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Experimental Study on Effect of Lime Peel oil on Efficiency of Diesel Engine: A Review

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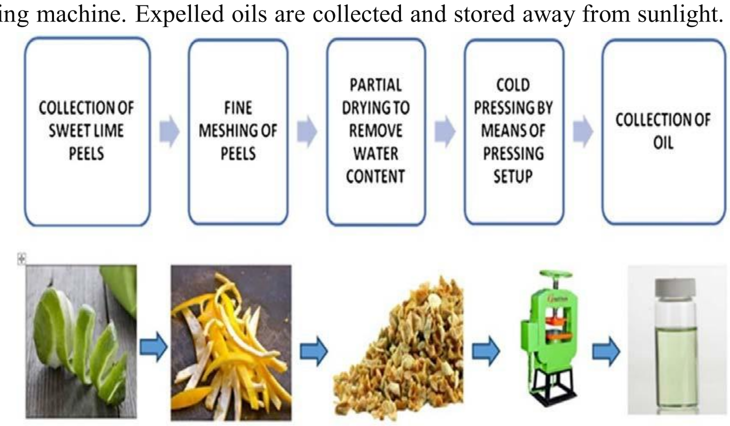
I. INTRODUCTION

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. 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

III. BIODIESEL ON CI ENGINE

Can (2014) studied the behaviour of waste cooking oil as an alternative fuel in diesel engine. They found that, on advancement of fuel injection timing outcome results showed improvement in BSFC and BTE.Ignition delay period has reduced considerably. In addition, it was observed that the indicated mean effective pressure values were slightly varied

depending on the start of combustion timing and the centre of heat release location. It was found that 5% and 10% biodiesel fuel addition resulted in slightly increment on BSFC up to 4% and reduction on BTE up to 2.8%. Italso increased NO_x emissions up to 8.7% and decreased smoke andhydrocarbon emissions at all load conditions. Although there were no significant changes on CO emissions at the low and medium engine loads, some reductions were observed at the full engine load. Also, CO_2 emissions were slightly increased for the all engine loads.

Shehata *et al.* (2011) conducted experiment using Jojoba and Sunflower oil. They also discussed the drawbacks of using biodiesel in engine. High viscosity, drying with time, thickening in cold conditions, poor flow and atomization characteristics are some of the drawbacks which has to be considered while selecting oil. Emissions of hydrocarbon and carbon monoxide were greater while carbon dioxide and oxides of nitrogen werereduced.

Purushothanam *et al.* (2009) used oil extracted from orange peeland added diethyl ether to enhance the combustion process. Experiments were conducted on compression ignition engine with no modification. It was found that product of incomplete combustion such as CO, UBHC and smoke were reduced. On other hand product of complete combustion such as oxides of Nitrogen and CO_2 increased. It is concluded that addition of diethyl ether(DEE) has enhanced combustion process which led to increase NO_x and CO_2emissions. Reduction in BTE were also noted.

Ayatallah Gharehghani *et al.* (2016)used waste fish oil as diesel engine fuel. It was observed that combustion characteristics were better and oxygen content of biodiesel reduced hydrocarbon and carbon monoxide emission by 15 to 20% and 2 to 5%. Increase of brake thermal efficiency resulting in improved combustion. Fuel properties such as calorific value,

Velmuruganet al.(2016) analyzed the potential of using mango seed biodiesel in an unmodified diesel engine with various antioxidant additives like PHC (pyridoxine hydrochloride), DEA (diethyl amine) and TBHQ (Tert butyl hydro quinine). Biodiesel were tested with two concentrations namely B20 and B100. Antioxidants were investigated with 100, 250, 500 and 1000ppm respectively. Results indicated that, with 250ppm PHC addition on B20, lowest NOx emissions, greater CO and HC emissions occurs due to less fuel bound oxygen in comparison with B100. Also, with increasing concentration of antioxidants, smoke emissions increases and BTE reduced due to high viscosity and lowered heating value of the mixture.

Negmet al.(2016) proposed the preparation of biodiesel from Egyptian castor oil through conventional trans esterification using methanol and sodium methoxide as catalysts. The synthesized biodiesel were investigated for fatty acid profiles and various fuel properties like iodine value, cetane number, density, viscosity, flash point, cloud point, fire point, carbon residue and ash residual content. The results were in par with other biodiesels sourced from sunflower, rapeseed and soybean biodiesels. They also concluded that with B10 blend there is a significant reduction in BSFC and increase in BTE.

Dharet al.(2015) experimentally investigated the particulate size distribution and particulate emissions from an unmodified diesel engine fueled with Karanja biodiesel and its blends at various engine speeds and loads. They observed that, with increasing engine speed, there is an increase in particulate number concentration. Also, for all the biodiesel blends, the size of particulates were smaller than diesel at lower loads. Highest particulate number emissions were obtained for B100 (100% Karanja biodiesel) blend while lowest emission were obtained for B10 blend. It is also proposed that B20 can be effectively utilized for lowered particulate number concentrations.

Xiaohu Fan et al.(2011) studied two Cottonseed oil biodiesel samples (Cottonseed oil methyl esters, COME) produced in Clemson lab, together with other two commercial Cottonseed oil biodiesels and evaluated on their engine performance with the No. 2 diesel fuel as a reference. The results revealed that emission of CO, CO2 and NOx from cottonseed oil biodiesels was lower than that of the No. 2 diesel fuel. CO decreased by 13.8%, CO2 by 11.1% and NOx by 10%, though there was no significantly statistical difference at $p<0.05$. The engine test also showed a slightly higher amount of consumption and less tendency of coke formation from COME than the No. 2 diesel fuel. The oxidative stability study showed COME with acceptable stability. COME exhibited friendly environmental benefits and acceptable stability, demonstrating its feasibility as an alternative fuel.

Qi etal.(2020) experimented the cyclic variation of vapour distribution in incylinder of n-hexane and p-xylene fuel using binary component fuel spray. Vapour mass fuel distribution in a binary component fuel spray was examined using ultra violet-visible light absorption/scattering technique. At higher boiling point large fluctuations in vapour distribution was observed for p-xylene which indicated that evaporative characteristics has significant effect on cyclic variations. Based on the large data obtained gives more information about spray structure and new empirical formula for spray vapour distribution area for prediction was also found.

Gopal et al. (2015) used Pongamia-based biodiesel in various blend proportions like PME20, PME40, PME60, PME80 and PME100 and compared its combustion and emission characteristics with that of diesel fuel. They observed that, with the usage of biodiesel, there was a reduction in engine performance while there were significant changes in combustion.

IV. INFERENCES

The following conclusion were drawn on the above literature survey.

1. For biodiesel usage in diesel engine, viscosity has to be reduced using trans esterification technique. Diesel engine operation using biodiesel shows reduced brake thermal efficiency due to lower calorific value of fuel. Literature analysis indicated that 10%,20% and 40% addition with mineral diesel is found to lower the emission along with marginally improved performance. Hence for the current experimentation SLO10, SLO20 and SLO40 blends were considered. Emissions such as Hydrocarbon, Carbon monoxide and smoke opacity reduced while Oxides of Nitrogen increased certainly. However, usage of biodiesel for long time reduced lifetime of fuel systems such as fuel lines, injector and pump.
2. Low viscous biofuel can be directly used in IC engines without trans esterification in diesel engine. Low viscous biofuel operated engine resulted in reduced brake thermal efficiency of 6-7 %. Reduced hydrocarbon and carbon monoxide emissions were observed. However vapour pressure of low viscous oil affects the combustion process. This will cause pre ignition before actual combustion, resulting in knocking of fuel.
3. Geometry of CC, IP and IT definitely affects the performance, combustion and emission of biofuels in IC engines.
4. No major work was attempt towards utilizing sweet lime peel oil as an alternate fuel.
5. Studies has been carried out the influence of doping of nano particles, altering of IP,IT and CCG on SLO

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