Emission Characteristics of Rubber Seed Methyl Ester using a Nano Additive

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***Abstract* – Rubber seed oil is a substitute to the traditional fuels like coal, petroleum etc. They are mainly composed of fatty acid monoalkyl esters which is derived from various organic matter, such as vegetable oils, used cooking oils and animal fats. To make it customer friendly it is important to address the problems that are naturally encountered in VOME. One such problem is its susceptible nature to oxidation due to the presence of unsaturated fatty acid portion in the ester. Oxidation degradation may occur due to improper storage as well as metal contaminants. Nano additives is very effective in the elimination of oxidation stability problems. This study presents combustion characteristics of Rubber seed oil with nano additive**

Keywords: Rubber seed oil, Nano additives, Oxidation stability.

I. INTRODUCTION

Energy demand is increasing rapidly and our dependency on fossil fuel has reached its peak position, it is predicted that crude oil and petroleum products will become very less available and costly in future. With extencive use of fossil fuels and also the scarcity of fossil fuels, the alternate fuel technology will be in demand. Another reason for the development of alternate fuels for the IC engine is the concern over the emission problems of automobile engines such as gasoline and diesel engines.
With extensive research biodiesel is observed to be viable alternative but a problem which could possible come into picture is oxidation stability of Biodiesel which increases ppm of emissions from the engine.
It is necessary to address this problem at this development stage so that biodiesel not only act as an alternative but also become sustainable product to a customer. CO, UBHC, NOx, PM, SOx are main pollutants which effects environment.

Rubber seed oil is oil extracted from the seeds of rubber trees. In the latex manufacturing process, rubber seeds are not historically collected and commercialized. Recent analysis shows that rubber seed oil contained the following fatty acids:

- Palmitic (C16:0) - 0.2%
- Stearic (C18:0) - 8.7%
- Oleic (C18:1) - 24.6%
- Linoleic (C18:2) - 39.6%
- Linolenic (C18:3) - 16.3%

In Cambodia and other rubber manufacturing areas, rubber seeds are used to feed livestock. Although rubber seed is rich in nutrients, it also contains cyanogenic glycosides which will release prussic acid in the presence of enzymes or in slightly acidic conditions Oil from the rubber seed is also of commercial importance. Hitherto, rubber seed has largely been allowed to waste with very little used for raising root stock seedlings for propagation purposes. The useful properties of the rubber seed oil make it similar to well-known linseed and soybean oil. Rubber seed oil also could be used for the paint industry as a semidrying oil, in the manufacture of soap, for the production of linoleum and alkyd resin; in medicine as anti-malaria oil; and in engineering as core binder for factice preparation, and the cake left after oil extraction is used in fertilizer preparation and as feed for cattle and poultry.

Fig -1: Rubber Seed

II. LITERATURE SURVEY

M. Ghanbari etal [11] studied oxidation stability of biodiesel using Carbon nano tube and Silver nano particle as an additive. Experimental studies led to following conclusions torque output increased to about 2% also considerable reduction in emission levels are identified.

Adriana P. Herrera etal [12] studied synthesis of Alumina nano particle and also used Alumina with oleic acid as an additive to a biodiesel to evaluate stability of B10 biodiesel sample with regard to kinematic viscosity and flash point. Experimental studies revealed that with addition of nano particle kinematic

viscosity and flash point of biodiesel increased remarkably which is considered as an advantage aspect with regard to commercialization of biodiesel.

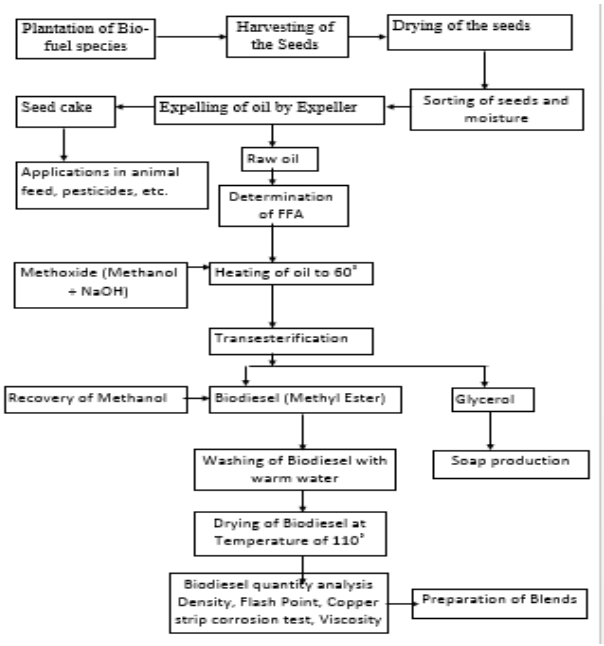
K. Nanthagopal etal [17] studied the use of a nanoparticle to evaluate the oxidation stability of biodiesel. zinc oxide and titanium dioxide nanoparticle was added to Calophyllum inophyllum biodiesel. Experimental study observed that CIME with nano particle improved brake thermal efficiency by 5–17% compared to pure CIME fuel also the CO and HC emissions were reduced considerably. The NOx emission was lower but slightly higher than conventional diesel fuel. The smoke emission was reduced drastically.

B. Ashok etal [23] studied experimentally the effect of two fuel additives namely titanium dioxide(TiO2) nanoparticle and butylated hydroxytoluene(BHT) on Calophyllum Inophyllum biodiesel. It was concluded in the study that the nanoparticles are capable of enhancing the combustion process and they also act as an oxidizing catalyst. Mixing of 100 ppm of TiO2 nanoparticle resulted in the improvement of brake thermal efficiency by 4% at full load condition along with comparable reduction in emission levels.

Vishal Saxena etal [30] reviewed various studies on the usage of nano particle in biodiesel to enhance combustion behavior, stability aspects, various engine performance parameters and emission characteristics. It is concluded from the study that various studied has presented satisfactory results in enhancement of thermo physical and chemical properties.

K. Nanthagopal etal [32] experimentally studied the influence of Zinc oxide and Titanium dioxide nanoparticle in inhibiting oxidation of Calophyllum inophyllum methyl ester. 50ppm and 100ppm concentration of nanoparticle are considered for study. From the study it is concluded that with addition of nano particle brake power increased also emission levels were reduced considerably.

III. EXPERIMENTAL ASPECTS



A. *Selection of Graphene Nano Additive*

Theoretically, Graphene is not a new object. However, before the discovery of Graphene, this was always a debate over whether carbon could exist in a two-dimensional (2D) form. In fact, it was commonly recognized that no standalone 2D crystal is stable under certain temperatures in which layers or macromolecules of such material would not be able to grow in a crystalline structure according to theoretic predictions.

B. *Mixing of Graphene into Blends*

Sonication is the act of applying sound energy to agitate particles in a sample, for various purposes such as the extraction of multiple compounds from plants, microalgae and seaweeds. The enhancement in the extraction of bioactive compounds achieved using sonication is attributed to cavitation in the solvent, a process that involves nucleation, growth, and collapse of bubbles in a liquid, driven by the passage of the ultrasonic waves. Ultrasonic frequencies (>20 kHz) are usually used, leading to the process also being known as ultra sonication or ultra-sonication.

Fig -2: Mixing of Graphene Nano Additives with B20 Blend

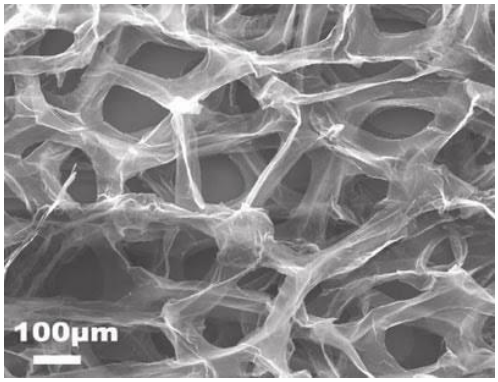


Fig -3: Particle behaviour when subjected to Vibrations

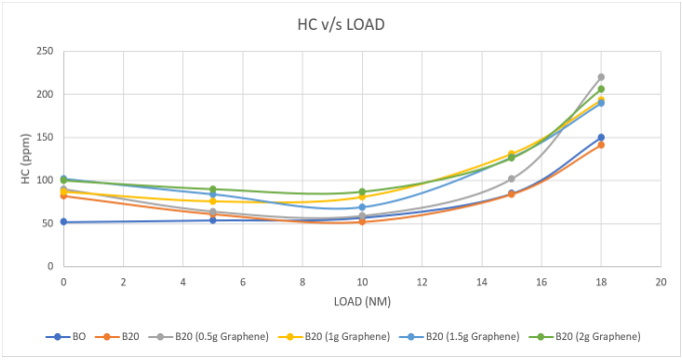
IV. Experimental Results

The engine tests were conducted on a computerized single cylinder, 4-stroke water cooled Cl engine test rig. It was directly coupled to an Eddy current dynamometer that permitted the engine motoring either fully or partially loaded. The exhaust gas analyser is used to the emission parameters such as HC, CO and NOx.
Once, the performance and emission test is carried out for pure diesel and Blends of biodiesel the Graphene Nano Additive is added to the best blend or probable blend.
In an adequately weighed amount of 0.5grams, 1gram, 1.5gram, & 2 grams into the biodiesel.
Further tests are carried out and are compared with and without additive.

Fig -4: Photographic view of 4-Stroke Single Cylinder Engine

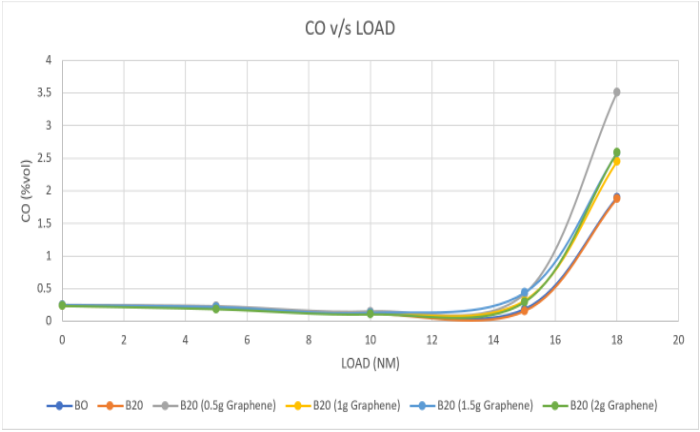
HC v/s LOAD

FUEL TYPE: B0, B20, B20 (0.5g Graphene), B20(1g Graphene), B20(1.5g Graphene), B20(2g Graphene)



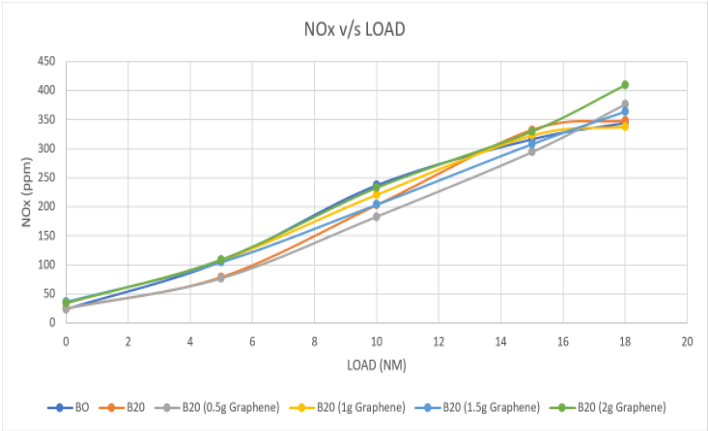
CO v/s LOAD

FUEL TYPE: B0, B20, B20 (0.5g Graphene), B20(1g Graphene), B20(1.5g Graphene), B20(2g Graphene)



NOx v/s LOAD

FUEL TYPE: B0, B20, B20 (0.5g Graphene), B20(1g Graphene), B20(1.5g Graphene), B20(2g Graphene)



V. CONCLUSIONS

The emission characteristics of single cylinder 4-stroke diesel engine (kirloskar AVI) fuelled with biodiesel blends of Rubber seed oil and graphene nano particles have been investigated and following conclusions were drawn

- The properties of blends of Rubber seed oil and graphene nano particles are nearer to that of Diesel.
- The direct injection diesel engine runs smoothly for all the blends of Rubber seed oil and graphene nano particles used in the experiment.
- The main use of Graphene nano additive is to have "High surface to Volume ratio" which is responsible for automization, vaporization, & mixing.
- The hydrocarbon emission of the Blends B20 & B20 with 0.5g additive shows high emissions at the initial stage which decreases for 55% load and then the emissions increases for B20 with 0.5g additive due to improper mixing of additives or inaccuracy of Sonicator.
- The N0x emission was found to be decreased for all the biodiesel blends compared to that of Diesel. Overall among all the biodiesel blends B20 with 0.5gm is having a low NOx emission.

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