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Experimental Investigation On Performance And Emissions Characteristics Of Diesel Engine Fuelled With Algae Bio-Diesel With Nano Additive. (Cerium Oxide)

M.Narendrasai[1], G.Venkateswara Rao[2], R.Samsukumar[3]

[1]M.tech, Student, B.V.C Engineering College odalarevu Andhra Pradesh, INDIA .
[2]Assoc.Professor, B.V.C Engineering College odalarevu Andhra Pradesh, INDIA .
[3] Assoc. Professor, Swarnandra College Of Engineering And Technology, Andhra Pradesh, INDIA

Abstract - In the day to day life, environment conditions have been changing continuously due to the effect of pollution. The consumption of natural resources and fossil fuels for the human activities were greatly increased, which leads to depletion of ozone layer. Fossil fuels were releasing harmful gases like CO, CO2, NOx ,SOx which consists of hydrocarbons that damage the environment, it is also hazardous to mankind . In order to overcome all these effects biofuel was introduced. The biodiesels will be prepared from algae oil by trans-esterification process. In order to have some better improvement in biofuel, cerium oxide are used as additive. In this work the experimental investigation are carried out on four stroke, single cylinder, water cooled, constant speed (1500RPM) diesel engine fuelled with algae bio-diesel blended with diesel in various proportions like B10, B20 and B30 at various loads ranging from 0, 25%, 50%, 75%, and 100% to find the best blends of diesel and algae oil which could be successfully used with acceptable performance and better emission than pure diesel up to a certain extent. Finally cerium oxide additive was added to best blend and investigations are carried out .based on the results we found little bit improvement in performance and more reduction of emissions by comparing with best blend of algae bio diesel. Finally algae bio diesel is suitable for diesel engine with any engine modifications.

Key Words: Algae bio diesel blends, Nano-particles, Experimental observations, Emission analysis with additive, Scope Of Future Work

1. INTRODUCTION

An alternative approach to fossil fuel rely on usage of biodiesel .Production of biodiesel can be made through animal oil/fats, waste cooking oil and straight vegetable oils. Transestirification is the best method to convert these viscous oils to form biodieselIn contrast to conventional petroleum based diesel fuel,bio can be regarded as biological and renewable energy source.In diesel engines,the pure diesel is regarded as base fuel.As an renewable fuel,biofuel can be straightly used in its form or it can be blended with conventional diesel fuel.Biodiesel is referred as ‘ An alternative for a diesel fuel that can be obtained through oils of plants and fats of animals. The triglycerides molecules in oil is reacted by a catalyst of simple monohydric alcohol to form mono alkyl

1.1 Introduction To Nano-particles

Nanotechnology is the science that deals with matter at the scale of 1 billionth of a meter (i.e., 10 − 9 m = 1 nm), and is also the study of manipulating matter at the atomic and molecular scale. A nanoparticle is the most fundamental component in the fabrication of a nanostructure, and is far smaller than the world of everyday objects that are described by Newton ’ s laws of motion, but bigger than an atom or a simple mole#cule that are governed by quantum mechanics. The United States instituted the National Nanotechnology Initiative (NNI) back in 2000, which was soon followed (2001) by a plethora of projects in nanotechnology in nearly most of the U.S. Departments and Agencies. About 20 Research Centers were subsequently funded by the Nationa1 Science Foundation (NSF), an agency responsible solely to the President of the United States and whose mandate is to fund the best of fundamental science and technology projects. NSF was the lead U.S. agency to carry forward the NNI. The word “nanotechnology” soon caught the attention of various media (TV networks, the internet, etc.) and the imagination and fascination of the community at large. In general, the size of a nanoparticle spans the range between 1 and 100 nm. Metallinanoparticles have different physical and chemical properties from bulk metals (e.g., lower melting points, higher specific surface areas, specific optical properties, mechanical strengths, and specific magnetizations), properties that might prove attractive in various industria applications. However, how a nanoparticle is viewed and is defined depends very much on the specific application. Of particular importance, the optical property is one of the fundamental attractions and a characteristic of a nanoparticle. For example, a 20-nm gold nanoparticle has a characteristic wine red color. A silver nanoparticle is yellowish grey. Platinum and palladium nanoparticles are black. Not surprisingly, the optical characteristics of nanoparticles have been used from time immemorial in sculptures paintings even before the 4th century AD. The most famous example is the Lycurgus cup (fourth centuryAD).

1.2. Effect Of Nano-particles On The Performance Of The Engine

Researchers and scientist have used different nanoparticles additives in diesel fuelled in VCR engine. A brief study of the effect of these fuel additives is presented here. Many researchers have reported that the performance of the mixture of nanoparticles and diesel is higher when additive is used. Scientists investigated that the use of cerium oxide nanoparticles in diesel engine. A single cylinder four stroke water cooled CI engine was used in test. The researchers found that the flash point decreases in volatility of fuel with addition of nanoparticles. Higher flash point temperatures are desirable for safer handling of fuel. Addition of catalytic nanoparticles in fuel increases its flash point. Nanoparticle added fuel inherently safer to handle as compared to its base diesel. BTH increases by 6% on addition of cerium oxide nanoparticles. Kinematic viscosity increases with catalytic nanoparticles addition in fuel. Scientists have investigated that the use of ZnO nanoparticles Grape seed oil methyl ester.

2. ALGAE OIL PRODUCTION

Algal oil is highly viscous, with viscosities ranging 10–20 times those of no. 2 Diesel fuel. The high viscosity is due to the large molecular mass and chemical structure of oils which in turn leads to problems in pumping, combustion and atomization in the injector systems of a diesel engine. Therefore, a reduction in viscosity is important to make high-viscous oil a suitable alternative fuel for diesel engines.There are a number of ways to reduce vegetable oil's viscosity. These methods include; transestrification, pyrolysis (Pyrolysis Definition from AFR, micro Emulsion (Emulsions & Emulsification), blending and thermal depolymerization. One of the most common methods used to reduce oil viscosity in the Biodiesel industry is called transesterification. It involves chemical conversion of the oil into its corresponding fatty ester.

2.1 Transesterification Of Algae Oil Into Biodiesel

Transesterification of algal oil is normally done with Ethanol and sodium ethanolate serving as the catalyst. Sodium ethanolate can be produced by reacting ethanol with sodium. Thus, with sodium ethanolate as the catalyst, ethanol is reacted with the algal oil (the triglyceride) to produce bio-diesel & glycerol. The end products of this reaction are hence biodiesel, sodium ethanolate and glycerol. This end-mixture is separated as follows: Ether and salt water are added to the mixture and mixed well. After sometime, the entire mixture would have separated into two layers, with the bottom layer containing a mixture of ether and biodiesel. This layer is separated. Biodiesel is in turn separated from ether by a vaporizer under a high vacuum. As the ether vaporizes first, the Biodiesel will remain. The biodiesel from algae is now ready for use!

3. EXPERIMENTAL SETUP AND PROCEDURE

The engine performance test was conducted on a single cylinder, four-stroke, naturally aspirated, open chamber (direct injection) water-cooled, 4.4Kw output computerized diesel engine test-rig. The engine was directly coupled to an Eddy current dynamometer that permitted engine motoring either fully or partially. The schematic diagram of the experimental setup is depicted in Figure 1 and the engine characteristics are cited in specifications of engine. The fuel is supplied to the test engine by an external tank of 5 liter capacity, which could easily be drained with the help of three way stop valve for Change of fuel. A glass burette of 100cc was also attached in parallel to this tank and was used for fuel flow rate measurement. For every fuel change the fuel line was purged out of the residual fuel. The engine was made to run under full load for at least 30 minutes to stabilize on new fuel conditions. Test-rig was provided with necessary equipment and instruments for recording the dynamic combustion pressure and crank-angle measurements. Provision was also made for interfacing airflow, fuel flow, temperatures and load measurement with computer. The setup facilitates, the study of engine performance for brake power, indicated power, frictional power, BMEP, IMEP, brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, volumetric efficiency, specific fuel consumption, A/F ratio and heat balance. Windows based engine performance analysis software package was used for online performance evaluation.

3.1 EXPERIMENTAL OBERVATIONS

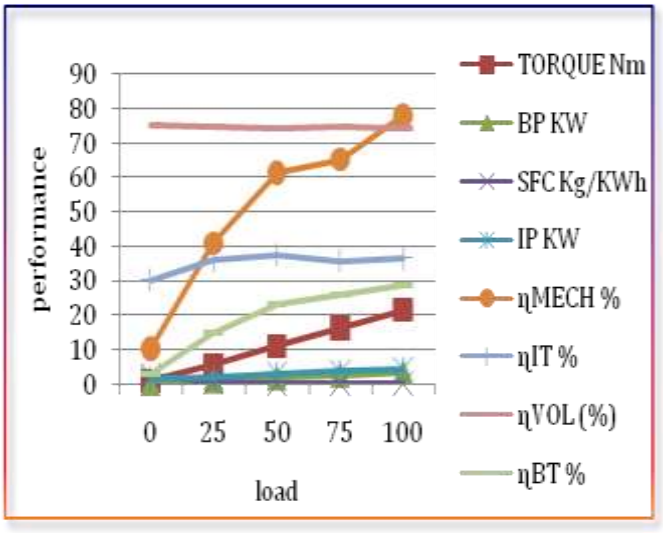

Chart- 1: Load vs Performance Analysis for pure diesel

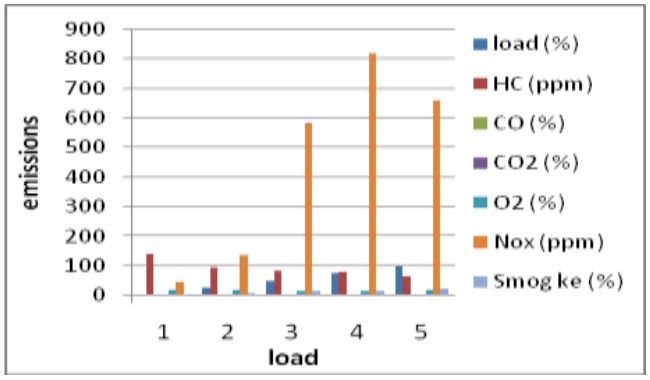

Chart- 2: Load vs Emission Analysis for pure diesel

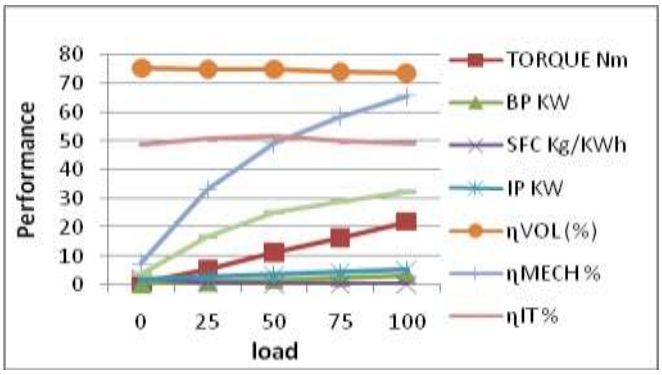

Chart- 3: Load vs Performance analysis for B20

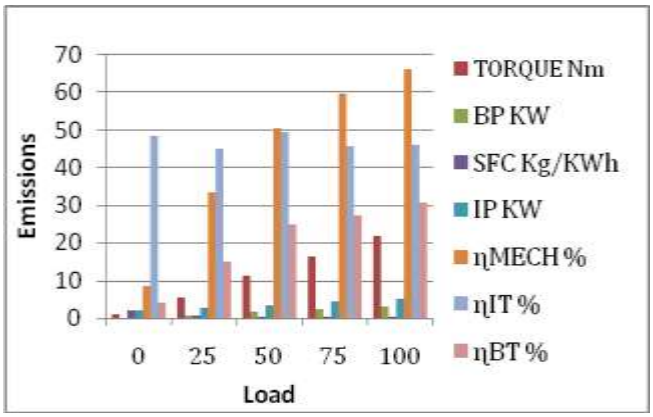

Chart- 4: Load vs Emission Analysis for B20

4. RESULTS AND DISCUSSIONS

Experiments are conducted o four stroke single cylinder water cooled diesel engine at constant speed 1500 rpm by varying loads from 0 to 100 % at compression rtio 17.5:1 and different blends of B10, B20 and B30.

The performance parameters such as brake power, mechanicl efficiency, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency, air-fuel ratio, exhaust gas temperature, exaust gas temperature , exaust gas emission like carbon monoxide , hydrocarbons, carbon dioxide unused oxygen and smoke are taken from the system which is connected to the engine by using ic engine analysis software and discussed with respect to load and optimum blend of the bio diesel is identify which has similar characteristics as the diesel. The various obtained are discussed below.

4.1 BREAK THERMAL EFFICIENCY

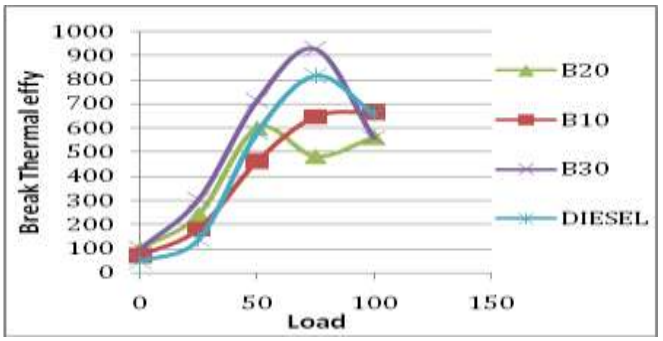

Chart- 5: Comparison of Load Vs Brake thermal efficiency for different blends of algae oil.

All the curves are moving linearly with small deviations. at all load conditions the bio diesel blends are producing highest BTE when compared to diesel .At 100% load the combination B20 is producing highest BTE Of 32.31 kw. At 100% load the base line i.e diesel is producing BTE of 28.61kw and it is lower than its blends . when compared to diesel mode the bio diesel blend B20 is producing more.. Do not use abbreviations in the title or heads unless they are unavoidable.

4.2 PERFORMANCE ANALYSIS OF SFC

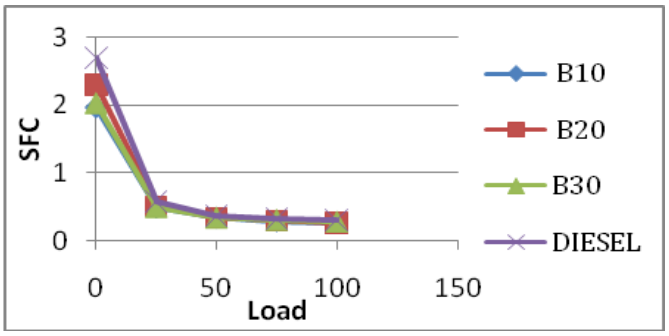

Chart- 6: Comparison of Load Vs SFC for different blends of algae oil.

allsfc curves are moving in same manner with small deviations. at full load condition the bio diesel blend B20 is producing a lowest SFC of 0.26 the base line i.e diesel is producing a bsfc of 0.3 and it is greater than the all blends when compared to diesel the bio diesel blend B20 is having less sfc. Sample papragraphDefine abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined.

Do not use abbreviations in the title or heads unless they are unavoidable. After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper.

5. EMISSION ANALYSIS WITH ADDITIVES

We analyzed the emission properties of Algae bio diesel. Results of the experiments in the form of carbon monoxide (CO), Nitrogen oxides (NOx), Hydrocarbons (HC) and carbon dioxide (CO2) for different load conditions for various blends of Algae bio diesel with additivies compare with the pure diesel in the form of graphs

5.1 NOx(PPM) EMISSION

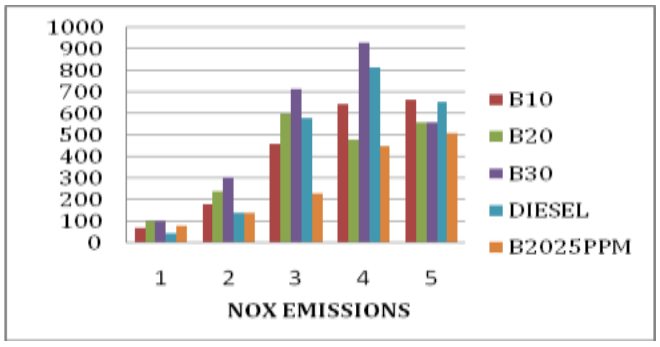

Chart- 7:Comparative Results of NOx Emissions of different blends of Algae Oil with additive

The comparision of NOx for various blends with respect to load and various blend proportions were made. The study of the poltted data gives the information that at all the blends diesel gives higher NOx emission. B2025PPM had given low NOx emission among all bio disel blends at all conditions.

5.2 HC EMISSIONS

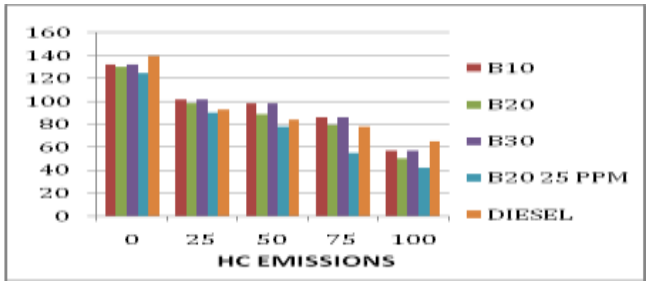

Chart- 8; Comparative Results of HC Emissions of different blends of Algae Oil with additive

Comparision of HC for various blends with respect to load and various blend proportions were made. The study of the plotted data gives the information that at all the blends diesel gives higher HC emission. B2025PPM had given low HC emission among all bio diesel blends at all conditions

5.3 O_2 EMISSIONS

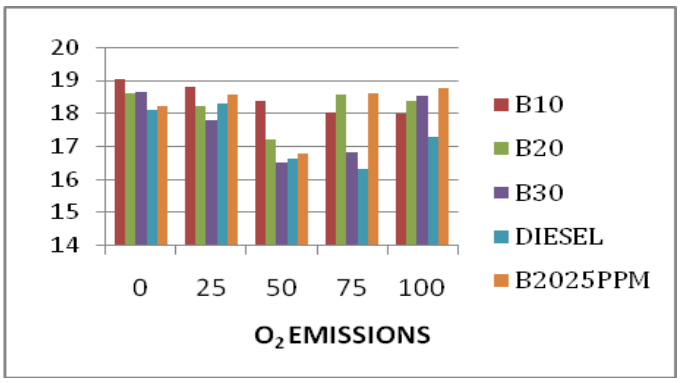

Chart- 9: Comparative Results of O_2 Emissions of different blends of Algae Oil with additive

The study of the plotted data gives the information that at all the blends diesel gives Lower O2 emission. B2025PPM had given high O2 emission among all bio disel blends at all conditions.

5.4 CO_2 EMISSIONS

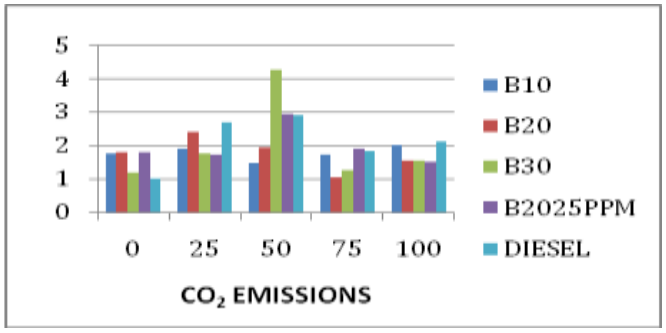

Chart- 10: Comparative Results of CO_2 Emissions of different blends of Algae Oil with additive

CONCLUSION

Recently, it is a challenge for finding different alternative resources, which can replace fossil fuels. Due to presence of several advan-tages in algal biofuels like low land requirement for biomass production and high oil content with high productivity, it has been considered as the best resource, which can replace the liquid petroleum fuel. However, one of its bottlenecks is the low biomass production, which is a barrier for industrial production. Also, another disadvantage includes harvesting of biomass, which possesses high energy inputs. For an economic process development in comparison to others, a cost-effective and energy efficient harvesting methods are required with low

energy input. Based On Experimental Results The Following Conclusions Are

Performance Results

1.B20 Gives Highest Break Power at full load

2.B20 Gives highest break thermal efficiency at full load

3.B20 gives less break specific fuel consumption at full load

4.B20 gives highest mechanical efficiency at full load

Emissions Results

1.B20 with additive gives better reduction in NOx emissions at full load

2.B20 with additive gives better reduction in HC emissions at full load

3.B20withadditive gives better improvement in O2 emissions at full load.

4.B20 with additive gives better reduction in CO2 at full load.

SCOPE OF FUTURE WORK

1) The research work can be extended by considering the different nano-particles with different biodiesel can be studied.

2) By increasing the dosage of the nanoparticle we can be study the performance and emissions characteristics.

3) This experiment carried out in vcr engine

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