

Comparison of Performance, Combustion and Emission Parameter for Aluminum Oxide Nano Particles Blended with used Vegetable oil Biodiesel in an IC Engine

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ABSTRACT: This study exploration is establish the combustion performance and emission characteristics of a diesel engine which is fuelled with cotton seed oil methyl ester and diesel in a diesel engine with aluminum oxide as nano particle. A single cylinder four stroke diesel engine is used for the experiments at various loads and constant speed. Then the biodiesel is produced from the CSO by standard transesterification process and consequently the nano particles are blended by means of an ultrasonicator. If the nano particles are used for this test is 25ppm. Then the all investigation process is carried out in a single cylinder D.I diesel engine. [1] The results are considerable improvement in brake thermal efficiency and specific fuel consumption due to the authority of aluminum oxide nanoparticles addition in biodiesel blend.

KEYWORDS: aluminum oxide nano particles, Diesel Engine, CSO

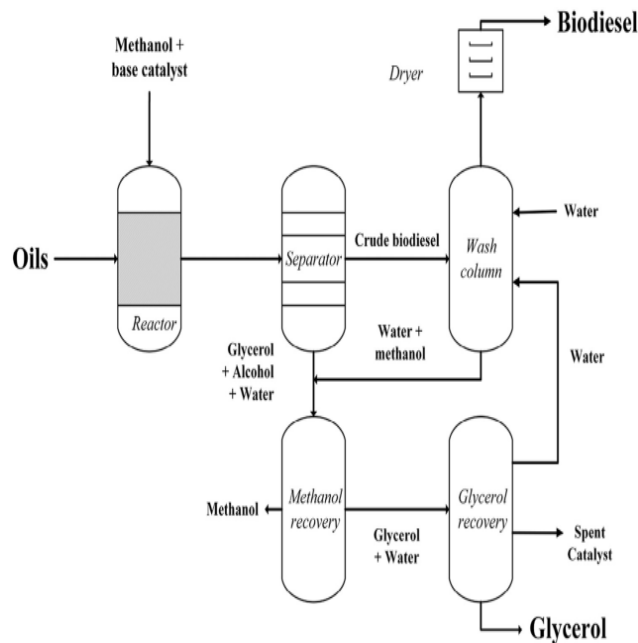
I. INTRODUCTION

The increase in energy consumption in precedent a number of decades has increased the awareness of exhausting natural resources. Swift industrialization and enormous growth of population have increased the hope and use of natural fuels. Around 90% of our energy requirements are met by fossil fuel. A study shows that if oppressed at the same rate, the coal depletes in next 200-300 years and petroleum will deplete in the next few decades. [1] Biodiesel fuels are measured as best alternative for diesel fuel as it is renewable, eco-friendly, non-hazardous. In recent year several kind of vegetable oil are working as fuel in engine. Various cooked oil such as peanut oil, corn oil, palm oil where used as alternative fuel for diesel engines. [2] The cooked oils are increases the cost of food products they are not recommended to use directly. The oil after use is being wasted. Which can be used as alternative fuel. The burning of fossil fuel is connected with emission such as CO₂, CO, NO_x, SO_x and particulate matter. [3] Nano oxides are reported to be successful in dropping diesel emissions. Then the metal based particles are to drop the diesel engine pollution and fuel consumption values. The cause for emission drop is that the metal reacting with water to create hydroxyl radicals. [4] This is to get better soot oxidation. We have to conduct a number of experiments in direct injection diesel engine using aluminum nanoparticles with biodiesel and diesel fuels. To observe a considerable increase in the brake thermal efficiency and drop in dangerous pollutants compared to that of neat biodiesel and neat diesel.

II. MATERIALS AND METHODS

The CSO is collected from a hosur. The collected oil is clean to remove the impurity present in it. Then the viscosity of the oil is higher than that of the biodiesel standards. [1] Then the high viscosity of oil is to meet improper combustion.

Hence, the transesterification is done to reduce the viscosity. A 550 ml of the filtered CSO is taken in a flask. A mixture containing 150 ml of methanol and 3.5g of KOH is mixed with CSO and stirred in a magnetic stirrer for 60 min at a reaction temperature of 60⁰c. Then the entire mixture is allowed to resolve in a separating flask for 24 hrs. Glycerine is the heavier liquid so established at the bottom is separated. After separation, the fatty acid methyl ester is washed in water.



S. N O	PROPERTIES	RAW C.S OIL	B0	B20	B100
1	Specific gravity	0.89	0.82	0.83	0.88
2	Kinematic Viscosity 400c	10.85	2.69	3.62	6.13
3	Flash point	192	66	73	170
4	Fire point	234	71	81	183
5	Calorific value in KJ/Kg	39,648	46,010	43,987	41,819

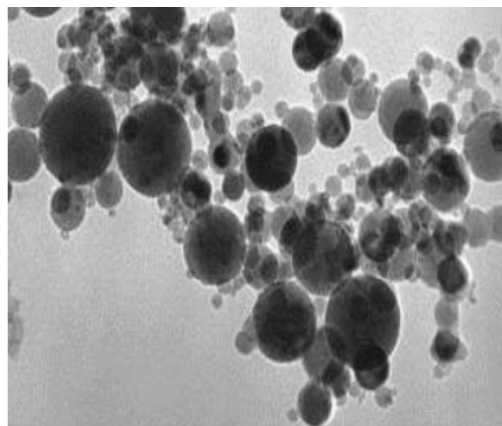
2.2 Preparation of nano blend

The Ultrasonicator is used to blending process of the Nanoparticles. Then the Aluminum oxide (Al_2O_3) alpha is 30-50 nm, purity is 99.5% was purchased from the Nano Lab Jamshedpur, India. The ultrasonication is a best method for Nano blend for uniform suspension. One liter of the B20 biodiesel and 25ppm of Al_2O_3 nanoparticles are mixed in an ultrasonicator for 30min. [1] Then this blending operation and mixing the 550 ml of the filtered CSO is taken in a flask. A mixture containing 150 ml of methanol and 3.5g of KOH is mixed with CSO and stirred in a magnetic stirrer for 60 min at a reaction temperature of $60^{\circ}C$. [2] Then the entire mixture is allowed to resolve in a separating flask for 24 hrs. Glycerine is the heavier liquid so established at the bottom is separated. After separation, the fatty acid methyl ester is washed in water. This process is repeated until the ester layer becomes clear [3] Then the properties of the Fatty acid methyl ester are found out to be presented in Table 1. The values are in line with the biodiesel standards.



A. bio diesel

[4] The fuel flow rate was measured on a volume basis using burette and a stop watch. Thermocouple and a digital were used to note the exhaust gas temperature. The Hartridgesmoke meter was used for measuring of smoke density. NO_x , HC and CO emissions were measured by AVL five gas analyzer. The inner cylinder pressure was measured with the help on the legion brothers combustion analyzer



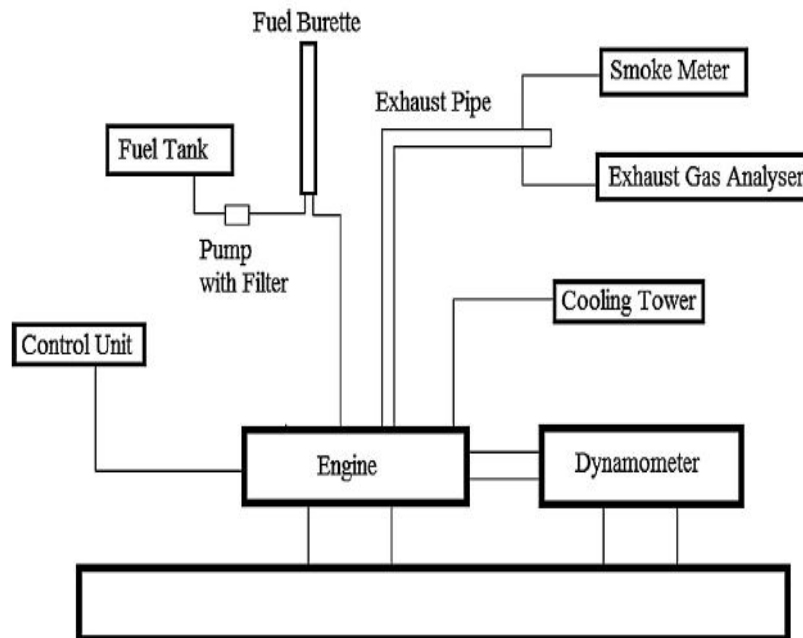
E. Blended aluminum Oxide

III. EXPERIMENTAL SETUP

The setup consists of single cylinder, four stroke, Multi-fuel, research engine connected to eddy current type dynamometer for loading. The operation mode of the engine can be changed from diesel to ECU Petrol or from ECU Petrol to Diesel mode by following some procedural steps. In both modes the compression ratio can be varied without

stopping the engine and without altering the combustion chamber geometry by specially designed *tilting cylinder block* arrangement. [1] In Diesel mode fuel injection point and pressure can be manipulated for research tests. In Petrol mode fuel injection time, fuel injection angle, ignition angle can be programmed with open ECU at each operating point based on RPM and throttle position. It helps in optimizing engine performance throughout its operating range. Air temp, coolant temp, Throttle position and trigger sensor are connected to Open ECU which control ignition coil, fuel injector, fuel pump and idle air. Set up is provided with necessary instruments for combustion pressure, Diesel line pressure and crank-angle measurements. [2] These signals are interfaced with computer for pressure crank-angle diagrams. Instruments are provided to interface airflow, fuel flow, temperatures and load measurements. [3] The set up has stand-alone panel box consisting of air box, two fuel tanks for duel fuel test, manometer, fuel measuring unit, transmitters for air and fuel flow measurements, process indicator and hardware interface. [4] Rotameters are provided for cooling water and calorimeter water flow measurement. A battery, starter and battery charger is provided for engine electric start arrangement.

Diesel fuel employed in the tests was obtained locally from commercial petroleum reserve. The Jatropha biodiesel was processed and obtained from Jatropha seeds. Jatropha biodiesel is prepared by a chemical process named transesterification where the glycerin is separated from the Jatropha oil. As a result, Jatropha oil methyl ester and glycerine is obtained. [5] The basic thermo physical fuel properties like density, calorific value, viscosity, flashpoint, cetane number along with carbon residue content, iodine value, oxidation stability, acid value, sulphur content and sulphated ash content were measured by standard test procedures.



F. I.C Engine Setup

IV. RESULT AND DISCUSSION

It has an experimental that the operation of the engine be very smooth during the rated load without operational problem.

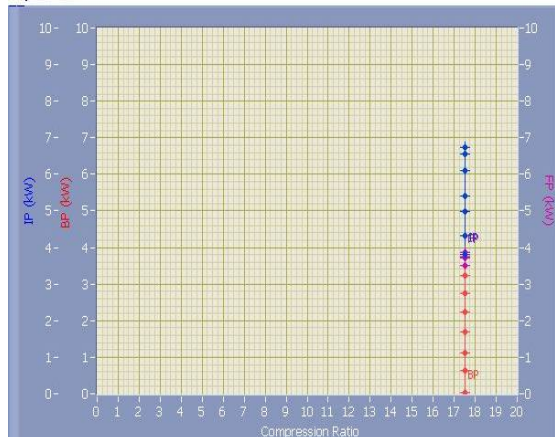
A.Brake thermal efficiency

The indicatedVsbrake thermal efficiency. Then the effect shows that all the blends of Al₂O₃so higher value of BTE is diesel,even if the higher percentage of Al₂O₃ shows improvement in BTE. The reason may be the aluminum oxide nanoparticle Present in the blend support longer and more complete combustion and also act an oxygen buffer thus increasing the efficiency,

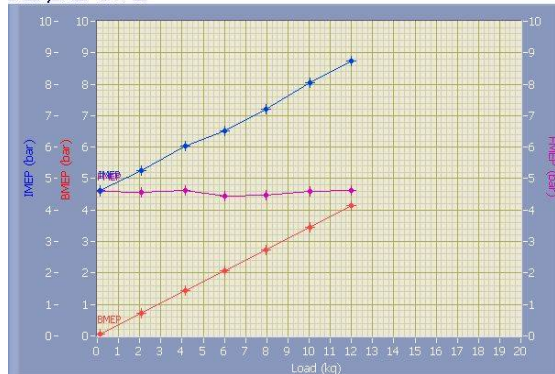
B.SFC & Fuel Consumption:

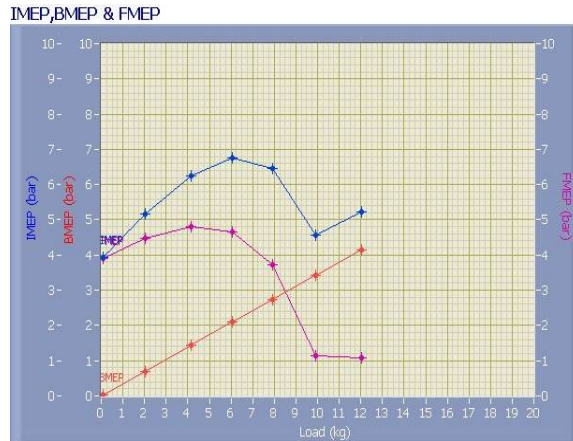
The brake specific fuel consumption is with brake power with the different dose level of biodiesel with blended to Al₂O₃ nanoparticles. The lowest brake Specific fuel consumption is obtained as 0.392619376 kg/kw-hr for 75ppm nanoparticles added with B20.

IP, BP &



IMEP, BMEP & FMPEP



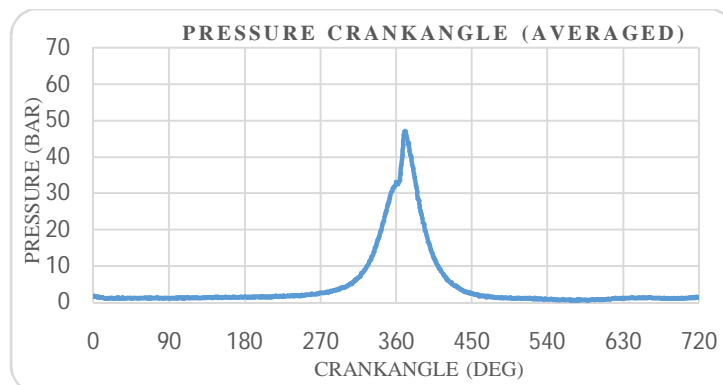
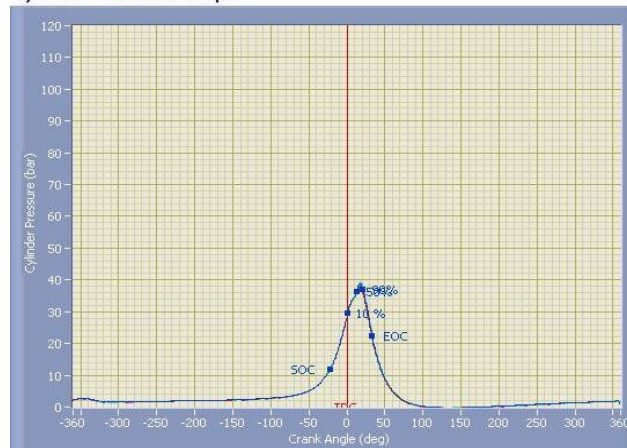


4.2 Combustion Testing

C.Cylinder pressure

Specific Gas Const (kJ/kgK) : 1.00, Air Density (kg/m³) : 1.17, Adiabatic Index : 1.41, Polytrophic Index : 1.28, Number Of Cycles : 10, Cylinder Pressure Reference : 4, Smoothing 2, TDC Reference : 0

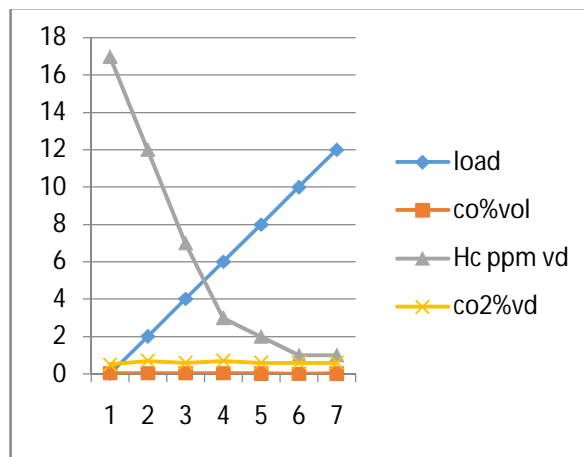
Cylinder Pressure Graph



4.3 Emission parameters

D. Emission parameters of exhaust gases

Then the emission of BP. The all values of nano blended biodiesel are higher value than that of diesel. As the nanoparticles plays a major role in combustion which in turns increases in cylinder temperature the formation of NO_x. The NO_x emissions for B20 Al₂O₃ 25ppm, B20 Al₂O₃ 50ppm, B20 Al₂O₃ 75ppm were 6.78, 6.98 and 7.5 respectively



V. CONCLUSIONS

A performance and emission personality of DI diesel engine with diesel-blended biodiesel with the addition of aluminum oxide nanoparticles was investigated. Then the following conclusion were drawn the experimental result. If the brake thermal efficiency is increased in B20 Al₂O₃ 75ppm at all loads than neat diesel.

A specific fuel consumption is higher for the B20 Al₂O₃ 75ppm than neat diesel at the entire load comparing with the different dosing level of blends. The CO emission decreases by addition of B20 Al₂O₃ 75ppm. The HC emission level was decreased at B20 Al₂O₃ 75ppm.

Then the NO_x emission is lower for the diesel than the addition of B20 Al₂O₃. By addition of Al₂O₃ slightly increased compared with diesel. The overall performance and emission characteristics were clearly obtained that the addition of aluminum oxide nanoparticles (Al₂O₃) is efficient in improving the properties of biodiesel blend.

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