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Effect of Compression Ratio on Emissions of Palm Waste Cooking Oil Extracted Biodiesel Operated CI Engine

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Abstract:

With the sharp decline in fossil fuel use and the large amounts of emissions they release into the atmosphere that are responsible for global warming, scientists are looking for alternative sources of energy. Biodiesel is an alternative source that can be used as an alternative to diesel and can lead to a reduction in pollutant emissions. It has been observed that transesterified cooking oil, like different biofuels, can be burned in an internal combustion engine without much modification. This article focuses on the effect of compression ratio on biodiesel made from palm oil waste blended with diesel in 10, 20 and 30 volume fractions; and studied the effect of compression ratios 17 and 18 on emission parameters such as CO2, CO, HC and NOx. The purpose of using biodiesel in blends with diesel is to establish biodiesel as an alternative fuel.

Keywords **—Biofuel, Palm Waste Cooking Oil, Combustion, Compression ratio, Engine Speed.**

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I. INTRODUCTION

Energy supply is a major problem for all developing industries and developing countries. In recent years, due to the increasing production of renewable energy such as coal, there has been a significant increase in greenhouse gas emissions, resulting in a significant increase in carbon dioxide emissions. The rapid increase in fossil fuel prices is also due to the alarming speed of their depletion. Scientists are searching for an alternative fuel as oil reserves are being depleted at a worrying rate. In this case, a reliable alternator and a suitable adaptation to the current diesel engine are required. One such alternative fuel is biodiesel. Due to its durability, biodegradability, high flash point and low sulfur content, biodiesel has the potential to replace diesel with biodiesel. Scientists believe it will use less fuel, be more efficient and cause less pollution than current fuel. As modern industrial society grows, the major challenge we face is the depletion and depletion of the fossil fuels that power it.

Tomesh Kumar Sahu and others. to [1] focused on the effect of compression ratio on used cooking oil fueled engines on parameters such as efficiency, BSFC, etc. Tests were done at five different loads at 1500rpm with the CR 20 and the result was 5% more efficient low power, BSFC for full load operating conditions. Swarup Kumar Nayak et al. [2] investigated the thermal and emission performance of a mahua biodiesel engine using additives. Ahmed I. El-Seesy et al. [3] investigated the effect of combining MWCNT and WCME on diesel engine emissions and performance, in particular CO and HC emissions and BSFC performance. K.A. Abed et al. to [4] was obtained from waste cooking oil from biodiesel fueled engines, showing that mixing biodiesel with diesel reduces HC and increases CO and CO2 emissions and also increases fuel consumption. Selvakumar Raja et al. to [5] experimentally investigated emission control strategies for a variable-compensation engine using waste biodiesel fuel with compression ratios of 16, 17, and 18, respectively, in terms of emissions, combustion, and efficiency. Hoi Nguyen et al. [6] investigated and compared the effect of used cooking oil synthetic diesel on engine performance with conventional diesel oil. Mohamed F et al. [7] investigated the heat emission performance using methyl ester of waste oil (MEWCO) combined with 10, 20 and 100% diesel fuel. lker Ors [8] investigated the effect of blending bioethanol made from sugar beet and waste oil biodiesel with diesel fuel at 20% and 80% by volume. Gabriel Galván Mucio et al [9] used sea sand as a source of calcium oxide. XRD, SEM, BET and Hammett techniques were used to characterize the catalyst. Hasan Maksum et al [10] conducted experiments using biodiesel based on waste oil with conventional diesel as fuel and the results show a decrease in torque, energy and thermal efficiency by increasing the consumption of certain fuels. M. Kalam et al [11] investigated the performance and emission characteristics of a multi-cylinder engine using a blended fuel of diesel and biodiesel extracted from coconut oil. Alpaslan Atmanli et al. [12] focused on a comprehensive mathematical optimization evaluation of diesel butanol-vegetable oil (cotton oil) blends based on the operating parameters of engines using RSM in an experiment at 2200 rpm. Seid Reza Amini-Niaki et al [13] conducted experiments using sunflower biodiesel as fuel. Bhupendra Singh Chauhan and others. [14] Jatropha methyl ester and its blends with diesel had lower braking efficiency than diesel and higher fuel consumption per brake. Javier Campos-Fernandez et al.[15] experimented with mixed alcohols and fossil fuels to see if they could produce an attractive alternative energy for IC engines. B.K.Venkann et al [16] conducted experiments using biodiesel extracted from rice bran oil as a fuel blend with diesel oil at 10-50% by volume with diesel oil. P.K. Devan et al. [17] worked on methyl esters of poon oils and this diesel fuel blend produced lower smoke, hydrocarbon and CO emissions and higher NOx emissions compared to conventional diesel. K. Muralidharan et al [18] conducted tests on a single cylinder -stroke variable CR multi-fuel engine fueled with waste cooking oil methyl ester and its 20%, 0%, 60% and 80% blends with diesel engines. T. D. Tsoutsos et al. [19] investigated the conversion of used cooking oils (UCO) to biodiesel for fuel and the biodiesel chain. Shiv Kumar Sharma at el [20] conducted tests on six biodiesel-diesel blends to evaluate the performance characteristics and the main conclusion is that due to high viscosity and density and low calorific value of biodiesel. Abdullah Al-Ghafisst al [21] focused on the effect of injection pressure on thermal efficiency and emission characteristics using a mixture of 10, 20 and 30% waste cooking oil in diesel oil with a compression ratio of 17.5. Haseeb Yaqoob et al [22] carried out a detailed review of waste cooking oil biodiesel, where various parameters of compression ignition engine emissions, heat and combustion efficiency were considered to take into account technical, economic and environmental impacts. Hoi Nguyen Xa and others [23] conducted experiments to collect biodiesel from waste cooking oil using a catalyst and start an engine with biodiesel mixed with commercial diesel. Lochan Kendra Devkota et al [2] conducted experiments by blending 5, 10, 15 and 20% biodiesel obtained from waste cooking oil with diesel oil of compression ratio 17.5 at an engine speed of 1500 rpm. And Hazwani Abdullah et al [25] did not produce biodiesel from waste cooking oil according to ASTM 6751. Jeewan VachanTirkey et al [26] conducted experiments using biodiesel extracted from waste oil and mixed with diesel oil at 10, 20, 30, 0 and 50% by volume. Mohd. Yunus Khan [27] gave a detailed review of diesel engines derived from waste oil, including thermophysical properties and combustion, heat and emissions to convert biodiesel as an alternative fuel. Yahya Ulusoy and others [28] focused on waste cooking oil methyl ester as a diesel engine fuel and investigated the thermal, combustion and emission characteristics of said fuel considering two speeds of 1800 and 2800 rpm with 10, 20, 30 and 0% blending. Nik Nur Fatin Amiera Nik Aziz et al [29] obtained emission results of 10 and 30% waste oil biodiesel and diesel fuel blends and found that 30% biodiesel has lower emissions compared to diesel but at the same time produces a lower temperature profile. X. J. Man et al [30] focused on the effect of waste oil biodiesel on particle mass, number concentration, nanostructure and oxidative reactivity at different engine speeds and engine loads. Souvik Barman et al [31] developed a pilot plant to produce biodiesel from cooking waste and analyzed its production costs to determine the commercial viability of biodiesel. Mohammed Abdul Raqeeb et al [32] reported the physical and chemical properties of waste oil, esterification, transesterification and biodiesel production from waste oil using different methods and procedures. [33] Aleš Hribernik et al. performs combustion emission analysis of an diesel engine using waste cooking oil.[34] [35] Nikul K Patel et al. [36] SK Singh et al. includes various studies of biofuel extracted from non-edible seeds and cotton waste. Biofuel are integrated with various applications such as heat exchanger [37-41] Patel Anand et al. and solar air & water heater [42-53] Anand Patel et al. to increase energy efficacy and renewability.

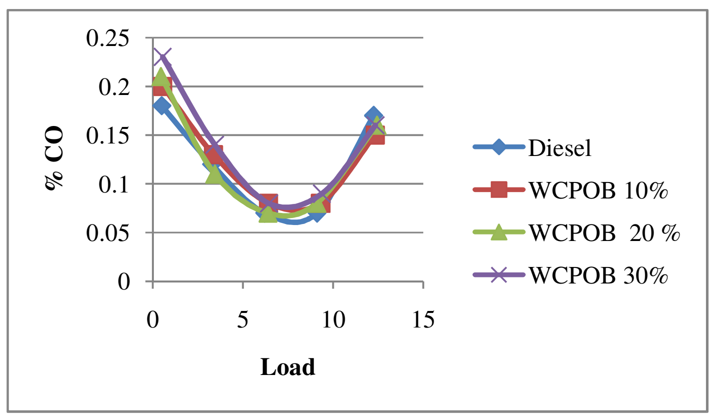
II. EXPERIMENTAL SETUP

The experimental test rig consists of a variable compression ratio compression ignition engine, eddy current dynamometer as loading system, fuel supply system for both diesel oil oil supply and biodiesel supply, water cooling system, lubrication system and various sensors and instruments integrated with computerized data acquisition system for online measurement of load, air and fuel flow rate, instantaneous cylinder pressure, injection pressure, position of crank angle, exhaust emissions and smoke opacity. The thermal performance parameters include brake power, brake mean effective pressure, brake thermal efficiency, volumetric efficiency, brake specific fuel consumption, exhaust gas temperature, heat equivalent of brake power and heat equivalent of exhaust gas. Commercially available labview based Engine Performance Analysis software package—Engine softLV is used for online performance evaluation.

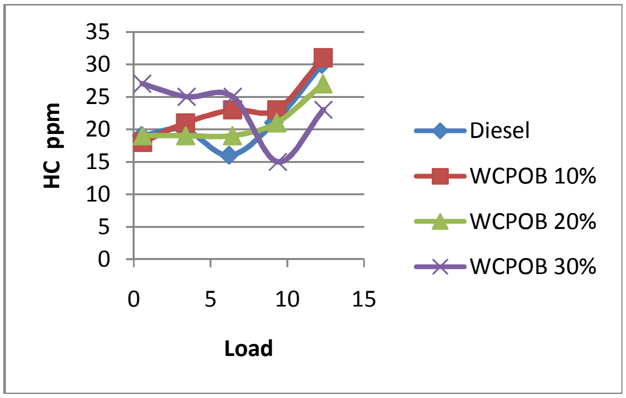
Fig. 1 View of Experimental Set up.

III. RESULT AND DISCUSSION

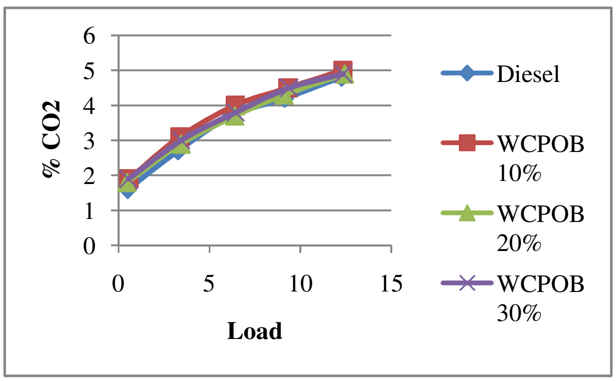
WASTE COOKING PAM OIL BIODIESEL (WCPOB) + DIESEL, CR= 17, SPEED 1500 RPM



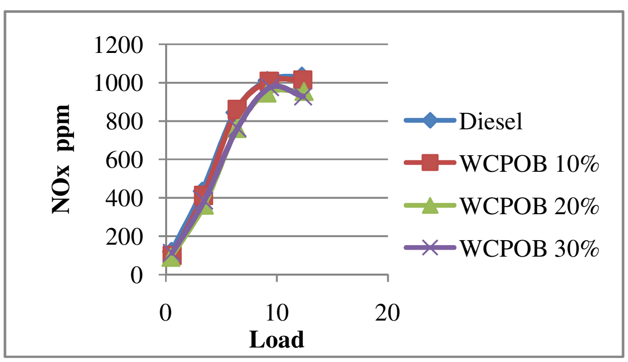
(A): CO % VOLUME



(B): HC PPM



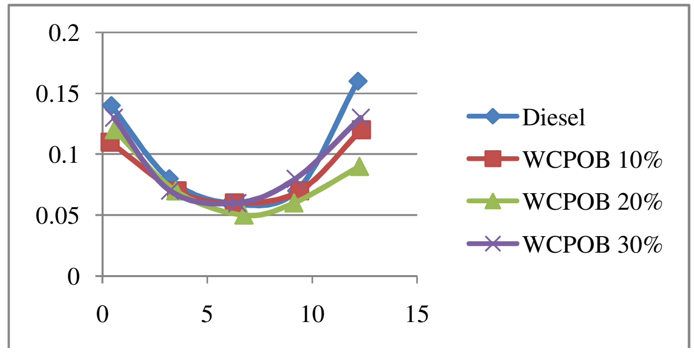
(C) CO_2 % VOLUME



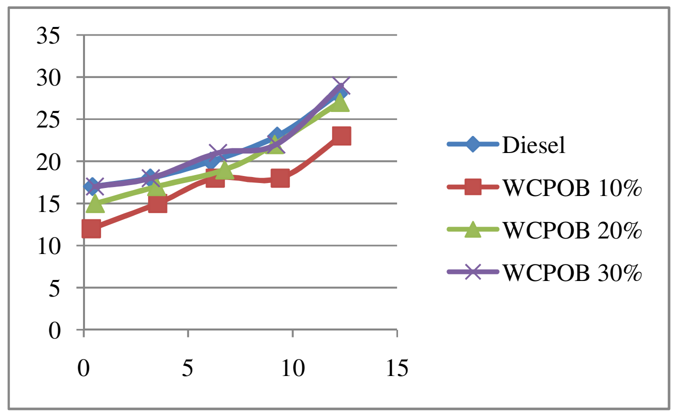
(D) NO_x PPM

FIG.2 (A,B,C,D) EMISSION CHARACTERISTICS AT 1500 RPM AND AT CR 17

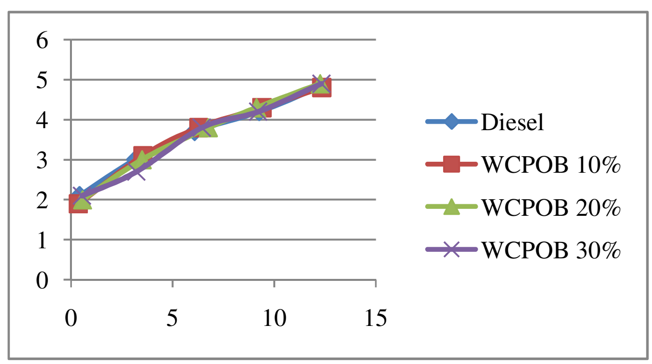
WASTE COOKING PAM OIL BIODIESEL (WCPOB) + DIESEL, CR= 18, SPEED 1500 RPM



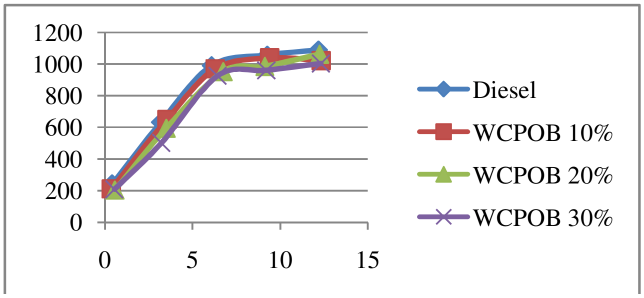
(A): CO % VOLUME



(B): HC PPM



(C) CO_2 % VOLUME



(D) NO_X PPM

FIG 3 (A,B,C,D) EMISSION CHARACTERISTICS AT 1500 RPM AND AT CR 18

Fig 2 and Fig 3 indicate emissions values at 1500 RPM for compression ratio of 17 and 18 respectively. Fig 1 (a) represent % CO emission at CR 17 which is high at low load and high load and minimum for 50% load and similar trend is observed at CR 18 and minimum % CO emission for 20 % blending of biodiesel and it decreases with compression ratio; while % CO2 and NOX values increases with load but values of % CO2 higher than diesel and values of NOX lower than diesel particularly in case of 30% blending. The values of HC increases with load in both the cases for compression ratio but for compassion ratio 17 HC values drastically pulsation in values of HC in comparison 18. For compression ratio 18 in case of 10 % blending of biodiesel is lowest with increase in load.

IV. CONCLUSIONS

The compassion ratio is highly influencing parameter on emission performance of biodiesel operated engine and with increment in value of compression ratio all emission parameters are decreasing but again the % blending also played an important role.

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