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A detailed analysis and performance analysis of diesel blended with eucalyptus/pine seed oil on a CI engine

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ABSTRACT

In the recent era, an alternative fuel plays a vital role in the automobile and petroleum industry because of the fuel (petrol and diesel) demand, development of industries and diminution of natural resources. The economic way to produce bio-diesel from various resources and mixing or blending bio-oil with diesel, this method can widely follow by all developing and developed countries. This paper mainly examines the consumption of pine oil, methanol and eucalyptus blend with diesel in a diesel engine, the performance and emission characteristics of three different blends of pine oil, methanol, and eucalyptus oils. It is found that the above said bio-diesel blend is the best substitute for the pure diesel which plays a vital role against natural resource which may help the future generation. From these reports, the outcome of bio-diesel against engine power, economy, durability and combustion, and the corresponding effect factors are surveyed and analysed in detail.

ARTICLE HISTORY
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KEYWORDS
Eucalyptus oil; pine seed oil; neat diesel; oil blends; testing in CI engine; emission control

1. Introduction

In the present word, the fuel is playing the major role. The fossil fuels are widely used in automobiles (Naga Prasad et al. 2009; Patel and Kirar 2012; Subramani and Vinoth Kanna 2019; Vinoth Kanna and Pinky 2018a; Vinoth Kanna 2018b). But these fuels are causing many pollutants in our environment and vast usage may also get demand in the fuel. So, the researches in the area of Bio-fuels are needed for future (Rahman et al. 2010; Ranganathan, Rao, and Sampath 2011; Vinoth Kanna and Paturu 2018; Vinoth Kanna, Tamil Selvan, and Pinky 2018; Vinoth Kanna and Pinky 2018b). Bio-fuel is similar to normal diesel and petroleum, these biofuels are extracted from the edible or non-edible plant seeds (Agarwal and Das 2001; Prabhahar, Murali Manohar, and Sendilvelan 2012; Vashist and Ahmad 2012; Vinoth Kanna and Subramani 2019; Vinoth Kanna, Devaraj, and Subramani 2018). The fat in the seeds is directly extracted the bio-fuel (Navindgi, Dutta, and Sudheer Prem Kumar 2012; Paturu and Vinoth Kanna 2018; Vinoth Kanna, Vasudevan, and Subramani 2018; Devaraj, Yuvarajan, and Vinoth Kanna 2018a; Vinoth Kanna 2018a). In many types of research, the researchers are tested only Eucalyptus oil – Neat Diesel blend as 30:70 and Pine oil – Neat Diesel Blend 30:70 (Vashist and Ahmad 2011; Deshpande, Urunkar, and Thakare 2012; Vinoth Kanna and Devaraj 2019; Vinoth Kanna 2018b; Vinoth Kanna and Pinky 2018c). In my research am going to Blend both eucalyptus and pine seed oil with diesel in the mixing ratio of 20:10:70 and 15:15:70 (Ramadhas, Muraleedharan, and Jayaraj 2005; Patel and Kirar 2012; Nagappan and Vinoth Kanna 2018; Vinoth Kanna, Devaraj, and Subramani 2018; Vinoth Kanna, Tamil selvan, and Pinky 2018; Devaraj, Yuvarajan, and Vinoth Kanna 2018b).

2. Experimental works

The experiment is carried out in Kirloskar TAF 1 single cylinder, air-cooled, 4 stroke, and direct injection diesel engine.

The engine set up contains a single cylinder 4 stroke engines (Naga Prasad et al. 2009), alternator (Vashist and Ahmad 2012). The load is skilful by the load cell which in turn triggers the alternator for smearing load on the engine. Air is drawn by the air box and flows over an air-flow sensor which procedures the quantity of air drawn. Fuel analyses are noted with the aid of a fuel sensor. These extents are provided as inputs to the data acquisition system. AVL 444 gas analyser is used to measure the emissions from the drain pipe (Figures 1–6; Table 1).

3. Result and analysis

3.1. Engine performance results

Engine performance results are shown in Tables 2–6.

3.2. Engine combustion

Engine combustion are shown in Figures 7–11.

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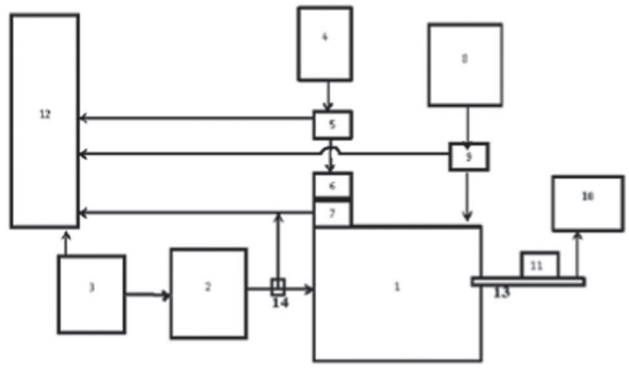

1. engine	2.alternator	3. load cell with control panel
4. Fuel tank	5. fuel sensor	6.fuel filter
7.fuel pump	8. Air box and air filter	9. Air flow sensor
10. Gas analyzer	11. Thermocouple	12.Computerised data acquisition system
13. exhaust pipe	14. speed sensor	

Figure 1. Schematic setup.

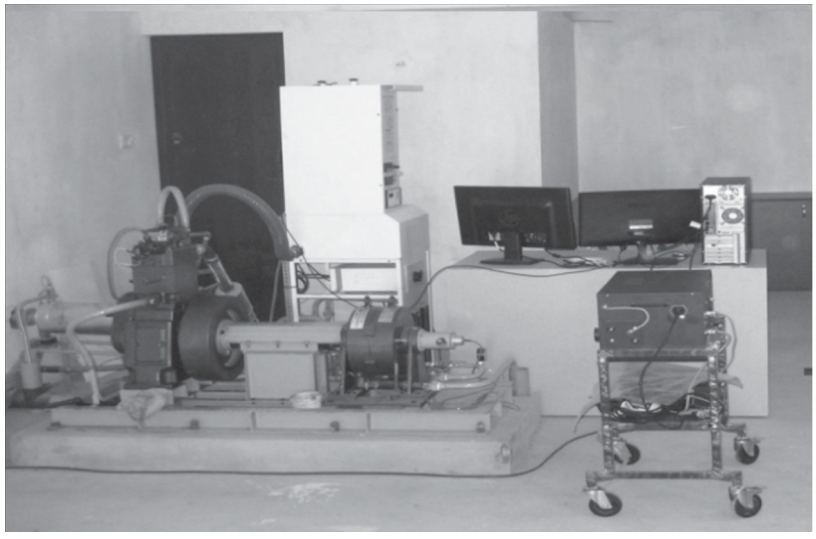

Figure 2. Testing machine.

Figure 3. Eucalyptus-pine oil blends.

3.3. Comparison of results – engine emissions

Comparison of results – engine emissions are shown in Table 7.

4. Conclusion

The present investigational report has apportioned with the manufacture of bio-diesel from eucalyptus, pine oil quantity

Figure 4. Smoke meter.

Figure 5. Gas analyser.

of belongings and concert assessment on blends of bio-diesel at various loads. The low efficacy may be due to low volatility, slightly higher viscosity and higher density of the biodiesel

Table 1. Properties of bio-diesel.

Property	Neat diesel	Eucalyptus	Pine oil
Flash point °C	65	32	54
Fire point °C	78	42	65
Viscosity at 40°C	2.86 cSt	4.85 cSt	3.07 cSt
Calorific value (MJ/Kg)	44.34	42.5	41.50

of pine oil, which affects mixture formation of the fuel and thus leads to good combustion. The performance characteristics of single cylinder compression ignition engine fuelled with eucalyptus, pine oil, and its different blends have been studied and compared to the standard diesel fuel. The experiment was carried out with different parameters Vs various loading conditions.

Figure 6. Experimental setup.

Table 2. Engine performance analysis.

Blend details	Total fuel consumption (TFC) kg/h	Specific fuel consumption (SFC) kg/kwh	Brake power (BP) kw	Indicated Power (IP) kw	Mechanical efficiency (η_M)	Brake thermal efficiency (η_{BT})	Indicated thermal efficiency (ηIT)
ND	1.31	0.26	5.06	6.73	75.22	32.72	43.5
B10	1.22	0.24	5.1	6.02	84.69	35.45	41.86
B15	1.28	0.25	5.1	5.89	86.49	33.89	39.18

Table 3. Brake power and specific consumption.

Blend details	Brake power (BP) kw	Specific fuel consumption (SFC) kg/kwh
Diesel	5.06	0.26
B10	5.1	0.24
B15	5.1	0.25

Table 4. Mechanical efficiency.

Blend details	Brake power (BP) kw	Mechanical efficiency (η_M)
Diesel	5.06	75.22
B10	5.1	84.69
B15	5.1	86.49

Table 5. Indicated thermal efficiency.

Blend details	Brake power (BP) kw	Indicated thermal efficiency (η_{IT})
Diesel	5.06	43.5
B10	5.1	41.86
B15	5.1	39.18

Table 6. Brake thermal efficiency.

Blend details	Brake power (BP) kw	Brake thermal efficiency (η_{BT})
Diesel	5.06	32.72
B10	5.1	35.45
B15	5.1	33.89

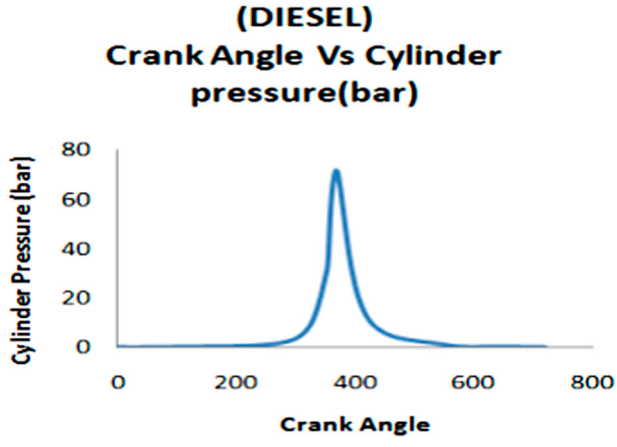

Figure 7. Crank angle vs cylinder pressure (DIESEL).

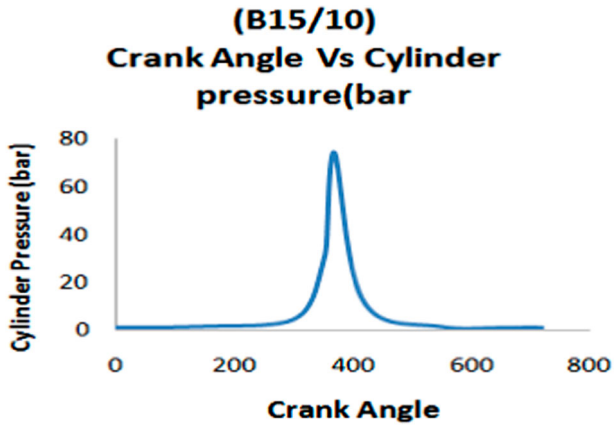

Figure 8. Crank angle vs cylinder pressure (B15/B10).

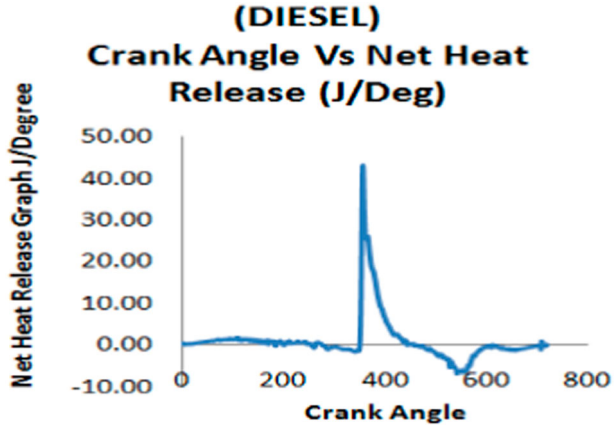

Figure 9. Crank angle vs heat release J/degree (DIESEL).

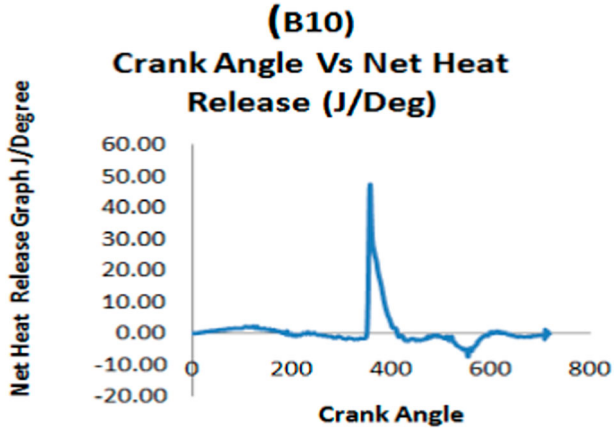

Figure 10. Crank angle vs heat release J/degree (B10).

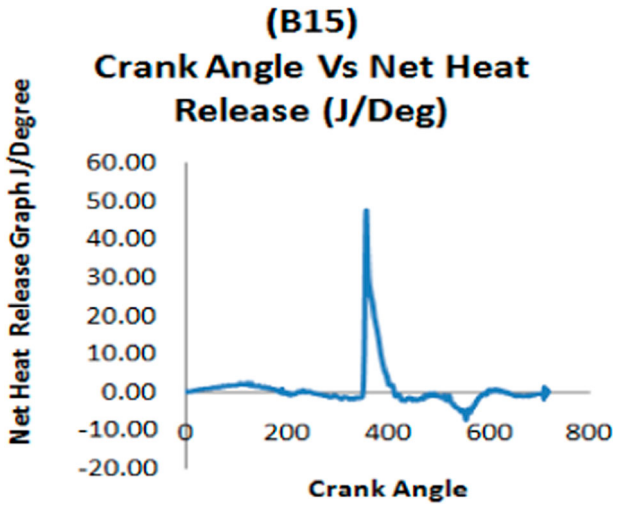

Figure 11. Crank angle vs heat release J/degree (B15).

Table 7. Engine emissions.

Blend details	CO %	HC PPM	NOX PPM	CO_2 %
Diesel	0.239	45	2023	9.96
B10	0.075	15	2328	9.4
B15	0.078	19	2316	9.55

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Agarwal, A. K., and L. M. Das. 2001. "Bio Diesel Development and Characterization for Use as Fuel in Compression Engines." *Transactions of ASME* 123: 440–447.

Deshpande, D. P., Y. D. Urunkar, and P. D. Thakare. 2012. "Production of Biodiesel from Castor Oil Using Acid and Base Catalysts." *Research Journal of Chemical Sciences* 2 (8): 51–56. ISSN 2231-606X.

Devaraj, A., D. Yuvarajan, and I. Vinoth Kanna. 2018a. "Effect of Di-Ethyl-Ether on Biodiesel Fuelled Diesel Engine." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1557546.

Devaraj, A., D. Yuvarajan, and I. Vinoth Kanna. 2018b. "Study on the Outcome of a Cetane Improver on the Emission Characteristics of a Diesel Engine." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1492452.

Nagappan, M., and I. Vinoth Kanna. 2018. "A Novel Technique and Detailed Analysis of Cars in Indian Roads to Adopt Low Ground Clearance." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1501753.

Naga Prasad, C. S., K. Vijaya Kumar Reddy, B. S. P. Kumar, E. Ramjee, O. D. Hebbel, and M. C. Nivendgi. 2009. "Performance and Emission Characteristics of a Diesel Engine with Castor Oil." *Indian Journal of Science and Technology* 2 (10). doi:10.17485/ijst/2009/v2i10/30714.

Navindgi, M. C., M. Dutta, and B. Sudheer Prem Kumar. 2012. "Performance Evaluation, Emission Characteristics and Economic Analysis of Four Non-edible Straight Vegetable Oils on a Single Cylinder CI Engine." *ARPN Journal of Engineering and Applied Sciences* 7 (2): 173–179. ISSN 1819-6608.

Patel, Sejal Narendra, and Ravindra Kirar. 2012. "An Experimental Analysis of Diesel Engine Using Biofuel at Varying Compression Ratio." *International Journal of Emerging Technology and Advanced Engineering* 2 (10): 385–391. ISSN 2250-2459.

Paturu, P., and I. Vinoth Kanna. 2018. "Experimental Investigation of Performance and Emissions Characteristics on Single-cylinder Direct-injection Diesel Engine with PSZ Coating Using Radish Biodiesel." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1492455.

Prabhahar, M., R. Murali Manohar, and S. Sendilvelan. 2012. "Performance and Emission Studies of a Diesel Engine with Pongamia Methyl Ester at Different Load Conditions." *International Journal of Engineering Research and Applications* 2 (3): 2707–2713. ISSN: 2248-9622.

Rahman, Kazi Mostafijur, Mohammad Mashud, M. Roknuzzaman, and Asadullah Al-Galib. 2010. "Biodiesel from Jatropha Oil as an Alternative Fuel for Diesel Engine." *International Journal of Mechanical & Mechatronics IJMME-IJENS* 10 (3): 1–6.

Ramadhas, A. S., C. Muraleedharan, and S. Jayaraj. 2005. "Performance and Emission Evaluation of a Diesel Engine Fueled with Methyl Esters of Rubber Seed Oil." *Renewable Energy* 30: 1789–1800.

Ranganathan, L., G. L. N. Rao, and S. Sampath. 2011. "Experimental Investigation of a Diesel Engine Fuelled With Optimum Biodiesel Produced From Cotton Seed Oil." *European Journal of Scientific Research* 62 (1): 101–115. ISSN 1450-216X.

Subramani, K., and I. Vinoth Kanna. 2019. "Numerical Simulation of High Velocity Impact on Composite Targets Using Advanced Computational Techniques." In *Innovative Design, Analysis and Development Practices in Aerospace and Automotive Engineering (I-DAD 2018)*, edited by U. Chandrasekhar, L. J. Yang, and S. Gowthaman, Lecture Notes in Mechanical Engineering, 399–413. Singapore: Springer. doi:10.1007/978-981-13-2697-4_44.

Vashist, Devendra, and Mukhtar Ahmad. 2011. "A Comparative Study of Castor and Jatropha Oil Source and Its Methyl Ester Test on the Diesel Engine." *International Journal of Engineering Science and Technology* 3 (6): 4765–4773. ISSN: 0975-5462.

Vashist, D., and M. Ahmad. 2012. "Comparative Study of Performance and Emission Characteristics of a Diesel Engine Fueled by Castor and Jatropha Methyl Ester with the Help of T Test." *International Journal of Automotive Engineering* 2 (2): 61–67.

Vinoth Kanna, I. 2018a. "Modelling and Thermal Analysis of Air-cooling System with Fin Pitch in IC Engines." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1507939.

Vinoth Kanna, I. 2018b. "Optimisation of the Evaporator of a Refrigerator Employing Hydrocarbon as a Refrigerant." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1507943.

Vinoth Kanna, I., and A. Devaraj. 2019. "Discussion of Past, Present and Future Perspectives of Refrigerants and Its Future Scope." In *Innovative Design, Analysis and Development Practices in Aerospace and Automotive Engineering (I-DAD 2018)*, edited by U. Chandrasekhar, L. J. Yang, and S. Gowthaman, Lecture Notes in Mechanical Engineering, 461–471. Singapore: Springer. doi:10.1007/978-981-13-2697-4_50.

Vinoth Kanna, I., A. Devaraj, and K. Subramani. 2018. "Bio Diesel Production by Using Jatropha: The Fuel for Future." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1456962.

Vinoth Kanna, I., and P. Paturu. 2018. "A Study of Hydrogen as an Alternative Fuel." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1484803.

Vinoth Kanna, I., and D. Pinky. 2018a. "Automatic Seat Level Control Using MEMS Programmed with Lab VIEW." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1484813.

Vinoth Kanna, I., and D. Pinky. 2018b. "Investigation of the Effects of Exhaust and Power Loss in Dual-fuel Six-Stroke Engine with EGR Technology." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1507942.

Vinoth Kanna, I., and D. Pinky. 2018c. "Solar Research – A Review and Recommendations for the Most Important Supplier of Energy for the Earth with Solar Systems." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1472658.

Vinoth Kanna, I., and K. Subramani. 2019. "Study of Future Refrigerant for Vapor Compression Refrigeration Systems." In *Innovative Design, Analysis and Development Practices in Aerospace and Automotive Engineering (I-DAD 2018)*, edited by U. Chandrasekhar, L. J. Yang, and S. Gowthaman, Lecture Notes in Mechanical Engineering, 415–428. Singapore: Springer. doi:10.1007/978-981-13-2697-4_45.

Vinoth Kanna, I., R. Tamil selvan, and D. Pinky. 2018. "An Analysis of Rice-bran Oil as Biofuel for Four-stroke, Twin Cylinders CI Engine." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1550015.

Vinoth Kanna, I., A. Vasudevan, and K. Subramani. 2018. "Internal Combustion Engine Efficiency Enhancer by Using Hydrogen." *International Journal of Ambient Energy*. doi:10.1080/01430750.2018.1456961.