IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Impact Factor: 6.252

Volume 2, Issue 2, June 2022

Experimental Study on Effect of Lime Peel Oil on Efficiency of Diesel Engine.

Ms. Genda Patel[1] and Dr. Shrihar Pandey[2]

Student, Department of Mechanical Engineering[1]

Associate Professor & Head, Department of Mechanical Engineering[2]

Ojaswini Institute of Management and Technology, Damoh, Madhya Pradesh, India

I. INTRODUCTION

Energy demand is a main problem of all countries especially highly populated countries such as India and China. The population of entire world before 200 years was less than 1 billion (Coale & Hoover 2015). Recent population report of UN states that it has reached 7 billion and is expected to reach 8.5 billion in 2030 (Desa 2019). China and India are highly populated countries with 18.5 and 17.9 % of total world population. These fast growing rates of population attribute for dependency such as food, freshwater, minerals and energy for daily living. Though many renewable resources such solar, wind, hydro and tidal energy serves the energy requirements they do not satisfy completely because they rely on weather for power generation. Hence dependency for fossil fuel has increased for past few decades drastically. Other factor such as increasing automobiles is also one of the important reasons for fossil fuel dependency, especially crude oil for petrol and diesel.

II. EXPERIMENTAL AND INSTRUMENTATION SETUP

Single cylinder, air cooled, direct injection four stroke stationary diesel engine (Kirloskar Model: TAF-1) was employed for present research work. Engine outcomes on operation with different fuels are clearly monitored using various instruments for different load conditions. The experimental overview about various equipment used for measurement are discussed in this chapter.

Modification of combustion chamber geometry, injection timing and injection pressure parameter are also discussed in this chapter. This chapter also deals with the procedure to find BSEC and BTE. Emission measurement procedure adopted forHC,CO,CO_2, NOx and smoke opacity are also presented.

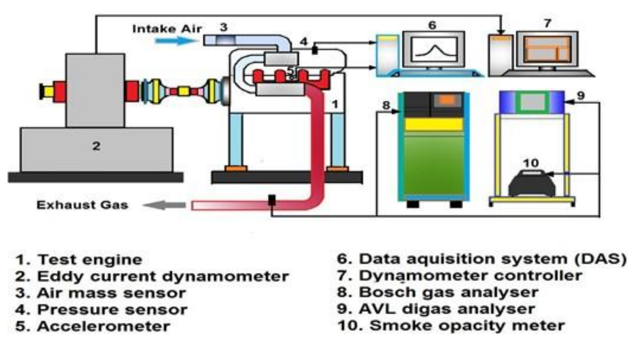
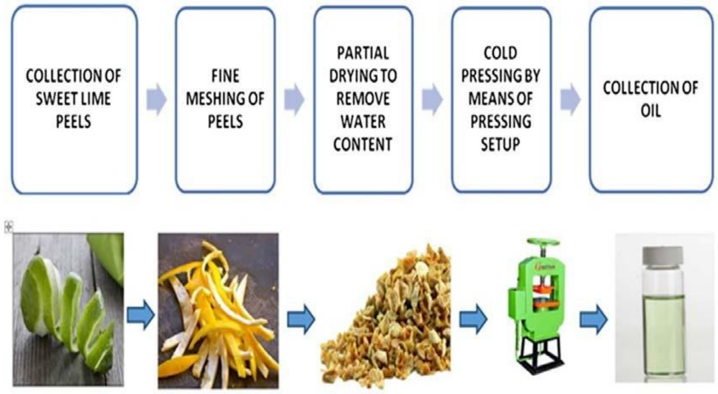


Fig : 1

III. SWEET LIME PEEL OIL

Sweet lime peel oil is a novel biofuel that can replace wholly or partially the conventional diesel fuel. India is one of the leading producer of citrus fruits and ranks in number 5 (Spreen 2020). At present the peels from citrus fruits are dumped without usage. It is proposed to extract oil from waste peel and use as an alternative fuels. Oil can be extracted either by cold pressing or steam distillation process.

Peels of sweet lime fruit are collected first and cleaned. Then it iscut into small meshes using cutter. In order to remove water content and other sediments, peels are dried under shadow. Exposure to sunlight is avoided to prevent from evaporation of oil from peels. This process may take from twoto three days. Dried peels are now cold pressed using conventional oil pressing machine. Expelled oils are collected and stored away from sunlight.



Properties	Test method	Diesel	Sweet lime oil
Density at 20ºC, kg/m^3	ASTM D 4052	840	900
Kinematic Viscosity at 40ºC, cSt	ASTM D 445	1.8	1.56
Calorific Value, kJ/kg	ASTM D 240	42700	40048
Cetane number	ASTM D 613	48	51
Flash point , ºC	ASTM D 93	68	72
Fire point,ºC	ASTM D 93	75	80

Table 1: Comparison of properties of Sweet lime oil with Diesel

3.1 Performance Characteristics

Brake Thermal Efficiency (BTE) indicates the capacity of engine in converting the heat available in input fuel to Brake Horse Power (BHP).

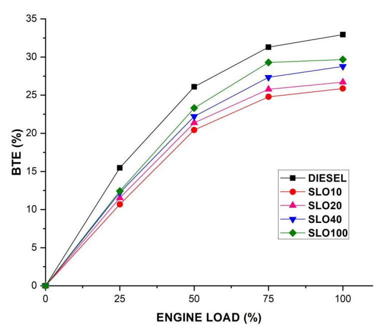


Figure 2 Brake thermal efficiency with varying engine load

Figure 2 shows the variation of Brake Thermal Efficiency (BTE) for the various blends of Sweet Lime Oil (SLO) and diesel with different loading conditions. Initially properties of Sweet lime oil was tested and it was found that SLO100 has least viscosity and higher density than other fuel blends. The viscosity of SLO100 was lower and better calorific value which resulted in better brake thermal efficiency than other SLO blends. It is observed that with increasing SLO concentration in dieselie SLO10, SLO20, SLO40 viscosity of blends decreased leading to better atomization and spray characteristics which also caused increased in BTE. However BTE is less than diesel (1.8cSt) because of superior combustion quality of diesel (higher Carbon to Hydrogen Ratio) and presence of moisture content in SLO fuels.

SLO has good combustion quality. Because of its superior combustion properties it undergoes complete combustion. Hence fuel energyis utilized effectively. This phenomenon causes SLO100 to exhibit lower BSFC than other blends. Lower viscosity and higher cetane number enabled lower BSFC of SLO compared to its blends. The trends are in-line with Singh*et al.* (2014), Lopez *et al.*(2014), Purushothaman *et al.* (2009), Ayatallah *et al.* (2016), Dhar*et al.* (2011), Ozer *et al.* (2014), Negm*et al.* (2016) and Agarwal *et al.* (2016).

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, June 2022
Impact Factor: 6.252

3.2 Combustion Characteristics

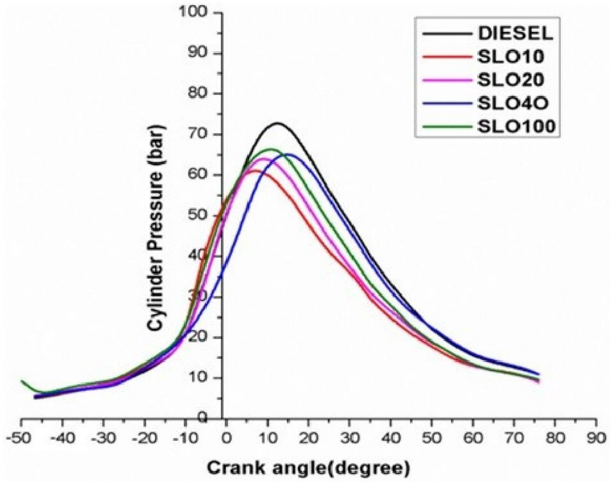


Figure 3 In-cylinder pressure with respect to Crank angle

Figure 3 represents the variation of in-cylinder pressure forvarious crank angle. It is clear from the figure that maximum cylinder pressure is obtained for Diesel around 74.2 bar and lowest is obtained for SLO10 of 60.12 bar. Calorific value, viscosity and Cetane number of a fuelare the three major parameters that affects in cylinder pressure. When Cetane number and calorific value is good and fuel viscosity is lower, uniform airfuel mixture is formed owing to increased cylinder pressure. Lower calorific value of SLO and viscosity in comparison with diesel would have affected air fuel mixture formation followed by lowered cylinder pressure. S100 showing improved cylinder pressure of 65.4 bar in comparison with SLO40 of 63.2 bar due to better calorific value, high pressure and lower viscosity. Additionally presence of oxygen molecules involves in combustion also causes improved cylinder pressure for SLO100 in comparison with SLO40, SLO20 and SLO10with 63.2 bar, 62.4 bar, 60.12 bar respectively.

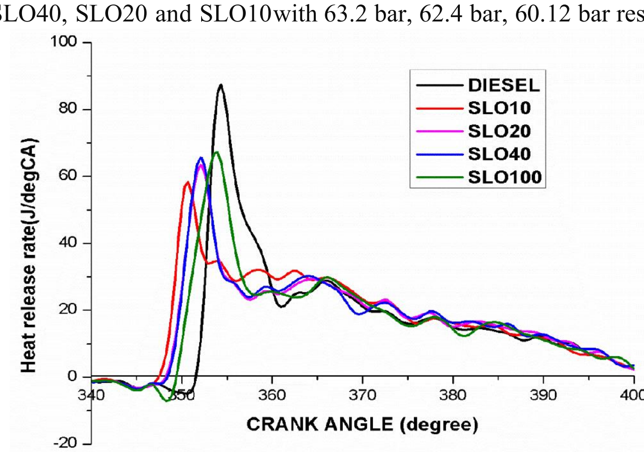
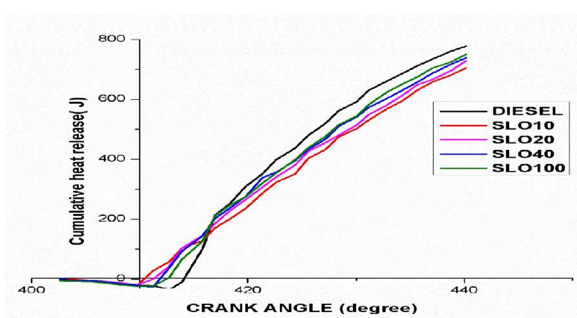


Figure 4 Heat release rate with varying Crank angle



Figures 4 and 5 shows the variation of Heat release rate andcumulative heat release rate with varying crank angle at 100% load condition. Highest value of heat release rate and a cumulative heat release rate of 84. 14 J/ºCA is obtained for Diesel. Accumulation of fuel at premixed combustion phase (primary stage) and lower cetane number of diesel liberating more amount of heat than any other testing fuels. SLO10 exhibits lower CHRR of 56.92 J/ºCA because of high viscosity and lower density than other blends affected evaporation rate at premixed combustion stage. Improved cetane number of SLO10 makes it to liberate heat at early stage of crank angle before TDC and makes more prolonged diffusion combustion. Presence of oxygen plays major effect during latter stage of combustion. Though SLO100 has high cetane number rise in HRR is late because of itshigher flash point and density.

SLO100 exhibits CHRR of 787.66 J and it is about 22% higher than SLO10. Presence of more oxygen molecules and better combustion qualityattributes for more HRR. SLO10, SLO20, SLO40 exhibited peak values of 56.92J/ºCA, 60.12 J/ºCA and 63.41 J/ºCA. It is observed that highest cumulative heatrelease rate is obtained for SLO100 (787.66 J) and is lower than diesel by 7.12%.Hence SLO100 resulted in enhanced combustion than other fuels.

IV. CONCLUSION & FUTURE SCOPE

1. SLO is proven to be a reliable optimum fuel in terms of performance, combustion and emission aspects. Apart from above benefits NOx emission increased.
2. Fuel borne nano additive (Al_2O_3) was used to reduce emission and improve performance. HC, CO & smoke emission reduced reasonably but NOx increased. The following results obtained which highlights the role of Al_2O_3nano particle inblends.
3. Addition of alumina nano particles has enhanced the inherent properties of sweet lime oil such as reduced viscosity and improved calorific value. These effects had good impact on atomization and vaporization of fuel.
4. BTE of SLO 20ppm was 8.88% higher than SLO and whereas CO,HC, NOx and smoke were 25%,6.625% 4.57% and 8.17%less than SLO100.
5. Optimum dosage of alumina with SLO is identified as 20ppm and is treated as best blend (BB) for carrying out further experimentations.

REFERENCES

[1]. Agarwal, AK, Dhar, A, Gupta, JG, Kim, WI, Choi, K, Lee, CS & Park, S 2015, 'Effect of fuel injection pressure and injection timing of Karanja biodiesel blends on fuel spray, engine performance, emissions and combustion characteristics', Energy Conversion and Management, vol. 91, pp. 302-314.

[2]. Agarwal, AK, Shrivastava, A & Prasad, RK 2016, 'Evaluation of Toxic Potential of Particulates Emitted from Jatropha Biodiesel Fuelled Engine', Renewable Energy, vol. 99, pp. 564–572, https://doi.org/10.1016/j.renene.2016.07.056

[3]. Ahmed, SA, Prabhakar, S, Soloman, BK & Ahmed, MI 2013, 'Performance Test for Lemon Grass Oil in Twin Cylinder Diesel Engine', ARPN J. Eng. Appl. Sci., vol. 8, no. 6, pp. 435-437

[4]. Ayatallah Gharehghani, Mostafa Mirsalim & Reza Hosseini 2016, 'Effects of waste fish oil biodiesel on diesel engine combustion characteristics and emission' Renewable Energy, vol. 101, pp. 930-936

[5]. Basha, J & Anand, RB 2010, 'Effects of nanoparticle-blended water biodiesel emulsion fuel on working characteristics of a diesel engine', International Journal of Global Warming, vol. 2, no. 4, pp. 330-346.

[6]. Belagur, VK, Reddy, V & Wadawadagi, SB 2009, 'Effect of Injection Pressure on Performance', Emission and Combustion Characteristics of Direct Injection Diesel Engine Running on Blends of Pongamia Pinnata Linn (Honge oil) Oil and Diesel Fuel. Agricultural Engineering International: CIGR Journal.

[7]. Cardona, CA & Sanchez, OJ 2007, 'Fuel ethanol production: process design trends and integration opportunities', Bioresource technology, vol. 98, no. 12, pp. 2415-2457.

[8]. Cenk Sayin & Mustafa Canakci 2009, 'Effects of injection timing on the engine performance and exhaust emissions of a dual-fuel diesel engine', Energy Conversion and Management, vol. 50, pp. 203-213.

[9]. Chattopadhyay, S & Sen, R 2013, 'Fuel properties, engine performance and environmental benefits of biodiesel produced by a green process', Applied energy, vol. 105, pp. 319-326.

[10]. Chew, SC 2020, 'Cold-pressed rapeseed (Brassica napus) oil: Chemistry and functionality', Food Research International, vol. 131, pp. 108997.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
IJARSCT
Impact Factor: 6.252
Volume 2, Issue 2, June 2022
[11]. Coale, AJ & Hoover, EM 2015, Population growth and economic development. Princeton University Press.
[12]. Deep, A, Sandhu, SS & Chander, S 2017, 'Experimental investigations on the influence of fuel injection timing and pressure on single cylinder CI engine fueled with 20% blend of castor biodiesel in diesel',Fuel, vol. 210, pp. 15-22.
[13]. Desa, UN 2019, 'World population prospects 2019: Highlights', New York (US): United Nations Department for Economic and Social Affairs.
[14]. Dhar, A & Agarwal, AK 2015, 'Effect of Karanja Biodiesel Blends on Particulate Emissions from a Transportation Engine', Fuel, vol. 141, pp. 154-163, https://doi.org/10.1016/j.fuel.2014.09.124
[15]. Dhinesh, B,Annamalai, M, Isaac Joshua Ramesh Lalvani, J & Annamalai, K 2017, 'Studies on the influence of combustion bowl modification for the operation of Cymbopogon flexuosus biofuel based
[16]. diesel blends in a DI diesel engine', Applied Thermal Engineering, vol. 112, pp. 627- 637. ISSN: 1359-4311
[17]. Ezekoye, V, Adinde, R, Ezekoye, D & Ofomatah, A 2019, 'Syntheses and characterization of biodiesel from citrus sinensis seed oil', Scientific African, vol. 6, p. e00217.
[18]. Gad, MS & Jayaraj, S 2020, 'A comparative study on the effect of nano-additives on the performance and emissions of a diesel engine run on Jatropha biodiesel', Fuel, vol. 267, pp. 117-168.
[19]. Ganapathy, T, Gakkhar, RP & Murugesan, K 2011, 'Influence of injection timing on performance, combustion and emission characteristics of Jatropha biodiesel engine', Applied energy, vol. 88, no. 12, pp. 4376-4386.
[20]. Ganapathy, T, Gakkhar, RP & Murugesan, K 2011, 'Influence of injection timing on performance, combustion and emission characteristics of Jatropha biodiesel engine', Applied energy, vol. 88,no. 12, pp. 4376-4386.
[21]. Ghahdarijani, A.M., Hormozi, F. and Asl, A.H., 2017. Convective heat transfer and pressure drop study on nanofluids in double-walled reactor by developing an optimal multilayer perceptron artificial neural network. International Communications in Heat and Mass Transfer, 84, pp.11-19.
[22]. Gnanasekaran, S, Saravanan, N & Ilangkumaran, M 2016, 'Influence of injection timing on performance, emission and combustion characteristics of a DI diesel engine running on fish oil biodiesel', Energy, vol. 116, pp. 1218-1229.
[23]. Goel, V, Kumar, N & Singh, P 2018, 'Impact of modified parameters on diesel engine characteristics using biodiesel: A review', Renewable and Sustainable Energy Reviews, vol. 82, pp.2716-2729.
[24]. Goldemberg, J & Guardabassi, P 2010, 'The potential for first-generation ethanol production from sugarcane', Biofuels, Bioproducts and Biorefining: Innovation for a sustainable economy, vol. 4, no. 1, pp. 17-24.
[25]. Gopal, KN & Karupparaj, RT 2014, 'Effect of Pongamia Biodiesel on Emission and Combustion Characteristics of DI Compression Ignition Engine', Ain Shams Eng. J., vol. 6, no. 1, pp. 297-305, https://doi.org/10.1016/j.asej.2014.10.001
[26]. Gumus, S, Ozcan, H, Ozbey, M & Topaloglu, B 2016, 'Aluminum oxide and copper oxide nanodiesel fuel properties and usage in a compression ignition engine', Fuel, vol. 163, pp. 80-87.