Impact of Natural Additives on the Performance of a Bio-diesel Fuelled Diesel Engine

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Abstract—The biodiesel is a renewable alternative to the fossil diesel as the properties of the bio-diesel is like to the fossil diesel. However, the bio-diesel have lower volatility and has lower oxidation stability. Hence, in this work we have chosen the Black seedoil, clove oil + Pg and turmeric oil as a natural additive for the honge biodiesel. Anti-oxidative properties and stability of ethanolic extracts of Black seed oil, clove oil + Pg and turmeric oil is studied. Along with that constituent’s black seed, turmeric oil and clove oil+ accounting a 90% of essential oil content which preferred as additive to the biodiesel. Also, we calculated the effect of these additives on the fuel properties of the bio-diesel and its impact on compression ignition thermal efficiency and exhaust emissions. The additive concentration ratio of binary anti-oxidants is the key factor to get best synergy for greatest stabilization. In an engine, temperature has reaction completeness is the most critical fuel quality parameter as well as engines’ durability and reliability. By adding natural additives to the biodiesel, as the amount of concentration increases it led to reduction in hazardous emissions through engine exhaust like NOx, CO2, HCs, CO decreases. But the O2 content increases in an engine exhaust. All these emissions are as compared with conventional diesel which gives the best results for lowering the environmental pollution. As the proper qualities of biodiesel blends met by adding these naturally available additives, these biodiesel blends can be used in most modern engines.

Keywords: Biodiesel, Black Seed oil, Clove Oil, Turmeric, Additives

I. INTRODUCTION

From day to day, in modern society, unconventional energy sources are constantly expanding due to the growing demand of the use of petroleum products as follows petrol, kerosene diesel and white gasoline. India imports over 70% of oil based goods from different nations. That is the reason you have to locate an elective fuel. Biodiesel is viewed as a satisfactory option in contrast to diesel. Nonetheless, it has less oxidation security. In this manner, we discovered added substances for reasonable powers that can be included with bio-diesel. Biodiesel, a substitute for fuel acquired from an collection of fats, oils and fats, is important to ranchers for a few reasons: it be able to offer an extra promote to vegetable oils & creature fats, be able to enable ranchers develop fuel it requirements for farming hardware, and can diminish the country's reliance on import oil, since the fuel crude material can develop in the nation. It is a sustainable power source that can be help limit ozone depleting substances out flowing and reduces agriculture's carbon impressions. It is contributes least to an Earth-wide temperature boost in light of the fact that can carbon in fuel has been expelled on from the a air by the plants crude material.

II. MATERIALS AND METHODOLOGY

- Alternative fuels: Hongo biodiesel
- Natural additives: Black Seed oil, Turmeric oil, Clove oil + Propyl Gallate
- Mixing ratio: 500, 1000 and 1500 ppm with the biodiesel
- Determination of fuel properties: As per ASTM Procedures
- Engine test setup: Diesel engine experimental setup
- Engine Exhaust Emission Analyzer: AVL Exhaust Gas Analyzer
- Engine Exhaust smoke Analyzer: Smoke meter test setup

Biodiesel manufacturing is the method of manufacturing biofuels, biodiesel, through chemical reactions of transesterification and an esterification. includes vegetable or animal fat and oils that react with short chain alcohols (generally methanol or ethanol). The alcohols used want to be of low molecular weight, with ethanol being the maximum used due to the low rate; however, it is viable to acquire higher conversions in biodiesel using methanol. although the transesterification response which may be catalyzed through using the use of acids or bases, the most commonly used approach of producing is catalyzed transesterification. This path has decrease reaction times and catalyst expenses than those presented via manner of acid catalysis. however, alkaline catalysis it has a first-rate drawback of fairly sensitivity, which is observed in both water and loose fatty acids gift within the oils. a primary constituent of glyceroides tri the use of anhydrous alcohol within the presence of a base chain together with a sodium hydroxide as catalyst produces the monoaalkyl fatty acid ester (reputation), this is known as biodiesel and glycerin as a derivative, as shown in figure.

A. Oil Extraction:

The hongo seeds are overwhelmed in a screwdriver to extract the oil. The crude oil turned into then filtered and used for biodiesel production. The productions of a bio-diesel from waste vegetable oils offers a 3-sided, financial, nature and waste management solution.

The time period "used vegetable oil" (WVO) refers to vegetable oil that has been utilized in meals manufacturing and is not usable for its intended use. India’s biodiesel processing capacity is predicted at six hundred,000 lots regular with 12 months. Used cooking oil (WCO) is a residue of a ramification of assets, which includes consuming places, Commercial Corporation or domestic elements, which no longer handiest harm human fitness, but also cause environmental troubles. But, OMA can be used as a uncooked cloth for biodiesel production. On this manner, the producing of biodiesel from OMA to partly update petroleum diesel is an opportunity way of protective the environment and electricity protection. The american Society for testing and
materials (ASTM) defines biodiesel gas as monoalkyl esters of prolonged chain fatty acids in derived from a renewable lipid uncooked cloth, along with vegetable oil or animal fat. Determine 4.2.2 shows the steps worried in getting prepared the Honge oil.

The types of biodiesel can be a classified according to their origin and the production process, as follows:
1. Esterificated oils 2. Non-esterificated oils
3. Waste vegetable oils

B. Steps Involved in Biodiesel Production:
1) Pre-treatment for high ffa oils
The oils are glycerol esters of fatty acids, glycerine molecules and oily acids, these triglycerides a oxidized to unfastened acids (FFA) in the course of storage, these free oily acids form soap throughout the transesterification process. If the FFA exceeds three%, biodiesel restoration is appreciably reduced. consequently, an acid remedy is administered at some stage in which the FFA are transformed to biodiesel with the aid of acidification of the acid. Vegetable oils that have a low content material of loose fatty acids (less than 3%) can be converted to biodiesel through direct transesterification. The acidification of the acid changed into done the usage of focused sulfuric acid as catalyst and FFA40:1. The volume of H2SO4 (ml) asked changed into decided through (FFA weight * zero.05) / H2SO4 density) the burden of FFA in a liter changed into determined primarily based at the acid variety. The methanol-H2SO4 mixture was introduced slowly and allowed to react for 1 hour. After the reaction turned into completed, the aggregate was stored for an hour, forming a skinny layer wealthy in better acid. The top level became discarded and the lower level become analyzed to decide the FFA content material.

The decrease layer changed into then subjected to a transesterification manner. The required amount of catalyst became decided through titration as shown in figure.

C. Titration Testing:
The amount of NaOH required to neutralize the FFA gift in the oil was determined with the aid of titration checking out the usage of known awareness NaOH solution. generally, the oil without FFA requires three.5gNaOH for transesterification. more quantity of NaOH need to be brought to neutralize FFA which consequently shaped into cleaning soap.

The total amount of catalyst (NaOH) required for the reaction was calculated by using the formula
Amount of NaOH required Amount of NaOH required Transesterification of + for neutralization of FFA Triglyceroids (3.5 g ) (titration)

The biodiesel was then dried by heating at 110℃ till the humidity content be removed wholly. It was frozen and clean, then subjected for further analysis. Figure: shows the biodiesel washing with water and drying of Biodiesel using heating.
III. ADDITIVES

A. Black Seed Oil:
The Black Seed oil has good antioxidant properties and hence it will be used as additive in this work. It contains thymoquinone, which is an anti-inflammatory compound, antioxidant and hence it has better antioxidant activity. Figure 4.3.1 shows the Black seed oil.

B. Turmeric oil:
The Turmeric oil has good antioxidant properties and hence it will be used as additives in this work. The data indicated the presence of twenty-five compounds in turmeric oil. Aromatic in turmerone, α-zingiberene, β-(Z)-farnesene, aromatic curcumene, turmerone and the Curlone are the major compounds as in turmeric oil. Figure 4.3.2 shows the Turmeric oil.

C. Clove oil + Pyrogallol:
Clove oil is a mixture of different compounds, with the three main active ingredients being eugenol, eugenyl acetate and caryophyllene. Figure 4.3.3 shows the Clove oil. It has essential oil content about 87%, which can be used as a natural additive.

D. Sample Preparation:

IV. EMISSION TEST

An emission screening cycle, it is a protocol and it accommodate in an emission general to permit new release and parallel measurement of exhaust emissions for one-of-a-kind vehicles. Vehicle is operated while cycles specify the specific situations below which the engine sooner or later of the emission check. There are numerous methods to test series issued by means of the usage of diverse national and international governments and operating organizations. Particular parameters in a test cycle, it includes a variety of pace, load and working temperature. Theoretically those are particular as to mainly and nearly represents the variety of situations underneath which ther engine may be operated in actual use. Due to the fact it’s far unrealistic to check an engine or vehicle below each practicable aggregate of pace, load, and temperature, this could no longer literally be the case. Car and engine producers may capitalize the restricted range of take a look at new release situations within the cycle via the usage of programming their engine management systems to control emissions to regulated ranges on the suitable test factors contained in the cycle, but generate a splendid deal more pollution under situations completed in real operation but now not represented in the check technology. The ones consequences in real emissions higher than the requirements are imagined to allow, reduces the necessities and public health as shows in figure 4.9.

A. ASTM Procedure:
heat up time: 7min.
Operating- temperature: 5 to 45OC
Relative- Humidity :< 95 percentage
Interface: RS232C; pickup, oil- temperature probe.

B. Smokemeter Test
Smoke capacity units degree the optical homes of diesel smoke, introducing a slanted method to quantify diesel
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particulate discharges. There are organizations of units: darkness meters, which assess smoke in fumes gases, and smoke assortment meters, which optically check the sediment assembled in paper channels. Connections were progressed to evaluate PM mass outflows essentially dependent on obscurity estimate. Second-generation opacity meters based totally absolutely actually at the diffusion of laser mild are masses extra sensitive and appear promising for utility to extra modern engines with a lousy lot lower particle emissions. Diesel Exhaust Smoke meters, additionally known as opacity meters, discover and measure the quantity of moderate blocked in a pattern of smoke emitted through diesel engines from automobiles, cars, ships, buses, motorcycles, locomotives and massive stacks from commercial operations. The smoke meter readout shows the smoke density giving a diploma of the performance of combustion. This makes the smoke meter an terrific diagnostic device to make certain proper protection of diesel engines for stepped forward fuel financial system and protection of the surroundings.

Partial drift non-stop gasoline sampling blended with a heated and temperature-controlled smoke chamber compensates for adjustments in strain and check situations to provide you the most accurate readings possible.

All cutting-edge Diesel Exhaust Smoke Meters need to diploma diesel emissions (darkish smoke) in Opacity (N) and/or Smoke Density (ok) in line with SAEJ1667.

There become quite some misconception approximately the Diesel Exhaust monitoring and size in recent times all constant with the sector's requirement to lessen CO2 emissions. This is why the government introduced a by way of manner of regulation-model for adoption via the one of a kind municipalities in SA as an smooth manual as indicates indicates in figure.

V. RESULTS AND DISCUSSIONS

A. Load V/s CO

CO emission at distinct engine loads and with exceptional fuels and additives. From the figure, it's miles found that the version in CO emission is low at low loads. However, the version is full-size at higher hundreds because of consumption of huge amount of fuel. The diesel gasoline consequences in better CO emission in comparison to biodiesel. The biodiesel is brought with components because of in decreasing CO emission.

B. Load V/s Hydrocarbons

Variation of HC’s emission at different engine loads and with different fuels and additives. From the figure, it is observed that the variation in HC’s emission is low at low loads. However, the variation is significant at higher loads due to consumption of large amount of fuel. The diesel fuel results in higher HC’semission as compared to biodiesel. The biodiesel is added with additives due to in lower HC’s emission.

C. Load V/s NOx

NOx emission at different engine loads and with different fuels and additives. From the figure, it is observed that the variation in NOx emission is low at low loads. However, the variation is significant at higher loads due to consumption of large amount of fuel. The diesel fuel results in higher NOX emission as compared to biodiesel. The biodiesel is added with additives due to in lower NOX emission.

D. Load V/s CO2
CO2 emission at different engine loads and with different fuels and additives. From the figure, it is observed that the variation in CO2 emission is low at low loads. However, the variation is significant at higher loads due to consumption of large amount of fuel. The diesel fuel results in higher O2 emission as compared to biodiesel. The biodiesel is added with additives due to in lower O2 emission.

VI. CONCLUSIONS

The biodiesel is a renewable alternative to the fossil diesel as the properties of the bio-diesel is like to the fossil diesel. However, the bio-diesel have lower volatility and has lower oxidation stability. Hence, in this work we have chosen the Black seedoil, clove oil + Pg and turmeric oil as a natural additive for the honge biodiesel. Anti-oxidative properties and stability of ethanolic extracts of Black seed oil, clove oil + Pg and turmeric oil is studied. Along with that constituent’s black seed, turmeric oil and clove oil+ accounting a 90% of essential oil content which preferred as additive to the biodiesel. Also, we calculated the effect of these additives on the fuel properties of the bio-diesel and its impact on compression ignition thermal efficiency and exhaust emissions. The additive concentration ratio of binary anti-oxidants is the key factor to get best synergy for greatest stabilization. In an engine, temperature has reaction completeness is the most critical fuel quality parameter as well as engines’ durability and reliability. By adding natural additives to the biodiesel, as the amount of concentration increases it led to reduction in hazardous emissions through engine exhaust like NOx, CO2, HC’s, CO decreases. But the O2 content increases in an engine exhaust. All these emissions are as compared with conventional diesel which gives the best results for lowering the environmental pollution. As the proper qualities of biodiesel blends met by adding these naturally available additives, these biodiesel blends can be used in most modern engines.

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