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Performance and Emission Characteristics of Algae as Bio Diesel by Using Earth Alkaline Metals as Catalyst

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ABSTRACT

Due to the rapid growth of industrialization and population leads to energy demand. In future fuel consumption may leads to high, so there is need of alternative fuel is essential to manage the crisis of energy demand. The bio-diesel can be derived from many sources like vegetable oil, seed oil, animal fat etc..,. The major part in alternative fuel is extraction of oil and other further process of preparation from raw material. So this tends to promote the renewable resources to harvesting the bio-diesel from algae. The extraction oil from the biomass of algae collected from open pond system, the oil extracted by cold pressing method. This experiment aim is produce bio-diesel from algae oil and followed blend with diesel. The experimental setup has been performed to comparison between the diesel and three different blends along with bio-diesel (algal oil) to notice performance and combustion characteristics of VCR engine. The bio-diesel has been prepared by using transesterification method and Hcl is used as catalyst. There is a viscosity changes in algae oil which is converted into algal oil bio-diesel by transesterification process. Finally engine test is conducted at various loads at different ratio of blends and additive. Di-Methyl ether is used as a additive, that may increase the performance of engine. Then studies about the performance and emission characteristics of Variable Compression engine running with algal oil as bio-diesel blended with diesel. There is a differences had been noticed in performance of VCR engine by using diesel and bio-diesel blends with diesel.

KEYWORDS

Metals as Catalyst, Blends with Diesel, Consumption of Diesel.

Introduction

Now a Due to scarcity of crude oil and local government taxes are high for imported oil researcher are move to bio diesel for cost reduction of local automobile fuels. For bio diesel production edible oil is not preferable it will increasers the scarcity of edible oil so non edible oil is most suitable for production of bio diesel.

Biodiesel Production from Macro Algae as a Green Fuel for Diesel Engine by A.S. Ahmed they have taken different kind of algae for the preparation of algae oil. The sodium and potassium hydroxide like homogeneous catalyst that helps to enhance the reaction than heterogeneous catalyst, that's why they take base catalyst for transesterification. The solvent hexanes were mixed with the biomass and take to the grinding process. The oil expeller method is used to extract the algae oil from the collected sample. The maximum yield were occurs at increasing the ratio of KOH. At 1600rpm the maximum brake power obtained for B10 is 11.2kW and D100 is 10.3kW respectively.

Biodiesel from algae by A.Kleinova et al they cultivate the algae by photoautotrophic method by using photo bioreactor. It was closed pond system cultivation, it had been yield low algae production but again of oil content rate is high. There are so many techniques involves in oil production algae cultivation, microbes cracking, hexane solvent extraction, pressing etc.., the algae were cultivated in laboratory had been contain more oil content and pure itself.

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The potassium hydroxide is used as a catalyst to enhance the transesterification.

Methodology

Dried algae, soapy in nature and contain bit of moisture. The extraction of oil from biomass, there are several ways by using laboratory apparatus and some kind methodology. Thus there are some traditional techniques are involved in the extraction of bio fuel from algae lipids. By mean of mechanical crusher is used here, the algae lipids are crushed gently until to achieve the semi-solid state. The semi-solid paste is slowly stirred often with a crusher, which encourage the oil to separate from lipids. The crushed semi solid algae lipids paste were taken to next process. Cold pressing method is used to press out the oil from the paste. Then that's goes through a series of filters that separate the small unwanted particles and other impurities. After the filtration process is completed, oil is stored and allowed it cool at room temperature for any remaining unwanted particles are settle down after that decantation is carried out. The algae oil is separated from sediments. The appearance oil is in clear and brownish color. At the end of cold pressing method the volume of algae oil is 2L. Before transesterification process, the extraction of oil is allowed to cool at room temperature for several hours the immiscible particles are settle at bottom of container. Then the oil is separated from immiscible substance by decantation. The dried biomass of algae lipids contains some amount of moisture content, so there is water molecules are also present in algae oil.The pre-treatment is required to purify the extracted oil. It's a simple process the algae oil heated with 800 for about 15mins to remove the trace of water molecules and other volatile substances. The transesterification is method which is used to change the property oil into biodiesel. The density and viscosity is one of the most important properties of fluid. Then algae oil filled in a beaker and added with 10% of diethyl ether and 1% of catalyst as H2SO4. The magnetic stirrer is device is used for transesterification, in magnetic stirrer the pellet is performed to agitate the solution. By adding OH group mixture and catalyst that tend to get the product. The temperature was considering 700 as well as agitates at rate of 600rpm to 650rpm. Both heating and stirring process was conducted with 700 heating temperature and agitating rate within 1 hr. After transesterification remaining volume of oil is 1600ml. Blending is a process of mixing two fluids almost similar characteristics property by volume. The flavor of well-balanced mixture of two fluids is blending. Typically blending is required to reduce the consumption of diesel.

Catalytic Converter

Three major emission in automobile are hydrocarbon (HC), Nitrogen Oxide (NOx) and Carbon monoxide. Automobile emission is treated by before and after techniques to reduce the pollution. In this research take after techniques three way catalytic converter. In this technique reduce the emission by using chemical reaction. Now a days platinum, palladium and Rhodium used as a catalyst in catalytic converter but there are expensive so barium nitride, calcium nitride and zirconium oxide (ZrO2) are mixed and coated by spray pyrolysis methodology for catalyst in catalytic converter.

Experimental Work

The main objective of present investigation is to prepare the biodiesel from algae lipids. To achieve the desired objectives, the experimental work was carried out by following sequences. Prepare the algae oil from biomass. By using magnetic stirrer, we can obtain the both heating and agitating. Studying the biodiesel preparation, heating at 700 and agitate with 650rpm. By transesterification process we can change the properties of natural fatty matter with OH group and acid catalyst. In this process, the density and viscosity of oil is changed. Then the biodiesel is blended with diesel and additive, to evaluate the performance of VCR Used AVL 5gas analyzer to analyze the emission like Hydro Carbon (HC), Carbon Monoxide (CO) and Nitrogen Oxide (NOx) at different load condition.

Performance and Emission Characteristics

The comparison between diesel and four different blends of bio-diesel and additive with and without using catalytic converter.

Table 1. Indicated Power for different fuels without using catalytic converter

SPEED	LOAD	D100	D80B20	D80B10A10
1472	0.19	1.47	1.23	1.25
1459	2.79	2.15	1.57	1.6

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1442	5.78	2.82	2.12	2.22
1424	8.78	3.64	2.96	3.04
1405	11.65	4.18	3.18	3.18

Table 2. Indicated Power for different fuels with using catalytic converter

SPEED	LOAD	D100	D80B20	D80B10A10
1472	0.19	1.41	1.16	1.19
1459	2.79	2.08	1.41	1.52
1442	5.78	2.51	2.01	2.12
1424	8.78	3.01	2.80	2.92
1405	11.65	4.07	3.05	3.10

There is a similarity between the fuels except diesel the indicated power is quite closer to them. The indicated power of engine is high in diesel. It is the power that actually developed in the engine cylinder. The combustion of piston that achieves the work is indicated power. The biodiesel are slightly denser than the diesel, so the indicated power of biodiesel blends are lower than diesel but by adding additives it will improve the performance of the bio diesel.

Table 3.NOx emission without catalytic converter

NITROGEN OXIDE (NOx)

SPEED	LOAD	D100	D80B20	D80B10A10
1472	0.19	400	350	325
1459	2.79	750	681	602
1442	5.78	1150	1001	985
1424	8.78	1300	1152	1021
1405	11.65	1460	1241	1114

Table 4.NOx emission with catalytic converter

SPEED	LOAD	D100	D80B20	D80B10A10
1472	0.19	260	195	142
1459	2.79	480	314	281
1442	5.78	850	761	701
1424	8.78	980	892	811
1405	11.65	1050	943	893

By adding Bio diesel and additive NOx emission reduced approximately 15% from its original value due to bio diesel having low energy content engine temperature reduced so NOx emission reduced. Further by attaching catalytic converter NOx emission reduced 30% approximately.

Table 5. HC emission with catalytic converter

HYDROCARBON (HC)

SPEED	LOAD	D100	D80B20	D80B10A10
1472	0.19	51	56	57
1459	2.79	55	64	66
1442	5.78	62	76	79
1424	8.78	74	87	86
1405	11.65	113	121	118

Table 6.HC emission with catalytic converter

SPEED	LOAD	D100	D80B20	D80B10A10
1472	0.19	34	38	39
1459	2.79	37	43	44
1442	5.78	43	51	81

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1424	8.78	56	62	87
1405	11.65	68	81	120

HC emission slightly increases with adding bio diesel due to the incomplete combustion of bio diesel and additive added but it not helped in complete combustion. Catalytic converter reduced 20% approximately due to oxidation process.

Table 7. CO emission without catalytic converter

CARBON MONOXIDE (CO)				
SPEED	LOAD	D100	D80B20	D80B10A10
1472	0.19	0.08	0.11	0.09
1459	2.79	0.09	0.13	0.10
1442	5.78	0.12	0.14	0.12
1424	8.78	0.17	0.19	0.17
1405	11.65	0.28	0.33	0.29

Table 8. CO emission with catalytic converter

SPEED	LOAD	D100	D80B20	D80B10A10
1472	0.19	0.03	0.06	0.04
1459	2.79	0.04	0.08	0.04
1442	5.78	0.08	0.10	0.09
1424	8.78	0.10	0.13	0.10
1405	11.65	0.13	0.17	0.14

CO emission slightly increased with adding bio diesel due to high density of bio diesel compare to diesel but by adding additive it reduced the CO emission further by adding catalytic converter it reduced 15% approximately from original value due to oxidation process.

Conclusion

A detailed experimental study was conducted to evaluate and analyze the performance and emission characteristics of algal oil biodiesel and diesel blends in a fully instrumented single cylinder, variable compression ratio multi fuel engine.The property of oil get changed by transesterification method and using viscometer to determine the flow time of biodiesel. In this algae oil project, the blend of 20% biodiesel and 20% additive of diethyl ether is closely compare with some of performance and few other it show higher than the diesel. The blend 4(D60B20A20) had been increasing in brake power is 3.24kW at 11.65kg and the diesel had a maximum brake power is 3.11 at load 11.65kg. calcium nitride, Barium nitride and zirconium oxide used as a catalyst in catalytic converter to reduce the hydrocarbon, carbon monoxide and nitrogen oxide emission.

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