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RESEARCH ARTICLE

EXPERIMENTAL INVESTIGATION OF CI ENGINE USING OXYGEN ENRICHED BIO-DIESEL AND DIESEL BLEND TO CHECK EMISSION UNDER DIFFERENT LOADING CONDITIONS

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Abstract

Pollution in the environment is increasing the global warming effect. We are also looking forward for alternative fuel. While using alternative fuel it's also increase in some percentage of emissions and decreases the efficiency. We can increasing efficiency by enhance the oxygen in the combustion chamber it would result in better combustion, better performance and lower emissions. The Oxygen can be provided in the intake manifold by the help of an external source. This additional increase of oxygen in air will affects all parameters of the engine like Brake power, emissions, and heat release. But here we are considering only emissions. With load test conducted on compression Ignition engine oxygen consumption was increase with the load. This analysis shows better performance and less fuel consumption and it's also reduced the carbon monoxide (CO), hydrocarbon (HC) emission.

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Introduction

As civilization is growing, transport becomes essential part of life. The biggest problem is the growing population and depletion of fossil fuel. About 100 years ago, the major source of energy shifted from recent solar to fossil fuel (hydrocarbons). technology has generally led to a greater use of hydrocarbon fuels making civilization vulnerable to decrease in supply. This necessitates the search for alternative of oil as energy source. Biodiesel is an alternative fuel for diesel engine. Biodiesel is an alternative fuel for diesel engine. The esters of vegetable oils and animal fats are known collectively as biodiesel. It is a domestic, renewable fuel for diesel engine derived from natural oil like Jatropha oil. Biodiesel has an energy content of about 12% less than petroleum-based diesel fuel on a mass basis. It has a higher molecular weight, viscosity, density, and flash point than diesel fuel. Alternative fuels, other than being renewable, are also required to serve to decrease the net production of carbon dioxide (CO₂), oxides of nitrogen (NO_x), particulate matter etc. from combustion sources [1]. Diesel engine manufacturers face major challenges to meet emissions norms with high combustion efficiency. Moreover how to decrease fuel consumption has put focus on the automobile industry and forced them to produce engines with new Technology. This has led to development of new combustions systems. Lot of research works are going on to meet the above challenges. Today the diesel engine is one of the most exciting and promising technologies in the hunt for new engine solutions for an increasingly eco-aware and resource efficient world [2]. here providing emission characteristics for different load with oxygen enrichment.

Materials and methods

The setup consists of single cylinder, four stroke, multi-fuel, research engine connected to eddy type dynamometer for loading. The operation mode of the engine is Diesel. Rota meters are provided for cooling water and calorimeter water flow measurement. Detailed specifications of the test engine are shown in Table 1. In the experimental set up

the components schematic diagram is shown in the figure the main components of engine is 1.water chamber 2.control valve 3.mano meter.

Water chamber: It is maintain the oxygen temperature. It's working on the room temperature and attached with the oxygen gas supply cell to the control valve. Its filled with the water and the gas flow flowed by the pipe which inner diameter d_i : 0.523cm and the outer diameter of pipe is d_o :0.623 cm. The main function of the supply pipe is to supply O_2 at maintained pressure in the inlet for the engine.

Fuel delivery system: The Fuel from the tank is connected to a solenoid valve. The outlet of the solenoid valve is connected to a glass burette and the same is connected to the engine through a manual ball valve. The fuel solenoid of the tank will remain open until the burette is filled to the high level sensor, during this time the fuel is flowing to the engine directly from fuel tank and also fills the burette. We used 20% blend jetropha biodiesel.

No. of cylinder	Single cylinder
No. of stroke	4
Cylinder dia.	87.5 mm
Stroke length	110 mm
C.R. length	234 mm
Orifice dia.	20 mm
Dynamometer arm length	185 mm
Fuel	Diesel
Power	3.5 kw
Speed	1500 rpm
C.R. range	12:1 to 18:1
Inj. Point variation	0 to 25 Btdc

Table.1 Engine specification

When the fuel level reaches the high level optical slot sensor, the sequence running in the computer records the time of this event. Likewise when the fuel crosses the low level optical slot sensor, the sequence running in the computer records the time of this event. And immediately the fuel solenoid opens filling up the burette and the cycle is repeated. Here the injection is direct with multi nozzle.

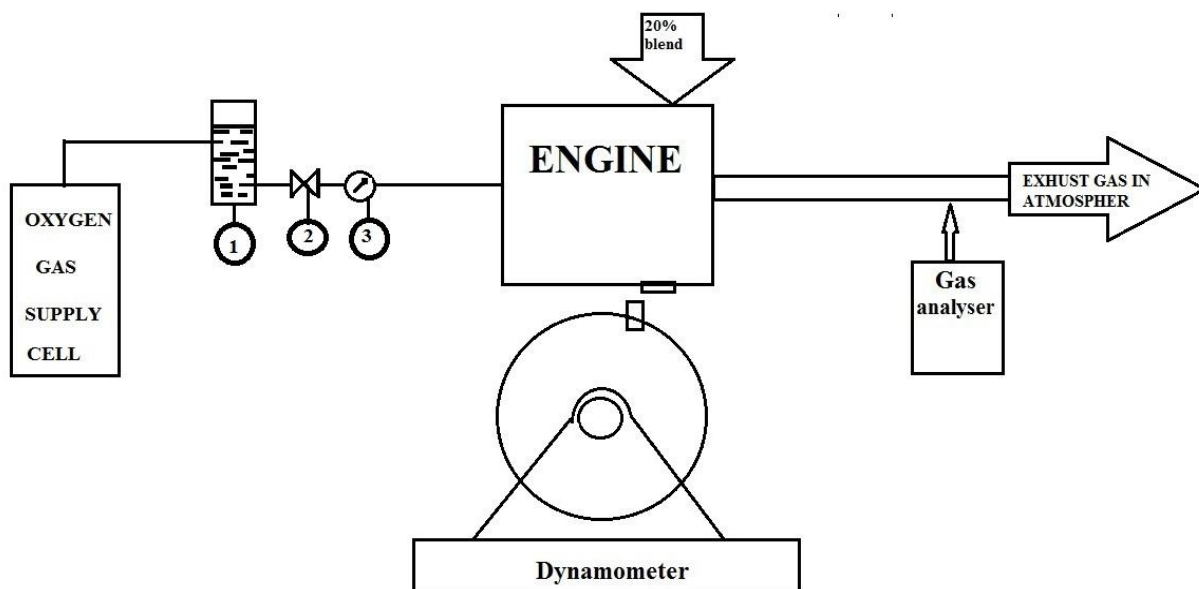


Figure 1

For intake air low levels of oxygen enrichment were used it did not exceed 1.85 kg/hr of the intake air in order to protect the engine. Higher oxygen enrichment levels need special engine modifications because of the expected higher output temperature which is expected to be produced. The intake air oxygen concentration was increased by injecting pure oxygen from a cylinder to the mixing chamber. To ensure effective oxygen enrichment, the pure oxygen was injected directly through mixing chamber in its inlet and the intake air.

Oxygen supply system: For the purpose of tests reported here using oxygen supply cell was used. The oxygen and the atmospheric air were mixed in the mixing chamber provided before entering to the intake manifold of the engine. The amount of oxygen supplied from the cylinder varies from 1.81 to 1.85 kg/hr. We were used different load for experimental emission check.



Figure 2

Diesel Combustion Vs 20% bio diesel combustion Vs O₂ and biodiesel Combustion: Combustion in diesel engines is more complex and its detailed mechanisms are not well understood. Its complexity seems to challenge researcher's attempts to release its many secrets despite. Computational power of contemporary computers and the many mathematical models designed to take off combustion in diesel engines. The addition of oxygenated fuel can result in a sizable decrease of particulate matter in the exhaust gases. Oxygen enhanced combustion has producing oxygen less expensively and the second one is the increased importance of environmental regulations. Oxygen enriched combustion is a proven method to increase available heat value or to reduce fuel consumption. If more oxygen is fed in to the combustion chamber in any engine, then more combustion will be happened and bad

emissions become less. Because they will be oxidized in the oxygen enriched combustion the fuel/air mixture ignites and burns in a faster rate resulting in high energy [2].

Results and Discussion

Carbon monoxide:

CO emission is due to improper combustion of fuel and it mainly depends on many engine temperature, and A/F ratio [3]. Figure 3 explains variation of CO exhaust emissions for different three conditions in which shows that oxygen enriched bio-diesel fuelled engine emits less emissions. oxygen enriched in B20 bio-diesel was 1.81 to 1.85 kg/hr.

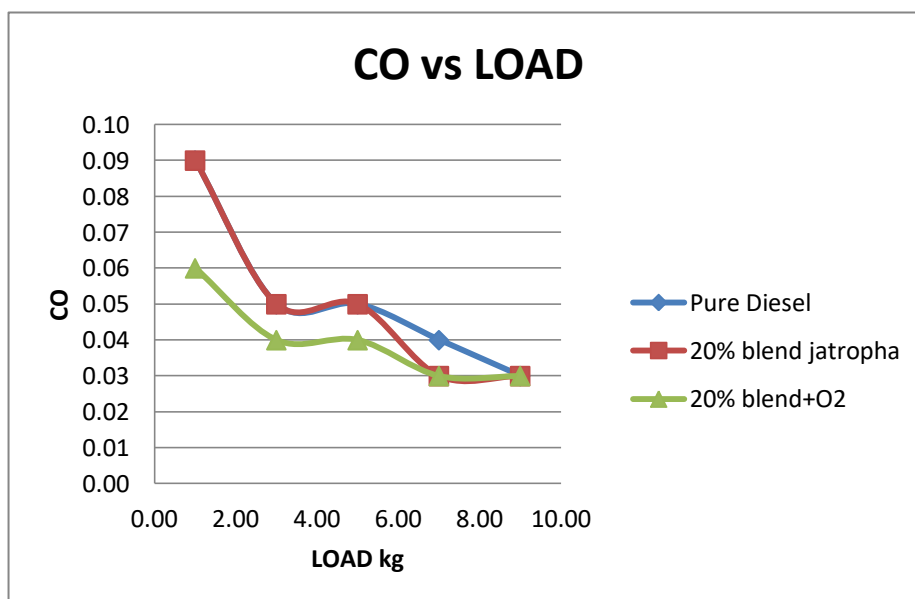


Figure 3

With use of B20 bio-diesel, reduction in CO emissions is found. CO emissions from citrus sinensis biodiesel were found as biodiesel and oxygen enriched bio-diesel respectively the carbon monoxide were 0.090 to 0.03 ppm and 0.070 to 0.04 ppm. It means oxygen enrichment with B20 reduced the CO emission.

HC Emissions:

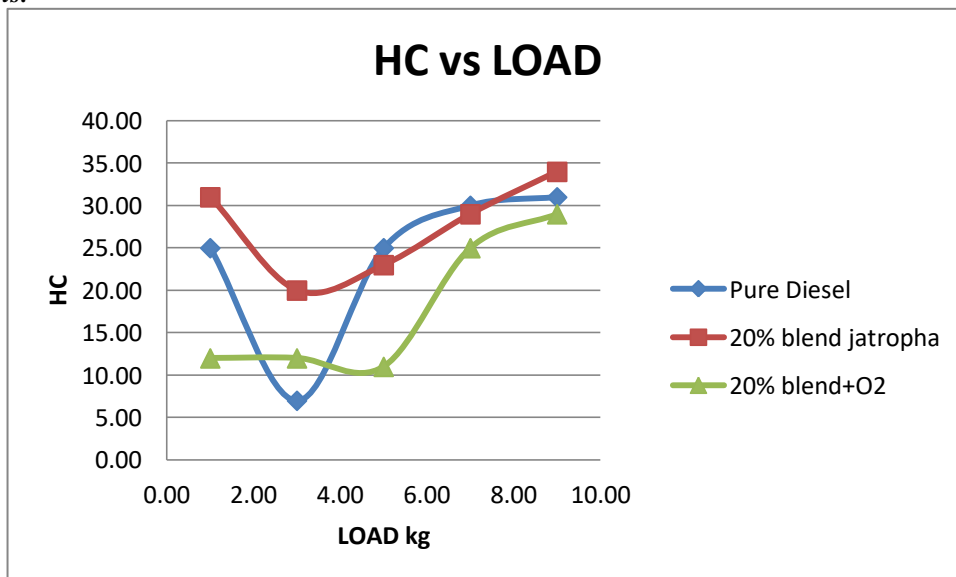


Figure 4

HC emission were reduced which shown in the figure 4 the hydro carbon in the diesel, B20 Bio-diesel and oxygen enriched bio-diesel were respectively 25 to 31 ppm, 31 to 34 ppm and 12 to 29 ppm from these data the HC emissions are less in the oxygen enriched B20 bio-diesel than the diesel and B20 bio-diesel which shown in the figure 4.

NO_x Emissions:

Main factors for NO_x are equivalence ratio, oxygen concentration, combustion temperature and time. NO_x are produced in cylinder areas where high temperature peaks appeared during the uncontrolled combustion. The NO_x from bio-diesel are found greater than petroleum diesel at all load conditions [3].

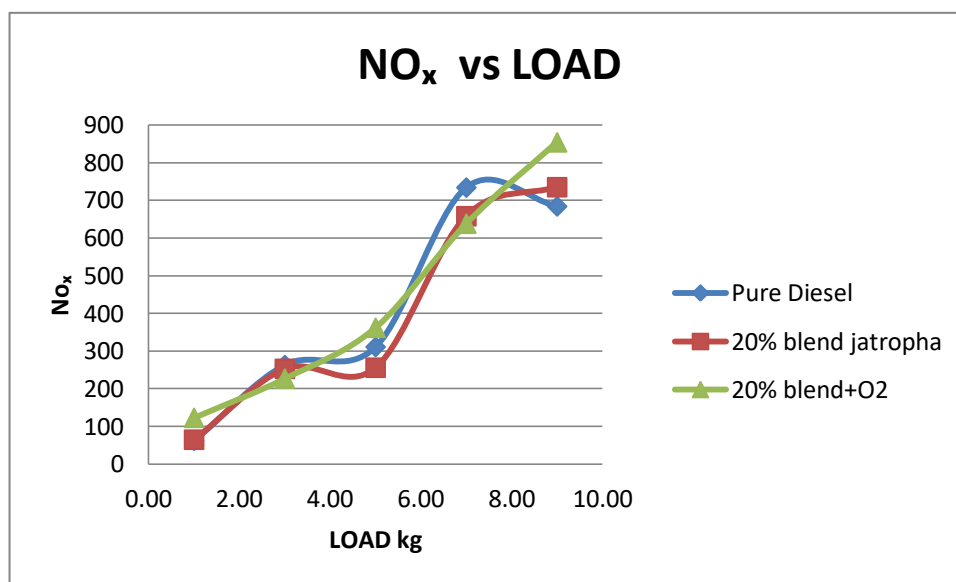


Figure 5

Under the constant inlet total with the increase of the inlet oxygen concentration, the peak of the pressure and the average temperature of the cylinder are increased and the engine power of the diesel engine is enhanced. In addition, oxygen enriched combustion can improve the combustion efficiency and the emissions of soot can decrease greatly. Thus, oxygen enriched combustion is an effective method to improve the diesel engine performance. However, the performance of the diesel engine is not linear improvement with the increase of the intake oxygen concentration. The cylinder wall heat loss increases greatly, which hinders the improvement of the effective thermal efficiency of the diesel engine. Therefore, the practical application of oxygen enriched combustion in diesel engine also needs to calibrate the best inlet oxygen concentration under different working conditions. With the improvement of inlet oxygen concentration, the soot emissions are greatly reduced, however, the NO_x emissions increased sharply. Therefore, the future research emphasis should focus on the combination of oxygen enriched combustion and NO_x emissions control technology, in order to achieve the purpose of controlling the emissions of NO_x and soot of diesel engine simultaneously [4]. The NO_x emission was for diesel, B20 bio-diesel and oxygen enriched B20 bio-diesel was respectively 62 to 684 ppm, 65 to 735 ppm and 123 to 854 ppm. This details shows that the increasing the oxygen concentration with atmosphere air which was the inlet for the engine is increasing the NO_x emissions.

CONCLUSIONS

Oxygen enriched combustion technology influences in increasing the cylinder pressure. This may be attributed to the reduction of the ignition delay period which means early starting of combustion and the availability of longer reaction duration result in a more completion of the combustion process due to the excess of oxygen and the higher gas temperature. The use of oxygen enrichment on diesel engine under different loading conditions was studied to discuss various emissions parameters like by increasing oxygen concentration in intake air the carbon monoxide (CO), hydro carbons and NO_x emissions for different three fuel operating system. The rate of fuel consumption is reduced along with increasing oxygen concentration in intake air. By increasing the load, rate of fuel consumption is gradually reduced for the diesel, B20 bio diesel and oxygen enriched B20 bio diesel fuelled engine produced emission study gives that the carbon monoxide is reduced operating with oxygen enrichment B20 bio diesel than

B20 operated engine. The hydrocarbons is also reduced gradually in the oxygen enrichment system but the NO_x emission was increased it will reduce by using the exhaust gas recirculation.

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