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EMISSION CHARACTERISTICS STUDIES ON BIODIESEL DERIVED FROM VEGETABLE OIL AND ANIMAL FAT

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Abstract

Bio-diesel is a mono- alkyl esters of vegetable oil or animal fat. Continuous use ofpetrol having high viscosity fuel or diesel leads to deposits inside the diesel engine. Thus improving the viscosity of vegetable oil or animal fat by blending, pyrolysis and emulsification does not solve the problem completely. But, it has been proved that trans esterification is the method to obtain ester from vegetable oil or animal fat.This paper provides a discussion on the fuel production, fuel properties, engine performances, emission characteristics, and impact of fuel.
Keywords : Bio- diesel, vegetable oil, animal fat..

Introduction

Carbon dioxide emission through engine exhaust is a big environmental issue. Researchers are focusing their research on this issue (Ghazvini *et al.,* 2019), (Ahmadi *et al.,* 2019), (Kumar *et al*., 2020). Bio–Diesel is produced from animal fats or vegetable oils. Bio-diesel is a mono- alkyl esters of vegetable oil or animal fat. Several type of fuels can be derived from triglycerides containing feed stock. Bio-diesel is a renewable Bio- degradable and non–toxic fuel. Continuous depletion of the reserves of non-renewable petroleum, price volatility, feed stock availability concerns have caused an intensified search for alternative sources of energy and when using high viscosity fuel or diesel leads to deposits inside the diesel engine. so, improving the viscosity of vegetable oil or animal fat by blending, pyrolysis and emulsification does not solve the problem completely. But, it has been proved that transesterification is the best way to produce ester from vegetable oil or animal fat.

In recent years, Biodiesel has attracted the attention of researchers for it is currently the only renewable energy source which can directly replace diesel in compression ignition engines. Current scenario of alternative arrangements of power generation energy resources and reserve in India is discussed (Kumar *et al.,* 2019).

Vonortas *et al*., 2005; Mythili *et al*., 2014; Machado *et al*. (2012); Reddy *et al*., 2005 and Sundaramurthy *et al*. (2014) and Azam *et al*. (2005) generally observedthe petroleum based fuels resulting major environmental problems that led to global warming, emission of CO, SO_2 and NO_x etc., Trabi *et al*. (1999), Hanna *et al*., 2005, Hansen *et al*., 2005 and Pramanik *et al*., 2003 emphasized the combustion product of diesel emission resulting the development of reduction in visibility, climate change, health problems and environmental pollution.

Singh *et al*. (2014); Anupam Kumar *et al*. (2017); Ambrish *et al*. (2013); Thakur Kumar *et al*. (2014); Kumar *et al*., (2014), Prabhjot Singh *et al*. (2018); Mehta *et al*. (2012); Praveen Kumar Sharma *et al*. (2018); Thakur *et al*., 2018, Suraj *et al*., 2018 and Amrinder Kaur *et al*., 2018, observed thatalternative fuels are easily available and derived from vegetable and animal fats. Trabi *et al*. (1999) obtained that bio-diesel produced from less expensive animal fats which are highly viscous fuel result in incomplete combustion. Transesterification process can be employed for animal fats in diesel engine.

Earlier studies Vijay Mishra *et al*., 2018; Monica *et al*. (2018), Apurna Joshi *et al*. (2018), Chander Prakash *et al*., (2018); VipinKumar Singh *et al*. (2017); Amit *et al*. (2018); Mankar *et al*. (2018) and Harish Modila *et al*. (2018) reported that biodiesel have produced from different sources like waste cooking oil and also have determined the density, viscosity, moisture content and acid value of the produced biodiesel. However, in the present work animal fat and vegetable oil has been chosen as raw material taking into consideration of its possible high triglycerides content to produce biodieselintensive method of transesterification.

Experimental Method: In the beginning, the round bottom flask heated to remove residual moisture. After that, it was cooled then 200 ml animal fat vegetable oil added in to flask. The oil then heated in a oil bath at 60^0 C and 0.5 gm NaOH and 200 ml CH_3OH were added and continued for 2 h, cooled by water and then continued for 60^0 C to which 0.5 gm Sodium methoxide added. Now the flask removed and cooled by water, two layers were formed. The top layer was bio-diesel. The bio-diesel was obtained after the top layer was separated and purified.

Source of bio-diesel

Animal fats are attractive feed stocks for bio-diesel because, their cost is substantially lower than the cost of vegetable oil. Since, much of the animal fat produced in the U.S is not considered edible by humans. Animal fat is currently added to pet food and animal feed used for industrial purposes such as soap making. Much of the domestic animal fat supply is exported. Animal fat feed stocks can be made into high quality bio-diesel. Waste fat from animal carcasses are removed and then made into oil using a rendering process. Rendering consists of grinding the animal by-products to a fine consistency and cooking them until the liquid fat separated and pathogens are destroyed. The solids are usually passed through a screw press to complete the removal of the fat from the solid residue. The cooking process also removes which makes the fat and solid

material stable against vancidity. The end products are fat and a high protein feed additive known as meat and bone meal.

Results and Discussion

Experimental set up for the use of bio-diesel in diesel engine can be shown in the Figure1.

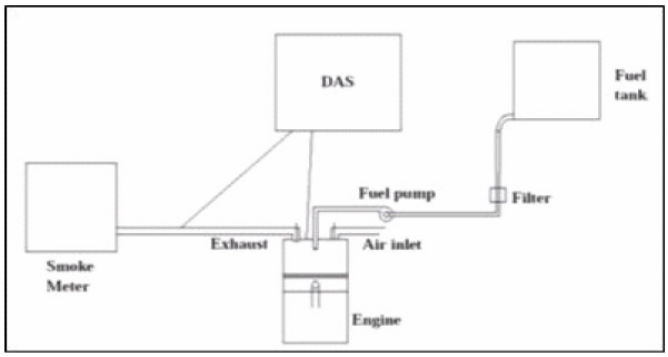

Fig. 1: Experimental setup

Table 1 : The various properties of fuel

FUEL PROPERTIES	DIESEL	BIO-DIESEL
Lower heating value	42	36.9
Specific gravity	0.85	0.88
Kinetic viscosity	3.05	6.0
Cetane number	47	56
Flash point	85	170
Fire point	76	136
Pour point	-4	-5 to 10
Cloud point	-10 to -15	-3 to 15

The various properties of bio diesel obtained by trans esterification method are given below in detail.

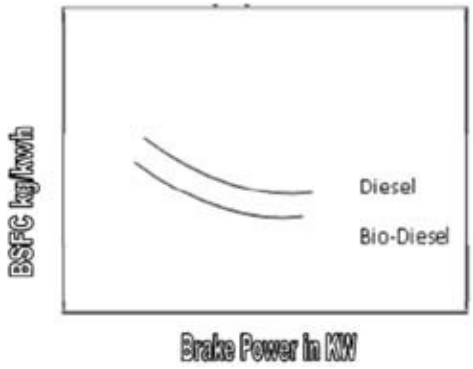

Fig. 2 : Engine performance

The Fig.2 shows fuel utilization of bio-diesel and diesel. From the results it is being observed that fuel consumption is higher for bio-diesel thandiesel. Because, there will be one plunger in fuel injection plump, that plunger will discharge more bio-diesel than diesel fuel.

Investigations offour approaches effectivelyused for bio-diesel, ethanol and diesel in diesel engine individually.

1. Ethanol + Diesel blends

Ethanol mixed with diesel from 0% to 15% in diesel engine. This experiment shows increase of NO_X (Nitrous oxide) and CO_2 as CO and HC emissions decreases with increased quantity of ethanol in fuel mixture.

2. Bio-diesel + Diesel blends

In this case, we observed that B100 (Pure biodiesel) lowered emissions of CO, NO_x, SO_2 and smoke opacity 15%, 38.5% and 72.7% and 56.8%. For B20 (Bio diesel 80+diesel 20), lowest CO, NO_x emissions and highest temperature were obtained. The B20 is an expected alternative fuel for diesel engine thereby could solve in controlling air pollution.

3. Bio-diesel + Alcohol blends

This combination was used for testing the effect of dilution. When the bio-diesel fuel can be replaced with bio-diesel-alcohol, the harmful effects can be reduced whileNO_x (Nitrous oxide) reductionincreased.

4. Bio-diesel + Diesel + Alcohol blends

In this combination resulted, a mix of 80% diesel, 15% bio-diesel and 5% ethanol considered to be the required ratio. The bio-diesel has lower calorific value 12% as compared to diesel. Flash and fire point are higher which are advantages for fuel transportation. When ethanol blended with diesel result in increase of NO_x (Nitrous oxide) and CO_2 emission. Cetane number is proportional to density value. Alcohol has low cetane number value when blended with diesel its value will be decreased.

Conclusion

The following conclusion can be drawn from the results: The vegetable oil and Animal fat are esterifies with methanol in presence of NaOH and then two layers formed. The upper layer is purified by distillation method, pure solution is obtained. The pure solution is subjected for engine performance. Emission of CO_2, carbon monoxide, sulphur dioxide, hydrocarbon are extremely low for bio-diesel prepared from Animal fat and vegetable oil than diesel. Emission of nitrousoxide is slightly low for bio-diesel compared with diesel. When alcohol is blended with bio-diesel and diesel density is decreased cetane number also decreases. The cetane number is responsible for combustion property of bio-diesel. This type of biodiesel is harmless to human beings and pollution free. Further studies can be initiated by modifying this method with use of different combinations of fat and blends to establish the hydrocarbon contents.

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