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Experimental Investigations on the Effects of Cerium Oxide Fuel Additive as Nano Particle in Palm Oil Biodiesel

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ABSTRACT

The ever rising cost of fossil fuel internationally has forced major world economies, which are also major importers of fossil fuel, to examine renewable and cheaper alternatives to fossil fuel to meet their energy demands. Biodiesel have emerged as the most suitable renewable alternatives to fossil fuel as their quality constituents match diesel. In addition they are less polluting than their fossil fuel counterparts. Environmental concerns and the desire to be less dependent on imported fossil fuel have intensified worldwide efforts for production of biodiesel from various sources. This paper reports the results of experimental investigations on the influence of the addition of cerium oxide in the nano particle form on the major physicochemical properties and the performance of biodiesel. The physicochemical properties of the base fuel and the modified fuel formed by dispersing the catalyst nano particles by ultrasonic agitation are measured using ASTM standard test methods. The effects of the additive nano particles on the individual fuel properties, the engine performance, and emissions are studied, and the dosing level of the additive is optimized. Comparisons of the performance of the fuel with and without the additive are also presented. The flash point and the viscosity of biodiesel were found to increase with the inclusion of the cerium oxide nano particles. The emission levels of hydrocarbon and NOx are appreciably reduced with the addition of cerium oxide nano particles.

INTRODUCTION

The consistently increasing expense of petroleum derivative globally has constrained real world economies, which are likewise real shippers of non-renewable energy source, to analyze sustainable and less expensive options in contrast to non-renewable energy source to meet their vitality requests. Biodiesel have risen as the most reasonable sustainable options in contrast to non-renewable energy source as their quality constituents coordinate diesel [1-3]. Moreover they are less dirtying than their petroleum product partners. Ecological concerns and the longing to be less reliant on imported petroleum product have strengthened overall endeavors for generation of biodiesel from different sources.

Research on vegetable oils as diesel fuel was directed no less than 100 years back however intrigue slacked due to shoddy and copious supplies of oil energizes. Intermittent increment in oil costs because of more interest, stringent emanation standards, and dreaded deficiencies of oil energizes [5] because of quick consumption and net creation of carbon dioxide from burning sources have revived enthusiasm for sustainable vegetable oil fills. Vegetable oil was utilized as a diesel fuel as right on time as 1900, when Rudolf Diesel showed that a diesel motor could keep running on nut oil. Notwithstanding, its utilization as a fuel pulled in little consideration aside from in the midst of emergency, for example, amid World War II. Since the oil cost expanded of 1970s, different elective powers have been explored with the objective of supplanting ordinary oil supplies. The underlying interest was

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essentially one of fuel supply security, yet as of late more consideration has been centered around the utilization of inexhaustible energizes with the end goal to decrease the net generation of CO_2 from petroleum product burning sources. Thusly it lightens the expanding carbon dioxide substance of the air [7].

The primary points of interest of utilizing the BIODIESEL are its inexhaustibility, better quality fumes gas emanation, biodegradability; it doesn't add to an ascent in the level of carbon dioxide in the environment. For creating nations energizes of bio-source, for example, liquor, vegetable oils, biomass, biogas, engineered fills, and so forth are getting to be imperative. Such energizes can be utilized specifically, while others require a type of change before they are utilized as substitute of traditional fills.

Biodiesel is viewed as spotless fuel since it has no sulfur, no aromatics and has around 10 % worked in oxygen, which encourages it to consume completely. Its higher cetane number enhances the start quality notwithstanding when mixed in the oil diesel. B20 (a mix of 20 percent by volume biodiesel with 80 percent by volume oil diesel) has exhibited noteworthy natural advantages. Studies led with biodiesel on motors have indicated generous decrease in Particulate issue (25–half). Be that as it may, a peripheral increment in NOx (1-6%) is additionally announced. HC and CO emanations were likewise answered to be lower.USA utilizes B20 and B100 biodiesel. France utilizes B5 as obligatory in all diesel fuel. It can likewise be utilized as an added substance to decrease the general sulfur substance of mix and to make up for lubricity misfortune because of sulfur expulsion from diesel fuel [9].

INDIA BIODIESEL SCENARIO

India is a colossal merchant of unrefined petroleum and spends about Rs. 1,200 billion of outside trade each year to meet 75% of its oil needs. This has influenced its parity of installment unfavorably, particularly after the phenomenal ascent in unrefined petroleum costs. Being an agrarian nation enriched with changed atmospheres, supplement rich soil and capacity to develop a wide range of harvests, India offers an extraordinary guarantee as a maker of surplus crude material for biodiesel and bioethanol creation. In spite of the fact that by and by it meets around 30-40% of its vegetable oil necessities through imports, India has a potential and capacity to deliver enough vegetable oil not exclusively to meet its eatable oil prerequisites yet additionally for biodiesel creation [11].

At present India is shy of oil hold, it has immense measure of land and in addition great climatic conditions (tropical) with satisfactory precipitation in expansive parts of the territory to represent substantial biomass generation every year. Since palatable oil request is higher than its household creation, there is no probability of occupying this oil for generation of biodiesel. Luckily there is a substantial garbage of corrupted woodland arrive and unutilized open land, field limits and neglected grounds of agriculturists where non-palatable oil-seeds can be developed. Of these some encouraging tree species have been assessed and it has been discovered that there are various them, for example, Jatrophacurcas (Ratanjyot) and PongamiaPinnata ('Honge' or 'Karanja') which would be exceptionally appropriate in our conditions. Nonetheless, Jatrophacurcas (Ratanjyot) has been discovered most reasonable for the reason.

Table-1.1: Annual Production of Non-edible Oil Seeds in India

Type	Production (MT)	Oil %
Neem	500	30
Karanji	200	27-39
Kusum	80	34
Pilu	50	33
Jajoba	-	50
Bhikal	-	37
Wild Walnut	-	60-70
Undi (Calophylluminophyllum)	**04**	**50-73**
Palm	50	56

TRADE OF BIODIESEL: For making available fuel grade biodiesel the following sequence of events need to be firmed up.

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- Availability of raw material of desired quality
- Chemical treatment to produce biodiesel
- Testing of biodiesel
- Transportation of biodiesel to selected locations for blending
- Blending of Biodiesel into diesel
- Financial support

ADVANTAGES OF BIODIESEL

The principle advantages of biodiesel are expanded vitality independence for bringing in nations, expanded interest for local agrarian items, biodegradability and enhanced air quality, especially bring down sulfur outflows than from petroleum products. Fumes emanation upgrades incorporate considerable decreases in carbon monoxide, hydrocarbons ando particulates, in spite of the fact that the creation of nitrogen gases is like customary diesel fuel [13]. Biodiesel would balance out the arrival of ozone harming substances. Lessened emanations make biodiesel reasonable for use in real urban communities where air contamination is an issue. Likewise, its lower discharges make biodiesel appropriate for use in kept zones, for example, mines where ventilation is a worry. Unadulterated biodiesel has low amphibian danger and is totally biodegradable in 30days.

Europe, the United States, New Zealand and Canada have directed broad trial of biodiesel in trucks, autos, trains, transports, tractors and little water crafts. Results show decreased motor wear while execution remains for all intents and purposes unaltered. Numerous tests have inferred that the best by and large outcomes are acquired with a mix of 20 percent biodiesel and 80percent traditional diesel. An optional advantage of biodiesel generation is that it makes greater work as it is three to six times more work concentrated per unit of creation than non-renewable energy sources [6].

BIODIESEL FOR ELECTRICAL GENERATION:

Impermanent reinforcement oil diesel-powered generators normally work in crises without the advantage of fumes after-treatment to diminish emanations. Utilizing elective fills for these essential reinforcement control sources is a practical technique for ensuring the earth. Powered on 100% biodiesel (B100), these generators help diminish discharges contrasted with oil diesel in a few key regions. Hydrocarbons, a contributing variable in the restricted development of brown haze and ozone, and sulfur discharges, a noteworthy segment of corrosive rain, are basically wiped out with the utilization of B100. The fumes discharges of carbon monoxide, a noxious gas, are around half lower in biodiesel than carbon monoxide emanations [2] from oil diesel. Particulate issue, a human wellbeing danger, is lessened by a third, with the littler particulates decreased by more than 66%.

BIODIESEL IN MARINE ENVIRONMENT:

Autonomous tests have discovered that unadulterated biodiesel is non-lethal, promptly biodegradable and basically free of sulfur and aromatics. Biodiesel is simpler on people, as well. Vessel administrators report a detectable change in fumes smell. The decrease in smell and change of scent are more attractive with motor laborers. Actually, it's been contrasted with the smell of French fries. Biodiesel clients likewise report having no eye bothering. Biodiesel can work in a few marine groups. Since biodiesel can supplant or mix with oil diesel with almost no motor changes, it is a reasonable option in contrast to a few classifications of the marine business, including: recreational water crafts, inland business and maritime business ships, investigate vessels, and the U.S. Drift Guard Fleet. Today, a great part of the accentuation is on recreational water crafts, which devour around 95 million gallons of diesel fuel every year. The utilization of biodiesel and biodiesel mixes results in a discernible change in fumes scent. Clients additionally report no having eye disturbance. Since biodiesel is oxygenated [4].

BIODIESEL AVOIDS GLOBAL WARMING:

A 1998 biodiesel lifecycle examine, together supported by the US Department of Energy and the US Department of Agriculture, closed biodiesel lessens net CO^2 emanations by 78 percent contrasted with oil diesel. This

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is because of biodiesel's shut carbon cycle. The CO^2 discharged into the climate when biodiesel is copied is reused by developing plants, which are later prepared into fuel. Logical research affirms that biodiesel fumes has a less destructive effect on human wellbeing than oil diesel fuel. Biodiesel outflows have diminished levels of polycyclic fragrant hydrocarbons (PAH) and nitrited PAH aggravates that have been recognized as potential malignancy causing mixes [8].

PRODUCTION OF BIODIESEL

- There are ways to run a diesel engine on bio-power, using vegetable oils, animal fats or both. All three work with both fresh and used oils.
- Use the oil just as it is -- usually called SVO fuel (straight vegetable oil);
- Mix it with kerosene (paraffin) or diesel fuel.
- Convert it to biodiesel.

STRAIGHT VEGETABLE OIL:

To use straight vegetable oil (SVO), first the engine has to be started with ordinary petroleum diesel or biodiesel to warm it up, then switch to the straight vegetable oil, and switch back to biodiesel before stopping the engine. If it is not done the engine and the injectors will cokeup.

This means having two fuel tanks. SVO can also be used by preheating the oil before entering in to the engine to reduce the viscosity of the oil.

BLENDING OF SVO WITH DIESEL:

Raw oil can be directly mixed with diesel in required proportions and this can be used in diesel engines. Most people use a mix of up to 20% diesel and 80% vegetable oil, some use 50/50 mixes. It needs at least pre-heating and probably two-tank systems too, like SVO. One tank is used for starting and stopping of the engine and the other tank is used for SVO blended diesel. This method is also not preferable because this also causes coking in injectors and preheating is also required. To get good results the proportion of vegetable oil should be low in the blends [10].

PREPARING RAW OIL IN TO BIO DIESEL

Biodiesel has some clear advantages over SVO, it works in any diesel, without any conversion or modifications to the engine or the fuel system -- just put it in and go. It also has better cold weather properties than SVO (but not as good as petro-diesel). And, unlike SVO, it is backed by many long-term tests in many countries, including millions of miles on the road. Biodiesel is a clean, safe, ready-to-use, alternative fuel, whereas it is fair to say that SVO systems are mostly still experimental and need further development. On the other hand, biodiesel can be more expensive, depending on the type of oil used. And, unlike SVO, it has to be processed. But the large and rapidly growing worldwide band of home brewers don't seem to mind. Many have been doing it for years. Various advantages of using Biodiesel rather than SVO are shown in table.

TYPE OF FUEL	NEEDS PROCESSING	GUARANTEED TROUBLE-FREE	ENGINE CONVERSION	CHEAPER
BIODIESEL	YES	YES	NO	SOMETIMES
SVO/WVO	LESS	NO	YES	USUALLY

PROCESS OF PRODUCING BIODIESEL:

Vegetable oils and animal fats are triglycerides, contains glycerine. The biodiesel process turns the oils into esters, separating out the glycerine. The glycerine sinks to the bottom and the biodiesel floats on top and can be syphoned off. The process is called ESTERIFICATION, which substitutes alcohol for the glycerine in a chemical reaction, using lye as a catalyst. Methanol is used to make methyl esters. Methanol is also called methyl alcohol. Methylated spirits (denatured alcohol) doesn't work; isopropyl alcohol also doesn't work. The lye catalyst can be either sodium hydroxide (NaOH) or potassium hydroxide (KOH), which is easier to use.

Sodium hydroxide is often easier to get and it's cheaper to use. The process is same when potassium hydroxide is used, but it requires 1.4times as much than sodium hydroxide [12].

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BLEND LEVELS FOR BIODIESEL:

Biodiesel has turned into a profitable mixing part with diesel fuel at low rate mixes due to biodiesel's "excellent" viewpoints. Unadulterated biodiesel has high lubricity, high cetane, and a high glimmer point. A few business "premium diesel" items have fused the positive advantages of biodiesel as a part of their multi-practical added substance bundles. These items ordinarily guarantee that biodiesel fills in as the bearer for the added substance and conveys the lubricity properties. Be that as it may, as mix fixations increment there is a higher shot for contortion. Henceforth, all biodiesel (B100) should meet ASTM's [7] biodiesel standard, preceding mixing with diesel fuel at any level.

MANUFACTURING PROCESS

For palm oil:

1. Palm oil is sifted to evacuate any strong particles.
2. Palm oil is then warmed to evacuate any water content (discretionary).
3. Titration is done to decide how much impetus is required.
4. Exact amount of Sodium Hydroxide is then throughly blended in Methanol till it disolves totally to get Sodium methoxide.
5. Palm oil is warmed whenever required (amid winter), and blended in the Sodium methoxide while with instigator running.
6. It is then permitted to settle and glycerine is expelled from base.
7. BioDiesel division is then washed and dried.
8. It is then checked for quality.

In transesterification, NaOH and methanol are blended to make Sodium methoxide (Na+ CH3O-). At the point when blended in with the oil this solid polar-fortified synthetic breaks the transfatty corrosive into glycerine and ester chains (biodiesel), alongside some cleanser in the event that you are not watchful. The esters moved toward becoming methyl esters. They would be ethyl esters whenever responded with ethanol rather than methanol.

Fig: Experimental Setup for production of Palm oil as Biodiesel.

RESULTS

The experiment is carried out for different blends of Calophylluminophyllum diesel and the performance is evaluated for all the blends. Considering the readings

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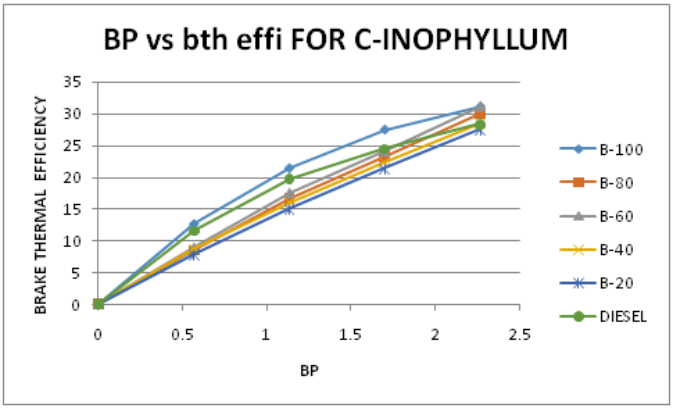
obtained in chapter 5 in this chapter the properties and different efficiencies of blends were compared with diesel and are shown graphically.

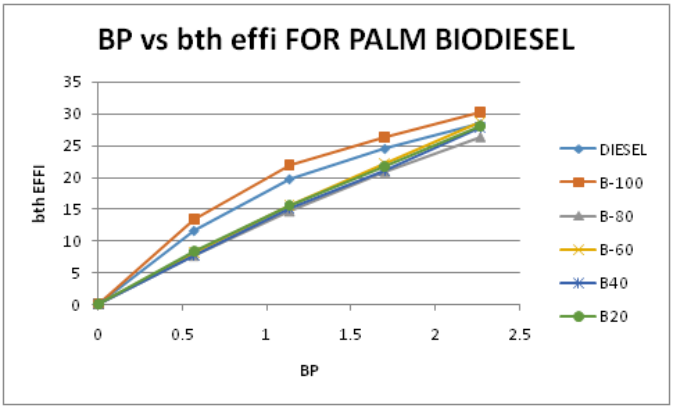
CHARACTERISTICS	CALOPHYLLUM INOPHYLLUM METHYL ESTER (CIME)	DIESEL
Specific Gravity	0.875	0.81
Flash Point	170	56
Fire Point	186	58
Kinematic Viscosity at 40°C (mm^2 /s)	5.34	1.83
Calorific Value (kJ/kg)	40600	44800

TABLE 6.1 COMPARISON OF PROPERTIES

From table 6.1 by comparing different properties of Calophylluminophyllum oil with diesel, it is observed that the properties of CIME closely matches with the petroleum Diesel.

GRAPHS





From the graph 6.1, it is observed that the brake thermal efficiency is high for B100blends of Calophylluminophyllum oil and palm oil and the brake thermal efficiency of B100 is high compared to the brake thermal efficiency of Diesel at different loading conditions. So B100 can be suggested as best combination for biodiesel preparation with Calophylluminophyllum oil and palm oil.

CONCLUSION

- A true exertion has been made for the readiness of Calophylluminophyllum biodiesel and palm oil biodiesel from their particular crude oils. What's more, such acquired biodiesels of Calophylluminophyllum oil and Palm oil are mixed as B20, B40, B60, B80& B100 with oil diesel.
- Properties and efficiencies of various mixes of biodiesel are firmly coordinating to the diesel and along these lines B100 has great outcomes when contrasted with oil diesel.
- India comprise of extensive seaside territory and required ecological conditions for the development of Calophylluminophyllum trees and palm oil along its fruitless grounds of beach front regions. Additionally Calophylluminophyllum oil and palm oil got from its seeds comprise of high oil content i.e., half – 73% when it is contrasted with other TBO's (Tree Born Oils) like jatropha, neem and so forth. In this way, It can be recommended as one of the elective fills in future.
- Employment openings and waste land recovery will enhance and biodegradable outflow will develop.
- Under current conditions biodiesel can legitimately be sold into the diesel market and it can diminish the import bill of oil based goods of our nation.

FUTURE WORK

- This work can be extend for testing of Calophylluminophyllum oil blends with diesel (B5, B10, B15,.....).

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- Testing is required to evaluate the performance of straight oils as a fuel for diesel engines.
- Fuel emission levels can be experimented for different blends of Calophylluminophyllum oil by using emission analyser.

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