Fabrication of Small Scale Biodiesel Plant

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***Abstract*- This paper gives details of work carried out in developing assembly of a prototype semi-continuous batch biodiesel production plant that is not only portable but also suitable to support rural. The new process technologies developed during the years made it possible to produce biodiesel from recycled frying oils comparable in quality to that of virgin vegetable oil biodiesel with an added attractive advantage of being lower in price. Population that wish to become self-manufacturer of biodiesel. Biodiesel is produce by transesterification reaction in which oil is mixed with methanol & potassium hydroxide (KOH) or sodium hydroxide (NaOH) and heating at 40-60 Celsius .The Crude Oil and Alcohol is use for Biodiesel and Glycerin. The new process technologies developed during the last years made it possible to produce biodiesel from recycled frying oils comparable inequality to that of virgin vegetable oil biodiesel with an added attractive advantage of being lower in price. The main aim of this research is to incorporate suitable design modifications in biodiesel plant to improve oil recovery and good quality of fuel from vegetable oil or animal fat using transesterification process.**

Index Terms- Biodiesel Plant, Design Modifications, Oil Recovery, Transesterification.

INTRODUCTION

The concept of bio-fuel is not new. Rudolph Diesel was the first to use a vegetable oil (peanut oil) diesel engine in 1911.Wherein pure vegetable oils were used in diesel engines for agriculture, where petroleum diesel was not available. Biodiesel is a renewable alternative fuel created from vegetable oils, animal fats and greases through a chemical process. The chemical process involves reaction of natural oils with an alcohol in the presence of a catalyst (usually sodium hydroxide [NaOH] or potassium hydroxide [KOH] and then refining the mixture to create molecules which can be easily burned in a diesel engine[13]. Blend of 20% to 80 % with petroleum diesel. Indian approach towards the development of biodiesel program is different than the other parts of world[2] . Diesel fuels are used in passenger vehicles, city buses, locomotives, electric generators and others and they have an essential function in the industrial economy of a country it is clear that the supply of fossil fuels. The diesel engine has the benefit of running more fuel-efficiently than gasoline engines due to much higher compression ratios and longer duration of combustion, which means the temperature rises more slowly, allowing more heat to be converted to mechanical work. Diesel was interested in using vegetable oil as fuel, and in fact, his engine was run on peanut oil.[1]Its primary advantages are biodegradable, renewable, carbon neutral and do not produce hazardous toxic gases [6].Among this, biodiesels have received increasing attention as an alternative fuel because they can be employed in diesel engines without needing modification. Furthermore, fuel properties of biodiesel are almost similar to diesel fuel. Biodiesel plant is portable and essay to use biofuel in diesel engine.

LITERATURE REVIEW

Biodiesels have higher viscosity than diesel oil and preheating is used to reduce the viscosity [8]. This approach is to improve combustion without modifying the engine design. Pure vegetable oils were used in diesel engines. Oil blends. Performance included the comparison of Load and Brake thermal efficiency, Load and brake power and load and BSFC (brake specific fuel Consumption).The Blends used were proportions and found that Brake Power does not get much effected in these proportions, Brake

specific fuel consumption is Higher due to lower calorific value of biodiesels and brake thermal efficiency is higher.

PROPOSED METHDOLOGY

In the present work, performance of the use of biodiesel has been verified experimentally on a 4-stroke compression ignition engine. Normal and preheated biodiesel has been used. The experiments have used vegetable oil. The properties of these can be compared favorably with the internal combustion engine fuels specially diesel engine. Experiments will performed for three compression ratio i.e. 16, 17 and 18 using biodiesel diesel. The rpm of engine with pure diesel is 1267 and with increasing blend, it continuously decreases and with pure biodiesel or B50 it is 560. But after heating process RPM of engine increasers. RPM before heating 740, 580 and 479 and after heating it increased 920, 730 and 628 respectively which is 25% to 35% higher than normal fuel.To produce biodiesel for diesel engine by using waste vegetable oil or animal fat with alcohol like methanol or ethanol & potassium hydroxide (KOH) or NaOH.

DESIGN OF BIODIESEL PLANT

Biodiesel production process is carried out in three steps pre-treatment, biodiesel production process and purification i.e stturing, separating, & washing. Since this project deals with design modifications of existing plant at IBDC(International Bicycle Design Competition) to oil recovery and quality of fuel[7]. Following are the design parameters which has maximum influence on oil recovery. Design of Reactor Vessel: Biodiesel reactor vessel design was modified with eliminating pre-treatment vessel and carrying out esterification and biodiesel production process in same reactor vessel without affecting quality of methyl ester produced.

Figure01 Biodiesel Reactor

Sizing of reactor unit 50liters capacity of reactor vessel suitable for batch production system was designed. Sizing calculation for reactor vessel is done according to [7].

DESIGN CONDITIONS FOR REACTOR VESSEL

Design Pressure: According to standards, design pressure (internal) should be equivalent to pressure set for relief valve. Internal pressure (gauge) (Pg.) is taken as 25kpa and hydrostatic pressure is calculated. Assuming average density of feedstock oil as 920 kg/m3 and liquid height approximately 500mm Design Temperature: Generally transesterification process is carried out at temperature range of 50-60 °C. Maximum operating temperature of reactor vessel was taken as 40°C with 50°C additional safety margin. Therefore design temperature was taken as 40°C which facilitate in selection of design of heating element.

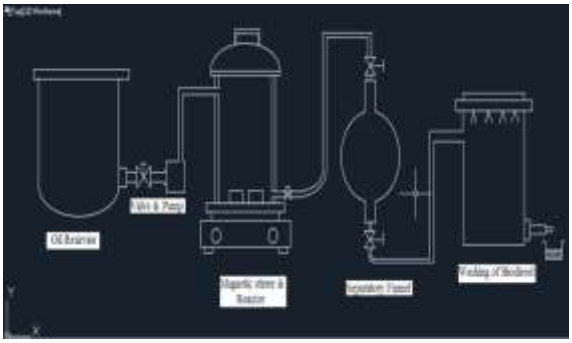

Figure 02 Proposed Biodiesel plan

MATERIAL SELECTION

Selection of material for biodiesel production process was done according to design conditions. Also material should be capable to withstand chemical reactivity during process. Material is selected according to manufacturer's recommendation for the design of reactor vessel and carbon steel for the structure of biodiesel plant structure.

DESIGN OF MIXING / SEPARATING MECHANISM

Design of mixing mechanism is a critical parameter since it affects reaction time need to complete the transesterification process and ultimately quality of

biodiesel fuel. Mechanical agitator or stirrers are commonly used for mixing purposes. Considering economic feasibility and safety constraints as mechanical agitators are more prone to ignition and electric spark it may cause explosion. Mechanical agitators were replaced by Jet mixing mechanism as shown in fig has significant oil recovery in comparatively less reaction time[9]. Design of Jet mixing mechanism includes calculation of various design parameters such as

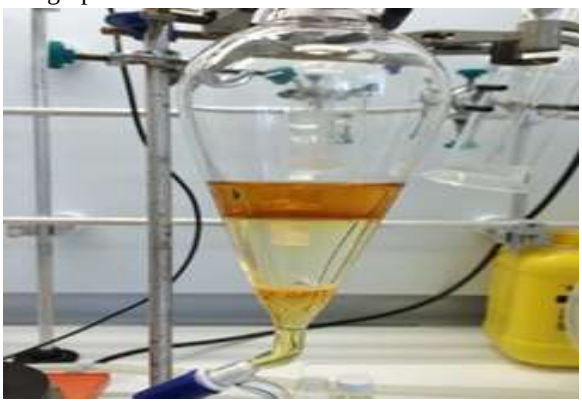

Figure03: Separator

Di= jet nozzle diameter

Vc = critical velocity

Qc= jet velocity and minimum circulation rate

Jet nozzle diameter According to single side entry nozzle was selected according

$0.25<H/D<1.5$

Where H = Liquid height in tank

D = Diameter of reactor vessel

According to it was reported that liquid height in the tank should be within 0.25 to 1.5 times diameter of the reactor vessel. Generally higher H/D ratio is recommended for better mixing ability. Therefore the liquid height of reactor H was estimated to 490mm.

Design of settling unit: Settling unit or storage tank design was modified to equipment with air spraging system to carry out biodiesel washing process. Maximum volume of settling tank was designed to handle 50 liters of reactants. It was recommended to design settling tank with additional 10 % volume (i.e. 5 liters) to accommodate liquid variations during biodiesel washing process.

Table 01:Equipment Use in Biodiesel plant:

Sr.No	Equipment	Qty.Nos
1	Reservoir (7 Lit)	2
2	Reactor (7 Lit)	2
3	Magnetic Stirrer	1
4	Chemicals & Oil	-
5	Filter	1
6	Tubing (10 Ft Approx.)	-
7	Washer	1
8	Separator	1
9	Pump	1
10	Miscellaneous	-

Health & Safety aspects:

Biodiesel and their blend stocks are biodegradable, which may render them useful in applications where biodegradability is desired (e.g., marine) application Emissions from engines using biodiesel blends have undergone successful health effects testing. Biodiesel blends with diesel are reported to reduce particulate, HC and CO emissions.

Biodiesel has a higher flash point than petroleum-based diesel fuel, which allows for transportation and storage without the restrictions associated with flammable materials.

Biodiesel contains no hazardous materials and is generally regarded as safe. A number of studies have found that biodiesel biodegrades much more rapidly than conventional diesel. Users in environmentally sensitive areas such as wetlands, marine environments, and national parks have taken advantage of this property by replacing toxic petroleum diesel with biodiesel. The flash point of biodiesel is higher than 100C°, so it is considerably less dangerous as compared to Kerosene (flash point-38 C° to 72°C) and diesel flash point-52 C° to 96°C). However, biodiesel blends will have flash points intermediate to the two liquids.

ADVANTAGES

Biodiesel is a renewable energy source unlike other petroleum products that will vanish in years to come.

Since it is made from animal fat and vegetable oil it can be produced on demand and also causes less pollution than petroleum diesel.

One of the main advantage of using biodiesel is that can be used in existing diesel engines with little or no modifications at all and can replace fossil fuel to become the most preferred primary transport energy source.

It improves engine lubrication and increases engine life.

Fossil fuels when burnt release greenhouse gasses like carbon dioxide in the atmosphere that raises the temperature and causes global warming.

Fossil fuels are limited and may not be able to fulfill our demand for coal, oil and natural gas after a certain period.

Biodiesel can work as an alternative form of fuel and can reduce our dependence on foreign suppliers of oil as it is produced from domestic energy crop

Vehicles that run on biodiesel achieve 90% fuel economy than petroleum based diesel engines.

Biodiesel produce less toxic pollutants than other petroleum products.

CONCLUSION

The Fabrication of small scale biodiesel plant is study of various types of oil to production of biodiesel and use of vegetable oil. The safety of gear Dust mask or cartridge respirator and essay to work. The small-scale biodiesel production can be conducted in a safe and environmentally responsible manner which generates a quality product.

It is however, important to ensure that best management practices are followed in order to protect the health and safety of the producer and the environment, and to minimize the risk of vehicle/machinery problems. While we have tried to cover all aspects of small-scale production. Biodiesel derived from vegetable oil or animal facts, is recommended for use as a substitute for petroleum based diesel mainly because biodiesel is a renewable domestic resource.

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