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Production of Biodiesel from Used Cooking Oil and Jatropha Oil and Comparison Review between Properties

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Abstract - *Increasing fuel cost, rising energy demand, worrying domestic energy security and global warming from greenhouse gas emissions have caused the global attentiveness in bio-energy and bio-fuel crop development. Now-a-days biodiesel is getting attention for its positive impact on the environment. Biodiesel is an alternative renewable fuel that has obtained huge attention in recent years. Research on the physical properties of biodiesel have reveal that it is totally compatible with petroleum diesel. This paper deals with the production of biodiesel from used cooking oil and jatropha oil then the further process of production of biodiesel and blending it with diesel with further addition of additive. This research presents comparison review of properties between blends of used cooking oil and jatropha oil with additive diethyl ether. The properties evaluated were density, viscosity, calorific value, flash point fire point.*

Key Words: Biodiesel, Used cooking oil, Jatropha oil, Blends, Additive

1.INTRODUCTION

The roots of mineral diesel are reducing day by day and the exhaust emission of diesel engines is a big source of air pollution. Biodiesel, obtained from vegetable oil or animal fats by transesterification with alcohol like methanol and ethanol, is suggested for use as a replacement for petroleum-based diesel mostly because biodiesel is an oxygenated, renewable, biodegradable and environmentally friendly biodiesel with alike flow and combustion properties and also low emission figure. It helps to decrease global warming gas emissions such as carbon dioxide. Biodiesel has no ambrosial, nearly no sulfur and contains 11% oxygen by weight. These features of biodiesel decrease the emissions of carbon monoxide, hydrocarbon and particulate matter in the exhaust gas differentiate to petroleum-based diesel fuels. Normally the blend of biodiesel diesel mix is represent by "B" obeyed by percentage of biodiesel in a composition; so if 30% biodiesel and 80% diesel is in a composition on a volume basis then it is represent as B30 In this project biodiesel is made using jatropha curcas seed oil and used cooking oil by the process of transesterification and addition of catalyst And then blending it with diesel to make B30 blend and then addition of additive 0.1% diethyl ether to the B30 blend Jatropha curcas is completely considered as an perfect feed stock of biodiesel production. The properties of Jatropha crop and Jatropha oil are main consideration to make Jatropha as a potential cradle of biodiesel in Asiatic climate. Used cooking oil as a biofuel, is environmentally friendly. Biodiesels produced from used cooking oil can replace fossil fuel diesel. It burns efficiently and has almost zero emissions that cannot be harmful to the environment thus, the objectives of this work are to compare the properties of used cooking oil and jatropha oil biodiesel them with their various blends by properties like density, viscosity, calorific value, flash point fire point.

2.METHODOLOGY

2.1 Pre-treatment (Drying and Filtration)

Drying and filtration is the starting process in Biodiesel operation. The process consists of removal of impurities like phospholipids, gums and proteins which are soluble in oil in their anhydrous form, but insoluble once they are processed are removed. Then the same oil is treated to reduce the FFA content to the required level of less than 1 %.

Fig-1: Filtration of Oil

2.2 Enzymic Esterification and Transesterification

Esterification in our process done by enzymes and in this no chemicals is used except methanol and small quantity of Sodium Hydroxide, so that effluent coming out because of Neutralization and washing in conventional process is avoided. The catalyst is typically sodium hydroxide (caustic soda). It is liquefy in the alcohol using a standard agitator or mixer reaction. The alcohol mix is then charged into a closed reaction vessel and the oil is added. The system from here on is completely closed to the atmosphere to block the loss of alcohol. The reaction mix is kept just above the boiling point of the alcohol (around 160 °F) to speed up the reaction and the reaction takes place. Recommended reaction time varies from 1 to 18 hours.

Fig -2: Transesterification Process

2.3 Methanol Removal

Once the glycerin and biodiesel phases have been separated, the excess alcohol in each phase is removed with a by distillation. In others systems, the alcohol is removed and the mixture neutralized before the glycerin and esters have been separated. In either case, the alcohol is recovered using distillation equipment and is re-used. Care must be taken to ensure no water accumulates in the recovered alcohol stream.

Fig -3: Methanol

2.4 Glycerin Neutralization & Purification (Optional)

The glycerin by-product carries unutilized catalyst and soaps that are neutralized with an acid and sent to storage as crude glycerin. In some cases, the salt formed during this phase is retrieved for use as fertilizer. In many cases the salt is left in the glycerin. Water and alcohol are removed to produce 80-88% pure glycerin that is ready to be sold as crude glycerin. The glycerin may be further distilled to 99% or higher purity and sold into the cosmetic and pharmaceutical markets.

Fig -4: Removal of Glycerin

Fig -5: Glycerin

2.5 Methyl Ester Wash

After split up from the glycerin, the biodiesel is at times purified by washing. Gently With resins from special categories to remove residual catalyst or soaps, dried. In some processes this step is unnecessary. This is normally the end of the production process resulting in a clear amber-yellow liquid with a viscosity similar to gasoline & diesel. In several procedure the biodiesel is distilled in a supplementary step to remove small amounts of color bodies to produce a colorless biodiesel.

Fig -6: Distillation Process

2.6 Biodiesel Purification

Biodiesel formed by this is washed with water to remove the traces of catalyst present if any and once the water has come to neutral the resultant mixture is again heated up to 110 degree Celsius and cooled and filtered through Whatman filter paper no.40.

Fig -7: Biodiesel

3. RESULTS AND DISCUSSION

Chemical properties of biodiesel tested to find out properties like Density, Viscosity, Flash point, Fire point, Calorific Value

Table -1: Chemical Testing Properties

Sr. No	Biodiesel	Density (g/ml)	Viscosity (Centistokes)
1	B-100 Used Cooking Oil	0.915	6.5
2	B-100 Jatropha Oil	0.902	5.3
3	B-30 Used Cooking Oil	0.842	4.3
4	B-30 Jatropha Oil	0.840	3.7
5	B-30 Used Cooking Oil with Additive	0.834	3.08
6	B-30 Jatropha Oil with Additive	0.83	2.73
7	Diesel	0.85	4.1

Table -2: Chemical Testing Properties

Sr. No	Biodiesel	Flash Point (Degree Celsius)	Fire Point (Degree Celsius)	Calorific Value (Kcal/kg)
1	B-100 Used Cooking Oil	120	136	10641.83
2	B-100 Jatropha Oil	118	133	10691.43
3	B-30 Used Cooking Oil	105	122	10911.18
4	B-30 Jatropha Oil	102	118	10918.24
5	B-30 Used Cooking Oil with Additive	79	94	10939.33
6	B-30 Jatropha Oil with Additive	90	105	10953.31
7	Diesel	66	81	10800

Fig -8: Density

Fig -9: Flash and fire point

3.1 Density

It is noticed that the density of all the fuel samples increases with distinct value. The variation of density is maximum for used cooking oil biodiesel (UCO) i.e., 0.915 g/ml followed by Jatropha biodiesel (JBD) i.e., 0.902 g/ml and the lowest for diesel (D) i.e., 0.85 g/ml. For blended biodiesels and blend with additive the maximum variation is for UCOB30 (0.842 g/ml), followed by JB30 (0.840 g/ml) which is followed by UCOB30 with additive (Diethyl Ether) (0.834 g/ml) and JB30 with additive (0.83 g/ml). It is observed that the rate of increase in density for pure biodiesels and diesel are in the order of UCO > JBD > D and for blended biodiesels and blends with additive it is in the order of UCOB30 > JB30 > UCOB30 with DE > JB30 with DE.

3.2 Viscosity

It is observed that the change in viscosity of used cooking oil biodiesel, jatropha biodiesel and diesel is 6.5 Centistokes, 5.3 Centistokes and 4.1 Centistokes respectively. The change in viscosity of blended biodiesels and blends with diethyl ether like UCOB30, JB30, UCOB30 with DE and JB30 with DE is 4.3 Centistokes, 3.7 Centistokes, 3.08 Centistokes and 2.73 Centistokes respectively. It is observed that the rate of increase of viscosity over storage pure biodiesels and diesel are in the order of UCO > JBD > D and for blended biodiesel and blends with additive it is in the order of UCOB30 > JB30 > UCOB30 with DE > JB30 with DE.

3.3 Flash point

It is observed that there is a reduction in flash point. The maximum variation of flash point is observed for used cooking oil biodiesel (120 Degree Celsius) followed by jatropha biodiesel (118 Degree Celsius) and minimum variation is observed for diesel (66 Degree Celsius). For blended biodiesels and blends with additive, maximum variation of flash point occurs for UCOB30 (105 Degree Celsius), followed by JB30 (102 Degree Celsius), further followed by JB30 with DE (90 Degree Celsius) and UCOB30 with DE (79 Degree Celsius) respectively. It is observed that the rate of decrease of flash point for pure biodiesels and diesel are in the order UCO > JBD > D and for blended biodiesels and blends with additive, it is in the order of UCOB30 > JB30 > JB30 with DE > UCO B30 with DE.

3.4 Fire Point

It is observed that there is a reduction in fire point. The maximum variation of fire point is observed for used cooking oil biodiesel (136 Degree Celsius) followed by jatropha biodiesel (133 Degree Celsius) and minimum variation is observed for diesel (81 Degree Celsius). For blended biodiesels and blends with additive, maximum variation of fire point occurs for UCOB30 (122 Degree Celsius), followed by JB30 (10918.24), further followed by UCOB30 (105 Degree Celsius) and UCOB30 with DE (94 Degree Celsius) respectively. It is observed that the rate of decrease of fire point for pure biodiesels and diesel are in the order UCO > JBD > D and for blended biodiesels and blends with additive, it is in the order of UCOB30 > JB30 > JB30 with DE > UCO B30 with DE.

3.5 Calorific Value

It is observed that there is an increase in calorific value. The maximum variation of calorific value is observed for jatropha oil biodiesel (10691.43 Kcal/kg) followed by used cooking oil biodiesel (10641.83 Kcal/kg) and for diesel (10800 Kcal/kg). For blended biodiesels and blends with additive, maximum variation of calorific value occurs for JB30 with DE (10953.31 Kcal/kg), followed by UCOB30 with DE (10939.33 Kcal/kg), further followed by JB30 (10918.24 Kcal/kg) and UCOB30 (10911.18 Kcal/kg) respectively. It is observed that the rate of increase of calorific value for pure biodiesels and diesel are in the order D > JBD > UCO and for blended biodiesels and blends with additive, it is in the order of JB30 with DE > UCOB30 with DE > JB30 > UCO B30.

4. LITERATURE REVIEW

Aswan Jyothi Babu, Abhilash Kumar Nair, Aravind A, K. Krishnakumar, Amal Das, Dr. M D Sreekumar (2020) production of biodiesel from used cooking oil and further emission testing and mileage testing followed by matching them with ARAI standards and catalyst used is KOH

Kutuva Rajaraman, Kavitha& Nagappan, Beemkumar & Rajendiran Rajaseka (2019) preparation of jatropha oil biodiesel by transesterification process and blending it in different composition with diesel. And the performance and emission characteristics of an engine fuelled with jatropha biodiesel–ethanol–diesel were evaluated by finding the BTE, BSFC, NOx emission, CO2 emission, CO emission, and HC emission.

N. Acharya a, P. Nanda b, S. Panda b, S. Acharya (2019) method and materials for making biodiesel from mahua and jatropha oil comparison of various properties of mahua biodiesel and jatropha biodiesel with diesel like oxidization stability, storage stability, density, viscosity, flash point and total acid number.

S.Gopalakrishnan, J.Ubaidullah, P.Shanmugasundaram, K.Yuvaraj, T.Tamilarasu (2017) process of making biodiesel using used cooking oil and the different steps involved in it. Taking KOH as a catalyst in the process of formation of biodiesel in different grams to check the highest yield of biodiesel is obtained at which proportion of KOH and METHANOL

Konica Sarker (2016) found various chemical properties of jatropha like kinematic viscosity density, flash point, fire point, cloud and pour point etc. and also the detailed information about the jatropha crop and how it is grown and properties such as biological, physical, chemical have been explained in detail.

M. U. Kaisan, F. O. Anafi, S. Umaru. M. Kulla and J. Nuszkowski (2015) different blends of biodiesel and checking their chemical properties and acid value, Sulphur content etc. This paper also has some comparative graphs of different biodiesel blends and their various properties of neem, cotton seed biodiesel.

Nor Hazwani Abdullah, Sulaiman Haji Hasan, and Nurrul Rahmah Mohd Yusoff (2013) production of biodiesel from waste cooking oil by transesterification process and blending it with diesel and then calculating its physical properties such as density, kinematic viscosity, flash point and fire point.

5. CONCLUSION

Biodiesel is a renewable substitute fuel that can be used in a diesel engine either pure or in blends with petroleum diesel. But blends are more preferable than pure biodiesel for better performance It has the ability to replace petroleum diesel in the future, or being used in blends with petroleum diesel to enhance performance and decrease toxic exhaust emissions. Biodiesel has been prepared by used cooking oil and jatropha oil Blends of biodiesel B100, B30, B30 with additive (Diethyl Ether) was prepared for both used cooking oil and jatropha oil biodiesel. Chemical properties of biodiesel and its blends like Density, Viscosity, Flash point, Fire point, Calorific Value were tested. Additives can improve properties of biodiesel, many types of additives in the reviewed studies were used to improve the performance of biodiesel in this study it is shown that blends with additive have better properties as compare to pure biodiesel and its blends like viscosity is less than other blends result to increase in fluidity of fuel, decrease in fire point results to faster ignition in engine, increase in calorific value leads to better performance of engine.

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REFERENCES

[1] Aswan Jyothi Babu, Abhilash Kumar Nair, Aravind A, K. Krishnakumar, Amal Das, Dr. M D Sreekumar (2020), "Bio-Diesel From used Cooking Oil", Vol. 9 Issue 06, June-2020.

[2] N. Acharya a, P. Nanda b, S. Panda b, S. Acharya (2019) "A comparative study of stability characteristics of mahua and jatropha biodiesel and their blends" Journal of King Saud University – Engineering Sciences 31 (2019)

[3] Obed M. Ali, Rizalman, Mamat and Che Ku M. Faizal (2013), "Review of the effects of additives on biodiesel properties, performance, and emission features", Journal of renewable and sustainable energy 5, 012701 (2013).

[4] M. U. Kaisan, F. O. Anafi, S. Umaru. M. Kulla and J. Nuszkowski (2015), "Fuel properties of biodiesel from neem, cotton and jatropha binary and multi-blends with diesel", Nigerian Journal of Materials Science and Engineering Vol. 7 No. 1 (2015).

[5] S.Gopalakrishnan, J.Ubaidullah, P.Shanmugasundaram, K.Yuvaraj, T.Tamilarasu (2017), "Production of Biodiesel from used Cooking Oil", IJIRST March 2017.

[6] Konica Sarker (2016), "Review and Comparison of Various Properties of Jatropha oil Biodiesel",Vol 7 No 6 Dec 2015-Jan 2016.

[7] Kutuva Rajaraman, Kavitha& Nagappan, Beemkumar & Rajendiran Rajaseka (2019), "Experimental investigation of diesel engine performance fuelled with the blends of Jatropha curcas, ethanol, and diesel", Springer-Verlag GmbH Germany, part of Springer Nature 2019.

[8] Nor Hazwani Abdullah, Sulaiman Haji Hasan, and Nurrul Rahmah Mohd Yusoff (2013) "Biodiesel Production Based on Waste Cooking Oil (WCO)" International Journal of Materials Science and Engineering Vol. 1, No. 2 December 2013.

[9] Demshemino S. Innocent,O'Donnell P. Sylvester, Muhammad F. Yahaya, IsiomaNwadike, and Linus N. Okoro. (2013) "Comparative Analysis of Biodiesel and Petroleum Diesel" International Journal of Education and Research Vol. 1 No. 8 August 2013.

[10] Mohammed Abdul Raqeeb and Bhargavi R. (2015) "Biodiesel production from waste cooking oil" Journal of Chemical and Pharmaceutical Research, 2015, 7(12):670-681.

[11] Afaf Ghais, Abadi and Salwa Malik Omer (2015) "Physical and Chemical Properties of Jatropha Biodiesel" International Journal of Recent Scientific Research Research Vol. 6, Issue, 7, pp.5172-5174, July, 2015.

[12] Mr. Mukesh Kumar Vyas, SVM Agro Processors, B-32, Kalmeshwar MIDC.

[13] Prof. V. Ganveer, Prof. P Shende, Laxaminarayan Institute of Technology, Nagpur.