Modeling and Construction of Bio-Diesel processor

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***Abstract*- Bio-Diesel the word itself defines almost all the features of the Bio-Diesel literary. In the Era of this Global warming where the people are making their living more and more comfortable and they are deteriorating the environment also. The uses of the automobiles with the conventional source of fuel leads to the production of the toxic gaseous substances like carbon monoxide, carbon dioxide, oxides of nitrogen, oxide of sulphur, hydro-carbons etc. The limitation comes with the rise in the price of the fuel as well as the produce of the green house gases as the exhaust gas. In the present study, a new method has been employed to produce Bio-Diesel. The production of the Bio-Diesel is done by using Bio-Diesel processor. It requires the used vegetable oil, methanol and the lye with the accurate proportionate. The objective of this paper is modeling and construction of Bio-Diesel processor and produces the Bio-Diesel by using the Bio-Diesel processor.**

Keywords: Bio-Diesel, Vegetable oil, Bio-Diesel Processor, modeling, construction.

I. INTRODUCTION

With the exhaustion of fossil fuel in the near future, the need to find a renewable energy sources becomes more and more important all over the world. Bio-diesel originating from vegetable oils and animal fats has characteristics similar to petroleum-derived diesel oil and has received considerable attention in recent years as a substitute fuel for diesel engines [Gui et al]. Currently, about 84% the world bio-diesel production is met by rapeseed oil. The remaining portion is from sunflower oil (13%), palm oil (1%), soybean oil, and others (2%) [Themes P].The major hurdle of widespread bio-diesel industrialization is the high cost of feedstock oil [. Kulkarni M.G et al]. One way of reducing the cost of biodiesel production is to employ waste oil as feedstock, such as waste cooking oil, oil deodorizer distillates, stale non-edible oils, and so on[Canakci M.]. The technologies for converting waste oil to bio-diesel are well established, which include alkali [Hass M.J et al],acid[Canakci M et al], or no catalytic reaction in supercriticamethanol [Kusdiana D.et al]. Due to the presence of considerable free fatty acids (FFAs) in such feedstock, the alkali-catalyzed process is not recommended because a large amount of soap byproduct is formed during reaction, which creates a serious problem of product separation and ultimately lows the yield substantially [Canakci M et al]. Bio-diesel can be Produced from non-edible oils[Murugesan A.,et al] The bio-diesel yield can achieve 85.6 – 97.1 % under the following operating conditions: used vegetable oil to methanol molar ratio 1:9, reaction temperature 60°C, and reaction time 4 hours. The effects of several crucial variables in a packed column reactor were also studied, such as reaction temperature from 40°C to 80°C, molar ratio of oil/methanol from 1:3 to 1:15, and reaction time from 2 to 6 h. [Lui yun et al]. The impurities, excess methanol, and glycerin all eventually settle to the bottom of mixing tank after the batch is properly mixed under certain condition like constant. Before the production of Bio-Diesel, the Bio-diesel processor is to be designed and constructed. This paper investigates the modeling and construction of the Bio-diesel processor and the properties of produced Bio-Diesel by using Bio-Diesel processor.

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II. EQUIPMENT AND PROCEDURE

1) *Bio-Diesel processor*

The fig1 shows the schematic diagram of Bio-Diesel processor (BDP) has a reservoir tank which is having the 30 liters capacity. Put 15 Liters of used vegetable oil that has been strained into the 30 Liter drum set up on Frame 1. Hook up the mixer unit in Frame 2 which has the mixing tank with stirrer.. Turn on heater which is under the reservoir tank at Frame 1 and get the oil heated up to 135̊F. The Digital thermometer is used to check the temperature. Heating the oil will melt any partially hydrogenated vegetable oil in the batch and will allow for a more thorough chemical reaction to take place. When the batch of oil, is heated to the required temperature then turn off the heater and drain the Used Vegetable Oil from 30 Liter drum Reservoir Tank after opening the check valve. The UVO will be gravity feed down to the Methanol, Lye and UVO Mixing Tank. Then the filtered and the heated Used Vegetable oil are mixed with the Methanol and Lye (Sodium Hydroxide) in the mixing tank. The speed of the motor fitted in the mixing tank can be controlled with the help of the regulator. The stirring of the mixture need vigorously fast so that the chemical reaction should take place with effect.

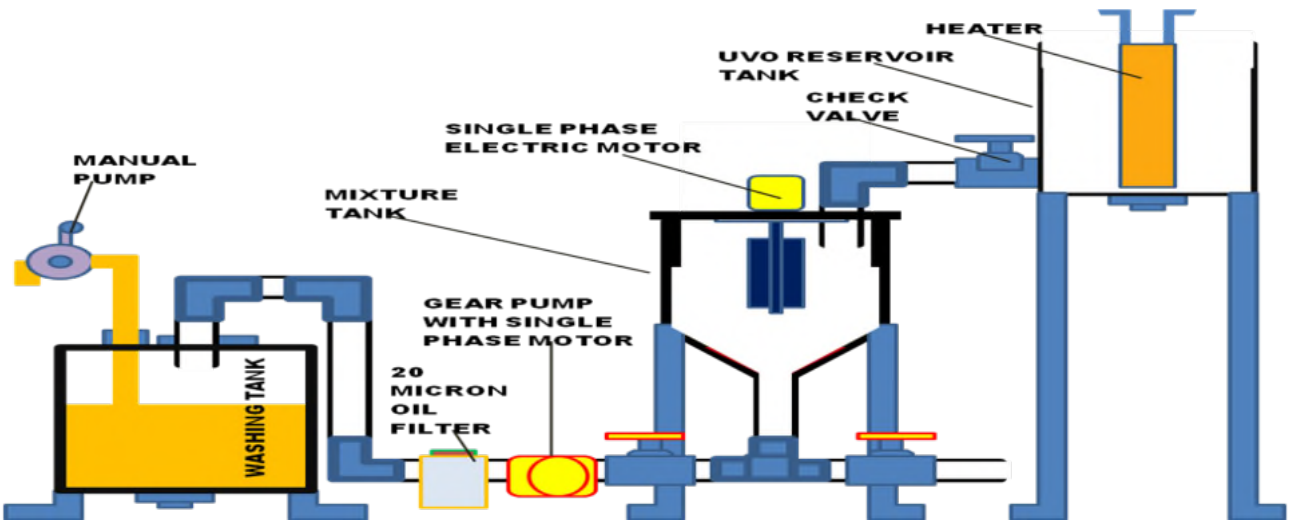

Fig 1.Bio-diesel processor

The mixture is kept to the mixing tank for the period of 4-6 hour at least, at a constant temperature of 40-50˚C below the boiling point which is maintained with electric bulb of 500W connected with Variable resistance of the methanol that is 60˚C, but the result can be far better if the mixture in mixing tank is kept for one day. The glycerin produce because of the chemical reaction takes place inside the mixing tank will be settled down at the bottom of the tank and the Bio-diesel produce will be remain over the glycerin as Bio-diesel is lighter than Glycerin. The glycerin can be drained off using the check valve fitted at the bottom of the mixing tank to the drain line or some collecting tank as the Glycerin can be used further to produce soap and extract the methanol back using the destructive distillation process. The check valve which opens the port of the pipe to the Washing Tank should be open now and the pump connected to the pipe is started to give the Bio-diesel a pressurize flow to the filter of 20 micron so that the Glycerin left on the Bio-Diesel must be filtered off. And the produced Bio-Diesel needs to wash. After washing and drying the Bio-Diesel is ready for the use directly to the C.I. Engine.

III. Modeling and Construction

1) Isometric view of the Bio-Diesel processor:

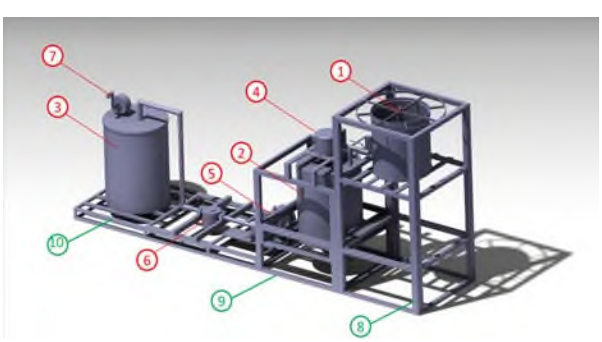

Fig.2.Schematic diagram of Bio-Diesel processor with support frame in isometric view

Table.1. Details of schematic diagram of Bio-Diesel processor with support frame in isometric view

Feature no.	Description
1.	Used vegetable oil reservoir tank with heater.
2.	Lye, Methanol and Used vegetable oil mixture tank with motor.
3.	Washing Tank washes the produced BIO-DIESEL.
4.	Electric Motor to stir the mixture in the mixing tank.
5.	Assembly of pump and the motor to pump the oil to the filter with pressure.
6.	Filter to filter the produced oil.
7.	Manual Pump which will pump out the stored Bio-diesel to the Diesel vehicle directly or to the other storage jar.
8.	Frame 1 fabricated with slotted angle to give support the Reservoir Tank of UVO.
9.	Frame 2 fabricated with slotted angle to give support the Methanol, Lye and UVO Mixing Tank and the Motor.
10.	Frame 3 fabricated with slotted angle to give support the assembly of the Oil Pump, Motor, filter and the Washing Tank.

Before to construct the Bio-Diesel processor, the model of the Bio-Diesel processor is done by using the CAD software CATIA-V5. The figure 2 shows the schematic model of Bio-Diesel processor with support frame and the table 1 shows the description of the Bio-Diesel processor.

2) *Pipe line connection from reservoir tank to mixing tank*

B .Pipe line connection from reservoir tank to mixing tank

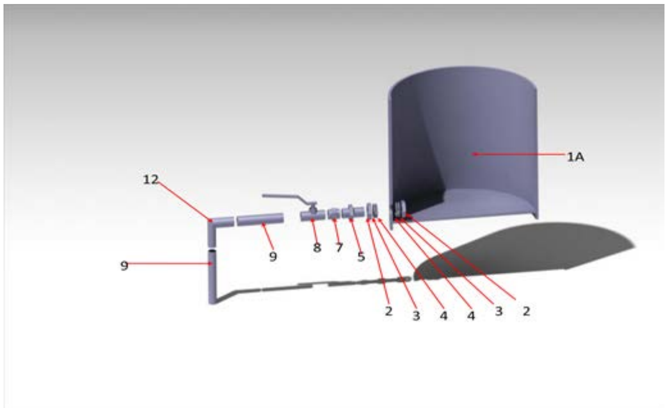

Fig3.Schematic pipe line connection from UVO reservoir to mixing tank

The figure 3 shows the pipe line connection from the UVO reservoir to mixing tank of Bio-Diesel processor and the table2 shows the description of the pipe line connection from the UVO reservoir to mixing tank.

Table 2. Details of pipe line connection from UVO reservoir to mixing tank

Feature no.	Description
1A	UVO reservoir
2	Check nut of drain plug 12mm
3	Steel washer 12mm
4	Anti oil rust rubber washer
5	Drain plug head 12mm
7	Nipple 12mm
8	Check ball valve 12mm
9	G.I. pipe 12mm
12	Elbow 12mm

3) *Pipe line connection from mixing tank to washing tank*

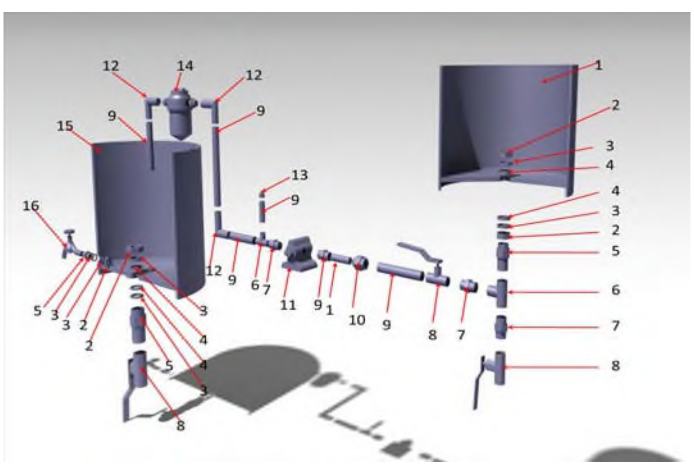

Fig4. Schematic pipe line connection from mixing tank to washing tank

The figure 4 shows the pipe line connection from the mixing tank to washing tank of Bio-Diesel processor and the table3 shows the description of the pipe line connection from the mixing tank to washing tank.

Table 3. Details of pipe line connection from mixing tank to washing tank

Feature no.	Description
1	Methanol, lye and UVO mixing tank
2	Check nut of drain plug 12mm
3	Steel washer 12mm
4	Anti oil rust rubber washer
5	Drain plug head 12mm
6	Tee 12mm
7	Nipple 12mm
8	Check ball valve 12mm
9	G.I. pipe 12mm
10	Union
11	Pump
12	Elbow 12mm
13	End cap
14	Filter 12mm
15	Washing tank
16	Steel tap

4) *Electrical circuit used*

The Fig 5 shows the schematic circuit of electrical component used in bio-diesel processor and the table 4 shows the details of schematic circuit of electrical component used in bio-diesel processor.

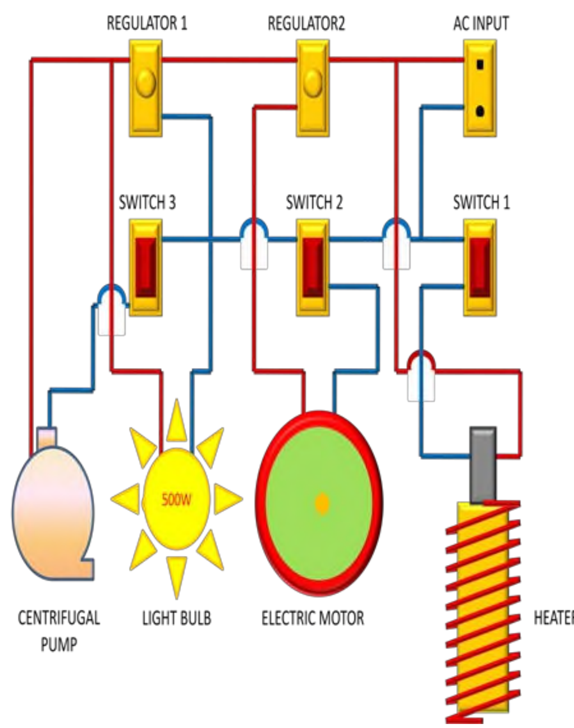

Fig 5.Schematic circuit of electrical component used in Bio-diesel processor

Table 4. Details of schematic circuit of electrical component used in bio-diesel processor.

Feature no	Description
Ac input	Takes the supplies the AC of 230V from the workshop.
Regulator 1	Controls the intensity as well as heat of the 500W Electric bulb, which will help to maintain the temperature of the mixing tank to take place the chemical reaction precisely.
Regulator 2	Controls the r.p.m. of the Electric Motor fitted to the Mixing Tank.
Switch 1	Switch On/Off the Heater fitted to the Reservoir Tank.
Switch 2	Switch On/Off the Electric Motor fitted to the Mixing Tank.
Switch 3	Switch On/Off the Centrifugal Oil Pump.
Heater	Heats the Used Vegetable Oil inside the Reservoir Tank.
Electric motor	Mixes the mixture in the Methanol, Lye and UVO Mixing Tank.
Electric bulb	Helps to maintain the temperature in the mixing tank to take the chemical reaction very precisely between Lye, Methanol and UVO.

IV. Results and Discussion

1) *Front view of the Bio-Diesel processor*

After the model of the Bio-Diesel processor had been done by using the CAD software CATIA V5, the frames are assembled and the Bio-Diesel processor is constructed. The fig 6 clearly shows the model of the front view of the Bio-Diesel processor and the fig 7 shows the original photograph of the Bio-Diesel processor as front view. The Description of the feature of Bio-Diesel processor is as described in table 5 for front view.

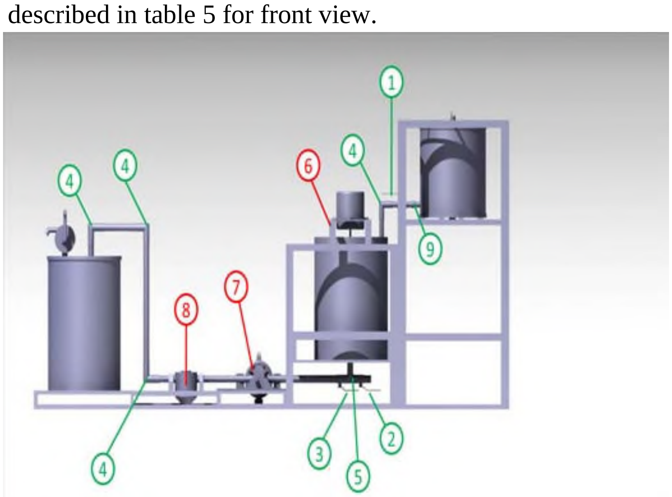

Fig.6.Schematic model of Bio-Diesel processor Front view

Table 5. Details of .Schematic model of Bio-Diesel processor Front view

Feature no	Description
1.	Check valve: - Opening the port from UVO Tank to the Mixing Tank
2.	Check valve: - Opening the port to the drain or any collector tank.
3.	Check valve: - Opening the port towards the Pump, filter and to the Washing Tank.
4.	Elbow: - Joints the pipes to the right angle.
5.	TEE: - Opens to port from one.
6.	Frame: - Frame which can be dissemble easily for the regular inspections.
7.	Pump and electric motor assembly: - Assembly of Pump and Motor.
8.	Filter: - Filters the Processed Bio-Diesel.

Fig 7. Front view of Bio-Diesel processor

2) *Top view of the Bio-Diesel processor*

The fig 8 and fig 9 shows the top view of the Bio-Diesel processor in CAD model and in original photo respectively. The Description of the feature number 1 of Bio-Diesel processor as shown in fig 8 is the Assembly of electric motor and oil gear pump: - The assembly of the Electric Motor and The Oil Gear Pump is done on the Frame 3 using Coupling in between the two spindles.

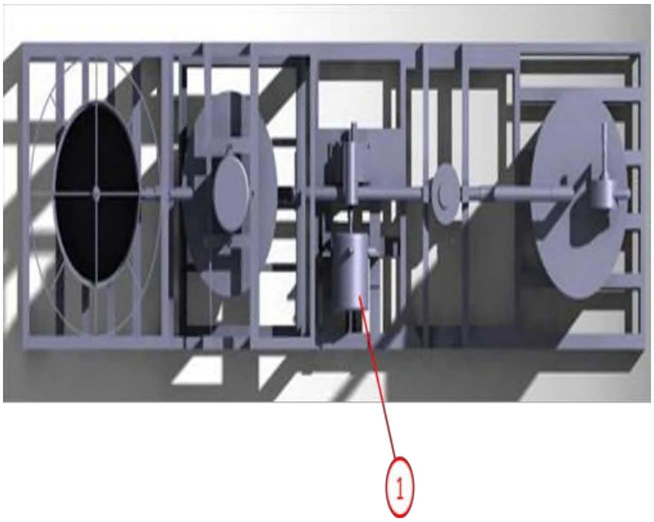

Fig.8. Schematic diagram of Bio-Diesel processor top view

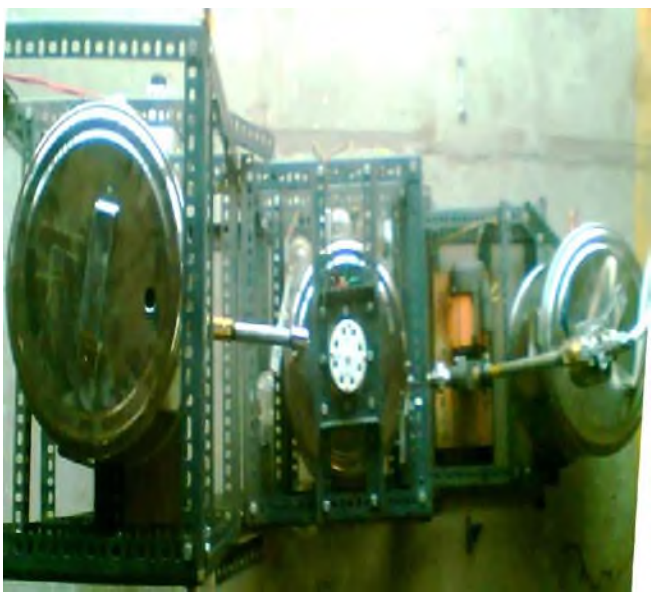

Fig 9.Original photograph of the Top view of the Bio-Diesel processor

3) *Properties of produced Bio-Diesel and blends*

The properties of produced Bio-Diesel are found by appropriate testing process and they are compared with the properties of Diesel is shown in table 6.The Fig10 and Fig11 shows the comparisons of the properties of the produced Bio-Diesel with Diesel. The values of cetane number, kinematic viscosity at 40^{0}C, flash point of produced Bio-Diesel are greater than the values of Diesel. Fig 11 shows in constant heating value, the value of specific gravity at 15^{0}C of produced Bio-Diesel is greater than the value of Diesel and the value of Stochiometric Air/ Fuel Ratio of produced Bio-Diesel is less than the value of Diesel**.**

Table 6. Characteristics of Diesel and produced Bio-diesel

Characteristics	Diesel	Bio-diesel
Specific gravity @ 15 Degree Celsius	0.82	0.88
Heating Value MJ/kg	43.0	43.0
Cetane Number	40-55	48 – 60
Kinematic viscosity at 40 Degree Celsius	1.3 - 4.1	1.9 – 6.0
Flash Point, Degree Celsius	60 – 80	100 – 170
Stochiometric Air/ Fuel Ratio	15	13.8

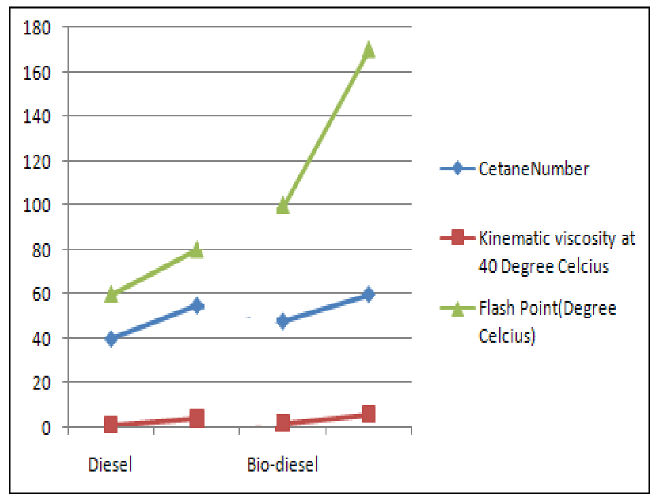

Fig10.Comparision of properties of Diesel Vs Bio-Diesel (Cetane Number, kinematic viscosity, Flash point)

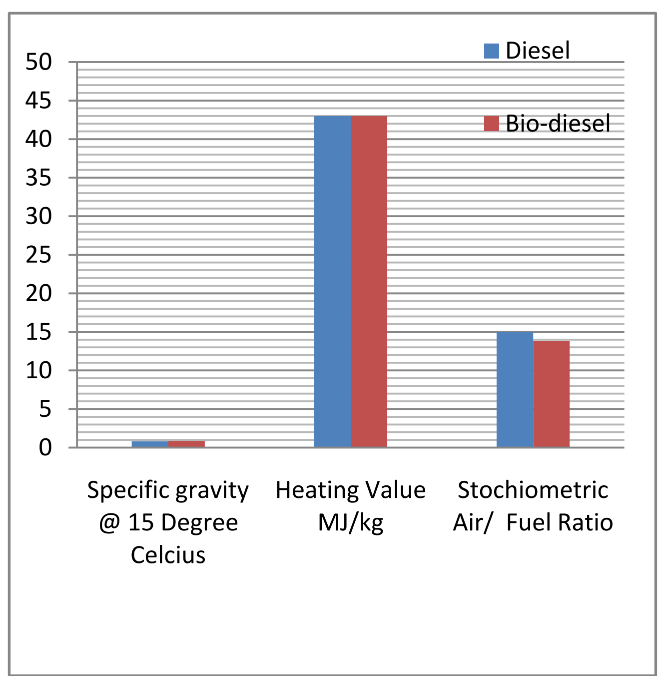

Fig11.Comparision of properties of Diesel Vs Bio-Diesel (specific gravity, Stochiometric Air/Fuel Ratio with constant heating value)

V. Conclusion

This work clearly shows that the modeling and construction of Bio-Diesel processor and the Bio-Diesel production from used vegetable oil by using Bio-Diesel processor shows the promise in applications. When the properties of Bio-Diesel are compared with the Diesel properties, the values of cetane number, kinematic viscosity, flash point of produced Bio-Diesel are greater than the values of Diesel and the value of specific gravity of produced Bio-Diesel is greater than the value of Diesel and the value of Stochiometric Air/ Fuel Ratio of produced Bio-Diesel is less than the value of Diesel**.**

VI. References

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