Comparative Study of Use of CNG With Bio Fuels in Diesel Engines

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Abstract— Due to increase in population and rapid industrialization there is increase in consumption of conventional fuels. So the word is getting modernizesedand industrialized day by day. As a result vehicles and engines are increasing rapidly. So that this paper emphasizes on the comparative study of compressed natural gas with dieselfules such as Neem oil, Soysbeen oil, Rice Bran oilmethyle Ester, Jathropa oil, Karanja oil, Mahua oil, Eucaliptus oil, Simarouba oil, Cotton methyl ester, Palm ethyle ester, Sun flower oil, Rape seed oil, and Argimon oil etc,. The study was omade on various aspects regarding BTE, SFC, all efficiencies and properties etc., Finally the results were obtained based on their performance.

1 INTRODUCTION

A significant portion of modern energy demands are met by the use of CNG based fuels especially in the transporation sector recently supreme court order to the Government to reduce the pollution in atmosphere use CNG as possible as maximum in vehicles. Already DTC running with CNG only. In this scenario we must study and discuss with compressed natural gas and further we study the alternative fuels i.e., Biodiesel fules

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2.1 Sunflower is the raw material used as a diesel in Europe Countries.

* Soyabean is used in USA
* Palm oil is used in Thailand.
* Frying oil and animal fats are uses in Ireland.

* In India, Chattisgarh State has set up a 3 tonnes per day refinery to promote the use of biodiesel in tractors, jeeps and pump sets. **[1]**

COMPRESSED NATURAL GAS (CNG) PROPERTIES

S.NO.	Properties	Values
1.	Molecular Weight	18(Practical) 16.04 (pure HC)
2.	Specific Gravity	0.79 Kg/m^3
3.	Heat vaporization	509 KJ/Kg
4.	Specific Heat	0.63 KJ/Kg (L), 2.2 KJ/Kg (V)
5.	Heating Value	50 MJ/Kg Higher
6.	LHV of stoicho mixture	2.0 MJ/Kg
7.	Research octane No.& MOM	120&120
8.	Air Fuel Ratio	14.5 (P), 17.23 (Pure HC)

Table - 1

. 2.2 CNG is popular fuel for autorikhaws and buses. It is an environment friendly fuel, which causes drastic reduction in emissions to the environment. The compressed natural gas has Imethane gas (CH_4) the main constituent. It has good calorific vaule. Compressed natural gas is methane, ethane, propane and other consutitutant low consentration.The methane content is 90%,ethane contant is 40%, propane content is 1.7%. **[2]**

ADVANTAGES OF USING CNG

1) It has good antiknock quality.
2) It can be used with high compression ratio of the order of 12:1 or high;er.
3) Engine running on CNG has thermal effieiency.
4) There is reduction in pollutants emitted to the environment.
5) It is nontoxic in nature and so is safe.
6) It is lighter than air, so it quickly dissipates after leaking.
7) Pre ignition tendency of CNG is very less **[3]**
8) It is easily available and promotes long life of the engine

METHODOLOGY-TRANSESTERIFICATION OF BIODIE SEL OIL

2.3. NEEM OIL

The Plant neem oil is selected for the present studies. A totol of four different blends (10%, 15%, 20%, and 25%) with diesel were made. The neem oil is esterified so as to obtain their butyl esters before blending. Biodiesel is mostly obtained from renewable vegetable oils – animal fats and hence it may improve the fuel or energy security and thus leading to economy independence. Bio diesel is better than the conventional fossile fuel as it does not emit harmful fumes and is a cheaper source for generating fuels. Using bio fuels is the only way to lessen the environmental pollution and the lesson the usage of conventional fuels**.** **[4]**

Properties of Neem oil is compared with diesel (ASTM D975)

Before Blend		
Properties	Diesel	**Neem Oil**
Cetane number (CN)	45 – 55	31
Specific gravity	.83	0.968
Viscosity (20^{0}C) mm^2/sec	4.7	37.42
Calorific value (MJ/Kg)	42	29.97
Carbon (%)	86	78.92
Hydrogen (%)	14	13.41
After blend (20% by volume with diesel		
Cetane number (CN)	45 – 55	48
Specific gravity	0.83	0.934
Viscosity (20^{0}C) mm^2/sec	4.7	6.3
Calorific value (MJ/Kg)	42	31.142
Carbon (%)	86	83
Hydrogen (%)	14	15

Table – 2

2.4 Soya bean oil

The densities of soya bean oil – solvent mixtures at various temperatures are important for engineering calculations and have been reported for hexane, ethylene, dichloride,and tri-choloroethylene at 25^{0}C, 37.8^0 C,and 50^{0}C (81); Skellysolve B at --20^{0}C,--10^{o}C, 0^{0}C, 10^{o}C, 25^{o}C, and 40^{0}C (82); dichloromethane at 25 ^{0}C (83); and hexane at 25 ^{0}C (84). **[5]**

Some physical properties of typical soya bean oil

Table - 3

Density 20^{0}C	0.9165 to 0.9261g/mL
Specific Heat Capacity 20^{o}C	0.448 cal/g ^{o}C
Melting Point	0.6 ^{o}C (35)
Cloud point	--9 ^{0}C (69)
Pour point	--12 to –16 ^{0}C
Heat of combustion	9450 – 9388 cal/gm
Heat transfer coefficient	269.7 watts/ ^{o}K M ^{2} at 180 ^{o}C
Surface Tension 30 ^{o}C	27.6 dyne/cm
Viscosity 20 ^{o}C	58.5 – 62.cP
Refractive Index no 20 ^{o}C	1.4733 – 1.4760
Vapor pressure	1u at 254 ^{0}C (74)
Heat of Vaporization	44,200 cal/mol (74)
Electrical Resistivity 24 ^{o}C	
Dry	23.7 Tohm. Cm (75)
Water saturated	7.25 Tohm. Cm (75)
Smoke point	~245 ^{o}C (76)
Flash point	~324 ^{o}C (76)
Fire point	~360 ^{o}C (76)

2.5 Comparison of Eucalyptus oil with petro diesel

Property	**Petro-Diesel**	**Eucalyptus biodiesel**
Calorific value MJ.Kg	43.2MJ/Kg	42.5 MJ/Kg
Densityat 20 ^{0}C, g/cm3	0.845	0.908
Viscosity (40 ^{0} C)	1.57	1.85
Flash Point ($_0$C)	56	32
Fire Point (^{0} C)	65	42
Cetane number	50	48

Table - 4

The various physico-chemical properties of the obtained bio-diesel were studied so as to find its suitabililty for use in die-sel engine. The closeness in properties of the proposed bio-diesel with petro-diesel shows that it could be used as an al-ternatilvle with reasonable performance. The table - 6 shows The various perperties of the tested fuels**.** **[6]**

2.6 Comparison of Karanja Biodiesel (KOME) with Diesel fuel

Properties	Unit	Karanja methyle ester	Diesel
Density	m/cc	0.860	0.840
Kinematic Viscosity @ 40^{o}C	Cst	4.78	2.98
Acid Value	mgKOH/gm	0.42	0.35
Free glycerin	Wt%	0.015	-----
Cloud Point	^{o}C	6	-16
Flash point	^{o}C	144	74
Cetane number		41.7	49.0
Calorific Value	Kcal/KG	3700	4285
Iodine Value		91	-----
Saponification Value		187	----
Moiature	%	0.02	0.02
Carbon residue	%	0.005	0.01
Ash Content	Wt%	0.005	0.02

Table - 5

Karanja methyl ester Properties as per ASTM Standard:

Table 5 shows the fuel properties of biodiesel determined as per ASTM standards. Among the general paramenters for biodiesel the viscosity controls the characteristics of the injec-tion from the diesel injector. The viscosity of vegetable oil derived biodiesel can go very high levels and hence it is im-portant to control it within acceptable level to avoid negative impact on fuel injector system performance. Therfore viscosi-ty specification proposed are nearly same as that of the diesel fuel. It is further reduced with increase in petroleum diesel amount in the blend.

Flash point of a fuel is the temperature at which it ignites when exposed to a flame or spark. The flash point of biodiesel is higher than the petro diesel, which is safe for transport purpose**.** **[7]**

Cold filter plugging point (CFPP) of a fuel reflects its cold weather performance. At low operating temperature, fuel

may thicken and might not flow properly thereby affecting the performance of fuel lines. Fuel pumps and injectors. CFPP Defines the fuels limit of filterability having a better correlation than cloud point for biodiesel as well as petro diesel.

The product of imcomplete transesterification and separation may produce biodiesel of low quality. Thus the reaction should be completed and the glycerol and methyl ester layers should be separated completely and also the flavonoids are to be removed from the product. Thus the reaction condition needs to be optimized in order to get high yield of biodiesel and also complete reaction. Also the reaction depends upon the raw materials. For base catalysed transesterification reaction, all the substances should be unhydrous and FFA content of oil should be low.

The above listed fuel properties from experimental Results indicate that the karanja oil methyl ester (KOME) is the best suited as per American atandards for testing and Meterial (ASTM) norms for using biodiesel in pure as well as in blending form.

The karanja biodiesel used for this is available commercially and conforms to the standards specified in ASTM-D6751.

OTHER USES OF KARANJA

- Its fruits are used in abdominal remedies.
- Its seeds are used in tumor treatment.
- Oil is used for curing rheumatism.
- Leaves are used against Micrococcus.
- Their leaves juices are used for the treatment of diarrhea cold and cough.
- Its oil is used as a lubricant, water paint binder.

2.6 Comparison of Fuel properties of Mahua oil with diesel

Properties	Diesel oil	Mahua oil
Density (15 ^{0}C),kg/m3	835	945
Kinematic Viscosity,	2.4	25
Flash point, ^{0}C	70	226
Fire point, ^{0}C	76	250
Cloud Point, ^{0}C	10 to 15	15
Pour point, ^{0}C	-35 to -15	15
Acid Value,mg of KOH	NM	30
Calorific value, (MJ/kg/)	43	35
Saponification Value	NM	191
Colour	Light brown	Slight greenish yellow
Cetane number	47	NM
Aniline Point, ^{0}C	69	60
Iodine Value	NM	65
Diesel Index	150	140

Table - 6

Mahua is a large sized multipurpose forest tree that is found throughout the mixed deciduous forest of India, Nepal, Srilanka and other south Asian countries. It is an important economic tree used as food, medicine and for other commericialuses such as soap and detergent manufacture,oil extraction, skin care etc., ahua flowers and seeds are edible. The fruites of tree are used as vegetable. The seeds of treecontainm about 40% pale yellow oil.This oil is used as cooking oilby most of the tribes in Odisha, Chhattisgarhand Maharastra. Muhua tree is an impotant medical tree as well. Mahua flowers are stimulant, demulcent, laxative, anthelmintic and caugh relieving. Mahua tree is native to dry regeion of India. It is a multy purpose tree. Various parts of Mahua tree are used for treatment of variety of diseases**.** **[8]**

2.7 Properties of the Rape seed oil Methyle Esters (RME) with diesel properties.

No	Paramenter tested	Unit	RME	Diesel
1.	Density at the 15 ^{0}Ctemp	Kg/	886-900	817-856
2.	Cold filter plug point	^{0}C		34
3.	Kinematic Viscosity		6-9	2.9-5.5
4.	Calorific value	--	37-37.2	42.7-43
5.	Cetane number	---	45-59	47-58.6
6.	Cloud Point, ^{0}C	^{0}C	-3	-33
7.	Ignition temp	^{0}C	166	62
8.	Elementary analysis C H O	%	 76.6-78 12.1 10-11	 86-86.4 13.4-14 ---
9.	Stoichiometric O_2		12.5	14.57
10.	Impurities content		14	9
11.	Fractional content			
	20% get distilled to temp		334	
	40% get distilled to temp	^{0}C	336	
	60% get distilled to temp		336	
	80% get distilled to temp		339	
	95% get distilled to temp		343	
	End of distrilled		345	
	Up to temp 190^{0}C			3.0
	Up to temp 240^{0}C	%(vv)		59.0
	Up to temp 290^{0}C			97.0

Table - 7

RME > Rape seed Methyle Ester

The biodiesel is produced mainly from rapeseed with doubly improved varieties of seeds. The composition of rape seed oil must meet specific quality requirements that are included in the standard for methyl esters as fuels for diesel engines.

Vegetable oils can be obtained by mechanical or chemical extraction. Crushing of seeds is a traditional way of producing oils using different types of presses. The main stage of the rapeseed oil process is based on the transertification reaction of rapeseed oil with an alcohol (methanol, ethanol)which results in formation of alcohols and glycerol. The reaction is

reversible due to formation of water, which is responsible for shifting the equilibrium towards the reagents. **[9]**

Cetane Number: It is a measure of the ignition quality of diesel fuel, higher this number, the easier to start a standard diesel Engine.

Results and discussion: Coparative studyof use of CNG with biofuels in diesel engines.

Brake thermal efficiency increases for all fuels as there is an increase in Load. The properties of the results shows, that the Cetane number of biodiesel With Diesel cetane number almost all equivalent. And in the same way calorific value of the all biodiesel are nearly same In some cases cetane number is greater than diesel cetane number, so that biodesel oils with CNG is prefferable to reduce emissions and knocking tendency IN Internal Combustion engines.

In case of rape seed biodiesel the use fuel containg bio components fromn renewable source fuels derived from vegetable iols have wide spread applications . How ever, its use is the most effective while adding to the fossile fuels. Rape seed oil is the main source of quality biodiesel which is important platform chemicalas produced by the Oleochemical industry. Transesterification of vegetable oil is a process by which trigycerides react with methonol in the presence of a catalyst to obtain fatty acid methyl esters and glycerol.

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