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Investigation of Performance Parameter on Application of Microalgae on 4S Diesel Engine

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ABSTRACT: Experiment were carried out by using micro algae oil blends B08,B16, B20, B24, B30 on diesel engine. Parameter of engine performance like brake thermal efficiency, brake specific fuel consumption, indicated power, brake power, vibrations, exhaust gas temperature are studied. The graphical presentation of results was done to observe rate of decrease in losses and increase in efficiency of micro algae oil with respective blends and diesel. B08 has higher brake power at maximum load and have less BSFC as compare to diesel fuel. It was found that B08 has 23.72% break thermal efficiency than diesel which has 21.75%. B08 can be better replacement for diesel fuel in future. In future economically micro algae biodiesel can be better replacement to diesel fuel if we increase the cultivation.

KEYWORDS: micro algae oil, biodiesel, transesterification, performance characterization.

I. INTRODUCTION

Industries like mining, automobile, construction and manufacturing use petroleum based crude oil as a fuel for various engines they use. One of the most common fuels used for heavy work is diesel. Using diesel fuel comes with its own challenges. Extracting oil from underground reservoirs then its purification and transport is time consuming process and it also becomes economically unreliable when it comes to problems like leakage and fire hazards. Using diesel in engines is also relatively costly due to its poor efficiency. Average efficiency of diesel based engine is between 40 to 44%and so is the performance. Another major problem regarding conventional fuel is its impact on nature and human beings due to pollution. All diesel based engines have exhaust gases such as CO, CO_2, NO_x, HC and smoke.

These oils which are used to make biodiesel can be divided into two main groups. Edible and non-edible. Though edible oils can be used to make bio diesel but it can have negative impact on food industry. So we use non edible oils for making biodiesel. There are several sources such as jatropha tree (Jatropha curcas), karanja (Pongamia pinnata), mahua (Madhuca indica), castor bean seed (Ricinus communis), neem (Azadirachta indica), rubber seed tree (Heveabra siliensis), tobacco seed (Nicotianata bacum). But before using these biodiesels it's important to study their properties and behavior through various experiments. This will helps us to decide the optimum amount which can be added in diesel fuel for best performance. So we have selected micro algae based biodiesel for this experiment we have observed and study its performance and emission characteristics. We have prepared 5 different blends of microalgae biodiesel. All with varying added quantity of algae oil in them. And a pure diesel for comparison.

II. EXPERIMENTATION

Experiment is done on single cylinder four stroke diesel engine at the APEX INNOVATION SANGLI. Micro algae oil is used for the test, there is no change required in the set of engine before testing. Engine is single cylinder four stroke diesel engine with compression ratio which can be varies over range of 14:1, 16:1 and 18:1, speed is 1500rpm, 5.2KW power rating and is used.

Various blends used for test are as following:
B00, B08, B16, B20, B24, B30.

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Fig.1 Experimentation Set Up For micro algae Oil Biodiesel

Where,

T1 = Temperature of jacket water in
T2 = Temperature of jacket water out
T3 = Temperature of water Calorimeter in
T4 = Temperature of water Calorimeter out
T5 = Temperature of Exhaust Gas, before calorimeter.
T6 = Temperature of Exhaust Gas, after calorimeter

F1 = Flow rate of fuel
F2 = Flow rate of air
F3 = Flow rate of engine cooling water
F4 = Flow rate of calorimeter cooling water
Wt. = Load cell reading
N = Engine speed Tachometer reading.

III. METHODOLOGY

The engine was started and allowed to run for 10-20 minutes to get stabilized using pure diesel fuel and baseline data for B00 was generated. Compression ratio wassetat14:1, 16:1 and18:1. Performance parameters were noted using I.C. engine software. The exhaust gas emission parameters like HC, NOx, CO2, CO were recorded by pelting the probe of NPM-MGA gas analyser in the exhaust pipe. Then the load on the engine was further increased from 0 kg, 3 kg, 6 kg, 9 kg and 12 kg. The engine was run for sufficient time duration to ensure that the diesel fuel phase is over and the engine has started running with Hybrid biodiesel as fuel. The entire process was repeated while engine running with different blends of hybrid biodiesel i.e. B00, B08, B16, B20, B24, and B30 as a fuel and various performance and emission parameters were noted.

IV. ANN RESULTS

Graphical Presentation of comparison between variable parameters and output is shown. Performance of engine is validated by using ANN validation technique. Validation is carried out for checking performance parameters as Brake power, Brake thermal efficiency, Specific fuel consumption, volumetric efficiency, exhaust gas temperature and exhaust gases at compression ratio 18. ANN validation is carried out for calculation of regression coefficient (R) and Mean Square root Error (MSE). Graphs are plotted variable parameters against output of performance parameters.

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1. ANN Graphs for Brake Power

From graph it can be said that regression coefficient (R) for training, testing, validation and all is 0.99971, 0.99974, 0.99831 and 0.99925 which is near to 1 respectively.

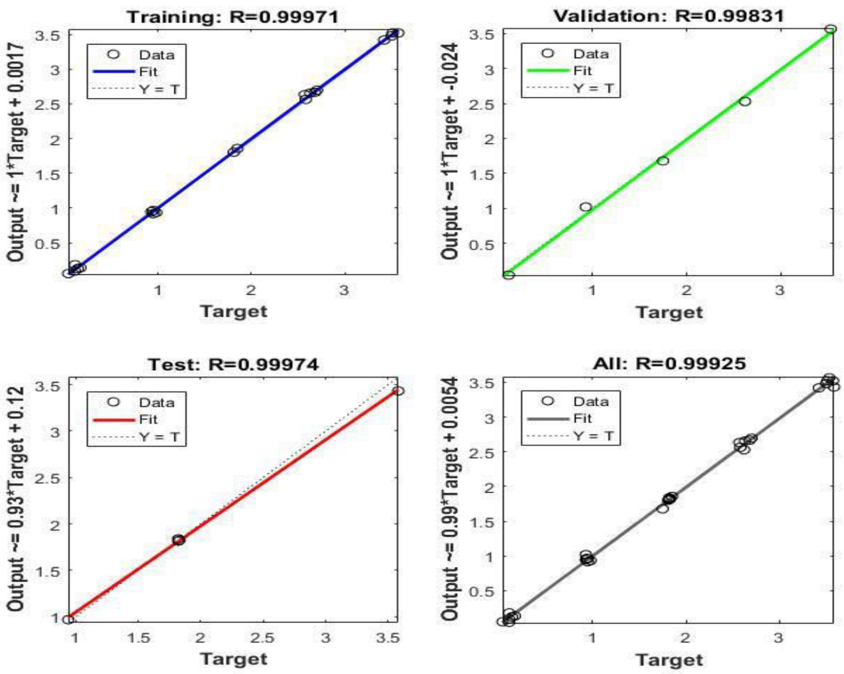

Fig 7: Graph for variable and output parameters of brake power

2. ANN Graphs for Indicated Power

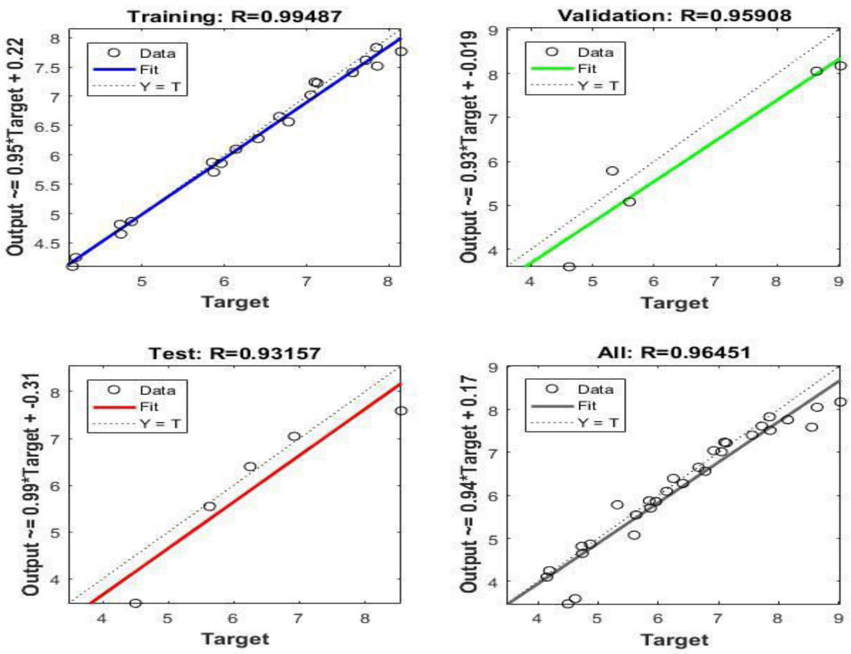

Fig. 8: Graph for variable and output parameters of indicated power

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From graph it can be said that regression coefficient (R) for training, validation and testing is 0.99487, 0.93157 and 0.95908 respectively which is near to 1 From this it can be said that experimental results of indicated power are validated by ANN.

3. ANN Graphs for Brake Specific Fuel Consumption

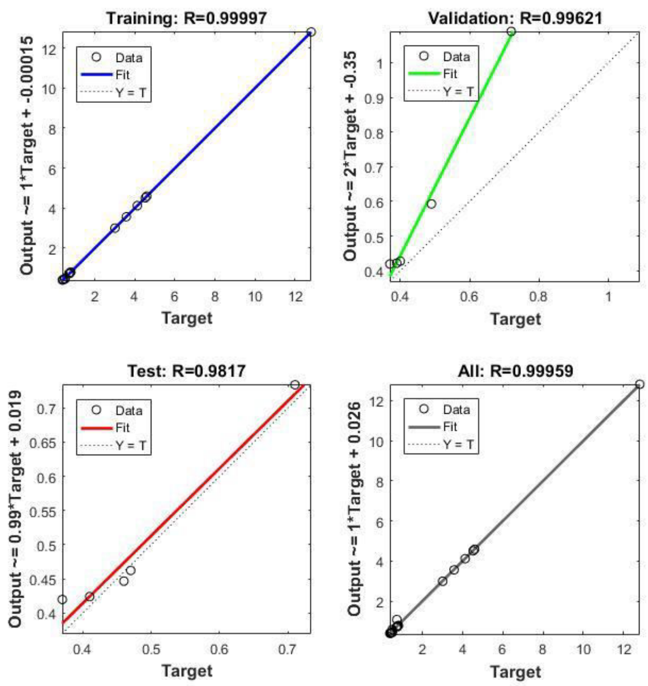

Fig. 9: Graph for variable and output parameters of Brake Specific Fuel Consumption

From graph it can be said that regression coefficient (R) for training, test, validation and all is 0.9997, 0.9817, 0.99621 and 0.99959 respectively which are closer to 1. From this it can be said that experimental results of Specific Fuel Consumption are validated by ANN.

4. ANN Graphs For Brake Thermal Efficiency

Figure 10 show the results for variable and output parameters of brake thermal efficiency. From graph it can be said that regression coefficient (R) for training, validation and testing is 0.99934, 0.99859 and 0.97125 respectively which is near to 1. From this it can be said that experimental results are validated by ANN.

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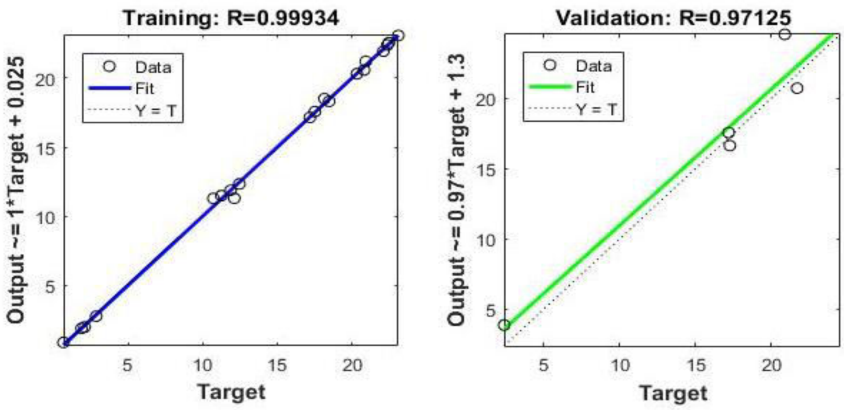
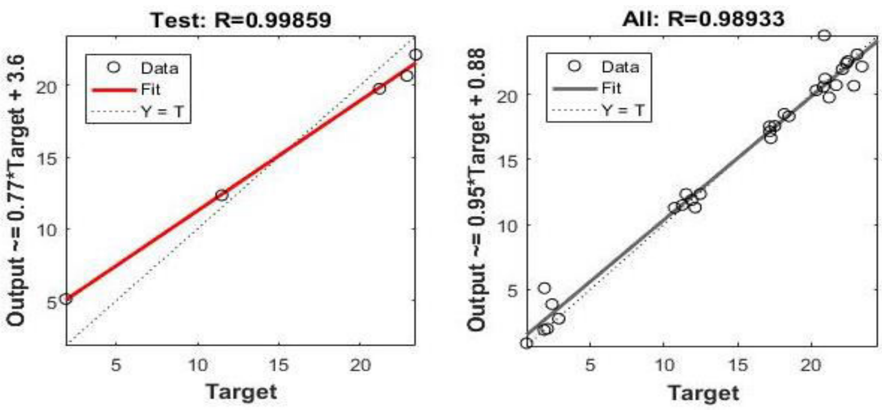


(a)



(b)

Fig. 10: Graph for variable and output parameters (a) Training and Validation (b) Test and All of Brake thermal efficiency

V. CONCLUSION

The experimental study is carried on single cylinder, four stroke diesel engines having variable compression ratio by using algal biodiesel blends with diesel. The emission analysis and performance analysis is evaluated by running the engine at different compression ratios like 14, 16 and 18 by varying load. The emission parameters measured are CO, HC and NO and performance parameters measured are brake power, specific fuel consumption, exhaust gas temperature. Based on the experimental studies, following are the observations found.

1. ANN validation is carried out for calculation of regression coefficient (R) and Mean Square root Error (MSE). The data is validated using ANN as the values of regression coefficient (R) are nearly equal to 1 and Mean Square root Error (MSE) is nearly equal to zero for graph of training, test and validation for different outputs.

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