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Investigation on the Performance and Emissions of Aloevera Blends with EGR System

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ABSTRACT: With the enormous energy demand and environmental concern the interest on the alternate fuels to the diesel engine has been increased. This simulated the world wide search for the renewable, less pollutant and agricultural based alternate fuel. In our country majority of the people lives in the villages and depends on the agriculture. Further, if this alternate fuel is prepared by the farmers, they become independent for their needs. Among all the crops, aloevera is best based on its properties. In the diesel engines much amount of heat is lost in exhaust. This heat can be utilized with exhaust gas recirculation system. The present experimental work is focused on the performance and emissions of the aloevera and diesel blends with EGR system. Here the EGR is maintained at constant (5%). The experiment conducted on single cylinder, four stroke, constant speed, water cooled, electric loaded, D.I Diesel Engine. The acquired data is analyzed for various blends of aloevera and diesel blends and the same is presented

KEYWORDS: Biodiesel, Aloevera ester oil, EGR.

I. INTRODUCTION

Aloevera Oil: Its scientific name is Aloe Vulgarize and is also called as Aloe Barbadensis. Aloevera plants are mostly used in Medical and cosmetic purpose. Now-a-days this can also be used as bio-diesel. The biodiesel oil can be prepared from the Aloevera plants by Maceration process.

Gajendra P. Sharma et al. done experiments on aloevera plant and concluded that this contains more constituents like sterols, amino acids, antraquinones, vitamins, minerals, saponines, lignin, polysaccharides etc. which is beneficial to humans.

V. Manieniyan et al. had done the experiment on single cylinder DI diesel engine with aloevera biodiesel with EGR. For 10% EGR the specific fuel consumption was lower compared to without EGR system. The performance and emissions are better due to the inherent oxygen content with biodiesel.

Pratibhu Roy et al evaluated the effect of EGR on NOx emissions and concluded that the EGR is a very useful technique for reducing the NOx emissions of diesel engines. Further it is observed that the smoke emissions are reduced with complete combustion where as the HC and CO emissions were increased with EGR system.

Pooja Ghodasara et al. worked on the reduction of NOX using biodiesel with EGR system and concluded. From the experiment, it can be suggested that 15% EGR is optimum for NOx reduction without significant penalty on brake thermal efficiency, HC and smoke capacity.

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Preparation of Aloevera biodiesel:

Aloevera is a very short stemmed succulent plant growing to 60-100 cm tall, spreading by offsets. The leaves are thick and fleshy, green to grey green with some varieties showing white flecks on the upper and lower stem surfaces. The aloevera plant is shown in the following figure 1 aloevera gel is shown in the following figure 2.

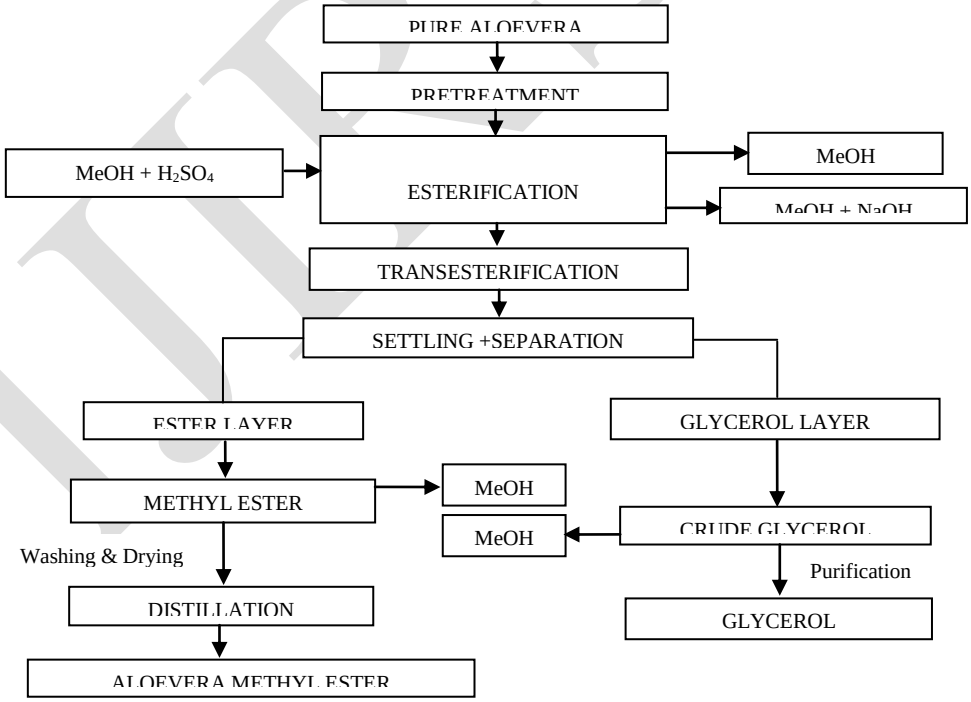
1

Fig.1 Aloevera Plant

2

Fig: 2 Aloevera Gel

Normally the aloevera leaves consists of more moisture in the form of flesh. The process of preparing the biodiesel from the aloevera plant is shown in the following figure 3 in the form of flow chart.



3

Fig: 3 Preparation of Aloevera Oil

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For the experiment the aloevera oil is blended with diesel fuel in various proportions and the properties are mentioned below.

Properties	B10	B20	B30	B40
Specific Gravity	0.859	0.868	0.877	0.886
Calorific Value (kJ/kg)	41022	38518	37907	33913
Flash Point (^oC)	52	58	64	70
Fire Point (^oC)	54	62	70	78
Kinematic Viscosity (cs)	5.705	8.71	11.715	14.72

Table: 1Properties of Aloevera oil at Various Blends

Experimental Procedure: The experiments are conducted on single cylinder, water cooled, four stroke 3.68 kW kirloskar diesel engines with EGR setup. It is connected from the exhaust manifold to the inlet manifold with required pressure gauges and gate valves. As the viscosity of the aloevera oil is slightly higher than diesel the fuel injection pressure is increased to 200 bar and is kept constant throughout the experiment. The experimental setup is shown in figure 4. Exhaust gas analysis system also connect to the engine to find out the emissions.

4

Fig.4 Photo View of the Experimental Setup

Exhaust Gas Recirculation System: Mainly at the higher temperatures in the combustion chambers Nitrogen reacts with the oxygen and forms NOx emissions. These emissions can reduce with the lower temperatures in the combustion chamber. The Exhaust gas recirculating system purpose is to reduce the NO_X. This was done by recirculating the certain amount of exhaust gases into the intake manifold. Then it mixed into the incoming charge. The result is to reduce the high combustion temperatures and pressures, and reducing the NO_X.

EGR ratio is calculated as:

$$EGR\ (\%) = (M_{EGR} / M_i) \times 100$$

Where

M_{EGR} = mass of recirculated gas

M_i = mass of total intake air of the cylinder

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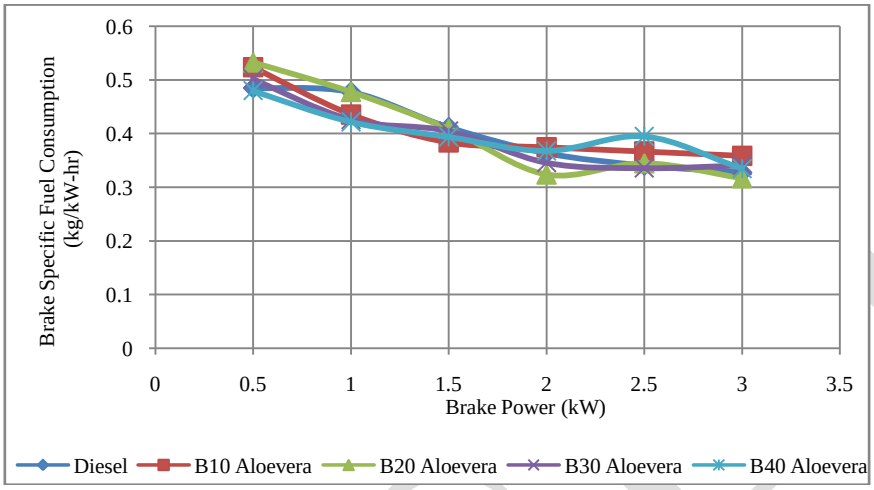
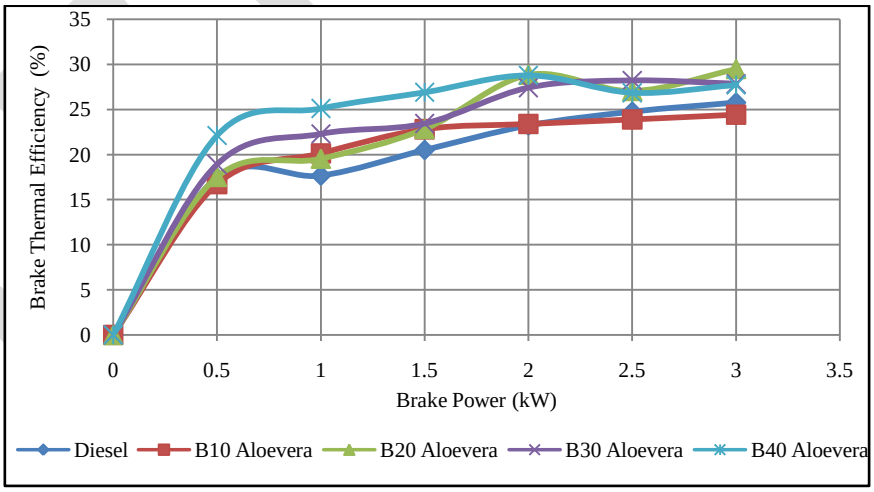
II. EXPERIMENTAL RESULTS

Experiments are conducted with various proportions of aloevera and diesel blends B10, B20, B30, and B40 with 5% constant EGR and the same thing is compared with pure diesel. The experimental results obtained are presented in the form of Graphs.



Graph: 1 Brake Power vs Brake Specific Fuel Consumption

Graph 1 shows the variation of BSFC for various blends of aloevera with the BP. It is observed that, BSFC for B20 is less than all other blends. This is due to the presence of oxygen in the aloevera oil. The oxygen acts as a combustion promoter which improves the combustion process and hence higher temperature in the combustion chamber. This makes the combustion complete. For B10 the BSFC is more because of less oxygen amount in that. For B30, B40 the BSFC is more and is due to its higher viscosity which reduces the combustion efficiency. Hence it is observed that, at rated load the BSFC for B20 is 0.334 kg/kW-hr. The BSFC for B10, B30 and B40 are increased by 11%, 4% and 14% respectively compared with B20.



Graph 2: Brake Power vs Brake Thermal Efficiency

Graph 2 shows the variation of Brake Thermal Efficiency (η_{bth}) for various blends of aloevera with the BP. η_{bth} for B20 is increased due to the less fuel consumption. For B10 the η_{bth} E is less due to the more fuel consumption. For B30, B40

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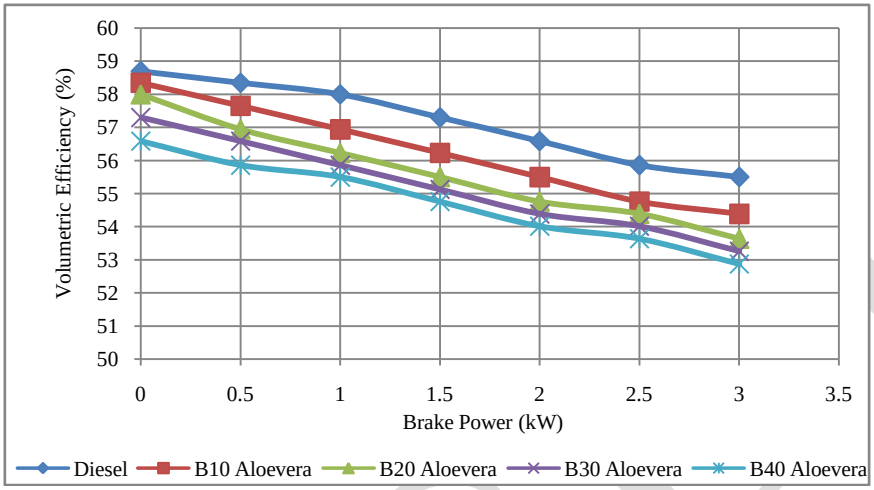
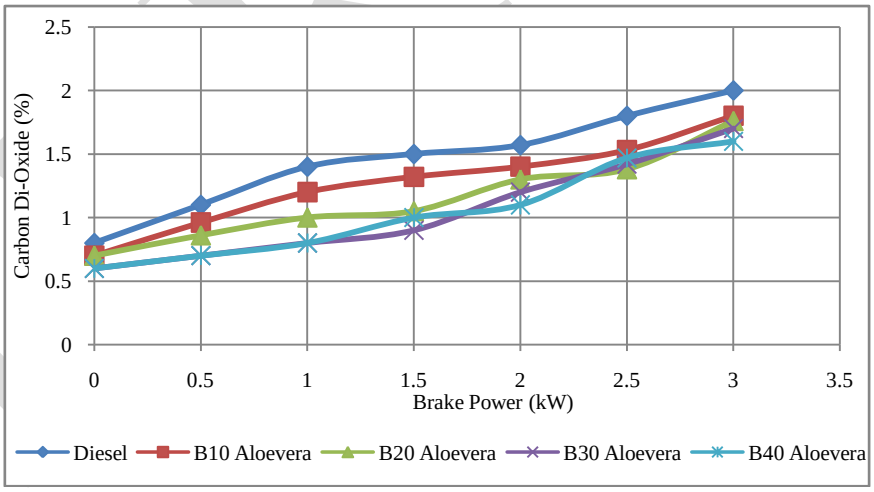
the BTE is increased initially but at rated load it is decreased due to the lower calorific value which reduces the thermal efficiency. Hence it is observed that, at rated load the η_{bth} for B20 is 27.93%. The η_{bth} for B10, B30 and B40 are decreased by 15%, 0.5% and 1% respectively compared with B20.



Graph 3: Brake Power vs Volumetric Efficiency

Graph 3 shows the variation of Volumetric Efficiency (η_{vol}) for various blends of aloevera with the BP. It is observed that, η_{vol} for B20 is increased due to the less fuel consumption. For B10, B30 and B40 are reduced due to the more fuel consumption. Hence it is observed that, at rated load the η_{vol} for B20 is 54.57%. The η_{vol} for B10 is increased by 1%. For B30 and B40 are decreased by 0.7%, 1.3% respectively compared with B20.



Graph 4: Brake Power vs Carbon Di-Oxide

Graph 4 shows the variation of CO_2 for various blends of aloevera with the BP. The CO_2 is greatly reduced when compared to diesel with the increase of aloevera blends. CO_2 is a by-product that is produced when the carbon from the fuel is fully oxidized during the combustion process. Hence it is observed that, at rated load the CO_2 for B20 is 1.34.

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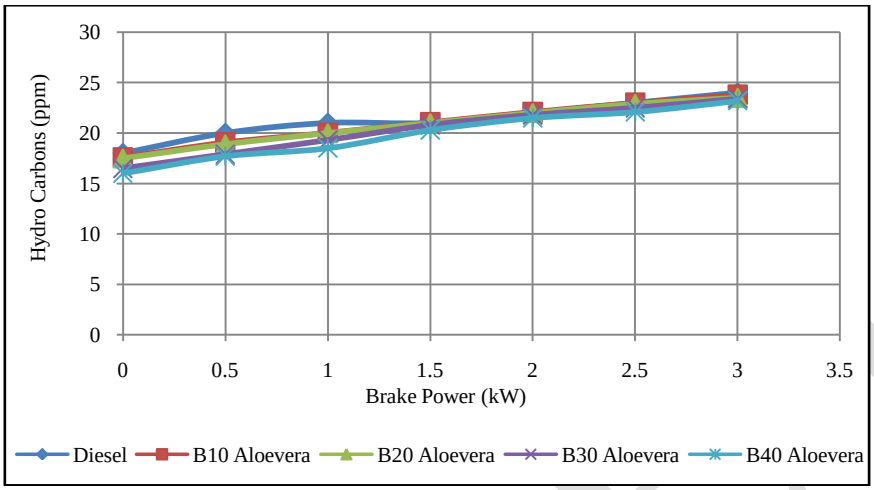
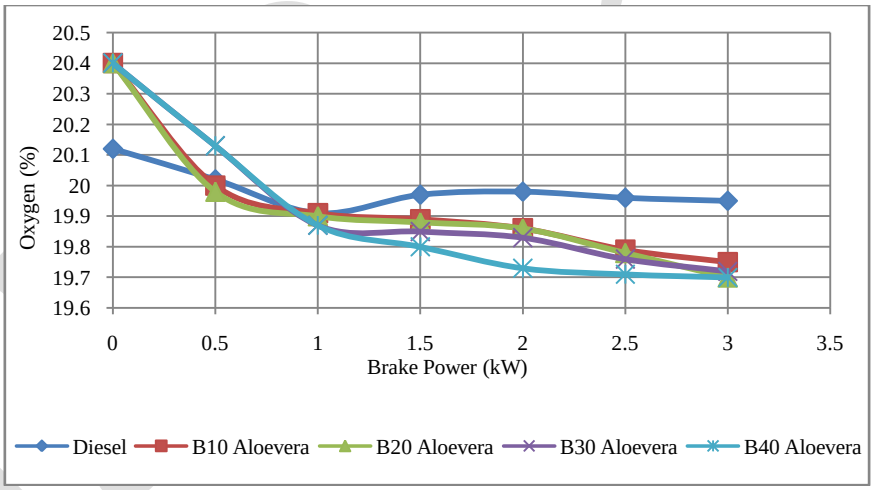
For B10 the CO_2 is increased by 8.9%. For B30, B40 the CO_2 is decreased by 2.2%, 4.1% respectively compared with B20.



Graph 5: Brake Power vs Hydro Carbons

Graph 5 shows the variation of HC for various blends of aloevera with the BP. It is observed that, the HC levels are reduced when compared to diesel while the compositions of aloevera blends are increased due to the oxygen supplementary are higher in biodiesel. Hence it is observed that, at rated load the HC for B20 is 22.45 ppm. For B10 the HC is increased by 0.4%. For B30, B40 the HC is decreased by 1.3%, 2.8% respectively compared with B20.



Graph 6: Brake Power vs Oxygen

Graph 6 shows the variation of O_2 for various blends of aloevera with the BP. It is observed that, the O_2isgreatly reduced in the exhaust when compared to diesel while the compositions of aloevera blends are increased with the increasing of the engine load. Hence it is observed that, at rated load the O_2 for B20 is 19.82. For B10 the O_2 is similar to B20. For B30, B40 the O_2 is decreased by 0.15%, 0.5% respectively compared with B20.

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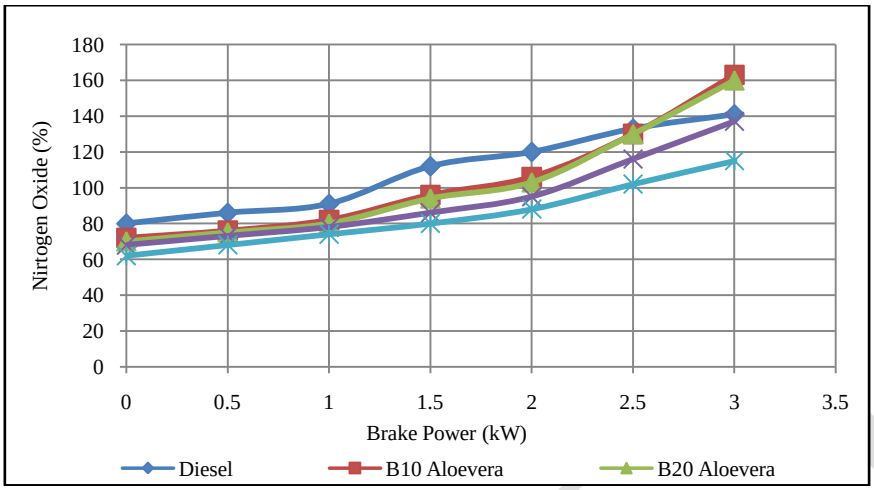

Graph 7: Brake Power vs Nitrogen Oxide

Graph 7 shows the variation of NO_X for various blends of aloevera with the BP. It is observed that, the NO_X is reduced when compared to diesel while the compositions of aloevera blends are increased due to increasing the specific heat in the combustion chamber. So it reduces the higher flame temperatures at rated load. Hence it is observed that, at rated load the NO_X for B20 is 116.5. For B10 the NO_X is increased by 1.3%. For B30, B40 the NO_X is decreased by 9.4%, 18% respectively compared with B20.

III. CONCLUSION

The conclusions are given below after the analysis of Performance and Emissions parameters of aloevera and diesel blend on C.I engine with exhaust gas re-circulation.

- The BSFC for diesel is increased by 5% compared with B20 aloevera.
- The η_{bth} for B20 aloevera is 27.93%. The η_{bth} for diesel is decreased by14% compared with B20 aloevera.
- The η_{vol} for B20 aloevera is 54.57%. The η_{vol} for diesel is increased by 3% to B20 aloevera.
- The CO_2 for B20 aloevera is 1.34. The CO_2 for diesel is increased by 25% compared with B20 aloevera.
- The HC for B20 aloevera is 22.45 ppm. The HC for diesel is almost similar compared with B20 aloevera.
- The O_2 for B20 aloevera is 19.82. The O_2 for diesel is increased by 1% compared with B20 aloevera.
- The NO_X for B20 aloevera is 116.5. The NO_X for diesel is increased by 8.5% compared with B20 aloevera.

Hence it is proved experimentally, for B20 aloevera the Performance is more and Emissions are reduced greatly.

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