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Design of Automated Biodiesel Blend Plant and Analysis of Rotational Effect on Biodiesel Blends

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ABSTRACT
Due to the high growth in demand for the use of fossil fuel in today's world, alternative sources of energy extraction is now the prime focus. One such viable medium is the Bio-Diesel**.** In this paper, different blends of biodiesel produced from newly designed automatic biodiesel plant have been studied. During esterification process various speeds were applied by using self-controlled servo motor and settlement time was observed over range of various speeds. Comparative study of the blends for chemical and mechanical properties such as kinematic viscosity, density, flash point and calorific value were also appraised. In this thesis, a clear idea and explanation upon the generation of biodiesel from various available oils as well as contrast of their mechanical, chemical properties have been illustrated**.** The design of the fully automated biodiesel plant and the working procedure of that plant for continuous production and supply have been shown**.**

KEYWORDS**:** Automated Biodiesel plant, Continuous production of biodiesel, Mechanical and chemical properties of biodiesel**.**

1. Introduction

Modern civilization is much dependent on fossil energy. Energy obtained from fossil resources is much higher than any other resources. Majority of the world's energy needs are supplied thorough petrochemical resources, coal, oil and natural gas. The consumption of fossil fuels is on increase from year to year. As the fossil resource is non-renewable, so fuel price is gouging as a consequence of spiraling demand and diminishing supply [1]. Fuel and energy crisis and the concern of the society for the depleting world's non-renewable energy resources led to a renewed interest in the quest for alternative fuels. One of the most promising alternative fuels is the Biodiesel fuel that is produced from vegetable oil or animal fat by the chemical process 'Transesterification'.

2. Review

B. Prbakaran and Dinoop Viswanathan published a paper on "experimental investigation of effects of addition of ethanol to bio-diesel on performance, combustion and emission characteristics in CI engine."[2] J. shen published a paper on "production and fuel properties of fast pyrolysis oil/bio-diesel blends" [3]. In world conference on technology, innovation and entrepreneurship, Radia Selaimia published a paper on "the synthesis of bio-diesel from vegetable oil" [4]. PV Ramana published a paper on "experimental study on CI engine performance using bio-diesel blends" [5]. L.S Khuong published another paper on "A review on the effect of bioethanol dilution on the properties and performance of automotive lubricants in gasoline engines" [6]. In all of these mentioned research works, researchers have done works mainly on Biodiesel blend and its performance, characteristics. In this paper we have studied the changing mechanical and chemical properties with the change of RPM and also established a new set up of biodiesel plant for its continuous production. So from that point of view, the process followed in this experimental conduction is different than the way of general progression of work in this field but the basic theory of it is implemented the same.

3. Experimental Setup

The setup consists of mainly two parts- one is major and another is minor. The major part is where the controller is set. With the help of controller the RPM can be changed. The minor section has two containers having shaft, propeller and servomotor. Motor helps to rotate the shaft and the propeller rotates with shaft. The setup is very simple and easy to handle. Many other equipment like manual valves, pipes, fittings, reducers, electronic components as microcontroller, relay, potentiometer, LM35, Arduino development board has been used in this setup. We also use some extra measurement devices which we measure the rotation of the fan. The rpm is measured by tachometer and the temperature is measured by thermometer.

4. Biodiesel Blend

Blends of biodiesel and conventional hydrocarbon based diesel are products most commonly distributed for use in the retail diesel fuel market place. Much of the world uses a system known as the "B" factor to state the amount of biodiesel in any fuel mix. [7]

Such as –

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Table 1: Percentages of fuel mixtures

Biodiesel	Petro Diesel	Type
10% Biodiesel	90% Petro Diesel	B10
20% Biodiesel	80% Petro Diesel	B20
30% Biodiesel	70% Petro Diesel	B30
50% Biodiesel	50% Petro Diesel	B50
85% Biodiesel	15% Petro Diesel	B85

Table 2: Quantity of biodiesel prepared -

Blend name	Fuel quantity (ml)	Biodiesel quantity (ml)	Diesel quantity (ml)
B10	1000	100	900
B20	1000	200	800
B30	1000	300	700
B50	1000	500	500

Biodiesel is a very versatile transport fuel and can be produced from local raw material or collection of used vegetable or frying oil in rural regions of developing countries. There are three basic routes to biodiesel production from oils and fats.

• Base catalyzed transesterification of the oil
• Direct acid catalyzed transesterification of the oil
• Conversion of oil to its fatty acids and then to biodiesel

Here Transesterification process has been used:

Transesterification reaction is a stage of converting oil or fat into methyl or ethyl esters of fatty acid, which constitutes to biodiesel. Biodiesel (methyl ester) is obtained through the reaction of triglycerides of vegetable oils with an active intermediary, formed by the reaction of an alcohol with a catalyst. The general reaction for obtaining biodiesel through transesterification is

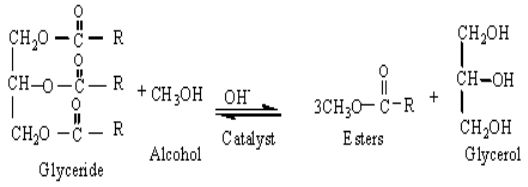

Fig1: Transesterification process [8]

Washing Biodiesel with water is the oldest and most common method of cleaning biodiesel. About 3% of raw unwashed biodiesel is methanol. Methanol is a solvent; it captures soap and other impurities and holds them dissolved in the biodiesel. Water soaks up that methanol, releasing impurities to be washed away with water.

Keeping the methanol liquid and diluted in water makes water washing the safest way to clean biodiesel. Water washing is the most flexible way to purify biodiesel. Under the right conditions, it can be power washed in just a few hours with extremely aggressive wash methods. Water washing can be automated, and can be mixed and matched with different wash methods to fit personal needs. [9]

5. Properties

The properties that have been obtained through this research have been shown below:

Table 3: Different properties of Biodiesel (for Methanol)

Name	0 rpm	45 rpm	60 rpm	90 rpm
Viscosity(cst)	4.18	4.29	4.54	3.91
Flash point(K)	330	329	332	331
Density(kg/m^3)	856.27	881	907.23	909
Cal. Value(MJ/kg)	42.09	41.8	41.12	40.9

Table 4: Different properties of Biodiesel (for Mustard oil)

Name	0 rpm	45 rpm	60 rpm	90 rpm
Viscosity(cst)	5.6	4.12	4.43	3.72
Flash point(K)	326.15	330	320	328
Density(kg/m^3)	881	851	846.075	839
Cal. Value(MJ/kg)	42.1	42.3	42.5	42.5

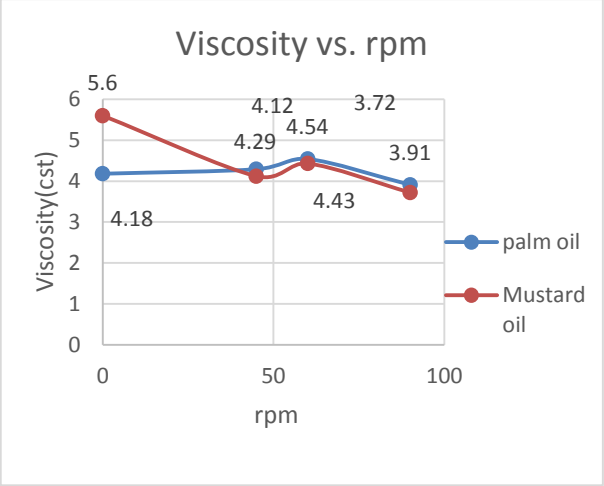

Fig.2: Graphical representation of Viscosity vs. Rpm for Palm and Mustard oil

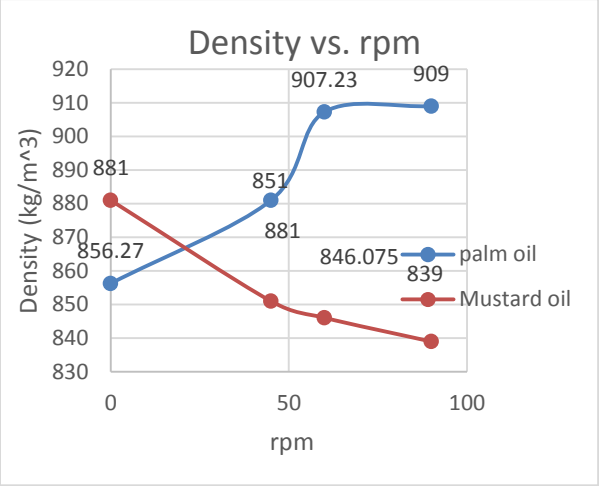

Fig.4: Graphical representation of Density vs. Rpm for Palm and Mustard oil

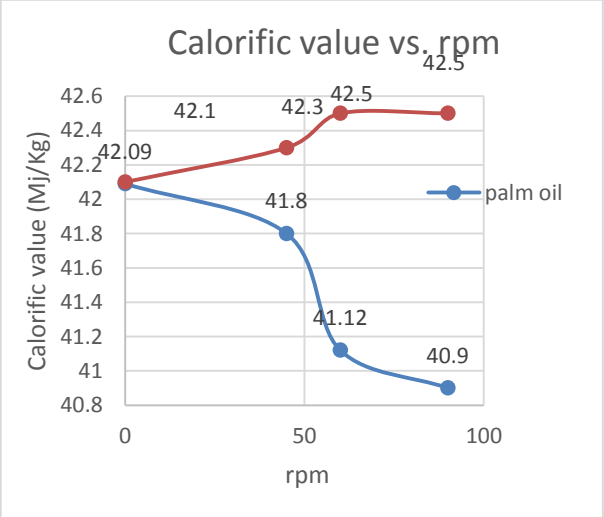

Fig.3: Graphical representation of Calorific Value vs. Rpm for Palm and Mustard oil

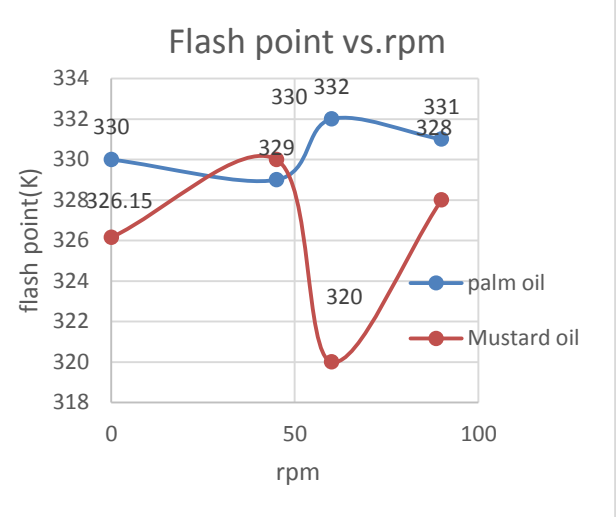

Fig.5: Graphical representation of Flash point vs. Rpm for Palm and Mustard oil

In these graphs, the changing mechanical and chemical properties are shown with the change of rpm. Flash point, Density, Viscosity and Calorific value are studied to achieve results.

6. Discussion and Scope

Biodiesel is probably the best solution to the ongoing quest for pollution free fuel. It is environmentally safe and the current engine construction design does not require any changes to be compatible with biodiesel. In spite of having many positive sides it is still not very popular among the consumers because of its high price. If the production cost can be lowered then the retail price will also be reduced. Extensive research in production method is required to bring the price down to everyone's grasp. Only then the world can advance towards a greener future. The global market for biodiesel is expected to increase in the next ten years. Europe currently represents 80% of global consumption and production, but the US is now catching up with a faster rate in production than Europe. Brazil is expected to surpass US and European biodiesel production by 2015. Europe, Brazil, China and India each have targets to replace 5% to 20% of total diesel with biodiesel. If governments continued to invest more in R&D on

bio fuel exploitation, it would be possible to reach the targets sooner.

7. Result Discussion

The experimented work emphasized on the calculated data's that have been derived and reflected the feasibility of bio-diesel (Mustard Oil and Methanol) with diesel in the IC engine. The calculated RPM on varying aspects of viscosity, flash point, calorific value and density illustrates a broad idea of how advantageous this mixture of fuel would be in the field of alternative fuel and assurance of green energy usage. It is true that the alternative fuel is very expensive but this work is a contribution towards the ongoing development of this field. The researchers strongly believe that this thesis paper will aid towards that cause.

8. Conclusion

This work was focused on the design of an automated small scale biodiesel production plant and analysis of fuel properties of the product obtained. The procedure has been tested by varying different parameters and satisfactory results were found in all cases. The manual control of the production process was very limited and it can even be used in home to produce homemade biodiesel. The system could be redesigned on a bigger scale to produce biodiesel in large quantities.

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