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EFFECT OF IGNITION TIMING ON PERFORMANCE AND EXHAUST EMISSIONS WHILE USING LEMON PEEL OIL AND GASOLINE BLENDS

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Abstract: In this present work the effect of lemon peel blend with gasoline is studied at different spark timings i.e. 18, 20 & 220 BTDC. The experiments were carried out at 5% and 10% lemon peel blend and compared with gasoline as base fuel at 50% loading condition. The experiments were carried out to find the optimum spark angle based on performance and exhaust emission. With increase in blend percentage there observed a decrease in break thermal efficiency at all the loading conditions. With increase in spark angle it is observed that the break thermal efficiency increased until it reached optimum spark angle and then decreased. Carbon monoxide and hydrocarbon emissions are studied. It is observed that there is increase in blend percentage the carbon monoxide emission decreased. Hydrocarbon emission decreased for LPO 5% blend and increased.
Keywords: Brake thermal efficiency, emissions, spark angle, Lemon Peel oil, Brake specific fuel consumption.

I. INTRODUCTION

The increase in population, urbanization, and industrialization, lead to rapid consumption of fossil fuels. Therefore, the world is looking for a new direction to develop long sustainable renewable energy resources. They maybe solar energy, wind energy, nuclear energy etc. But it is very difficult to incorporate these resources into vehicles. So it is imperative to develop fuels that would run with the existing engines. Synthetic fuels and bio fuels are developed to this extent. Bio fuels are developed from feed stock of vegetables, agricultural waste, and animal waste. Bio diesel can be produced from regular oils by producing their esters by using different processes. Crude oil is refined in to petrol, diesel and natural gases. Most of the petroleum products obtained from the crude oil are used as fuel for automobiles, generators, or for any other type of locomotives in a manner. Recently there are quite a few developments in automobiles i.e., electric vehicles, hybrid vehicles etc. But there are a lot of complications in adapting these technologies to our automobiles. It will take a lot of time in getting these resources available for daily use i.e. when electric vehicles used it would be difficult to charge it with in a short period of time. What we need is an alternative that was available now and can incorporate into the existing automobiles. Bio fuels are one such alternative that can implement in the existing vehicles with only fewer or no modifications to the engine or automobiles. Muharrem Eyidogan *et. al.*[1] studied the impact of different alcohol- gasoline fuel blends on performance and combustion characteristics of an SI engine. The tests were conducted with two different blends 5% and 10% at two different speeds 80 Km/h and 100 Km/h and compared both alcohols fuel consumption increased by 3.60% for ethan0l and 0.60% methanol. CO was decreased by 17% and 14%, CO_2 was decreased by 8% and 11.30%, HC was decreased by 32% and 35% and NOx was decreased by 15.5% and 9% for ethanol and methanol respectively. Xiaolei Gu *et. al.* [2] conducted a study to find out the emission characteristics of an SI engine fueled with gasoline and n- butanol blends when combined with EGR. It has been observed that there is an increase in specific CO with and without EGR and HC was decreased but while using EGR HC was increased. NOx was decreased with and without EGR. Mustafa Kemal Balki *et al.*[3] conducted an experiment find out the performance of experimental engine with different alcohols compared it with gasoline. There was significant increase in combustion efficiency specifically with methanol but the BSFC was very high about 84%. High HRR was constituted at 3^0,7^0,14^0 ATDC at the three different speeds they conducted. C. Wu, R.Chen, J.Pu *et al.*[4] investigated the effect of ethanol and gasoline blends compared the performance and emission values as a function of percentage throttling and equivalence ratio at different speeds performance and NO_x emissions is higher at 100% throttle at all blends ,CO, HC has less emissions at 80% throttle. The torque for pure gasoline is slightly lower than Ethanol blends especially when the throttling position is very low i.e., 20% F. Yukisel*et al*. [5] designed a new carburetor to produce stable homogeneous liquid phase to study the effect of ethanol and gasoline blends due to this new type they increased the maximum amount to 40% and achieved 80% and 50% reduction in CO and HC emission respectively. Hakan Bayraktar [6] conducted theoretical and experimental investigation of the effect of ethanol and gasoline blends and by comparison found out that 16.5% ethanol blend was best suited theoretically and 7.5% blend experimentally at a compression of 7.75 and 8.75. agreement of 6% was determined between experimental and theoretical results. Tolga Tupgul *et al*. [7] studied the effect of ignition timing on ethanol-unleaded gasoline blends observed that with E10 blend there is a 4.26% increase in brake torque by advancing 10^0 CA but the increase is not very significant with further increase in ethanol blend up to 60% only 1.82% increase in break torque.CO emissions was reduced by 31.8% with 40% blends at compression ratio 9:1. Huseyin Serder Yucesu *et al*. [8] investigated the effect of compression ratio engine performance and emissions with different ethanol- gasoline blends ranging from 11:1 to 13:1 and compared with ratio of 8:1 Mingzhang *et al*. [9] studied the effects of EGR, compression ratio on a port fuel injection engine with wot operation using CFD tools and an experimental engine. It was observed that the maximum EGR rate that can be used is up to 20% after that cov% increases more than 10% which causes difficulties in operation of the vehicles for all the different compression ratios changing from 8:1 to 10:1. Ahmet Necati Ozsezen *et al.* [10] conducted experimentation to the study the performance and combustion characteristics of alcohols-gasoline blends with wide throttle operation. Unstable performance was observed at 5% alcohol blends proportionate to gasoline at WOT condition.

II. EXPERIMENTAL SETUP

A single cylinder four stroke engine, multi fuel with variable compression ratio and injection angle was used to carry out the experiments. The engine was equipped with eddy current dynamometer for loading purpose. The setup consists of two fuel tanks for both diesel and gasoline. port fuel injection system was used as fuel injection system. Exhaust gases were analyzed by AVL gas analyzer. The pressure sensor was attached to the engine head to measure the combustion pressure in the engine cylinder. Several data acquisition systems are connected to the experimental setup to process the data obtained. Different parameters (i.e. volumetric efficiency, brake thermal efficiency, brake power etc.) can be studied using this setup.

Engine Type	Single cylinder, 4- stroke SI engine
Cylinder bore	87 (mm)
Stroke length	110 (mm)
Connecting rod length	234 (mm)
Compression ratio	10:1
Swept volume	661 (cc)
Rated power	4.50 kw @1800 rpm
Throttle orifice diameter	20 (mm)
Orifice Coefficient of discharge	0.6
Dynamometer arm length	185 (mm)
Fuel Pipe Diameter	12 (mm)

Table 1: Engine Specifications

III. TEST FUEL PREPARATION

Lemon peel oil was made from rinds of lemon which are abundantly available throughout the world. Lemon peel oil was made through the steam distillation process. Fuel preparation set up consists of a steam boiler, Distillation chamber, cooling chamber and a Collection tank The steam from the boiler is passed through the distillation chamber. The distillation chamber consists of lemon rinds placed on a grid the steam is passed through the bottom of the rinds when it is passing through the rinds it collects the essence from the lemon rinds and goes to the cooling chamber by cooling the steam which containing lemon essence it converts into liquids and stored in the Collection tank. By allowing the liquid to settle in the Collection tank after some time due to the density difference both water lemon peel oil gets separated lemon peel floats on the top of the water and it was collected from there using valves.

Density @ 15 ^{0}C (kg/m3)	853
Kinematic viscosity @ 40^0 C (cSt)	1.06
Flash point (^{0}C)	54
Fire point (^{0}C)	64
Final boiling point (^{0}C)	176
Conradson carbon residue (%)	0.02
Lower calorific value (kJ/kg)	41510
Research octane number	73.7
Moisture content	0.05%
Ultimate analysis	
Carbon (%)	89.93
Hydrogen (%)	9.25
Sulphur (%)	0.01
Oxygen (%)	0.81

Table 2: Fuel Properties

IV. RESULTS AND DISCUSSIONS

A. Brake Thermal Efficiency

Brake thermal efficiency is the ratio of brake power and product of mass of fuel consumed and its calorific value it has been observed that with increase in blend percentage there is decrease in the efficiency and with increase in spark angle the efficiency increased and then decreased for LPO 5% and LPO 10% blend percentages. Maximum efficiency is obtained at 20^0 BTDC spark angle for LPO 5% and LPO 10% blends. This is due to change in ignition angle there is a delay in ignition due to low calorific value of the fuel the ignition angle need to be retarded there by increasing the efficiency but further retardation leads to in complete combustion leading to decrease in efficiency.

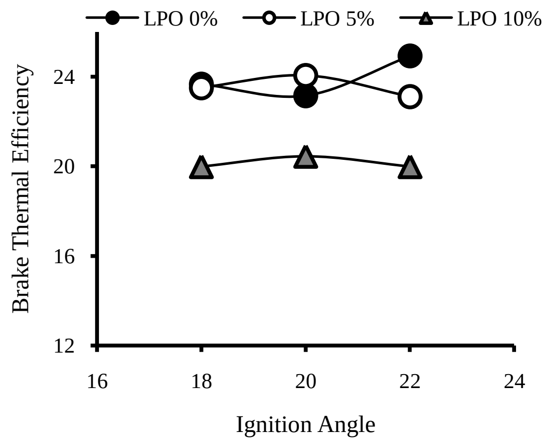

Figure: 1 Variation of Break thermal efficiency with ignition angle for different blends

B. Brake Specific Fuel Consumption

Brake specific fuel consumption is the ratio of brake power to the mass of fuel consumed. It is the vice versa of brake thermal efficiency. It is observed that with increase in blend percentage there is an increase in fuel consumption due to its less calorific value. For LPO 0% brake specific fuel consumption is minimum at 22^0 BTDC ignition angle. But for LPO 5% and LPO 10% the minimum brake specific fuel consumption was obtained at 20^0 BTDC ignition angle.

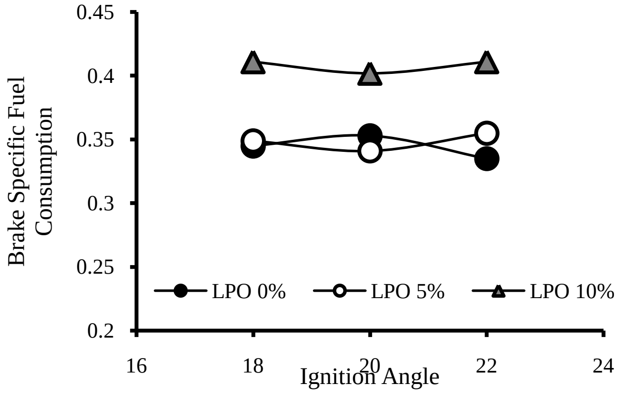

Figure: 2 Variation of Break Specific fuel consumption with ignition angle for different blends

C. Carbon Monoxide
Variation of carbon monoxide with different spark ignition angles for different blends of lemon peel oil and gasoline has been studied as shown in figure:3. Carbon monoxide emission has been decreased with increase in blend percentage and it is also observed that with increase in spark ignition angle the amount of carbon monoxide emission has also been decreased. Maximum carbon monoxide emission is obtained at 18^0 for all blends. For LPO 5% and LPO 10% blends the decrease in CO emissions for change in ignition angle is very less when compared to the LPO 0% blends.

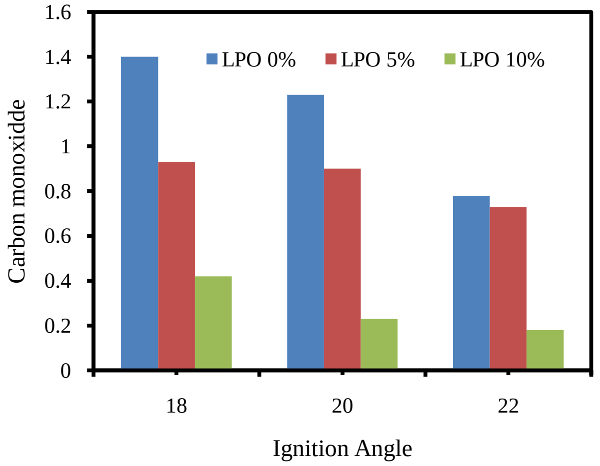

Figure: 3 Variation of Carbon monoxide with ignition angle for different blends

D. Hydrocarbons
Variation of Hydrocarbons with different spark ignition angles for different blends of lemon peel oil and gasoline has been studied as shown in figure:4. Hydrocarbon emission has been decreased for LPO 5% blend, and increased for LPO 10% blend when in compared with gasoline and it is also observed that with increase in spark ignition angle the amount of hydrocarbon emission has also been decreased for all blend percentages.

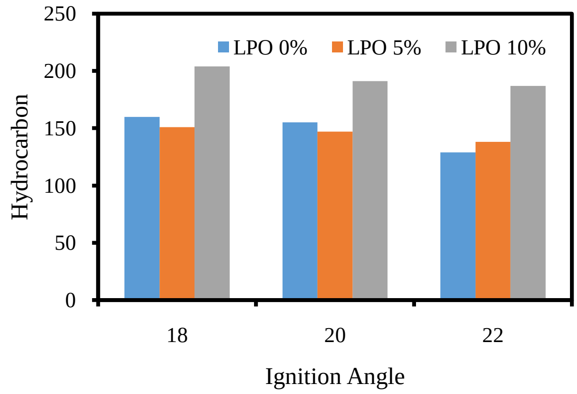

Figure: 4 Variation of Hydrocarbons with ignition angle for different blends

E. Carbon dioxide
Variation of Carbon dioxide with different spark ignition angles for different blends of lemon peel oil and gasoline has been studied as shown in figure:5. Carbon dioxide emission increased for LPO 5% blend with increase in spark ignition angle and decreased for LPO 10% blend percentage. At spark angle 18^0 emission increased with increase in blend percentage. For the remaining two spark angles the emission increased for LPO 5% blend and decreased for LPO 10% blend percentages.

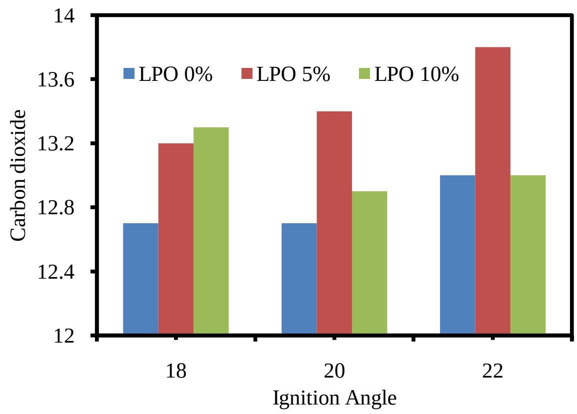

Figure: 5 Variation of Carbon dioxide with ignition angle for different blends

V. CONCLUSION

Lemon peel oil as an alternative to gasoline and its performance at different spark ignition angle has been studied in this experiment. It has been observed that at 22^0 spark angle the maximum break thermal efficiency obtained for gasoline (i.e. LPO 0%) and 20^0 for LPO 5% and LPO 10%. Break specific fuel consumption was minimum at 22^0 for gasoline and at 20^0 for both LPO 5% and LPO 10% as it is vice versa to break thermal efficiency. Carbon monoxide emissions increased with increase in blend percentage and decreased with increase in spark angle. Hydrocarbon emissions has been increased for LPO 10% and reduced slightly for LPO 10% blends.

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