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Sal (Shorea Robusta), an Environmentfriendly and Ecofriendly Alternative Vegetable Oil Fuel in Comparison to the Diesel Oil

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ABSTRACT: Sal seed oil is not only a green boon for the forest dwellers of Central Indian States of Orissa, Chattisgarh, and Madhya Pradesh but also it provides a sustainable medium for their livelihood by managing their several means of earning resources starting from arranging the different parts of this tree such as leaves, seeds andresins to use them as a substitute for confectionery item Cocoa butter, known as Cocoa Butter Equivalent (C.B.E.), a ingriedient of Chocolate, price, quantity and quality can be attributable and directly linked to its production. Apart from being a confectionery item, the sal seed oil now a days can also be used one of the better option for production of the vegetable oil based diesel or **Biodiesel** and its blend in a diesel engine such as direct injection engines. Biodiesel are vegetable oil methyl esters and can be used as a biodegradable transportation fuel in neat form or in blends with petroleum derived diesel in diesel engines. Biodiesel is similar to the conventional petroleum diesel. Biodiesel can be blended in any ratio for reduced emissions and the increased lubricity for better running vehicle. **"MOST COMMON BLEND IS A MIX OF 20% BIODIESEL AND 80% PETROLEUM DIESEL, CALLED "B20"**

KEYWORDS: Sal Seed Oil as such or in Blend form

1. INTRODUCTION

Vegetable oils are of two types (1) Edible (2) Nonedible, the examples of edible oil are soybeen, cashewnut, mustard, ground nut, unflower while examples of nonedible oil are ricebran, karanja, jatropha, linseed and castor. Vegetable oil based fuel can be most suited,appropriate and desired one in comparison to the mineral oil based diesel fuel if it will be containing of the following characteristics.

(1).Long chain hydrocarbon structure.
(2).Good ignition characteristics.
(3).Increased lubricity in blended form.

Diesel engines plays an important role and therefore have a big stake in carrying heavy load and thus becomes a important factor for claiming country's good economy as freight and runs one's country's machinery at a very fast pace and in a controllable manner. Also diesel engine plays a vital role and its dominating attitude in the field of commercial transportation and agricultural methods on account of its superior fuel efficiency.Thus fuel efficiency is a characteristic of a diesel engine based on which certain predictions can be made as,

(1).Diesel engine average
(2).Distance covered/volume
(3).Efficiency of its parts
(4).Durability of essential parts.

Because of shortage of fossil fuel resources we can not neglect the option of biodegradable and ecofriendly alternative such as vegetable oil based or biobased resources.If we want to overcome the scarcity of these green fuels then the better option is to go for **BIOBASED FUELS.** In other words it can be proved a better option for one's nation economy and providing employment. It can be proved beneficial for maintaining O2 cover and climate. It has also been proved that vegetable oils from crops such as soybean peanut, sunflower, rapeseed, coconut, karanja, neem, cotton, mustard, jatropha, linseed and castor that was produced and cultivated in many parts of world and that lack fossil fuel reserves can boost up that nation's energy related problems. Short term test flights gave positive results while long term endurance test gave comparable and approximately equivalent results.A slight difference was seen in thermal and ignition properties in cold weather in comparison to mineral fuel such as diesel.

2. DISCUSSION

Sal seed oil or vegetable oil can be proved as an important fuel in place of fossil fuel or use of it as a blend encourages its production through the barren land and provides the necessity to use it as a viable or suitable alternate. We know that the concept of using vegetable oil as fuel for diesel engines is nothing new. Dr. Rudolph diesel first developed the diesel engine in 1895 with the

full intention of running it on a variety of fuels, including vegetable oil.Rudolf Diesel demonstrated his engine at Paris exposition of 1900 using peanut oil as fuel. In 1911 he stated, "the diesel engine can be fed with vegetable oils and would help considerably in the development of agriculture of the countries which use it".

"The use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in course of time as important as petroleum and the coal tar products of the present time". The interest in using vegetable oils as alternative fuels originated with in the agricultural community as a fuel for agricultural tractors and equipment. Beginning in 1956 the U.S. Department of agriculture(U.S.D.A.) employed a multidisciplined approach to identify and establish new crops as renewable resources. The U.S.D.A., agricultural research service, northern regional research centre has examined about 8000 species for seed oil. Several hundred, mainly undeveloped species, contain more than 40% oil in their seed. At least 50 contain more than 60% or more oil. Initially, it was believed that vegetable oils could be used direct with minimal processing and preparation. However extensive engine testing proved that problems exit. Since 1981 vegetable oil fields test have been completed in Brazil on five different vehicles.

On the basis of these tests and extensive lab experience, customer in Brazil have been allowed to blend crude degummed vegetable oil with diesel fuel up to 30% by volume for use in earth moving equipment powered by prechamber engine since july 1982.

Diesel engines with divided combustion chamber and big cylinder units are able to operate permanently with neat(100%) rapeseed oil. However diesel engines according to today's state of development are not suited to operate with rapeseed oil. Tadashi Murayama et al. reported that vegetable oil fuels generated an acceptable engine performance and exhaust gas emission levels for short term operation only. He also suggested practical solutions to overcome the problems of rising fuel temp. above 200°C.He suggested B20 along with diesel fuel and B25 along with diesel fuel. Blending can be made with ethanol or methyl esters.

Biodiesel is made from renewable feedstock through simple refining process such as transesterification, dilution, micro emulsification and pyrolysis (2,6,7,9,10).One of the first use of transesterified vegetable oil was running the heavy duty vehicle in South Africa.

Biodiesel has been used extensively for over 20 years in Europe. France is the largest user in the world. It has been extensively Tested by government agencies, university researcher and private industry in the U.S., Canada, Europe. "Soy (vegetable) diesel has also been explored and commercialized. The committee concluded that commercialization of biodiesel would greatly benefit both the soy (vegetable) industry and American agricultural generally.

The principal bus engine manufacturers, Detroit Diesel Corporation Cummins and Navistar are co-operating with the board in testing their engines. In blends of biodiesel of up to 30% by volume, no instances of fuel system degradation have been identified. The oil crisis in 1973 triggered numerous studies on natural oils and fats all over the world, but we really entered the field only on August2, 1990, the day the gulf crisis began. Today, 11years later approximately 100,000 cars running on biodiesel in mainly Germany, Sweden and the Netherlands and in some other countries, representing possibly over 90% of today's cars powered by biodiesel.

Unprocessed oil can also be used in diesel engines, but require adjustment to the engines and driving habits. Unlike diesel fuel, vegetable oils consist mostly of saturated hydrocarbons and these vegetable oils are triglycerides consisting of glycerol esters of fatty acids. Vegetable oils have a different chemical structure. Up to three fatty acids are linked to a glycerine molecule with ester linkages. The fatty acids vary in their carbon chain length and in numbers of double bonds. The below shown table summarizes such data for some fatty acids that are commonly found in vegetable oils.

TABLE

Fatty Acid	**Structure***
Myristic	14:0
Palmitic	16:0
Stearic	18:0
Arachidic	20:0
Behenic	22:0
Lignoceric	24:0
Oleic	18:1
Ricinolic	18:1+
Erucic	22:1
Linilic	18:2
Linolenic	18:3

*X:Y indicates X means carbon in the fatty acids chain with Y double bonds.

+ Indicates Ricinoleic is the only fatty acid, which contains a hydroxyl (OH) group. Palmitic(16:0) and Stearic(18:0) were the two most common saturated fatty acids.

Some fuel properties eg. Oxidation resistance are markedly affected by the fatty acid composition of vegetable oils. The presence of oxygen in the molecules suggest that some fuel properties of vegetable oils would differ markedly from those of hydrocarbon fuels.

Because of the high molecular weights vegetable oils have low validity. Because of these chemical and physical properties, vegetable oils accumulate and remain as charred deposits when they contact engine cylinder walls.

Fuel – related properties of vegetable oils

Vegetable Oil	Iodine Value	CN	HG (Kj/kg)	Viscosity (mm^2/S)	CP (°C)
Neem	-	47	39399	30	-
Karanja	-	-	37100	120	-
Mahua	-	45	30248	16.9	-
Jatropha	-	40-45	39774	49.9	-
Cottonseed	90-140	41.8	39468	33.5	1.7
Sunflower	110-143	37.1	39575	37.1	7.2

Soybeen	117-143	37.9	39623	32.6	-3.9
Sesame	104-120	40.2	39349	35.5	-3.9
Palm	35-61	42	36553	63.6	27
Peanut	80-106	41.8	39782	39.6	12.8
Corn	103-140	37.6	39500	34.9	-1.1
Castor	82-88	-	39500	297	-
Crambe	93	44.6	40482	53.6	10
Rapeseed	94-120	37.6	39709	37	-3.9
Linseed	168-204	34.6	39307	27.2	1.7

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Diesel fuel dissolves quite well in vegetable oils. Conducted service tests with vegetable oil diesel blends shows that diesel engine without any modification would run successfully on a blend of 20% vegetable oil and 80% diesel fuel without damage to engine parts. The appropriate properties that make the vegetable oil suitable for diesel fuel are as follows-

(1).Cetane number
(2).Heat content
(3).Long chain saturated unbranched hydrocarbons
(4).Conversion of polymerization in to saturation one by decomposition of vegetable oil.
(5).Suitable modification in internal combustion engine on the basis of environment and climate change.
(6).Use of permissible amount of O_2 or in other words air to make adjustment for high temp. ignition operation for these oils.
(7).Use of high voltage batteries to make arrangements for the combustion of vegetable oil fuel and diesel blend while streamlining the methyl esters in cold weather.
(8). Use of certain additives in lowering the carbon deposits or use of low viscosity vegetable oil to avoid any carbon build up.
(9). Use of prechamber ignition should be given weightage.

It has also been seen that if straight unprocessed vegetable oil is burnt in the internal combustion engine then the fatty acid in the oil would start burn and hardens on the inside of the engine as well as in the fuel injectors.
The most appropriate form of vegetable oil if it is to be used in the combustion engines whether they are prechamber type or direct ignition type then the quantity of free acid should be low or it should be free from fatty acid content. To make vegetable oil free from F.A. it should firstly be done processed as compare to the counterpart diesel fuel and then should be applied for the engine.
Biodiesel is an alternative renewable, clean diesel fuel made from triglycerides (vegetable oils, fats, waste cooking oils),which can be used in processed neat form or blend with petroleum diesel for use in ignition engines. It is also well known fact that use of vegetable oil as a fuel or comparable to fossil fuel will reduce the poisonous gases such as carbon monoxide, nitric oxide, sulphur dioxide, hydrocarbons, benzene and particulate matter. But increase level of NO can be reduced by the use of such type of bacteria which can curtail this increase level of NO in the atmosphere or instead use of certain additives may prove beneficial.

Properties	100D2	100RE	50RE – 50D2
Flash Point,°C	72.2	-	86.7
Cloud Point,°C	- 10.0	-1.1	-7.8
Viscosity@40°C	3.17	5.65	4.34
Sulphur,%	.360	.031	.204
API Gravity,15°C	32.7	29.7	31
Heat of combustion, KJ/kg	45333	40721	42914

BIODIESEL STANDARD :->ASTM STANDARD FOR NEAT BIODIESEL

TEST	ASTM METHOD	LIMITS
Flash Point,°C	93	100.0min.
Water & Sediment vol,%	1796	.050max
Carbon Residue,100% Sample wt,%	4530	.050max
Sulphated Ash,wt%	874	.020max
Kinematics Viscosity 40°C, mm^2/S	445	1.9 – 6.0
Sulphur,wt%	622	.05max
Cetane	13	40min.
Cloud Point,°C	2500	Customer
Acid Number,mgKOH/gm	664	.80max
Free Glycerol,wt%	GC	.02max
Total Glycerol,wt%	GC	.40max

3. CONCLUSION

Biodiesel has some properties, which makes it a substitute of diesel oil as fuel.

(1). Low content of free glycerin (< .02 better < .002%).
(2).High degree of transesterification (>99.8%).
(3).Low acid number (< .5 better < .2%).
(4).No Polymers, very clean.
(5).Biodiesel can be used in any conventional, unmodified diesel engine.
(6).Biodiesel can be used alone or mixed in any amount with petroleum diesel fuel.
(7).Biodiesel is more lubricating than diesel fuel, so it increases the life of engines.

(8).Biodiesel is biodegradable and nontoxic.
(9).Biodiesel has a high flash point, or ignition temp. of about 300°F compared to petroleum diesel fuel, which has a flash point of 125°F.This means it's safer to transport.
(10).Auto ignition, fuel consumption, power output and engine torque are relatively unaffected by biodiesel. So basically the engine just runs like normal.
(11).Biodiesel is an oxygenated fuel, this implies that their oxygen content plays a role in making fatty compounds suitable as diesel fuel by "cleaner" burning.
(12).Ester have lower viscosities than the parent oils. Accordingly, they improve the injection process and ensure better atomization of the fuel in the combustion chamber.
(13).Cetane number of ester is greater than those of both vegetable oil and no.2 diesel fuel.
(14).Reduced exhaust emission such as sulphur dioxide, hydrocarbons, particulates, carbon monoxide and carbon dioxide by 100,56,55, 43,78 percent respectively.
(15).90% reduction in cancer risks, according to Ames Mutagenicity tests.
(16).Provides a domestic, renewable energy supply.
(17).Compared to diesel fuel, all of the vegetable oils are much more Viscous, are much more reactive to oxygen and has higher cloud point and pour point temp.
(18).Diesel engine with vegetable oils offer acceptable engine performance and emissions for short term operation. Long term operation results in operational and durability problems.
(19).A blend of 25% diesel fuel and 75% vegetable oil offer better engine performance and lower emissions and carbon deposit build up.
(20).The transesterification process, used for making bioidiesel is simple and cost effective to solve viscosity problems.

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