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Analysis of Combustion CI Engine Fuelled with Algae Biofuel Blends using ANN

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Abstract— Due to its potential for high yield, quicker rate of growth, biocompatible, non-toxicity, dioxide, low emission profile, and use of non-arable land and non-potable water with less publicity and resource consumption, algae-based biofuels are the most effective lengthy solutions to the energy crisis and global warming. In this research, a biofuel made by transformed into chlorella algae oil was used. Moreover, fuel and algae were mixed to produce bio - fuels blends on a volumetric basis for a net unit volume. By providing a comprehensive database of the characteristics of algal biofuel blends as next-generation biofuel and their use in a current diesel engine without modification, this thesis attempts to provide the necessary facts in the field of biofuel technology. Future biofuel research will be made easier by the research technique and computer model built in this study, which can be used for extended validation and prediction reasons. In order to determine whether algae-based biofuel is suitable to replace conventional fuel and thus satisfy all of our transport fuel needs, the key findings of this research are expected to serve as the foundation for future developments in the use of algae-based biofuel as a feedstock for commercial large-scale production of biofuels in an economically effective, technically feasible, and environmentally friendly manner.

Keywords: Biofuel, Algae oil, Artificial Neural Network, Compression Ratio, Back Propagation

I. INTRODUCTION

Extensive global research has been done to identify alternative energy sources for internal combustion engines due to the continuously rising demand, depletion, and cost of petroleum products. Biofuel is one of the top competitors among the different alternatives to conventional petroleum that have been investigated since it offers substantially enhanced performance and decreased exhaust emissions. A significant quantity of biofuel is already being used in place of conventional petroleum in a number of nations, including India. Such a widespread use of biofuels will benefit developing nations by reducing their reliance on oil imports by generating cash, creating jobs, and socioeconomic development in rural areas.

Algae are biologically capable of producing oil and useful biomass at the highest rates. They could thus be a successful alternative energy source. Algae, among of the oldest living things, develop a variety of clusters that are minute, fast-growing, and photosynthesizing. Algae have a much higher species diversity than plants, with more than 300,000 different species known to exist. Algae can produce different kinds of lipids, complex oils, and carbohydrates in varying bulk quantities during a brief period of time, depending on the species. Due to their promised high yield, faster growing rate, biodegradability, nontoxicity, low emission profile, and carbon neutrality, algae-based biofuels are the best option for the global energy crises and future environmental change. Algae can also grow in nonpotable water and on nonarable soil.

II. LITERATURE SURVEY

Algal biofuel and its blends in ID CI engines were experimentally studied by Haik, Selim, and Abdul rehman in 2011. For growing the microalgae and extracting the algal oil, they preferred an open pond system using ultrasonic/soxhlet extraction techniques. Algal oil was transformed into biofuel by the transesterification method. Algal oil methyl ester (AOME), which possessed qualities similar to those of regular diesel, may be used successfully in diesel engines, according to a thorough chemical examination. Shaija, Mubarak and Suchithra (2014) reviewed various techniques used to extract oils or lipids from microalgae biomass for biodiesel production. They discovered that suitable and optimised conditions are required for the lipid extraction to reduce the cost of producing biofuel from microalgae. They found that the lipid extraction yield from microalgae could be increased using pre-treatment methods, such as ultrasonication and microwave-assisted techniques, along with solvent extraction.

III. EXPERIMENTAL WORK

TABLE I

Properties	Diesel	Algae Oil
Calorific Value (KJ/KG)	43000	40072
Density(Kg/L)	0.84	0.912
Viscosity@40°C	2.64	5.06
Flash Point°C	71	145
Cetane Number	53.3	46.5

Figure.1: Mechanical Stirrer for Mixing

Figure.2: Mixing of solution in an ultrasonic homogenizer

Figure.3: Final prepared sample

Algae may one day be utilised to produce biofuels on a large scale using a technologically and economically viable approach that is both environmentally friendly and useful for supplying transportation fuel. Algae biofuels are oxygenated and have the ideal ratio of unsaturated fatty acids. Algal biofuel's extra oxygen molecules allow for complete burning, which boosts thermal efficiency and lowers unwanted emissions. Due to the current global energy crisis and technological advancements like creative genetic and metabolic engineering, hybrid biofuel refineries, and enhanced cultivating techniques, algae biofuel has emerged as a highly desirable and suitable alternative to engine fuel.

IV.PROPOSED METHODOLOGY

Currently, ANNs are preferred by the majority of researchers when forecasting the characteristics of internal combustion engines, especially in a few crucial areas where traditional modelling techniques fall short. Because they use a robust nonlinear multivariate process with error endurance qualities, ANNs are stronger engine optimization tools than other methodologies. Additionally, ANNs are inexpensive instruments with short simulation run times and little resource usage. For a knowledge of the engine's overall performance, combustion, and emission parameters, all of the output responses anticipated by the ANN were essential. The network model was trained and developed using the MATLAB software's neural network toolbox.

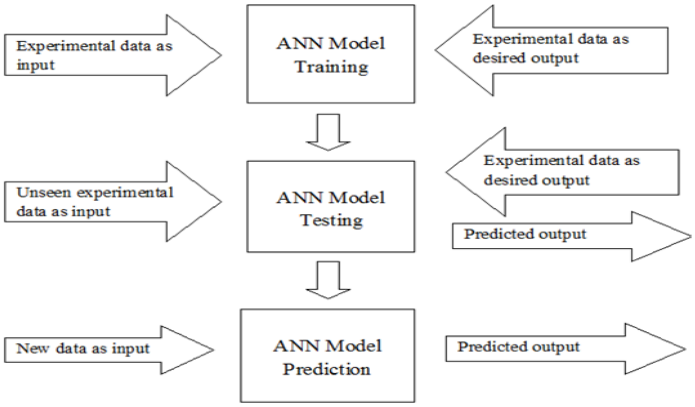

Figure.4: Working principle of ANN

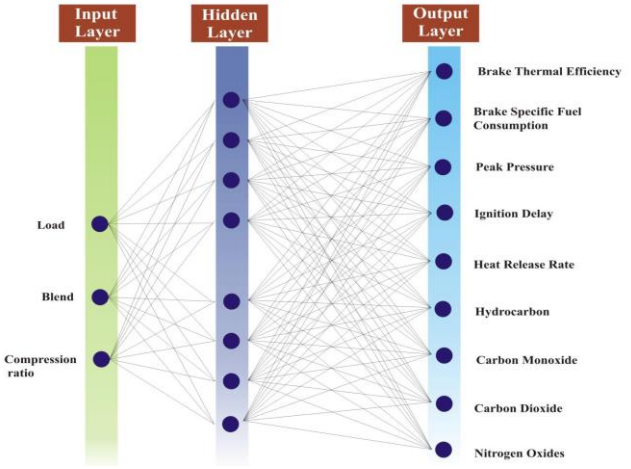

Figure.5: Network Configuration of the ANN model

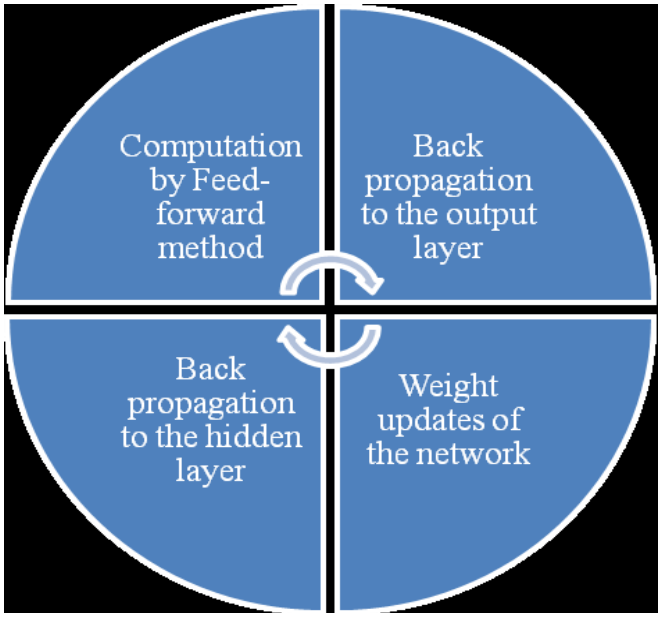

Figure.6: Working of the back propogation algorithm

Figure.7: Pictorial View of the Engine Setup

TABLE II

Parameters	Level 1	Level 2	Level 3	Level 4	Level 5
Load (%)	0	25	50	75	100
Speed(RPM)	1500	1500	1500	1500	1500
Biofuel Blends(%)	BD0	BD5	BD10	BD20	BD30
Compression Ratio	16	17	18	----	----

IV. RESULTS AND DISCUSSION

According to the goals and procedures outlined in this work experimental investigations were done. Graphs between the output parameters and the engine load are used to display the results. The performance, emission, and combustion parameters were divided into three groups as the output parameters.

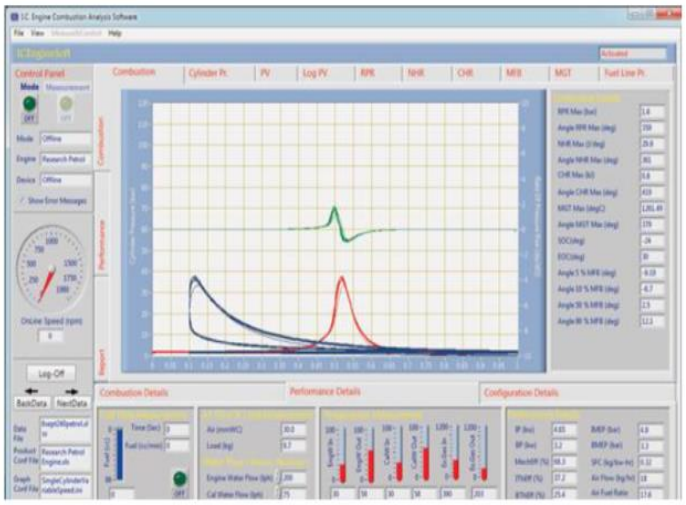

Figure.8: Screenshot of Engine Software

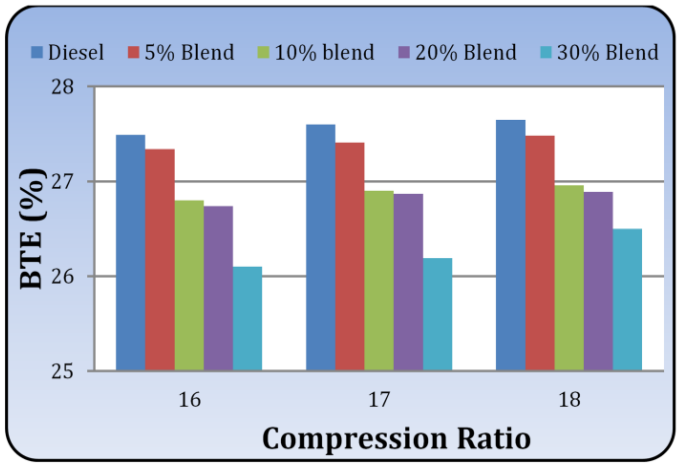

Figure.9: Variation in the BTE for different blends with different CRs

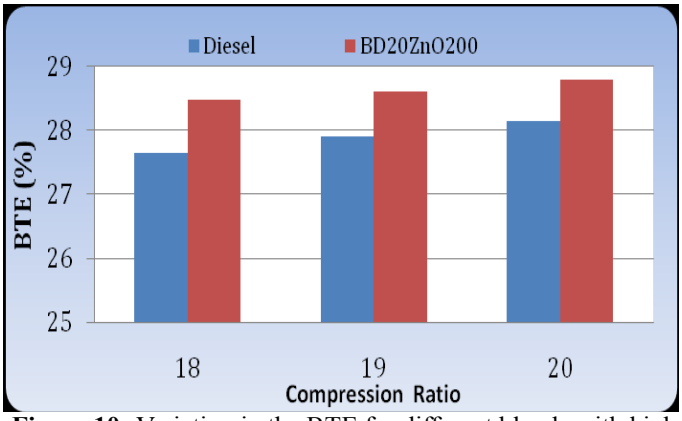

Figure.10: Variation in the BTE for different blends with higher CRs

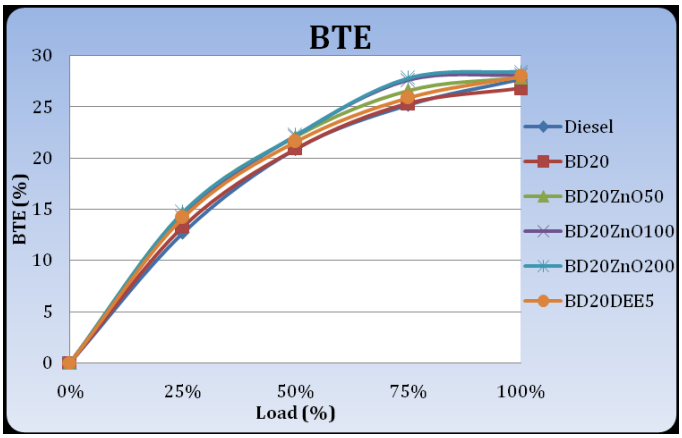

Figure.11: Variation in the BTE for different blends with different engine loads

V. CONCLUSION

In order to improve performance and combustion parameters while lowering emissions, a thorough experimental analysis was conducted to determine the effects of DEE and ZnO nanoparticles as fuel additives in next-generation algal biofuel blends. An ANN model was created and utilised to forecast engine characteristics and verify the outcomes of experiments. Algae may one day be employed in the industrial scale production of biofuels in a cost-effective, environmentally benign, and technically possible manner to supply transportation fuel. Algae biofuel has become a highly desirable and sensible alternative to engine gasoline due to the global energy crisis and technology advancements including innovative genetic and metabolic engineering, hybrid biofuel refineries, and superior growth procedures. Research must be done on novel combustion technologies with emission control approaches for contemporary diesel engines with different operating circumstances in order to further optimise the combustion process and reduce emissions. Moreover, models should be created to accurately correlate next-generation biofuels' engine operating parameters and overall performance metrics with less inputs.

REFERENCES

[1] S.Rajesh, B.M. Kulkarani, S.Kumarappa and S.Shanmugappa, "Investigations on fuel properties of ternary mixture of ethanol, bio diesel from acid oil and petroleum diesel to evaluate alternate fuel for diesel engine," International Journal , vol. 2, 2014 pp. 181-188.

[2] S.Karthikeyan, and A.Prathima, "Environmental effect of CI engine using microalgae methyl ester with doped nano additives," Transportation Research, vol. 50, 2014, pp. 385-396..

[3] M.Islam, M.M.Rahman, K.Heimann and Z.D.Ristoviziki "Combustion analysis of microalgae methyl ester in a common rail direct injection diesel engine," Fuel, vol. 143, 2015 pp. 351-360..

[4] V.MakarevicieneV.Lebedevas, and S.Rajapalis, "Performance and emission characteristics of diesel fuel containing microalgae oil methyl ester," Fuel, vol. 120, no. 4, 2014, pp. 233-239.

[5] D.Ambarish, and B.Kumar Madhal, "comprehensive review of biodiesel as an alternative fuel for compression ignition engine,"Renewable and Sustainable Energy Reviews, vol. 57,2016 pp. 799-821.

[6] F.Mohamed, and S.K.Batti, "Experimental and Computational Investigations for Combustion, Performance and Emission Parameters of a Diesel Engine Fueled with Soybean Biodiesel-Diesel Blends," Energy Procedia, vol. 52,2014, pp. 421-430.

[7] XueZinlin, "Combustion characteristics, engine performances and emissions of waste edible oil biodiesel in diesel engine," Renewable and Sustainable Energy Reviews, vol. 23, 2013,pp. 350-365.