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PERFORMANCE AND EMISSION EVALUATION OF BLENDS OF DIESEL FUEL WITH WASTE COOKING OIL IN A CI ENGINE WITH EGR.

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Abstract

The depletion of fossil fuel resources and strict regulation on emission parameters, it is essential to search for improved diesel engine performance and cleaner combustion. Alternative fuels are the candidate fuels of the present and the future. More number of vehicles using alternative fuels worldwide indicates a sure sign of their need. It is clear that without alternative fuels, mankind will not have sustained eco-mobility in the future. Using additives will play a very good role in improving the performance and emissions. The effect of waste cooking oil biodiesel with ethanol additives on the performance and emission of diesel engines were clearly discussed in this article. In this article mainly focused on waste cooking Oil and effect of ethanol and EGR. The different properties of this fuel are evaluated using ASTM test standard and compared in relation to that of conventional diesel oil. All experimentation carried out on TV2, Kirloskar, Single acting, 4-stroke, water cooled diesel engine having a rated output of 16HP at 1800 rpm and a compression ratio of 17.5:1, with varied load 0% to 100% of full load with increment of 20%. Waste cooking oil biodiesel and ethanol additives shows marginal variation in performance, combustion and emission characteristic like (UBHC, CO, NOx) are have been evaluated and compared with diesel.

Keywords: CI Engine, Waste cooking oil, Ethanol, EGR, Performance, Emissions and Combustion Characteristics.

I. INTRODUCTION

Over the last two decades in India, there has been a tremendous increase in number of automobiles. Currently the motor vehicle population in India is about hundred millions. The economic progress of a country will be decided by the amount of fuel consumption per capita. India is home to more than billion people, about "one sixth" of the world human population. One factor that has decelerated India's rate of economic development is the need to import of about 70% of petroleum demand which costs approximately

Rs.8,79,000 corers per annum. The compression ignition has gained the name and fame by serving the society in many ways viz. Automobile transportation, Industrial and agricultural sectors. With increasing demand on the use of petroleum products, a stronger threat to clean environment is being poised as the burning of these fuels is associated with emissions like carbon dioxide, carbon monoxide, oxides of nitrogen and particulate matter, which is currently the dominant global source of emissions. These emissions are major causes of air pollution and hence the environment. The most appealing alternative fuels are those, which can be used with minor or without modifications of existing engines. Development of new energy resources became important agenda in relation to national energy policy.

2. OBJECTIVES

It is seen from the literature survey that only few progress has been made in the concept of waste cooking oil used as alternative fuel for CI engines. However using of non-edible waste oil as substitute for diesel remains largely unexplored. In this research waste oil like waste cooking oil are used for investigation.

The following objectives were

- Biodiesel preparation from waste cooking oil.
- To modify waste cooking oil by using transisterification process method.
- To study and compare the properties of waste cooking oil and its blends with diesel oil.
- Optimized blend of waste cooking oil with diesel fuel.
- The experiments are conducted at No load, 20%, 40%, 60%, 80% and 100% of full load condition with waste cooking oil blend.
- To run the typical diesel engine on B20WCO to evaluate the performance, emissions, and combustion characteristics and compare this with conventional diesel operation.
- The experiments were repeated using Exhaust Gas Recirculation and to evaluate the performance, emissions, and combustion characteristics and compare this with conventional diesel operation.

3. METHODOLOGY

3.1. Waste cooking oil.

Waste cooking oil is from hotel industries. Approximately 17 million tons waste cooking oils are produced per annum in the world. From the fatty oils within the sight of alcohol with transesterification response we can deliver biodiesel. The biodiesel creation from squander cooking oil with methanol within the sight of nano-sized calcium oxide nano-impetus was done at a research facility scale.

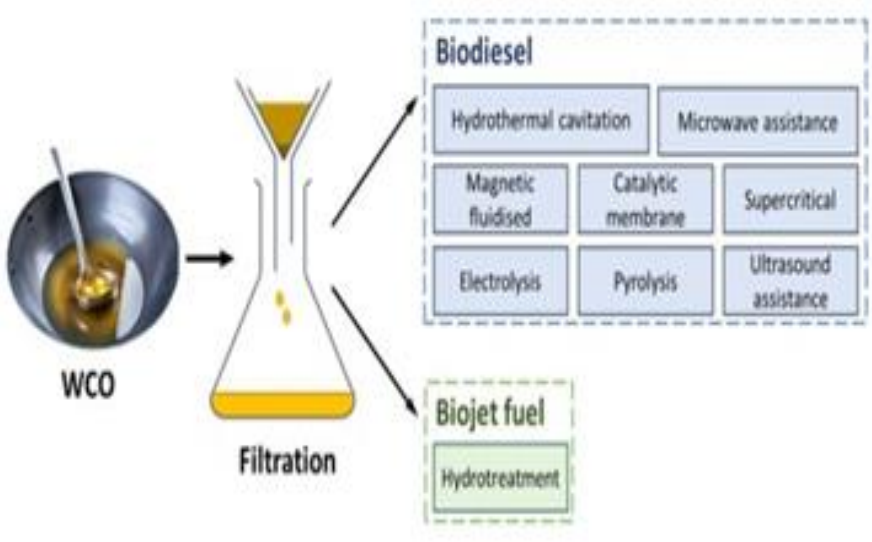

Figure 3.1: shows the WCO to Biodiesel process

3.2 Ethanol

Ethanol is basically made up of sugarcane or corn. In 2018 the global production of ethanol was 108.2 billion liters as the years pass by, this production rate increases, India sets a target to reach 375 to 400 core liter of ethanol from sugarcane in 2020-21, at present the blending rate are 5% and plans to increase blending of 20% by 2030. In 2019 the statistical data was taken in India and was found to be approximately 78,000 kilogram per hectare. India is the second largest producer of sugar in the world, where average production of sugarcane id around 35.5 crore tonnes and by which only 3 crore tonnes of sugar is produced, and 2.6 crore tonnes are consumed for domestic purpose. It takes around 2515 liters of water to produce 1kg of sugar.

On an average 1 tonnes of sugar can produce 10.8 liters of Ethanol. Today India 330 distilleries which can produce 4 billion liters of alcohol per year, among which 162 distilleries have capacity to produce 200 crore liters of conventional bio-ethanol. India produces its bio-ethanol mostly from sugar molasses and some part from grains.

Today in India at 10% blending of ethanol, India needs 313 crore liters, 1 million tonnes of sugar can be replaced by 60 crore liters of ethanol. Today India has no policy to convert sugarcane to Ethanol. These Ethanol can be used as a blending mode of fuel or can be used as alternative fuel, Ethanol is made up of 2-carbon alcohol, with as molar mass of 46.069gmol.

As it is a renewable resource it can reduce the consumption of crude oil in the India, which imports 80% of its crude oil required from other crude oil rich countries. Although the blending of ethanol is already made a compulsory in India to a small percent, if need to use the ethanol is excess quantity of blending the engine components should be altered, without alterations it could damage fuel pump, inlet components etc. eventually the whole engine may get damaged and become unsuitable for travel purpose which inturn increases the maintenance cost of running the vehicle, if it comes to pollution caused by ethanol, the pollution reduced, ethanol mixture burn cleaner and have high octane level than compared to the pure form of gasoline, but burning the ethanol causes greenhouse gas and produce carbon dioxide, and also ethanol tends to evaporate more from the tank of the vehicles or storage unit than the gasoline.

If the ethanol is made to use more, the farmers can be supported and more jobs can be created both in automobile sector and also for farmers. More over these ethanol can be distributed to consumer from normal petrol/diesel bunks, where modifications should be done for pipelines and storage unit.

4. TEST ENGINE SET-UP AND EXPERIMENTATION

Trial tests were done at five particular levels with an increase of 20% along the successive weights going from 0%, 20%, 40%, 60%, 80% and 100% weights keeping the speed steady at 1800 rpm. At first the test CI motor was run with impeccable diesel for 20 mins to warm it up before testing distinctive blends. Then, the test was passed on for diesel, biodiesel and biodiesel with added substance.

Execution, outflow and burning attributes for different burdens were estimated utilizing vortex current dynamometer and relating emanations with gas analyser and smoke meter. The got results were thought about for diesel, biodiesel and biodiesel with alumina oxide at standard working conditions.

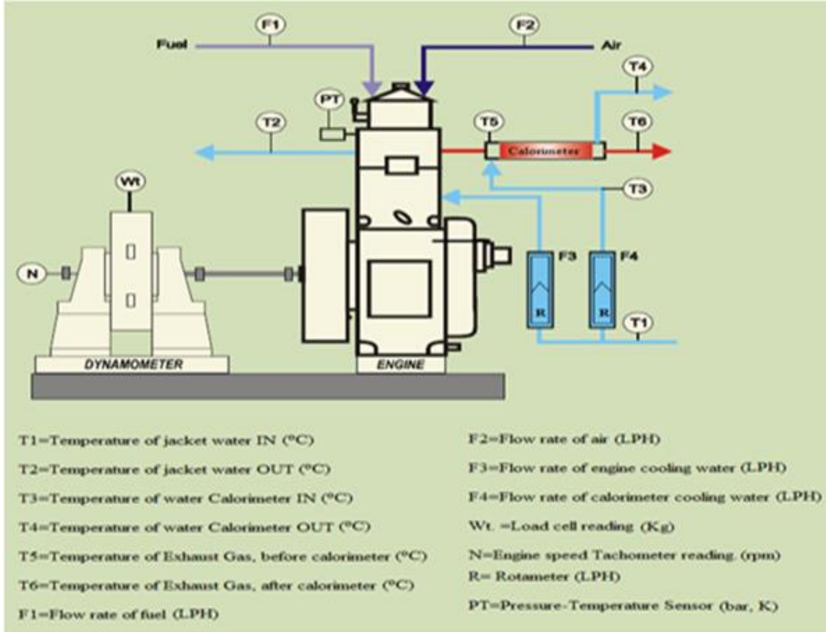

Figure 4.1: Engine layout

Table.2 Engine Specifications

Engine make	Kirloskar AVI
Type of engine	SingleCylinder 4-stroke,CI engine.
Cooling method	Water cooled
Rated B.P	3.5KW
Rated speed	1500rpm
Compression ratio	16.5:1
Fuel injection Type	Direct injection
Injection pressure	175 bar
Stroke length	210.00mm
Arm length	150.00mm
Clearance volume	38.00cc

5. RESULTS AND DISCUSSION

5.1 Performance attributes

In this segment different execution qualities like SFC and BTE were examined.

5.1.1 Brake Thermal Efficiency

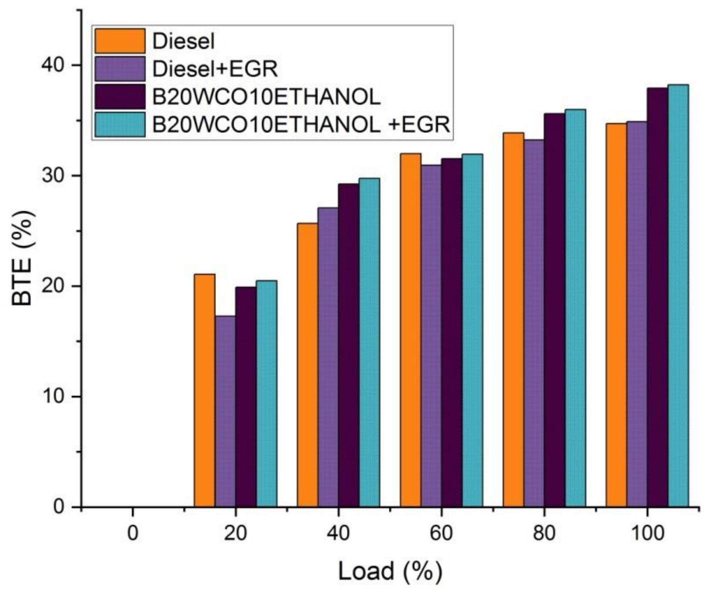

Figure 5.1 BTE Vs load.

The figure.1 is plotted for load vs Thermal efficiency. It is clearly shows that BTE of biodiesel is higher than the perfect diesel. The greatest BTE is represented B20WCO10ETHANOL (37.34%) and least is noticed for diesel (33.296%). This shows that there is increase in BTE contrasted with diesel and B20WCO10ETHANOL separately. This is a direct result of better air fuel blending, further developed burning.

5.1.2 Break Specific Fuel Consumption

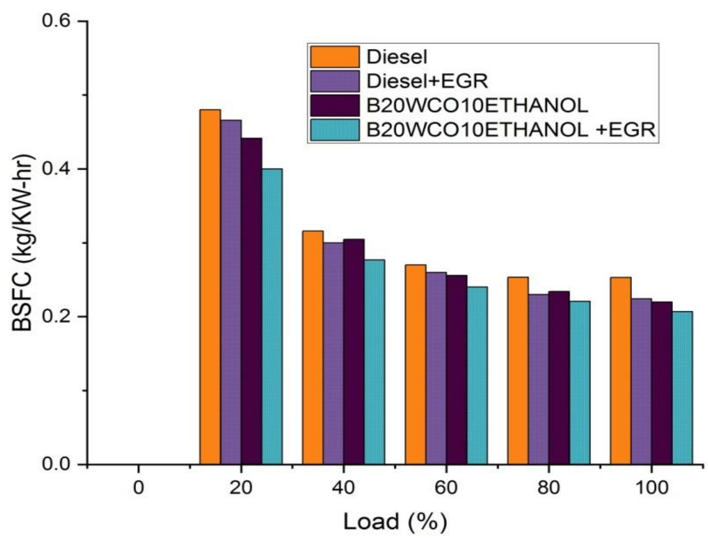

Figure 5.2 BSFC Vs load.

Figure.2 shows the BSFC varieties regarding load applied for every all tested fuels. It is obvious from the graph that BSFC diminishes with expansion in load. At full load the most extreme BSFC is noticed for diesel (0.28 Kg/kw-hr) and least for B20WCO10ETHANOL (0.25 Kg/kw-hr). So there is decrease in BSFC than diesel.

5.2 Combustion Characteristics

The ignition cycle can influence the discharge and execution qualities of CI motor. In this segment the ignition Characteristic, for example, Peak chamber pressure is talked about.

5.2.1 Peak Cylinder Pressure

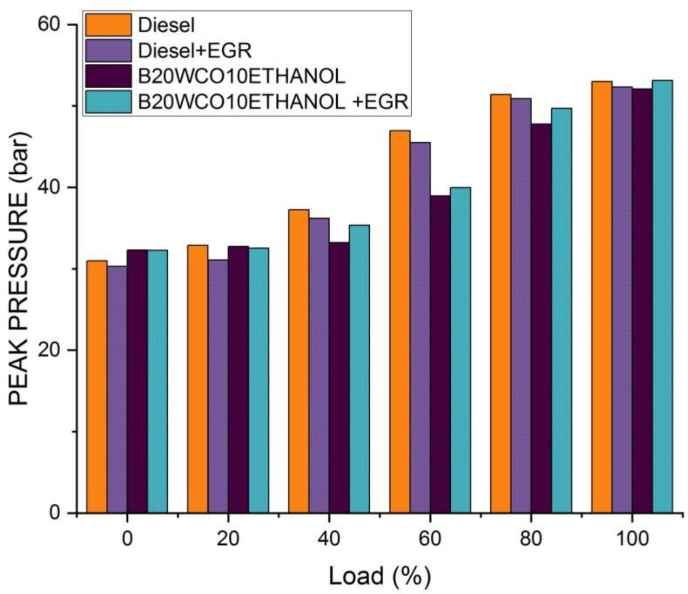

Figure 5.3 BMEP Vs load.

Figure.3 shows the varieties of peak pressure concerning load. The peak chamber pressure increments with increase in load. It is relatively high for blended fuels than diesel. It is most extreme for B20WCO10ETHANOL than B20WCO because of the expansion of ethanol. This higher pressure is a direct result of the great reactant movement of oxygen in ethanol and diminished start delay, which advances expansion in burning rate there by expanding the chamber pressure.

5.3 EMISSION CHARACTERISTICS.

5.3.1 CO Emissions

Figure.4 shows the discharge of CO Vs load. The figure.4 plainly shows the decline of biodiesel mixes showed up diversely according to flawless diesel. The CO discharge is generally important for diesel and least for B20WCO10ETHANOL. From the figure.4 plainly, the discharge of CO in B20WCO10ETHANOL is reduced by 16.66% showed up contrastingly according to diesel. This is a delayed consequence of the fine atomization and oxygen content in the fuel which accomplishes extension in consuming rate. The ethanol, they offer oxygen to the fuel considering that CO is converting into CO_2.

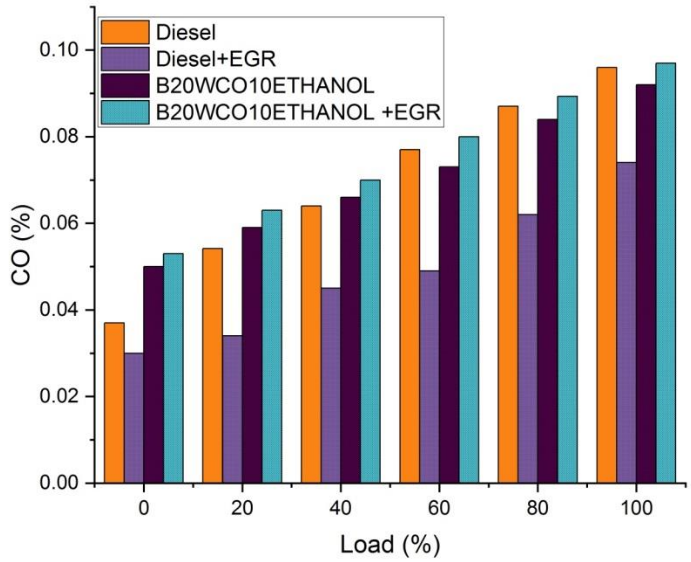

Figure 5.4 CO Vs load.

5.3.2 NOx emissions

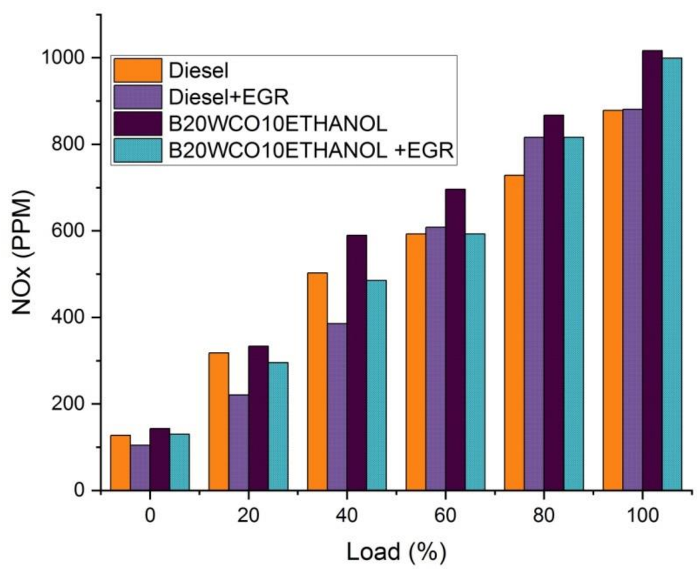

Figure 5.5 NOx Vs load.

Figure.5 shows the variation of NOx emanation with changing burden. Nitrogen reacts with oxygen just at high prompt expansion in temperature and pressure, the high temperature in chamber achieves reaction of nitrogen with oxygen, NOx release increases with the second temperature raise. From the diagram the best and least NOx releases were shown for B20WCO10ETHANOL and diesel separately. This is a direct result of which deals with the start there by extending the chamber temperature, which achieves higher NOx emanations.

5.3.3 UBHC Emission

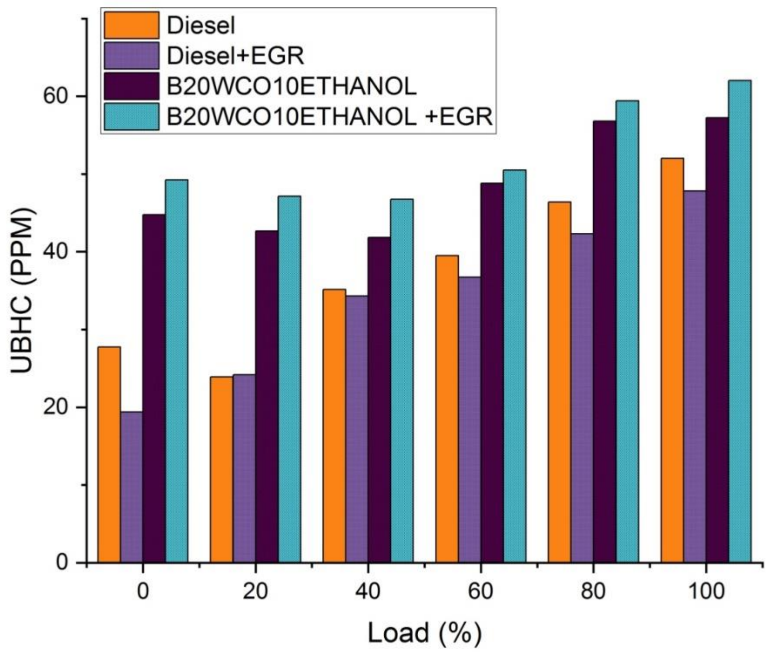

Figure 5.6 UBHC Vs load.

Figure.6 shows the variation of UBHC Vs Load. From all the load we can observe UBHC is low for all test energizes appeared differently in relation to diesel. The best and least UBHC releases are seen for diesel and B20WCO10ETHANOL separately. UBHC outflows are half lower than diesel as a result of high synergist property of ethanol which offers oxygen to complete start there by diminishing UBHC.

6. CONCLUSIONS

In view of the explored different attributes like Combustion, Performance and emission of CI engine with test fuels, the accompanying conclusions were made.

- The maximum BTE is represented B20WCO10ETHANOL and least is noticed for diesel. This shows that there is increase in BTE for B20WCOETHANOL compared with diesel. We can see there is decrease in BSFC for biodiesel compared with diesel.
- The ethanol which give oxygen for combustion it reduce the CO and UBHC emissions. NOx is expanded for B20WCO10ETHANOL because of oxygen content presents in biodiesel and ethanol and increase the cylinder pressure.

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