Biodiesel, an environmental friendly diesel fuel which is like a petro-diesel in combustion homes, has obtained wide spread attention inside the latest beyond international. Biodiesel is a methyl or ethyl ester of fatty acid crafted from renewable biological sources consisting of vegetable oils, recycled waste vegetable oil and animal fat [1]. The use of cotton seed oils as fuels has been around since 1900 whilst the inventor of the diesel engine Rudolph Diesel first tested diesel oil in his compression ignition engine [2]. However, due to reasonably-priced petroleum products such non-conventional fuels. Cottonseed curcas has been recognized as strength crop for the international locations to develop their very own renewable energy source with many promising advantages. With the growing hobby in biofuels international, there may be want for national governments in Africa to expand mechanisms for harnessing the ability of the quick growing industry and benefit from the growing worldwide alternate in biofuels. If Africa takes the lead within the manufacturing of bio fuel, particularly from cotton seed, the continent's efforts on this enterprise will function it as an exporter of biodiesel, hence growing its economic and political leverage in the global society. Many multinational organizations, especially Scandinavian, Chinese, European and Indian ones are scrambling for African land for cotton plantations. It is likewise said that wireless verbal exchange giants Ericsson, GSMA and MTN are making an investment in using bio fuel from cotton seed and other oils to electricity cell network base stations in the developing international for the untapped market place of the capability cellular customers [3]. Cruces Linnaeus plant originated from Mexico and then spread to Asia and Africa by the Portuguese traders as a hedge plant. Cruces Belongs to the family of Euphorbiaceous, which is the species that contravene the Geneva conventions on chemical battle. The genus name cotton seed derives from the Greek, which implies medicinal uses, hence the plant is traditionally used for medicinal purposes. It is a hardy shrub that can grow on poor soils and areas of low rainfall (from 250 mm a year) hence it is being promoted as the ideal plant to farmers [4]. Since cotton seed can grow relatively well in marginal areas compared to other traditional crops, it may help to reclaim degraded land and protecting the soil from soil erosion. The trees are easy to establish (from seeds or cuttings), grow relatively quickly (producing seed after their second year) and are hard to drought. On average, each mature tree produces about four kilograms of seed per year when cultivated under optimal conditions. It has a long productive period of around 30 - 50 years [5]. The proximate analysis of cotton seeds revealed that the percentage of crude protein, crude fat and moisture were 24.60, 47.25 and 5.54% respectively [6]. The seeds can be transported without deterioration and at low cost due to its high specific weight. The seeds of the cotton contain 30 - 40% oil that can be easily expressed for processing and refinement to produce biodiesel [7].

Cotton seed gives higher oil yield per hectare than peanuts, sunflower, soya or maize when grown under optimum conditions. The processed oil can be used directly in diesel engines after minor modifications or after blending with conventional diesel. The fact that the oil of cotton seed cannot be used for nutritional purposes without detoxification makes its use as an energy source for fuel production very attractive. The byproducts of the biodiesel processing plant are rich in nitrogen, press cake and glycerol, which are said to have good commercial value as fertilizer and as a base for soap and cosmetics, respectively found that crude protein was 56% in Cape Verde, 61% in Nicaragua, 56% in Ife-Nigeria and 64% in nontoxic Mexico Cotton seed oil varieties. They also found that the amino acid composition of meals both non-toxic variety and toxic varieties which are high and similar to each other. The levels of essential amino acids extract were compared with that for FAO reference protein. Cotton seed oil is traditionally used for medicines and as hedges to protect fields and gardens since animals do not eat it [8]. The leaves, root and bark also have potential for numerous other industrial and pharmaceutical uses as shown in Figure1. A number of enzymes such as protease, lipase and esterase with good properties of use in biotechnology and also been extracted and purified from J. cruces [9]. These features have generated a great interest in the cotton plant which is now becoming a cash crop in South and Central America, Europe, Africa and Asia. Table 1 summarizes some of the advantages and disadvantages of Cotton seed oil production. The positive claims on Cotton seed oil are numerous, but only a few of them can be scientifically sustained. The learn is completed to assess and evaluate using quite a lot of diesel gas supplements which has combination ratio of 50/50.

In a typical, thoroughly instrumented, twin cylinder, four stroke, direct injection (DI) Simpson s 217 engine. Extra mainly, an excessive variety of bio-diesels of various origins are validated as dietary supplements. The intense of assessments are conducted using every of the bio fuel blends, with the engine working at a speed of 1300 rpm and at a medium and high load. In each and every test volumetric gas consumption and brake thermal efficiency are computed. The variations in performance and exhaust emission parameters are measured from the baseline operation of the engine, when working with diesel it is determined. The evaluation in elevation in between using the Bio-diesel blends. Theoretical elements of diesel engine combustion, combined with the general differing physical and chemical properties of these diesel oil supplements towards the average diesel gas are used to help and correct the interpretation by engine behavior. Growing concern consisting with energy resources and therefore the setting has multiplied interest within the study of other supply of energy.

Therefore increasing energy necessities, it has been growing interest in various fuels like biodiesel to supply an acceptable diesel fuel substitute for IC engines. Biodiesels provides awfully promising various diesel fuel as they're renewable and have similar properties. Biodiesel is outlined as a Trans-esterifies renewable fuel derived from rosindicot genus oils with properties similar and higher than diesel oil. The demonstrations have shown that it is used purely or in blends with typical diesel oil in unqualified internal-combustion engine. Bio-diesel commands crucial benefits appreciate technical of mixing in any magnitude relation with oil diesel oil, use of existing storage facility and infrastructure, superiority within the setting, emission reduction, capability to supply energy security to remote and rural areas and employment generation.

There are quite 350 oil bearing crops known, among that solely helianthus, Soybean, Cottonseed, Rapeseed, rosindicot genus curcas and Peanut oils are thought-about as potential various fuels for Diesel engines.

2. MATERIALSANDMETHODS

2.1. Materials

Materials and equipment used in the manufacturing of biodiesel are as follows: thermometer, retort stand, pipette, measuring cylinder, separating funnel, magnetic stirrer, oven, water bath, hydrometer, conical flask, virtual weighing stability, stop watch, hot plate, distilled water, methanol, and cotton seed oil. Table1 represents the cotton seed quality and other specifications used for this process.

Table1materialsusedforproductionofbiodiesel blend

S.NO	DESCRIPTION	QUANTITY	UNIT
1.	Oil content in cotton seed	50	%
2.	Cotton seed quantity	3560	Kg
3.	Oil extracted by oil expander /expeller	670	Kg
4.	Seed cake taken to solvent extraction	2670	Kg
5.	Input to solvent extraction section, including Recycling of spent bleaching earth	2455	Kg
6.	Oil extracted by solvent extraction	480	Kg
7.	De–oiled seed cake	2552	Kg
8.	Hexane consumption in solvent extraction	5.7	Lit
9.	Crude oil fed to refinery	1102	Kg
10.	Bleaching earth used in oil refining	32	Kg
11.	Free fatty acid recovered in refining	168	Kg
12.	Refined oil taken directly for biodiesel	935	Kg
13.	Crude glycerin recycled to glycerolysis	37	Kg
14.	Pure glycerin taken to glycolysis	17	Kg
15.	Fatty acid methyl ester product	1214	Kg

2.2. Method

The usage of cotton seed oils in neat form is possible but it is not preferable. Due to high viscosity of cotton seed oils and low volatility affects atomization and spray pattern of fuel, leading incomplete combustion and severe carbon deposits, injector choking and piston rings ticking. The common method for extracting the cotton seed oil and the biodiesel blends areas follows transesterification, emulsification, pyrolysis, blending with diesel. Blending in cotton seed oil may also be instantly combined with diesel fuel and used for strolling an engine. The blending of cotton seed oil with diesel fuel in one-of-a-kind proportion have been

ISSN: 2278-4632
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experimented efficaciously via various researchers. Blend of 50% oil and 50% diesel have shown identical results as diesel and likewise houses of the combination is almost diesel. The mixture with greater than 30% has shown appreciable discount in flash point because of broaden in viscosity. Some researchers steered for heating of the gasoline lines to curb the viscosity. Although brief term assessments utilizing neat cotton seed oil confirmed the assured output, longer tests ended in injector coking, more engine deposits, ring sticking and thickening of the engine lubricant.

Pyrolysis is the procedure of conversion of 1 substance into another by the use of warmth or with the support of catalyst. It entails heating in the absence of air or oxygen and cleavage of chemical bonds to yield small molecules. The paralyzed material can be cotton seed oils, natural fatty acids and methyl esters of fatty acids. The pyrolysis of fat has been investigated for greater than 100years, specifically in these areas of the world that lack deposits of petroleum. Tung oil used to be saponified with lime and then thermally cracked to yield crude oil, which was once sophisticated to produce diesel gas. Trans esterification entails reaction of the triglycerides of cotton seed oil with methyl alcohol in the presence of a catalyst Sodium Hydroxide (NaOH) to provide glycerol and fatty acidester.

3. EXPERIMENTALINVESTIGATION

This experimental work has been conducted in 4 stroke 2 cylinder water cooled diesel engine.Table2 shows the specifications of the engine using for the investigation.

Table2 EnginetestdetailsandspecificationsTest Performed

S. No	Engine specification	Description
1.	Engine type	4 Stroke, 2 Cylinder, DI Diesel-Water Cooled
2.	Engine make & model	SIMPSONSS217
3.	Bore (mm)	92.47
4.	Stroke (mm)	128.00
5.	C.R.	18.50
6.	Rod Length (mm)	230.60
7.	Swept Volume (C.C)	1765.00

All experiments have been carrying out at standard temperature and stress. The engine pace become measured without delay from the tachometer connected with the dynamometer. A water brake dynamo became used for engine torque dimension. The outlet temperatures of cooling water and exhaust fuel were measured immediately from the thermocouples attached to the corresponding passages. The dynamic gasoline injection timing turned into set at 22BTDC (earlier than pinnacle useless middle). The engine out NOx, and CO were measured with a transportable virtual gasoline analyzer (IMR 1400), (specification shown in Table 2).The exhaust emissions had been measured at 30cm from the exhaust valve. Smoke emission changed into measured through preserving a filter out paper on the quit of the exhaust pipe. In order to measure particulate matter, a two-layer of filter cloth was weighed first, then the filter material was keep about minutes at the end of the exhaust pipe and the filter paper became weighed again. Differences of two weights imply the quantity of particulate depend emitted through the engine. The engine velocity changed into saved fixed at 950 rpm and an willing water tube manometer, related to the air box (drum) changed into used to degree the air stress. Fuel intake turned into measured by using a burette attached to the engine and a stop watch became used to measure gasoline intake time for every 10 cm^3 gas. A mechanical fuel pump was used inside the injection machine. One hole injector nozzle with a hole diameter of 0.2mm become used within the injection device. Each experimental

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information studying turned into taken three instances and the imply of the three became taken. Table three shows the end result received from the engine test rig.

Table3 Performancetest onDiesel Engine

Section	**Parameter**	**Symbol**	**Unit**	**Load 1**	**Load 2**	**Load 3**	**Load 4**
Dynamometer	Calculated Torque	T	N-m	79.0000	59.6000	39.5000	19.7500
	Speed	N	RPM	1500.2700	1497.3330	1496.7561	1499.8472
Tempera ture and Fuel	Water Outlet Temperature from Engine	Twoe	Deg.C	0.0000	0.0000	0.0000	0.0000
Flow	Water Outlet Temperature to Engine	Twie	Deg.C	0.0000	0.0000	0.0000	0.0000
	Exhaust Gas Temp.	Tgoe	Deg.C	0.0000	0.0000	0.0000	0.0000
	Fuel Flow Rate	FFLR	Cc/min	0.0000	0.0000	0.0000	0.0000
	Atmospheric Temperature	Tair	Deg.C	30.0000	30.0000	30.0000	30.0000
	Atmospheric Pressure	p1	Kg/Cu.m				
Power & Heat	Indicated Mean Effective Pressure	Pi	Bar	0.6588	2.4879	1.8113	1.1385
	Indicated Power	Pi	Kw	1.3250	4.9918	3.6342	2.2889
	Applied Load	Pbrk	Kw	12.4115	9.3453	6.1912	3.1020
	Indicated Power	Pi	Kw	1.3250	4.9918	3.6342	2.2889
	Mechanical Efficiency	Ŋmech	%	105.2398	94.1596	81.3401	67.3831
	Volume Displaced per min by Piston	Ve	Cu.m/min	0.0017	0.0017	0.0017	0.0017
Other	Air Flow Rate	AFLR	Kg/Hr.	0.98051	0.98051	0.98051	0.98051

In this study, readily available used cottonseeds cooking oil was provided by commercial. The molecular weight of the oil and characterization of used cottonseeds oil was determined by Oil characterization and catalyst preparation. The oil was characterized using GCMS. The waste egg shells were cleaned thoroughly in tap water and dried in an oven at 100 °C for 12 h. The dried egg shells were crushed into small pieces and calcinedina muffle furnace at800 °C for 3 h to the convert the calcium species presents in the shells into CaO particle. Then the CaO originated from the egg shells was refluxed in water at70°C. Egg shells particles were taken out and dried in hot air oven at 100 °C for 10 h. The calcined egg shell catalyst product was dehydrated by drying at a temperature 500 °C for 5 h. The catalyst prepared through calcinations was subjected to scanning electron microscopy (SEM) to study the micro structure and catalyst property.

Table4 Blendingofbiodiesel with cotton seed oil (500ml)

Load (%)	Torque (N/mm^2)	Fuel consumption 10ml	In let Water	Outlet water	Exhaust temperature	Smoke	CO	HC	CO2	NO
100	63.1	130.2	44	88	478	7.26	0.27	8	8.1	1403
75	47.1	240.9	55	86	423	5.27	0.17	5	7.3	1332
50	31.5	396.1	52	83	356	2.27	0.08	3	5.4	1023
25	15.7	489.2	52	81	281	1.39	0.03	2	3.4	998
0	0	573.2	50	75	250	1.15	0.01	2	1.8	742
DIESEL										
LOAD	TORQUE	FUEL CONSUMPTION (10ML)	WATER IN	WATER OUT	EXHAUSTTEMPERATURE	SMOKE	CO	HC	CO2	NO
100%	79	142.5	55	80	521	9.6	0.3	9	9.2	1665
75%	59.6	263.2	56	86	465	7.22	0.2	7	8.6	1452
50%	43.2	401.1	56	86	385	4.21	0.8	5	5.5	1325

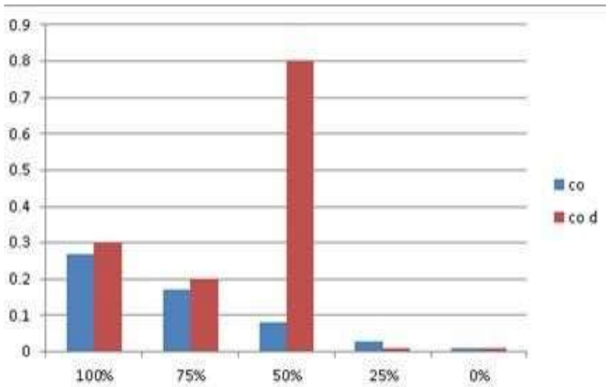

Figure 1 Carbon Emission

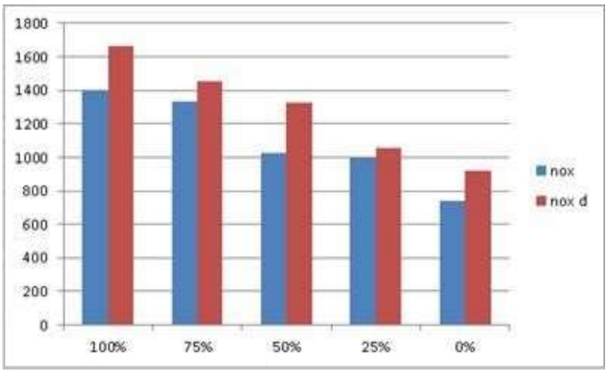

Figure 2 NOx Emission

Figure.1, shows that the percentage of carbon emissions in both the diesel and in the cotton seed oil. It is clear that in cotton seed oil the carbon emission is lower compared to normal diesel oil.Figure.2, shows that the NOx emission in the IC engine, it proves that the NOx emission can be controlled (or) maintained by using the cotton seed oil.

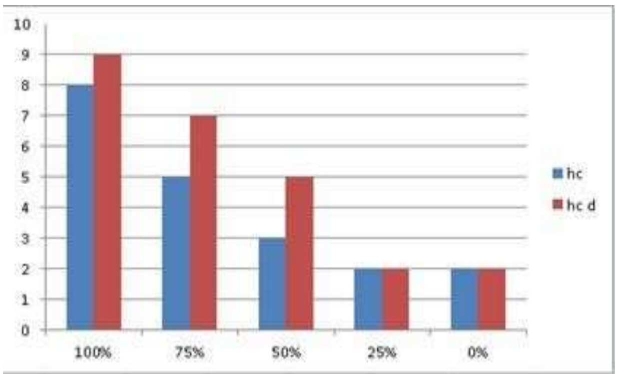

Figure 3 Hydrocarbon Emission

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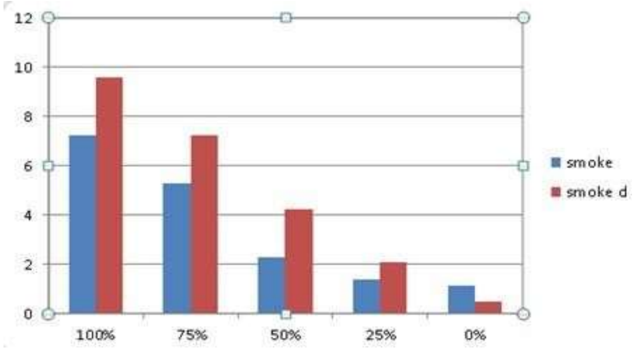

Figure 4 Smoke Emission

Fig.3, represents the emission control in cotton seed oil and the diesel oil.

Fig.4, represents the smoke emission in cotton seed oil and the diesel oil.

4. CONCLUSIONS

Cotton seed biodiesel can be used as an alternative gas in C.I. Engines without any substantial hardware adjustments inside the engine. The physical, chemical and thermal properties of cotton seed biodiesel is progressed via the process of trans esterification. As cotton seed oil is non-fit to be eaten, it is cheaply and abundantly to be had which boom in compression ratio of the engine, the overall performance of the cotton seed oil blends is progressed, further more better blends too showed a satisfactory overall performance with boom in compression ratio. Decrease in CO, HC and smokeopacity and increase in CO2 and NOx emissions are seen with cotton seed biodiesel. Cotton seed biodiesel with oxygenated components improved the overall performance of the engines and decreased emissions that are comparable with diesel fuel.

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