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Performance Evaluation of Diesel Engine Working On Unheated and Preheated Diesel and Karanja Oil Blends

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***Abstract**: Energy is a basic requirement for economic development and almost all petroleum product vitality utilization in the transportation division is from oil (97.6%), with a limited quantity from flammable gas.Karanja is medium sized tree and is found throughout India and can be a good alternative to the depleting fossil fuels. The tree is drought resistant. A thick yellow-orange to brown oil is extracted from its seeds and yields of 25% of volume are possible using a mechanical expeller. A single cylinder, four stroke, consistent speed, water cooled, direct infusion diesel engine put in NIT Kurukshetra was utilized for the investigations. The plans were made for preheating the fuel utilizing waste heat of fumes gases from the engine through heat exchanger. The experiments were conducted on some blends (K10, K20, K30, and K40) of diesel and Karanja oil at different loads. Graphs plotted between SFC (Specific Fuel Consumption) and BHP (Break Horse Power)helps to see the variation of specific fuel consumption with respect to BHP for diesel and the blends of Karanja oil. Hence, this study investigate the performance of diesel engine working on unheated and preheated Karanja oil blends with diesel and compare them that of diesel oil.*

***Keywords:** Karanja oil, Renewable Sources, Oil Blends, Thermal Efficiency, Brake Horse Power.*

I. INTRODUCTION

Energy is an essential necessity for financial advancement. Each segment of Indian economy-horticulture, industry, transport, business and household needs contribution of energy.Energy is the life line of modern civilizations. Coal, Oil and natural gas are the main sources of energy in the world. Conventional energy sources such as oil, coal and natural gas have limited reserves that are expected not to lose for an extended period. As per the International Energy Agency (IEA) report, World will require half more energy in 2030 than today of which 45% will be represented by China and India.Diesel motors are the significant wellspring of power generation and transportation consequently diesel is being utilized broadly, yet because of the slow effect of ecological contamination there is a alarming requirement for reasonable substitute to be used in diesel engine with no change. Karanja is medium sized tree and is found throughout India[1]. The tree is drought resistant. Major producing countries are East Indies, Philippines, and India. Figure 1 shows the Karanja tree with fruits.

Figure 1 Karanja tree with fruits

Pardeep and Sharma (2007) used HOT EGR technique of exhaust gas recirculation. Results indicated higher nitric oxide emission while a single cylinder diesel was fuelled with JBD, without EGR. NO emissions were reduced when engine was operated on HOT EGR levels of 5-25%[2]. Deeparanjan (2017)displayed the reasonableness of Pongamia Pinnata (Karanja) as a source of sustainable fuel subbing petrodiesel in CI motor. The fuel properties of esterified Karanja oil and its mix with diesel fuel at various extents were contemplated including engine tests.[3].L.C.Meher et al., (2007)introduced the system of a double procedure embraced for the creation of biodiesel from Karanja oil containing FFA up to 20%. The initial step is acid-catalyzed esterification by utilizing 0.5% H_2SO_4, liquor 6:1 molar proportion as for the high FFA Karanja oil to deliver methyl ester by bringing down the acid worth, and the subsequent stage is soluble base-catalyzed transesterification[4]. Srivastava and Verma (2007) determined physical and chemical properties of the karanja oil and that of the methyl ester. Maximum thermal efficiency of methyl ester found to be slightly less than that of the diesel[5].S.K.Dash et al. (2008) investigations carried out on performance of Karanja methyl ester and its blends with diesel from 20%, 40% and 60% by volume for running a diesel engine. Performance tests were carried out to evaluate and compute power output[6].Dhinagar and Nagalingam (2008)studied neem oil, rice-bran oil and Karanja oil on a low heat rejection engine. An electric heater was used to preheat the oil. B.Baiju et al. (2008) investigated the scope of utilizing biodiesel developed from methyl as well as ethyl alcohol route (methyl and ethyl ester) from Karanja oil as an alternative diesel fuel. Methyl and ethyl esters of Karanja oil were prepared by transesterification using both methanol and ethanol. The physical and chemical properties of ethyl esters were comparable with that of methyl esters[7].L.M.Das et al. (2009) arranged Karanja oil methyl ester (KOME) and put away for a time of 180 days under various storage conditions. The physicochemical parameters, peroxide value (PV) and dynamic viscosity (v) of tests were estimated at ordinary interims of time under various storage conditions. The stability of Karanja oil methyl ester (KOME) was considered under various storage conditions. [8].N.Maheshwari et al. (2011) experimentally investigated the performance of an IC engine fueled with a Karanja biodiesel blends, followed by multi-objective optimization with respect to engine emissions and fuel economy, in order to determine the optimum biodiesel blend and injection timings complying with Bharat Stage II emission norms[9]. However, many researchers had experimentally investigated the performance of diesel engine working on karanja oil, karanja oil methyl ester and other edible and non-edible oil blends with diesel. Some analysed exhaust emissions of diesel engine working on edible and non-edible oil blends with diesel[10]. But none of them focused on the performance of diesel engine working on preheated karanja oil blends with diesel[2][11].

II. EXPERIMENTAL SETUP AND ANALYSIS

A single cylinder, four stroke, constant speed, water cooled, direct injection diesel engine placed in NIT Kurukshetra was used for the experiments. The arrangements were made for preheating the fuel using waste heat of exhaust gases from the engine through heat exchanger. The technical specifications for the diesel engine used for experiment are given in Table 1.

Table 1 Engine Specifications

Manufacturer	Kirlosker
Type	Four Stroke, Naturally Aspirated
Injection	Direct Injection ,
Number of Cylinders	Single
Cylinder Position	Vertical
Rated Brake Horse Power	5
Rated Speed	1500
Bore X Stroke (mm)	800 X 110
Lubrication	Splash System
Cooling	Water Cooled

The experiment was conducted on some blends (K10, K20, K30, and K40) of diesel and karanja oil at different loads. Engine speed was maintained at 1500 rpm (rated speed) during all experiment. Due to high viscosity of Karanja oil than diesel, it can’t be used in pure form in engine.

Figure 2 Test Samples

Some parameters were measured directly by experimental setup and some were measured using other instruments. Density of different was measured using hydrometer while the viscosity of the blends were measured using redwood viscometer.

Figure 3Red Wood Viscometer

Figure 4 Hydrometer

a. Engine Brake Horse Power Test:

The test was conducted to measure the performance of different karanja and diesel oil blends at different Brake Horse Power (BHP). BHP is the power obtained at the shaft. The BHP was measured through electric dynamometer. It was also used in measurement of other important parameters.

Figure 5 Test setup arranged at NIT Kurukshetra.

b. Procedure

1. Check oil fuel level, lubricating oil level, circulating water supply and their unobstructed flow.
2. Note quantity of oil in the oil tank
3. Start engine, run it at no load for some time and bring it to normal speed.
4. With the help of stop watch, note the time taken for the consumption of a particular volume (20cc) of the fuel at no load.
5. Increase the load in steps of three ampere with help of electrical dynamometer and make observations as in step four. Keep the speed of the engine constant.
6. Unload the engine gradually, wait for few seconds and finally cut-off the oil supply to stop the engine
7. Make the calculation for BHP, SFC, and Thermal Efficiency.

III. RESULTS AND DISCUSSIONS

Figure 6 and Figure 7 shows the variation of SFC and thermal efficiency with BHP for Unheated and preheated diesel respectively. And figure 8 shows the variation of Thermal Efficiency with SFC for both unheated and preheated diesel. Figure 6 describe that as the BHP increases, SFC decreases in unheated and preheated diesel. When engine operated on preheated diesel SFC is low as compare to it operated on unheated Diesel but as the BHP increases SFC of preheated diesel comes closer to unheated diesel. Figure 7 describe that Thermal efficiency of engine is higher when it is operated on Preheated Diesel. At higher BHP engine becomes more efficient for preheated diesel as compared to unheated diesel. Figure 8 describe that the curves are nearly same for both unheated and preheated diesel.

Table 2 Results for Unheated Diesel

S. No.	Load	Time (sec.)	BHP	S.F.C.	Thermal efficiency (%)
1	160*3	130	0.653	0.708	8.83
2	160*6	112	1.305	0.411	15.20
3	160*9	96	1.958	0.320	19.53
4	160*12	79	2.61	0.292	21.40

Table 3 Results for Preheated Diesel

S. No.	Load	Time (sec.)	BHP	S.F.C.	$\eta_{thermal}$	Fuel Temp.)
1	160*3	132	0.653	0.697	8.98	61°c
2	160*6	113	1.305	0.408	15.32	65 °c
3	160*9	98	1.958	0.313	19.97	71 °c
4	160*12	81	2.61	0.284	22.00	76 °c

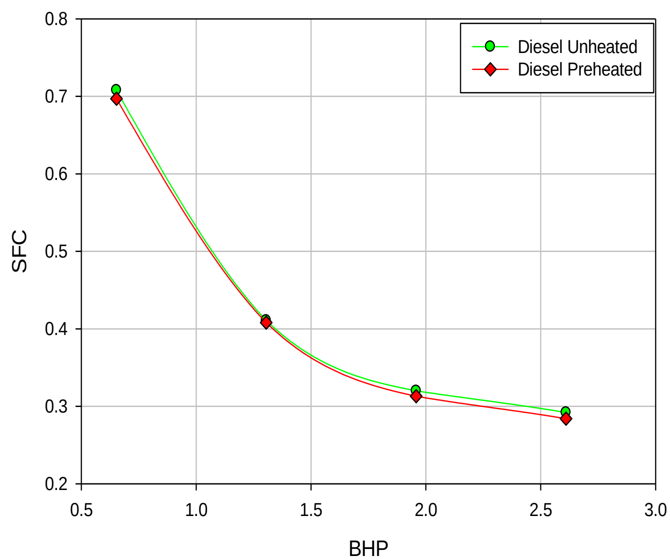

Figure 6 Variation of SFC with BHP for Unheated and Preheated Diesel

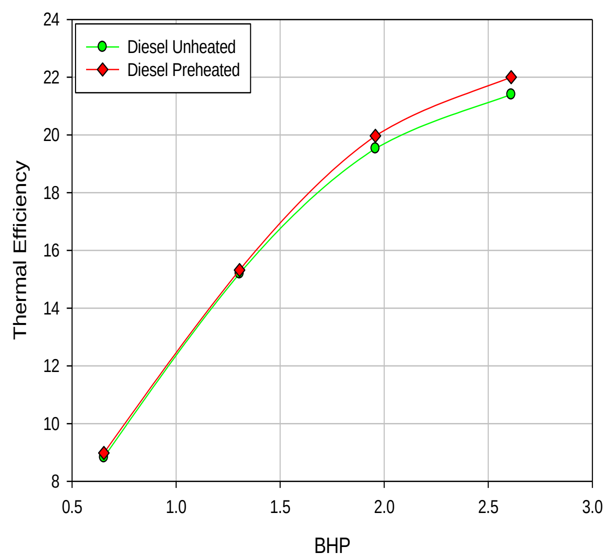

Figure 7 Variation of Thermal Efficiency with BHP for Unheated and Preheated Diesel

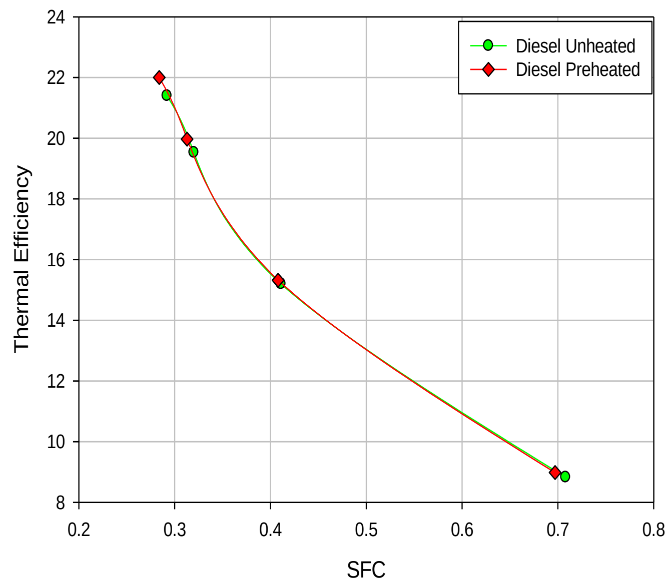

Figure 8 Variation Thermal Efficiency with SFC for unheated and Preheated Diesel.

Figure 9 shows the variation of SFC with BHP for unheated diesel and all unheated blended fuels it can be concluded that SFC is lowest for diesel among all blends. As the proportion of karanja oil increases in diesel, SFC decreases for engine. SFC decreases with increase in BHP. Figure 10 shows the variation of SFC with BHP for preheated diesel and all preheated blended fuels .It describe that all blends follow the same trend as followed by diesel. SFC is lowest for diesel. SFC deceases with increase in load.

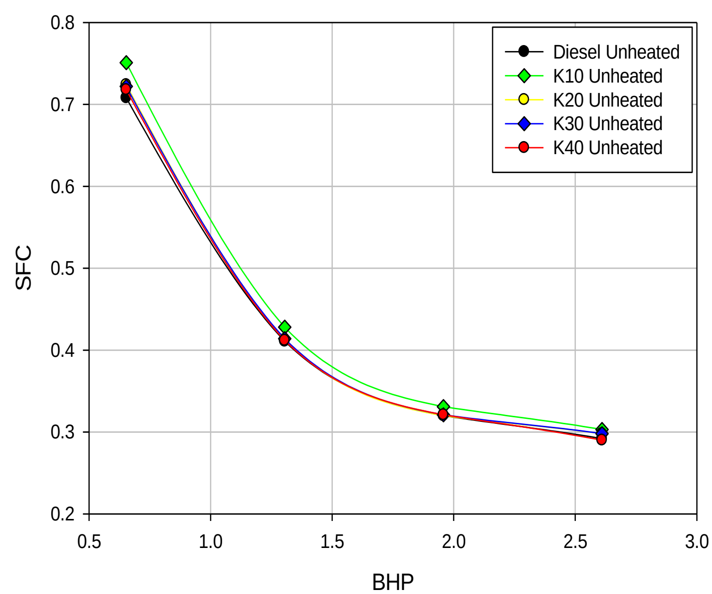

Figure 9 Variation of SFC with BHP for unheated diesel and all unheated blended fuels.

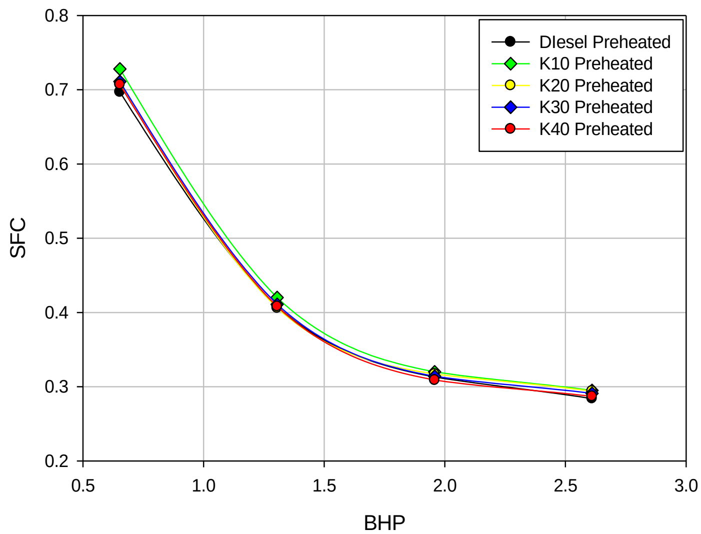

Figure 10 Variation of SFC with BHP for preheated diesel and all preheated blended fuels.

IV. CONCLUSION

Single chamber diesel engine ran effectively during tests on Karanja oil and its mixes even without preheating. In any case while utilizing preheated fuel, engine effectiveness improved somewhat. Diesel and all mixes were preheated in heat exchanger by utilizing warmth of fumes gases before acquainting with engine. Preheating of fuels was done in the scope of 50-80°C Preheating the fuel tests, which have higher consistency than diesel at room temperature, lessens the thickness and builds the unpredictability. This expands the fuel atomization prompting improved fuel air blending. Different charts were plotted between thermal efficiency of engine and brake horse power to show the variation of thermal efficiency. It very well may be seen that the thermal efficiency increases by large increments with increment in mix fixation. It was also observed that thermal efficiency of engine for diesel and various blends increases with increasing load. It was likewise seen that thermal efficiency for diesel and different mixes increments with expanding load. Charts between explicit fuel utilization and brake power for diesel and various mixes of Karanja oil portray that particular fuel utilization of diesel and K40 is about the same. Specific fuel consumption diminishes with the increment level of Karanja oil in diesel fuel. As the load builds specific fuel consumption diminishes of engine for diesel and all mixes. Specific fuel consumption was to be most reduced at heap of 2.61 BHP. The Calorific Value of diesel is more noteworthy than Karanja oil, in this manner expanding extent of Karanja oil in diesel diminishes the Calorific Value of the mix. The Specific fuel consumption of engine for preheated diesel and its mixes as the contrast with the unheated case since thickness decline with increment in temperature which permits the better blending and better atomization of Karanja oil mixes. This prompts better burning qualities.

REFERENCES

1. Nayan NK, Kumar S, Singh RK. 2012. Bioresource Technology Characterization of the liquid product obtained by pyrolysis of karanja seed. *Bioresource Technology*. 124:186–189.

2. Sharma RP. 2017. Use of HOT EGR for NOx Control in a Compression Ignition Engine Fuelled with Bio-Diesel from Jatropha Oil Use of HOT EGR for NO x control in a compression ignition engine fuelled with bio-diesel from Jatropha oil. doi:10.1016/j.renene.2006.04.017.

3. Deepanraj B, Srinivas M, Arun N, Sankaranarayanan G, Salam PA. 2017. Ac ce us cr t. 5075.

4. Naik M, Meher LC, Naik SN, Das LM. 2008. Production of biodiesel from high free fatty acid Karanja (Pongamia pinnata) oil. 32:354–357.

5. Srivastava PK, Verma M. 2008. Methyl ester of karanja oil as an alternative renewable source energy. 87:1673–1677.

6. Dash SK, Lingfa P. 2018. Performance evaluation of Nahar oil – diesel blends in a single cylinder direct injection diesel engine. *International Journal of Green Energy*. 00:1–6.

7. Baiju B, Naik MK, Das LM. 2009. A comparative evaluation of compression ignition engine characteristics using methyl and ethyl esters of Karanja oil. *Renewable Energy*. 34:1616–1621.

8. Das LM, Kumar D, Pradhan S, Naik MK, Naik SN. 2009. Long-term storage stability of biodiesel produced from Karanja oil. *Fuel*. 88:2315–2318.

9. Maheshwari N, Balaji C, Ramesh A. 2011. A nonlinear regression based multi-objective optimization of parameters based on experimental data from an IC engine fueled with biodiesel blends. *Biomass and Bioenergy*. 35:2171–2183.

10. Nagarhalli M, Mohite K. 2010. Emission and performance characteristics of karanja biodiesel and its blends in a CI engine and it ' s economics EMISSION AND PERFORMANCE CHARACTERISTICS OF KARANJA BIODIESEL AND ITS BLENDS IN A C . I . ENGINE AND IT ' S ECONOMICS.

11. Hossain AK, Smith DI, Davies PA. 2017. Effects of Engine Cooling Water Temperature on Performance and Emission Characteristics of a Ci Engine Operated with Biofuel Blend Effects of Engine Cooling Water Temperature on Performance and Emission Characteristics of a Compression Ignition Engine Operated with Biofuel Blend. doi:10.13044/j.sdewes.d5.0132.