Performance analysis of different blends of Undi oil on diesel engine

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Abstract—Experiment were carried out by using callophyllum inophyllum oil blends B10,B20, B30, B40, B50, B70 on diesel engine. Parameter of engine performance like brake thermal efficiency, brake specific fuel consumption, brake power, heat supplied are studied. The graphical presentation of results was done to observe rate of decrease in pollution and increase in efficiency of callophyllum inophyllum with respective blends and diesel. B70 has higher efficiency at maximum load and have less BSFC i.e 0.2355 kg/kw-hr as compare to diesel fuel BSFC which was 0.2691 kg/kw-hr. It was found that B70 has 22% higher efficiency than diesel. B70 can be better replacement for diesel fuel in future. The comparision was done with previous results of pongamia oil biodiesel blend and it was found that undi biodiesel B70 blends is having higher efficiency, less BSFC compare to pongamia oil blend. It was observed as undi oil performs better than pongamia oil. In future economically undi oil biodiesel can be better replacement to diesel fuel if we increase the plantation of seeds.

Index Terms - Undi oil, biodiesel, transesterification, performance analysis.

I. INTRODUCTION

Energy usage has increased in last few decades, due to rapid industrial development the need of energy is increasing. Also the increase in population and needs of developing nations are expanding rapidly. The major problem is that the sources of conventional energy fuels like oil, natural gas and coal are decreasing due to the excessive usage since years, it may finish within few years now so serious efforts are need to be taken to improve this situation. Currently petroleum fuels are the main sources of energy but economically these fuels are not feasible as the prices of petroleum fuels are rising badly due to the shortage of availability. The emissions like carbon dioxides and greenhouse gases increasing pollution and harming the environment very severely because these fuels produce very large amount of harmful emissions. Now the best way to reduce pollution and fulfill the energy requirement is to find alternative renewable energy sources. Biodiesel is very good fuel to improve efficiency as well as to reduce pollution.

Biodiesel can be made with help of many sources like vegetable oil, waste cooking oil, fish oil, cotton seed oil. Transesterification is the process which covert these oils into biodiesel. [1] Oils cannot be used directly for transesterification because free fatty acid value need to be checked carefully. For that purpose we must know the acid value of oil so that can use it for transesterification process, once Free fatty acid value is known can covert the oil into ester which nothing but the biodiesel. Two chemical process esterification and transesterification are used, in esterification oil with accurate value of FFA content is mixed with methanol , further preheated ester oil is used for transesterification along with methanol in presence of base catalyst.[6]

karanja oil can be used to develop biodiesel . vegetable oil is perfect match for making biodiesel as per the standards of india.edible oils are very good fro making esters but again the problem is cost. It is very costly to make the biodiesel from seeds of vegetable oil feedstocks. So we need to find nonedible sources of oil like karanja oil. Karanja oil is found in lot of areas of india , economically it is much better than the vegetables oil . The national benefits are many more due to the biodiesel production. To increase the development of biodiesel and for economic growth of country it is very important to find new ways.[3]

II. EXPERIMENTATION

Experiment is done on single cylinder four stroke diesel engine at the mechanical dept of ADCT,Ashta. Undi 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 16:1, speed is 1500rpm, 5.2KW power rating and rope brake dynometer is used.

Various blends used for test are as following:
B00, B10, B20, B30, B40, B50, B70.

Fig. 1 Experimentation Set Up For Undi 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. RESULTS AND DISCUSSIONS

1) Brake thermal efficiency

The Figure 2 depicted the variation in BTE vs. BP. It was observed that as load increases the efficiency of every biodiesel blend and diesel fuel is increases. At maximum loading condition of 27 kg and with brake power of 4.15 kw all blends of biodiesel except B10 has lower efficiency than diesel. For maximum loading condition B70 has obtained maximum efficiency amongst all blends i.e 38.73% which obtained nearly 7.26% more than diesel fuel, at maximum load B00 has only 31.47% efficiency.

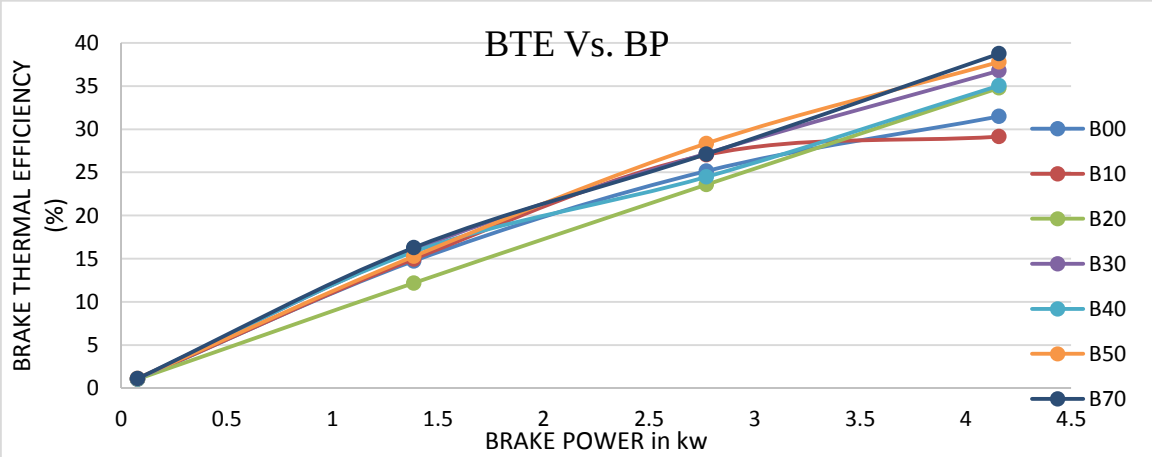

Fig.2 Brake thermal efficiency vs. Brake power for undi oil.

2) Brake specific fuel consumption

The Figure 3 shows variation in BSFC vs. BP. It shows that BSFC were getting reduced with rise in load. Except B10 all the other blends B20, B30, B40, B50 B70 was having less BSFC than B00 diesel fuel. In all blends B70 has lowest BSFC value of 0.2355 kg/kw-hr at full load. B00 having 0.2691 kg/kw-hr at full load which was more than bsfc of B70. The increase in oxygen content in case of biodiesel overcomes its low heating value and so obtained less bsfc than diesel fuel.

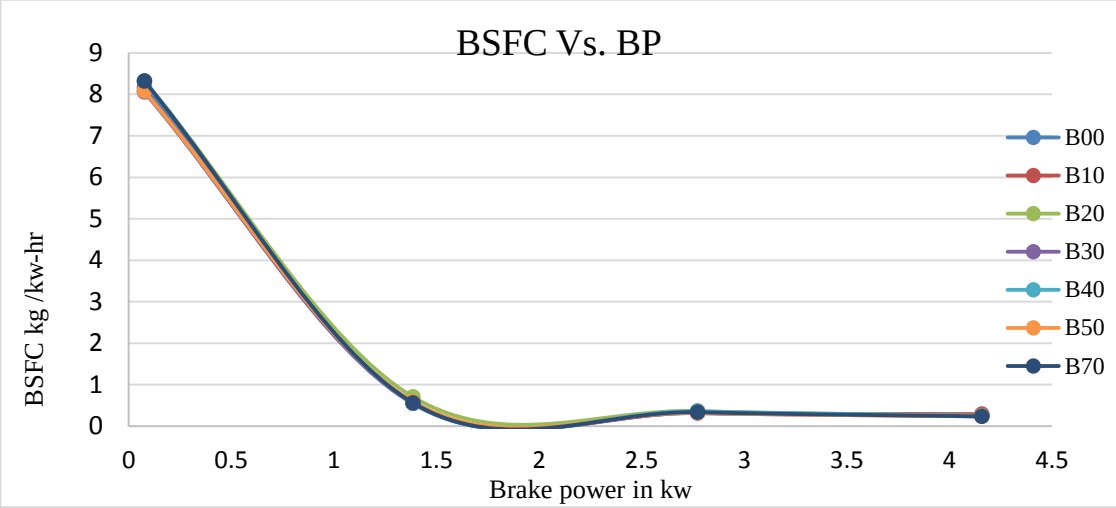

Fig.3 Brake specific fuel consumption vs. Brake power for undi oil.

3) **Exhaust gas temperature**

From figure 4 It can be observed that at maximum loading condition the exhaust gas temperature for B10 and B20 is has 395.5ºC, 385.4ºC respectively which is less than B00 temperature 405.5ºC. This is because of the higher oxygen content present in the undi biodiesel blends. The exhaust gas temperature of undi biodiesel blends B30, B40, B50, B70 are 410.5, 415, 417.3, 407.5 higher than diesel fuel, which might be attributed to better combustion caused improved fuel air mixture rate for biodiesel blends. B50 has maximum temperature amongst all and it is nearly 3 % more than diesel fuel. B70 has nearby temperature to B00.

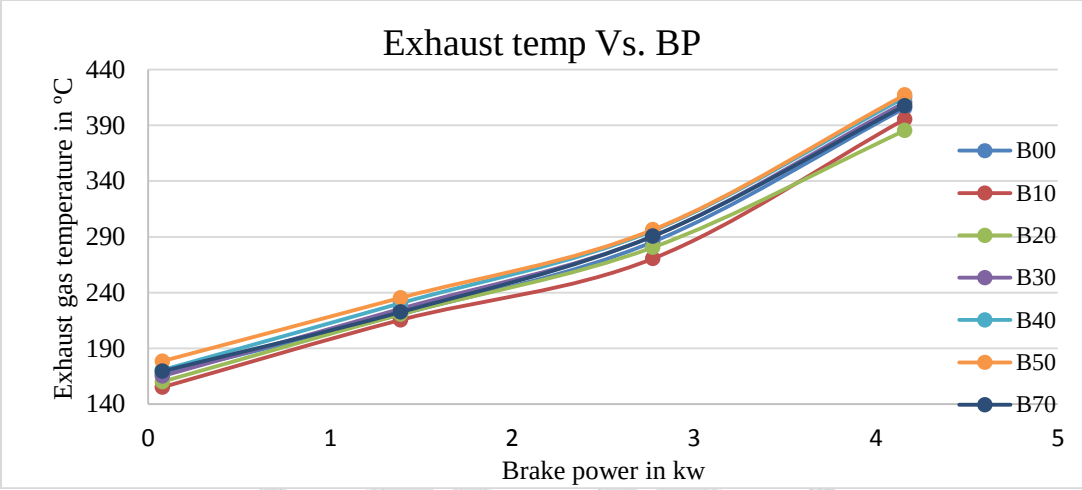

Fig 4 Exhaust gas temperature Vs. brake power for undi biodiesel

4) **Heat balance sheet**

Figure 5 shows the heat carried away in brake power, in jacket water, in exhaust gas and uncounted heat. Heat balance sheet of B70 foe maximum loading condition is shown in figure 5. Nearly 38.73% of heat carried away by brake power, heat carried away by exhaust gas is 10.76%, heat carried away by engine jacket water is 32.30% and finally unaccounted heat is 18.19%.

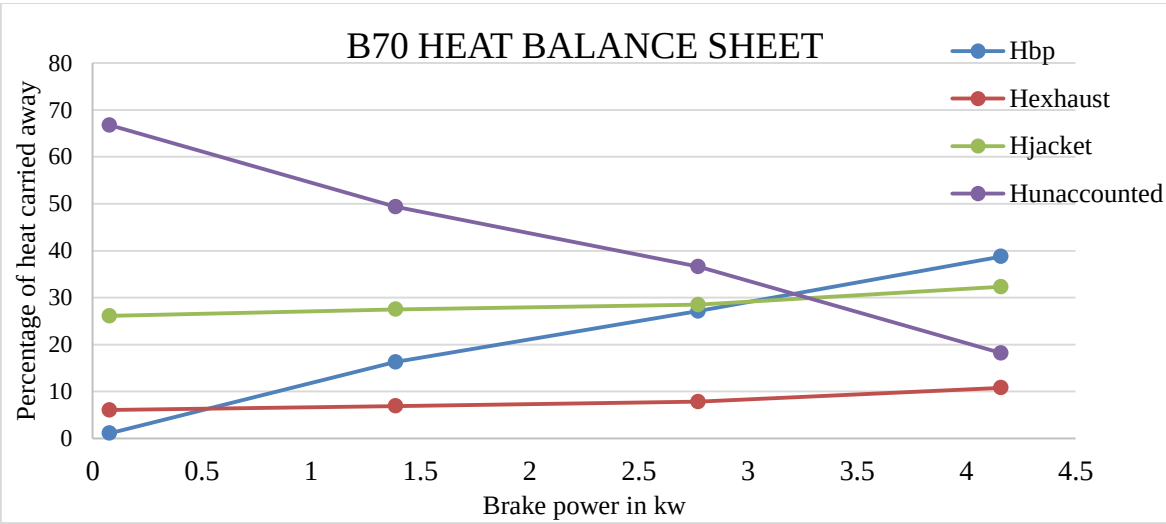

Fig. 5 Heat balance sheet for B70 at maximum loading condition.

IV. VALIDATION OF EXPERIMENTATION

Comparing performance results with Pongamia oil biodiesel

To validate our results comparison was done with similar work pongamia oil done by S.V.Kale having same engine specifications.[6]

1. Brake specific fuel consumption

Comparing from figure 6 both undi and pongamia oils, in case of callophyllum blends at full load B70 having minimum 0.2355 kg/kw-hr BSFC and diesel fuel B00 having 0.2691 kg/kw-hr which is nearly 14% more than B70 undi biodiesel and for pongamia biodiesel blends at full load B20 having less bsfc than diesel fuel 0.32 kg/kw-hr but still it is greater than minimum value for diesel fuel i.e bsfc 0.29 kg/kw-hr. it is observed that for undi ,bsfc for B70 is less than diesel fuel.

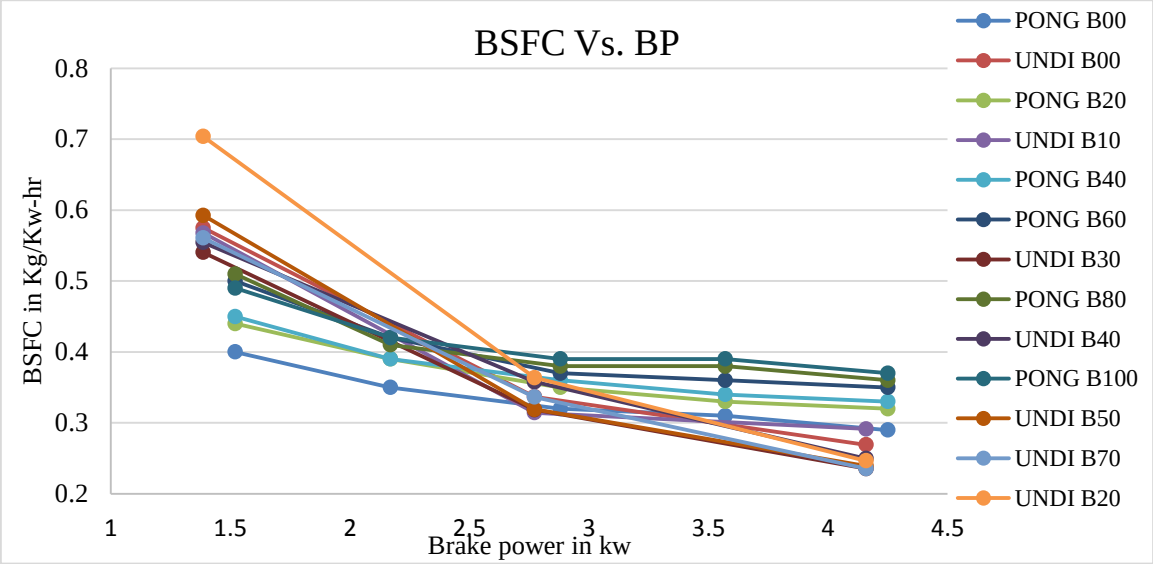

Fig.6 Brake specific fuel consumption vs. Brake power for undi oil and pongamia oil

2. Brake Thermal Efficiency

As we compare in case of undi oil biodiesel blends, at full load B70 has 22% more brake thermal efficiency than diesel fuel, but in case of pongamia biodiesel al full load B20 having 26.91% BTE and diesel fuel having 27.12% BTE, which was 0.77% greater than pongamia biodiesel blend, so pongamia oil biodiesel blends were having low efficiency than diesel fuel B00. It is not as efficient as callophyllum biodiesel which was having more efficiency than diesel. After comparing efficiencies of undi oil and pongamia oil we found that undi oil performs better than pongamia oil biodiesel.

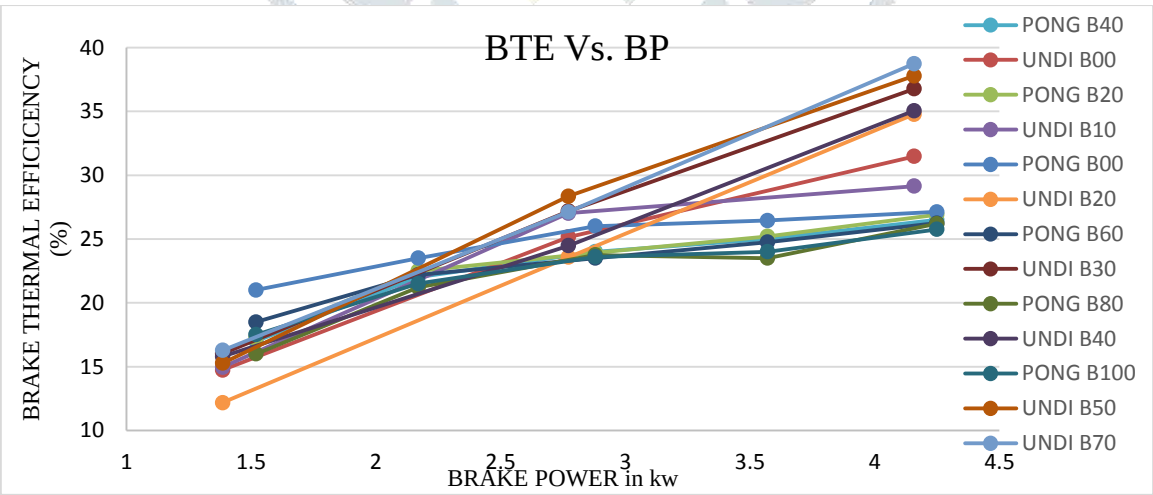

Fig.7 Brake thermal efficiency vs. Brake power for Undi and Pongamia oil.

V. CONCLUSIONS

The experiment was done on single cylinder four strokes diesel engine using Undi oil biodiesel blends and compared with diesel fuel gives conclusions as follow:

1. The Engine was easily started without any problem as well as undi oil biodiesel blends perform well with diesel engine, without any change in setup. Brake power of engine is increases with increase in load Heat supplied for diesel fuel is more than all blends except B10 but as a result of advance combustion due to oxygen content of biodiesel blends the efficiency of biodiesel is more than diesel fuel.
2. B70 has 22% more brake thermal efficiency than conventional diesel fuel which is good sign. BSFC value obtained with biodiesel blends is less as compare to diesel because of more oxygen content in biodiesel overcomes its lower heating value, B70 has nearly 14% less BSFC than diesel fuel. B70 could replace the diesel fuel because of greater efficiency with 38.73% which is greater than B00.

3. It can be possible to use undi biodiesel when more plantation will be done so that economically it will be acceptable. Comparison of undi B70 with pongamia blends has been done and found that undi oil is better in some aspects of engine performance and emissions percentage.
4. BSFC of undi blend B70 is less than diesel fuel by 14%, BSFC of pongamia blend B100 is more than diesel by 21%. Brake thermal efficiency of undi B70 is more than diesel fuel by 22%, highest BTE of pongamia blend B20 is 0.77% less than diesel fuel.

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