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A Brief about Aluminum Oxide Nano-Particle Dispersion in to Biodiesel

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Abstract:- The increasing efficiency and reducing the emission from the diesel engine is the main objectives of many research. Many researchers have many disadvantages like higher viscosity and lower calorific value. In order to overcome these many additives are used in biodiesel-diesel blends. One such way of improving performance and reducing the emission is adding the Nano particles as a fuel additives. Using of Nano particles in the fuel shows dramatically increase in the combustion quality and hence in the overall performance of the engine. This paper has a review on the effect of Nano particles as an additive with fuels.

The selected Nano-particle is dispersed effectively in sonicator, sonica 2400 S3. The SEM image of AL_2O_3 was taken which depicts the size and shape of the Nano-particle. XRD images were used to analyze the dispersion mode of the Nano-particle.

Keywords:- *Bio Diesel; Nano-Particles; Al_2O_3; SEM; XRD; Sonicator.*

I. INTRODUCTION

The resources of petroleum fuels are decreasing day by day. The environmental effect and increasing price of fossil fuels leads to find the new ways. Bio-fuels and Biodiesels are the effective alternate fuels to fossil fuels.

Biodiesel have many disadvantages like, higher density, higher viscosity and lower calorific values. Biodiesels may decrease some of the emission in meantime they increase the harmful emissions NO_x and CO_2 due to higher content of oxygen.

In winter seasons and cold conditions, Biodiesel have flowability problems, which leads to chocking of the pipeline. In these cold seasons Biodiesels needs to be heated.

Due to the disadvantages the biodiesel cannot be used as an effective fuel for IC Engines. Some of the additives are used to overcome the disadvantages of Biodiesels. Alcohols are used to reduce viscosity and density. Nano-particles are used to increase calorific values and smooth burning of Biodiesels.

The combustion characteristics may be improved by adding Nano particles in the biodiesel-diesel blends. Fuel additives are included at a level from a few PPM to thousand PPM. It is important that, additives which improve some properties do not impair other properties.

Some of the Nano particles are antioxidants, corrosion resistance; others may help in easy and smooth flow of fuel. Some of the metal based Nano particles are cerium (Ce), Cerium-iron(Ce-Fe), Platinum(Pt), CuO, $CuCl_2$, $COCl_2$, $FeCl_3$, Al_2O_3 and multiwall carbon nanotube (MWCNT), MgO, SiO_2 etc are used in biodiesel to improve viscosity, density and flow properties. Many researchers have used the above Nano particles and proved the effective results.

The objective of this paper is to provide the most comprehensive summary of the most result literature available on the Nano particles as on additive in biodiesel and its effect on the combustion, and overall performance of the diesel engines.

A. Importance of Nano-Particles

- The use of Nano particles will increase the engine life.
- Nano-particles help in complete combustion of fuel.
- At average speeds use of Nano particle increases the rate of oxidation reaction.
- The property of high surface to volume ratio of Nano particle will make them chemically more active.
- The Nano particles in the engine can even react at high temperatures (400-6000c).
- The Nanoparticles in the engine helps in the oxidation reaction by releasing the hydrogen which helps in combustion.

II. LITERATURE SURVEY

A wide literature survey shows that many researchers have identified different Nanoparticles and their effect on the performance and emission of the IC Engine.

Kao et al, used aluminium Nano- fluid along with diesel they found. Specific fuel consumption slightly decreases and also improves the emissions.

Kannan et al, used ferric chloride as an additive with waste cooking oil, they have found improve in the fuel consumption, brake thermal effenciey.

Mehta et al, compared the performance, and combustion properties of internal combustion engine with aluminium, iron and Boron Nanofuel as an additive with diesel fuel, they compared each other and with diesel fuel.

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Selvan et al, used cerium oxide as an Nanoparticle additive in diesel-Biodiesel-ethanol and in diesel fuel. They found a slight increase in the brake thermal efficiency, it also helps to create a linear mixture better than diesel fuel.

Lenin et al, used Mno and CuO as an additive in biodiesel conducted performance experiment and emissions. They found additives enhance the combustion Characteristics by reducing the ignition delay.

Shafi et al, found that the basic fuel properties depends on size and shape of the nanoparticles, which were added to the fuels. They found addition of water into fuels with Nanoparticles improves performance and emission. In this paper an effort is made to reveal the methods to prepare Nano particles fluid as additives into biodiesel-diesel blends. The basic fuel properties of the blend along with additives are determined as per Indian standards.

III. METHODOLOGY

A. To Make SEM Image of the Al_2O_3 for Analyzing the Crystal Structure

SEM is used to study the crystal structure and surface configuration of the Aluminium Oxide. Figure 1 shows detailed crystal structure of the Aluminium Oxide of 50nm size. The principle used in this method is the position of the beam is combined with intensity of detected signal which produces an image.

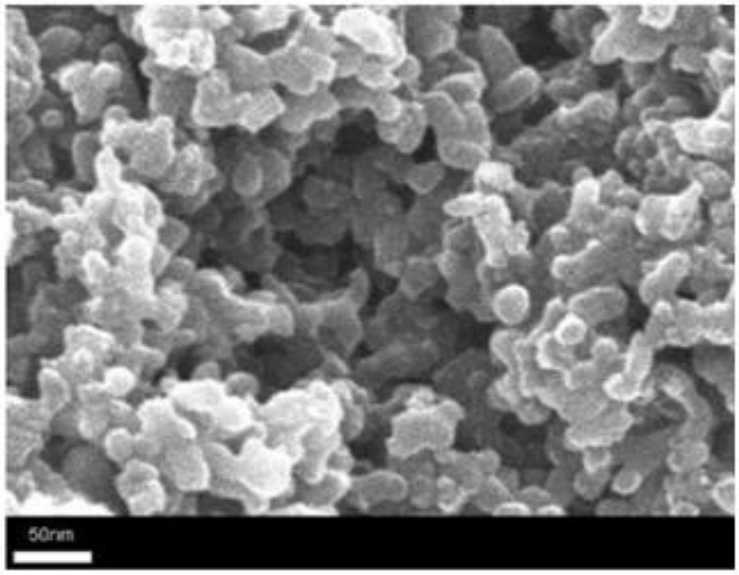

Fig 1:- Crystal Structure of Aluminium Oxide

B. To Analyse Al_20_3 Nano Particle using XRD Image

The XRD analysis method is used for the identification of crystalline form of nano-particles. The principle used in this method is the interaction of x-ray with the sample which produces finger print of the crystals of the sample.

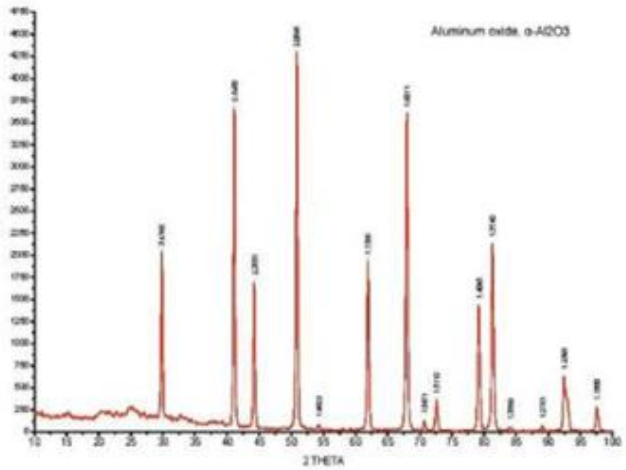

Fig 2

C. To Disperse the Nano-Particles in Biodiesel using Sonicator,Sonica 2400 S3

Sonicator is a device, which is used for through mixing of Nanoparticle and biodiesel blends. It uses the principle of sound energy to agitate particles in as sample.

Fig 3:- Ultra Sonica Setup

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Main line voltage :	230/240V= 50 to 60Hz
Main input power/ consumption	130W
Main input power with heating	305W
Peak HF ultrasound power	260W
US frequency	40Khz
Liquid drain	Tube 10*8mm
Transducer	2(2 piezoelectric ceramics each)
Tank capacity [litres]	4,5
Weight [Kg]	3,8
Environmental condition	Temperature up to 31 oC
Tank dimension internal	300/150/100 (W/D/H)
Tank dimension external	325/175/260 (W/D/H)
Constructing material of tank	Stainless steel AISI 304
Constructing material of housing	Stainless steel AISI 304

Table 1:- Shows The Specification of the Instrument Sonica 2400S3

Ultrasonic waves with frequencies > 20 KHz is used to agitate the Nanoparticles. It involves nucleation growth and collapse of the particle in a liquid.Figure-2 shows Ultrasonic set up of Sonica 2400S3 and Table1. Shows specifications of the device.

❖ *Pocess to Disperse Nano-Particles Using Sonicator*

- First prepare the MI20D80 (20% maduca-indica biodiesel and 80%diesel) sample bio diesel .
- Now take the Aluminium oxide Nano particle (99% pure and 40-50nm in size).
- Now prepare the solution of MI20D80+50ppm and MI20D80+100ppm. i.e., Add **0.2grams** of Aluminium oxide Nano particle to make **200ppm** solution similarly.
- A constant agitation time is of **30min** is maintained to produce uniform suspension.
- The agitation speed is set at **40 KHz** frequency for better dispersion of Nano particles in the solution

After the mixing is done for 30min it is checked for characterization by using SEM, TEM, or U-V spectroscopy MI20D80A50, MI20D80A100 Solution: The one litre MI20D80 bio diesel solution is prepared by mixing 100ml of maduca-indica bio diesel and 900ml of diesel. Similarly, one litre MI20D80 solution is prepared by mixing 100ml of maduca-indica bio diesel and 800ml of diesel.

Parameters to maintain: The minimum agitation time of 30 min should be maintained. The agitation amplitude of 40KHz is need to be set. The optimal pressure and surface intensity must be maintained for stability during agitation.

IV. BASIC FUEL PROPERTIES OF THE BLEND

After Madhuca-Indica (MI) and Aluminium oxide (Al2O3) are used to prepare blend. 20% of MI and 80% of diesel fuel (MI20D80) is added with 50ppm of Aluminium oxide and the blend is noted as MI20D80A50.

20% of MI and 80% of diesel fuel (MI20D80) is added with 100ppm of Aluminim Oxide and the blend is noted as MI20D80A100.

The basic fuel properties of both the blends were determined and compared with the diesel fuel and Madhuca-Indica.

Table2. Shows the properties of blend with 50ppm and 100ppm additives have better than pure diesel and biodiesel-diesel blends. This is due to Nano-Particle have better surface contact with other fuel particles.

Sl No	Fuel	Viscosity	Density	Flash Point	Calorific value
1	Diesel	3.2	816	58	42,000
2	MI	4.9	870	138	39,960
3	MI20D80	3.4	826	75	41,600
4	MI20D80A50	3.38	826	71	41,665
5	MI20D80A100	3.33	829	65	41,670

Table 2:- Fuel Properties

V. CONCLUSION

The objective of this paper is to show the importance of biodiesel as an alternate fuel. Using biodiesel only may cause poor efficiency and higher emissions, hence in order to improve the performance and emissions biodiesel was added with nanoparticles. Al_2O_3 was used as a Nano-particle, its structure was determined by using SEM image and was dispersed in biodiesel effectively by using sonicator.

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