A REVIEW PAPER ON BIODIESEL FROM CASHEW NUT SHELL OIL

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Abstract: CNSL mainly consists of Anacardic acid, cardol, cardanol and small amount of other phenols and less polar substances. The composition percentage varies with many parameters like, nature of origin, climatic condition, method of extraction, etc. In this article, method of processing of CNS, yielding percentage of CNSL, variation in their composition with respect to type of processing, use of different constituents and their separation are listed. In addition to that, methods for separation of cardanol (a major constituent of technical CNSL) from oil, and feasibility of its use in diesel engine as a biofuel were discussed along with the physiochemical properties[8]. An extended experimental study was conducted on a double cylinder CI engine, to evaluate the performance and emission characteristics. The cardanol biofuel volumetric blends between 0-25% and base fuel (Petro diesel) were tested at various loads between zero-full load. From the results, brake thermal efficiency, increased with increase in load. The brake specific energy consumption decreased by 30 to 40% with increase in brake power. The HC emissions were nominal up to B20, and more at B25. The NOx emissions (ppm) increased with increased proportion of blends. The carbon monoxide emissions increased with higher blends and decreased slightly at higher loads. From this investigation, it is observed that up to 20% blends of cardanol biofuels may be used in CI engines without any modifications[4].

Key Words: *Cashew, Nut, CNSL oil, Cardanol oil, properties of CNSL oil, Emission, Performance.*

I. INTRODUCTION:

The cashew tree, belongs to the family of anacardiaceous, has a native of north east Brazil with a name of "acajou". India has the largest area harvested under the raw cashew nuts in the world. Plantation of tree, flowering, fruit and nut: Cashew tree is a fast growing, hardy and drought resistant multipurpose tree that can be cultivated in many tropical climatic conditions. Trees are also suitable for use in reforestation in barren, slash and burned farmland, degraded land and coastal sandy land. In India, cashew trees were often used as a reforestation and to fix dunes. The cashew tree gum that has been proposed as an aqueous two phase extract and substitute for fractioned dextran (Sarrubo 2000), cashew tree wood can be used as termite resistant and useful for boat building.

It was found that the mixture of 10%, 20%, 30%, 40% and 50% by volume of CPO, respectively with 90%, 80%, 70%, 60% and 50% by volume of diesel and 10% by volume of biodiesel were found stable and homogeneous for a long period of time (one week). Beyond 50%, separation was noticed and hence the quantity of CPO used was limited up to 50%. Experiments were performed on a single cylinder diesel engine using them CPO10 (10%CPO oil +10% Bio diesel+80% Diesel), CPO20 (20% CPO oil +10% Bio diesel+70% Diesel), CPO30 (30%CPO oil +10% Bio diesel+60% Diesel), CPO40 (40%CPO oil +10% Bio diesel+50% Diesel) and CPO50 (50%CPO oil +10% Bio diesel+40% Diesel) are prepared with the volume of CPO to study the performance behavior of the engine. Results were compared with conventional diesel (BD) and analyzed[1].

Bio-diesel production is a very modern and technological area for researchers due to the relevance that it is winning everyday because of the increase in the petroleum prices and the environmental advantages biodiesel offers over diesel. Accordingly, many researchers around the world have dealt with these issues and in many cases devised unique solutions. Countless legislative and regulatory efforts around the world have helped pave the way toward the widespread application of the concept[2].

Work can be focused on using different solvents and combination of solvents for extraction of CNSO from Indian cashew nut shell, both for Steam roasted shells as well raw cashew nut shells and their yields at different solute to solvent ratios. This enables optimum solute to solvent ratios for extraction of CNSO. Supercritical extraction of Cold extracted CNSO as well as CNSO obtained from Steam extracted shells can also be carried out for recovery of anacardic acid to compare the extent of anacardic acid obtained with that of chemical methods[6].

II. CASHEW NUT SHELL LIQUID:

The cashew processing industries generates huge quantity of shell, which is about 67% percentage of raw seeds. The cashew nut shell is about 1/8 inch thickness, with a soft honeycomb structure inside, containing a dark reddish brown viscous liquid known as cashew nut shell liquid oil and is pericarp fluid. CNSL is a valuable raw material obtained as a byproduct from industry. The mixture was stirred vigorously until a homogenous mixture was formed. The stirrer speed was maintained as 1500 rpm. Stable oil preparations were obtained by stirring the mixture for 1200 sec and the stability of the blend was found as stable for one week. The blending of oil was mixed with help of a mechanical stirrer, and it is found that up to 50% of CPO bio oil blend diesel fuels, without any separation for long time.[1] . It is reported

to be 25 - 30% by weight of the unshelled nut in India which is higher than African based nuts. It is recognized as a valuable commodity because of its high concentration of unsaturated long chain phenols such as cardanol[8].

III. MATERIALS AND METHODS:

Extraction of CNSL oil: Extraction of CNSL oil from cashew nut shell includes open pan roasting, drum roasting, hot oil roasting, cold extraction, solvent extraction, super critical fluid extraction , pyrolysis process , Soxhlet extraction method and research have been carried out to improve the percentage of yield from raw cashew nut by using new extraction methods like Sub Critical Water extraction and two-step extraction methods .The percentage yield of oil varies with the type of extraction process[8].

All blends were made using a magnetic stirrer in which the different percentages by volume of CNSL and diesel were stirred continuously for 7-8 hours and then allowed to stand for at least 3-4 hours to ensure no separation of the constituents occurred[2].

As the extraction method varies, the quantity and quality of oil varies with the composition percentage of Anacardic acid, Cardanol and cardol. There are two types of CNSL oils and are known as natural or immature oil (iCNSL) and technical oil (tCNSL). The compositions of iCNSL are anacardic acid 70%, cardol 18%, Cardanol 5%, and remaining are the other phenols and less polar substances. The tCNSL oil have the composition of cardanol 83-84%, cardol 8-11%, polymeric material 10% and traces of methyl cardol[8].Cardanol is a natural phenol obtained from anacardic acid, the main component of cashew nutshell liquid (CNSL), a by-product of cashew nut processing being an eco-friendly substitute for phenols. Properties: Cardanol contributes to improved flexibility, good drying after baking, high electric insulation properties and thermal stability. These properties make Cardanol an effective substitute for the petroleum-based Phenol.

The mass flow of fuel was measured by mass basis. The exhaust gas analyzer (AVL DI gas analyzer) was used to measure HC, CO and NOx. The smoke density was measured by AVL smoke meter. . In this study, the diesel engine was not modified during all the tests. At each engine operating mode, experiments were carried out for the diesel fuel, and each of the CDB blends. The different injection timing (18º, 19º, 21º, 23º, 26º, and 28ºbTDC), and different injector opening pressure (18 Mpa, 20 Mpa, and 22Mpa) were tried to optimize the best brake thermal efficiency with neat diesel.[7]

IV. PROPERTIES OF DIESEL AND CNSL OIL[7]

Properties	Diesel	CNSL
Density at (g/cc)	0.8/0.84	0.9326
Kinematic Viscosity @ 40 °C(cSt)	2.0 to 4.5	17.2
Calorific value (kJ/kg)	48838	45363
Flash Point (°C)	80	198
Fire Point (°C)	86	206
Ash content (%)	0.01 to 0.1	0.01

V. Performance Characteristics – Bio-diesel 20% [2]

Sl No	Torque (N-M)	Time To Consume 10 CC (Secs)	Exhaust Gas Temperature (^{0}C)	Air Flow Rate(m3/Hr)
1	0	93.87	172	14.1
2	5	70.06	238	13.8
3	10	55.41	304	13.8
4	15	43.94	391	13.8
5	20	34.82	519	13.4

VI. SUMMARY:

Viscosity is the major drawback for every biomass and this can be reduced while blending with diesel or in addition to the ethanol as similar to the conventional biodiesel in different blends. The flash and fire points were higher than diesel, which indicates that the oil is well suited for storage, handling and transportation. Calorific value of cardanol is very closer to diesel and which enables higher quantity of heat liberation during combustion process and performs good combustion inside the chamber[8]. The BSEC obtained for VCR engine at 18:1 Compression ratio is 25% more compared to twin cylinder engine at no load conditions, and 8-10% higher BSEC in twin cylinder engine compared to other two engines at full load conditions[4]. As the molecular weight of cardanol is closer to diesel, there is no need for the trans-esterification process.

VII. CONCLUSION AND FURTHER STUDIES:

The properties like density, viscosity, flash and fire points of cardanol biofuel volumetric blends under test are higher, and calorific values are lower and are in the range of 94-96%that of diesel [4].From the above discussed properties of cardanol, it can be concluded that, the oil has most of the properties similar to the diesel fuel, and it is well suited as an alternative fuel in the compression ignition engine in blend with diesel. This will reduce the dependence of India on organization of petroleum exporting countries (OPEC) and will leads to the supporting of partial fulfillment of requirements of diesel in India. Further studies can be carried out to improve some of lagging properties like viscosity, corrosive nature by adding some additives to the cardanol oil[8]. Properties of CNSO is more reactive and also with the increase in the temperature little change in the kinematic viscosity is observed for CNSO[6].

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