INVESTIGATION OF INJECTION PRESSURE ON PERFORMANCE AND EMISSION IN BIO DIESEL FUELED SINGLE CYLINDER C.I. ENGINE

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Abstract: Compression Ignition engines (C.I) have boosted word's needs for fuel consumption. At present, as most the vitality required for transportation is met by conventional diesel, quick exhaustion of fuel hold is considered on the grounds that the principal drawback for vehicle segment. Another difficult issue in C.I motors is hurtful discharges which are causing a worldwide temperature alteration and posing health hazards due to pollution. Accordingly, biodiesel has become all the more vital because it has exhibited important environmental edges. Endeavors are being made everywhere throughout the globe to diminish the utilization of traditional fuels wherever conceivable. As indicated by Indian situation, the prerequisite for conventional diesel is expanding dynamically, and consequently there is a necessity to discover alternative choices also. Among the elective powers, biofuels is one the for the most part well known and recognizable to all since it tends to be utilized in any C.I motor without a significant part of the changes. In the present study three different types of biodiesels blends have been used such as blends (B10 and B20) of Soyabean oil, Palm oil and Waste cooking oil (WCO). Values of B.S.F.C and NOx were measured by varying Injection pressure (I.P) values. With increase in injection pressure value from 300 to 500 bar values of B.S.F.C increase 5.07% for Soyabean oil, 7.56% for Palm oil and 18.69% for WCO biodiesel. Values of NOx decrese with increase injection pressure values 2.57% for Soyabean oil, 3.06% for Palm oil and 1.79% for WCO biodiesel.

Index Terms: B.S.F.C, W.C.O, Injection Pressure, NOx.

I. INTRODUCTION

Energy resources are crucial to the future of the world, where energy is considered a vital factor in the development of the nation and economy. There are many sources of renewable energy that can be used on the place of fossil fuels. In the coming future, conventional diesel fuel will be hard to come by. Indeed, a guess of world oil utilization (oil-based powers) by the International Energy Agency (IEA) suggests a sensational increment in fuel utilization from 83.1 (2005) to 117.2 million barrels for every day 2035 [1]. Along these lines, much research has been done on biodiesel as a substitute inexhaustible fuel since the two energizes have tantamount qualities. Biodiesel has exceptional advantages as far as higher cetane number, lower Sulfur content (sans sulfur), and lower Hydrocarbons (HC), also be distributed via existing diesel fuel pumps, which is an extra biodiesel fuel advantage over additional alternative fuels. Furthermore, as it is environment friendly, non-toxic and renewable. Biodiesels are exceptionally simple to mix with ordinary diesel and can be utilized on diesel motors without requesting any engine alteration. As a rule, engine controlled with biodiesel produce a lower power of emissions, aside from NOx, as contrasted and fossil diesel fuel. Additionally, the utilization of biodiesel can be joined with Exhaust gas recirculation (EGR) to upgrade the NOx emanations. Exhaust gas distribution (EGR) is a proficient system to lessen NOx released from diesel motors. Notwithstanding, the strategy will in general convey high PM, fuel utilization and decline the grease oil quality and motor toughness. Hence, more investigation is required to consider the impacts of ignition procedure and EGR on diesel motor performance and outflows when fueled by biodiesel-diesel mixes. Based on the above discussion, this study has been developed to investigate the effects of injection timing (I.T) and injection pressure (I.P) on Break specific fuel consumption (BSFC) and emissions in bio diesel Fueled single cylinder C.I. Engine. So, in this study proposes the use of three advanced blends of biodiesels, soyabean oil, palm oil and waste cooking biodiesel (WCO).

II. MATERIALS AND METHODS

The experimentation was performed with 300 bar and 500 bar I.P's at constant load of 10N/m and different bio diesel blend (B10 Soyabean oil, B10 Palm oil, B10 WCO, B20 Soyabean oil, B20 Palm oil , B20 WCO) on the single cylinder C.I water cooled engine at 18:1 compression ratio and for all cases injection timing is kept constant at 10 º cad and 1600 RPM. The test rig is operating with open Electronic control unit (ECU) "OPEN (MCS1-i7)". The exhaust emission NOx was measured using NAMTECH (GA934) gas analyzer. The technical specifications of the engine are given in Table. 1. For Break specific fuel consumption (BSFC) measurement system comprises of a beaker furnished with two visual sensors one sensor at a more elevated amount and another was at an inferior level. with the biofuel goes through the abnormal state visual sensor, this to begin the time. When the fuel achieves the sensor gives a flag to the (ECU) low level sensor, the sensor gives a flag to the ECU to stop the time and refill the tube. Since this, the time taken for the utilization of fuel for a fixed volume is determined. The exploratory set-up and photographic perspectives on motor are as appeared in Fig. 1. And Fig. 2.

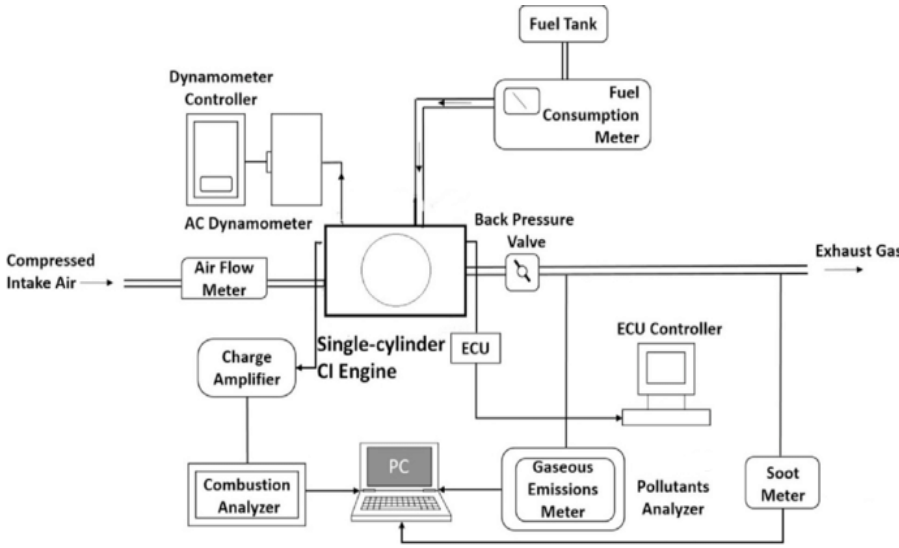

Fig. 1 Schematic Diagram of experimental set–up [2]

Table. 1 Engine Specification

NO. OF CYLINDERS	1
APPLICATION	AOTOMOTIVE (MULTISPEED)
VOLUME (cc)	625
BORE* STROKE (mm)	93*92
COMPRESSION RATIO	18:1
NO. OF VALVE/ CYL	2
NO. OF STROKES	4
IGNITION	C.I
COOLING SYSTEM	WATER COOLED
MAX. TORQUE (Nm)	38@1100-200 RPM
MAX. POWER (BHP)	11@3000 RPM

The test engine used an open ECU (MCS1-i7) which monitor many parameters such as, injection timing (I.T), injection pressure (I.P), crank-angle, engine speed, and EGR values. The experimentation was performed with 300 bar and 500 bar Injection pressure (I.P) at constant load of 10N/m and with different bio diesel blends (B10 Soyabean oil, B10 Palm oil, B10 WCO, B20 Soyabean oil, B20 Palm oil, B20 WCO) on the single cylinder C.I water cooled engine at 18:1 compression ratio (C.R) and for all cases injection timing and engine speed was kept constant at 10 ^{0} cad and 1600 RPM. response variable (BSFC and NOx) value calculated and output variable has been plotted from collected data for different Injection pressure (I.P) and NOx using various fuel blend combinations.

Fig. 2 Photographic View of Experiment

III. RESULTS AND DISCUSSION

3.1 Brake Specific Fuel Consumption (BSFC)

BSFC values is shown in Fig. 3 and fig. 4. As seen in the figure, when engine is filled with separate biodiesel at constant load 10 N/m and speed (1600rpm) of C.I engine at 300bar IP , B20 blend of Soyabean oil leads to higher BSFC (0.301) as compare to 10 % blend of Soyabean oil (0.256) a 17.57% increase and BSFC value for Palm oil and WCO Increase (4.12% and 6.89%) with increment in extent of mixes from B10 to B20 at both I.P values. BSFC value rise with increment in extent of mixes because of high density, viscosity, and inferior heating value of biofuel also with decline in the lower warming estimation of the mixes by including blends of biofuel comprises additional biodiesel to be infused into the inlet valve to equivalent the equal power yield, prompting the expansion in brake specific fuel consumption (BSFC) comparative discoveries are accounted for by different analysts [3, 4]. Advanced BSFC with use of WCO fuel is because of their inferior energy content and high viscosity and the esters of cooking oils have lower heat value consequently more biofuel is essential to sustain the torque comparative discoveries are accounted for by different analyst [5, 6]. With increase in I.P value of BSFC is also increase 5.07% for Soyabean oil, 7.56% for Palm oil and 18.69% for WCO biofuel due to injection duration extend with increasing I.P and the peak injection rate increased with increasing fuel I.P. similar findings are reported by other researchers [7, 8].

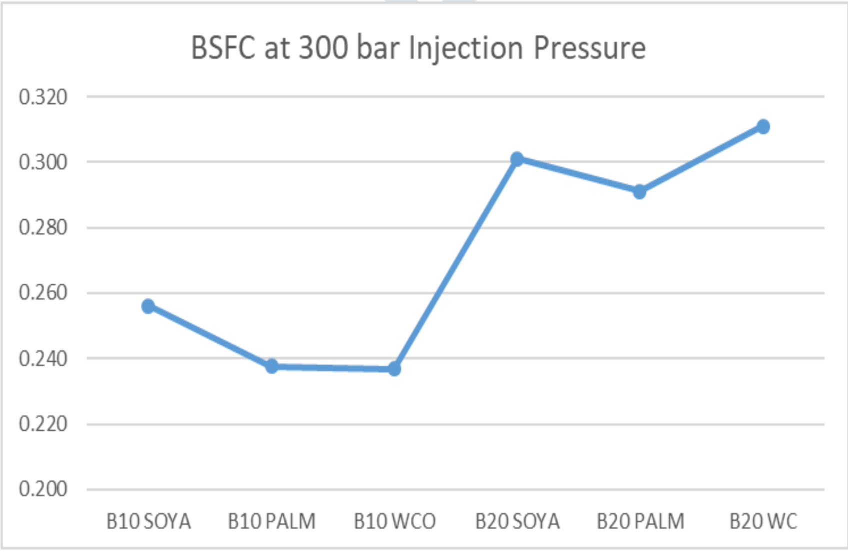

Fig. 3 Effect of different biodiesel blends on BSFC using 300 bar I.P

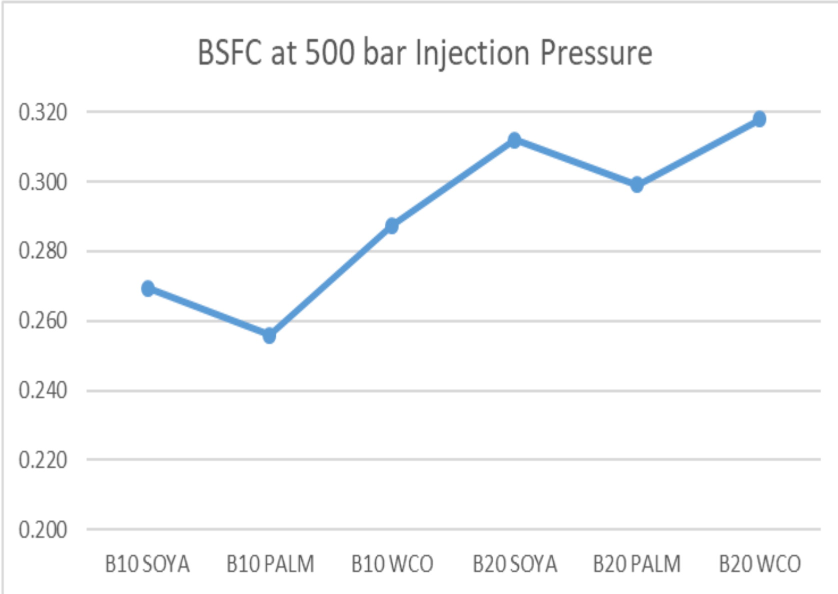

Fig. 4 Effect of different biodiesel blends on BSFC using 500 bar I.P

3.2 Nitrous Oxides (NOx)

NOx formation mainly depends on the combustion temperature, which is because of high energy vital for the reactions intricate. As shown in Fig. 5 and fig. 6, that at constant load and speed of C.I engine with 300bar I.P, blend of Soyabean oil leads toward higher NOX value (678ppm to 729 ppm) a 7.25% increase, for Palm oil (660ppm to 718ppm) a 8.78% increase, for WCO (696ppm to 731ppm) a 5.28% increase , with growth in proportion of blends from B10 to B20, this is because of high consistency, density and lower warming amount of biodiesel similar outcomes are reported by other researchers [9, 10].

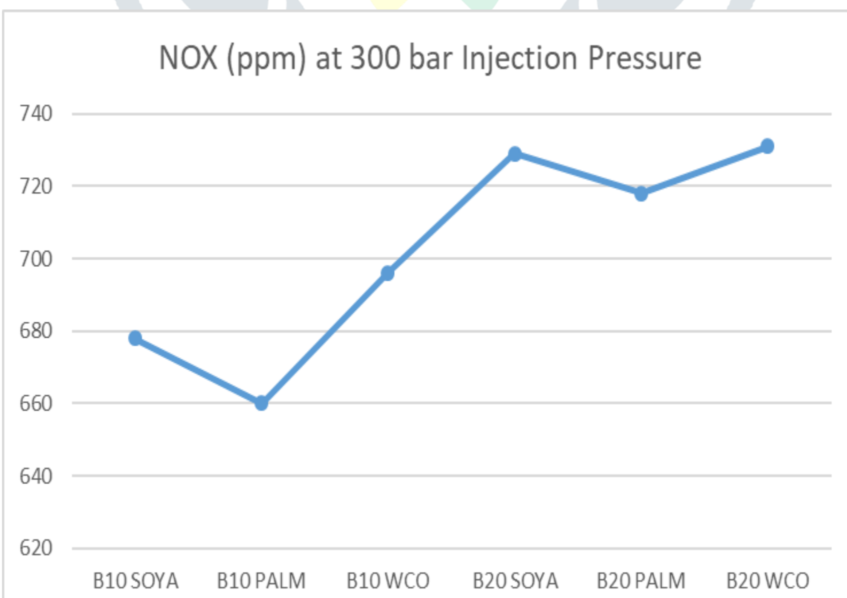

Figure. 5 Effect of different biodiesel blends on NOX using 300 bar I.P

This facilitates progressively total ignition, which prompts higher chamber temperature. Which leads in higher NOX emanations. Higher NOX value with WCO recorded due to size of infused elements of WCO is larger as compare to other blends, different powers, burning proficiency and most extreme ignition temperatures with WCO remained lower. In this manner, NOx outflows were high. NOX emission level increases with rising I.P for all type of blends and blending ratios. Value of NOX for Soyabean oil (678ppm to 698ppm) a 2.65% increase, for Palm oil (660ppm to 686ppm) a 3.93% increase, for WCO (696ppm to 703ppm) a 1.28% increase, this is for the reason that of quicker burning and advanced chamber gas temperature because of pinnacle pressure increment. The O2 substance of blends of biofuels remains an imperative factor for higher NOx exhaust's since they deliver an advanced Exhaust gas temperature (EGT) and an ensuing overabundance of air which is main reason of NOX formation, similar trends are reported by other researchers [13, 14].

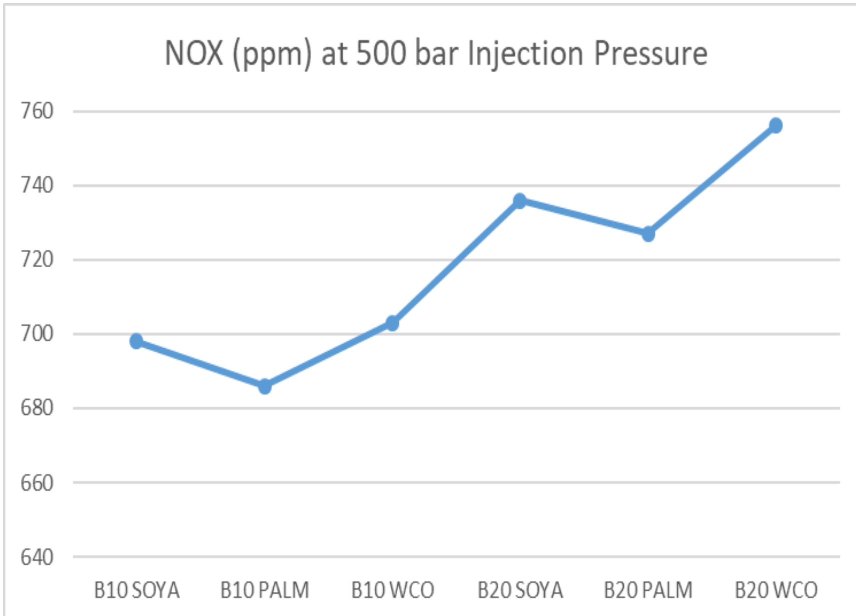

Figure. 6 Effect of different biodiesel blends on NOX using 500 bar I.P

IV.CONCLUSION

The value of response variable (BSFC and NOx) value calculated using different blends of biodiesel and compared. The experimental results showed the following:

1. Value of BSFC increase with increase in proportion of blends at injection pressure of 300 bars and with increase in the injection pressure from 300 bars to 500 bars values of BSFC increase in all types of biodiesel.

2. At 300 bar injection pressure B10 blend of WCO is give best optimized value of BSFC.

3. At 500 bar injection pressure B10 blend of Palm oil is give optimized value of BSFC.

4. Value of NOx increase with increase in percentage of biodiesel from B10 to B20 at 300 bars injection pressure but with increase in the injection pressure from 300 bars to 500 bars value of NOx decrese.

5. At 300 bar injection pressure B10 blend of Palm oil is give optimized value of NOx.

6. At 500 bar injection pressure B10 blend of soyabean oil give optimized value of NOx.

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