Trans-esterification of Non Edible Pongamia oil for Synthesis of Bio Lubricant

H M Gurudatt, B Sadashivegowda

Abstract*: *In this research work it is planned to produce pongamia oil bio lubricant, Initial The commercial pongamia oil is tested for free fatty acid(FFA) content which was found to be in the range of 25-28% then the same oil is subjected to esterification in which the percentage free fatty acid(FFA) was found to be reduced to 10% later the esterified pongamia oil is subjected to transesterification and finally the percentage free fatty acid was found to be in the range of 0.4 – 0.6 which is less than 1%.

Index Terms*: *Pongamia Oil, Bio Lubricant, Free Fatty Acid (Ffa), Esterification, Transesterification.

I. INTRODUCTION

Increase in demand for fossil fuels and their byproducts which are non renewable resources leading to the research on non edible oil bio fuels and bio lubricants which can reduce dependency and replace fossil fuel and fossil fuel derivatives[1]. In this regard the non edible oils such as Karanjana, Jatropha, Neem etc.., are tested to replace existing fuels as bio diesel and bio lubricants, in order to extract bio diesel / bio lubricant the major challenge is to reduce free fatty acid content, the raw oils generally contains triglycerides from which one has to extract glycerol and esters separately for which the process of esterification and transesterification are followed more popularly[8].

Esterification process

Esterification process is typically used when we have raw materials (oil) with increased content of FFA to convert those FFA to esters (usually with strong mineral acids such as H_2SO_4), During esterification the raw oil (Triglyceride) reacts with acid catalyst to form glycerol and esters during which some FFA also convert into esters. An ester is a compound derived from the chemical reaction between a carboxylic acid and an alcohol. The carboxylic acids react with the alcohols in the presence of reaction catalysts, which are strong acids, with the aim of forming an ester, with the removal of a molecule of water.

Transesterification process

Transesterification is a chemical reaction that aims at substituting the glycerol of the glycerides with three molecules of monoalcohols such as Methanol thus leading to three molecules of methyl ester of vegetable oil. Methanol and ethanol is widely used in the transesterification. Methanol is used because of low cost, and physicochemical advantages with triglycerides and sodium hydroxide. The acid catalyst is the choice for transesterification when Low - grade vegetable oil used as raw material because it contains high free fatty acid (FFA) and moisture.

II. METHODOLOGY

Initially the commercial pongamia oil was tested for FFA content at atm pressure, In a burette 50 ml of 0.1 normality NAOH is taken and conical flask is added with 50 ml of Isopropyl Alcohol, 10 grms oil and 3 droplets of 0.1 normality NAOH, the mixture is heated to 60°C at atm pressure, the mixture is shaken well and allowed to cool then the indicator phenolpthalein is added to the mixture and titration is performed against 0.1 normality NAOH, the FFA was found to be 28%. Since it is greater than 4% the oil is further subjected to esterification process,
The percentage FFA is calculated by using following formula

$$\%FFA = (28.2 \times N \times \text{volume of titrant}) \div w$$

Where,
28.2 = molecular weight of oleic acid (282/10)
N = Normality of NAOH
W = weight of oil used in grams

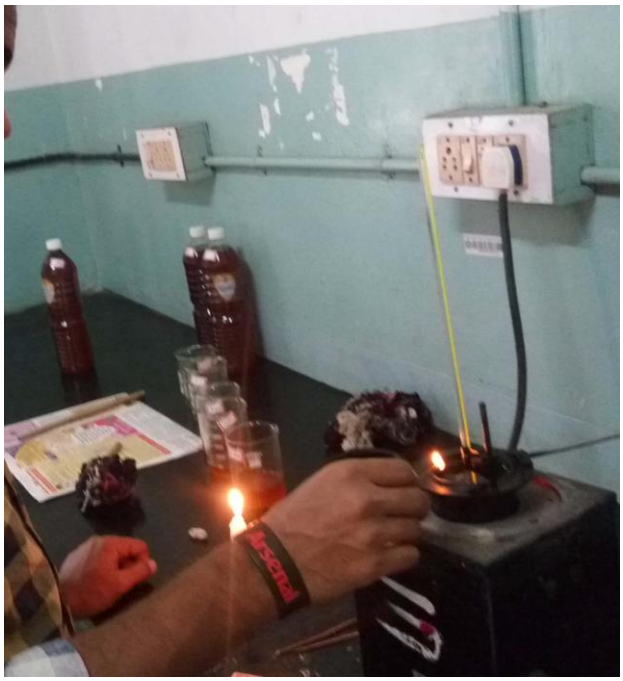

Figure 1 :- Preparation for FFA testing

Revised Manuscript Received on December 22, 2018.

H M GURUDATT, Assistant Professor, Department of Mechanical Engineering, Vidyavardhaka College of Engineering, Mysuru, Karnataka, India.

Dr. B SADASHIVEGOWDA, Principal and Professor in Department of Mechanical Engineering, Vidyavardhaka College of Engineering, Mysuru, Karnataka, India.

Esterification process

The reactor tank is filled with 20 lts of commercial pongamia oil and stirred for 30 min at 60°C at atm pressure, then 1800 ml of methanol and 40 grms of H_2SO_4 is added and again stirred for 90 min at 60°C, later the oil was allowed to cool down for 2 to 3 hrs, After cooling, a fatty acid layer is removed from the oil by separator, after separation of oil and fatty acid the titration procedure is followed to find the %FFA which was found to be 3.2% which is less than 4% hence the esterified pongamia oil is again subjected to transesterification,

Figure 2 :- Esterification process

Transesterification process

The esterified 20 lts pongamia oil is filled to the reactor tank and stirred for 30 min at 60°C, then 6 lts of methanol and 120 grms of NAOH is added to the oil and again stirred for 90 min at 60°C at atm pressure, later the oil was allowed to cool down for 2 to 3 hrs, After cooling, a fatty acid layer is removed from the oil by separator, after separation of oil and fatty acid the titration procedure is followed to find the %FFA which was found to be 0.54%.

III. CONCLUSION

Initially the commercial pongamia oil was found to be having 28% of FFA, after esterification the %FFA reduced to 3.4% and later after transesterification the FFA was found to be 0.54% which is less than 1%, Hence the esterification and transesterification process can be strongly employed to reduce the FFA of any commercial oil which is used to produce Bio diesel or Bio Lubricant.

REFERENCES

1. Manufacturing of environment friendly biolubricants from vegetable oils, Ebtisam K. Heikal, M.S. Elmelawy , Salah A. Khalil, N.M. Elbasuny, Egyptian Journal of Petroleum (Elsevier) pp 53-59,Issue 26, year 2017.
2. Comparative Study of Free Fatty Acid Composition and Physico Chemical Properties of Biodiesel Produced from Various Non Edible Oil Seeds, Prof. S. K. Pawar, International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064
3. 'Preparation of Methyl Ester (Biodiesel) from Karanja (Pogamia Pinnata) Oil'. Bobade S. N. and Khyade V. B, Research Journal of Chemical Sciences 2331-606X, pp 43-50,Aug. 2012
4. 'Biodiesel production from Karanja oil', Vivek and A. K. Gupta, Journal of Scientific & Industrial Research, Vol 63, pp 39-47,2004.
5. Hariram. V & Vagesh Shangar R, 'Characterization and Optimization of Biodiesel Production from Crude Mahua Oil by Two Stage Transesterification',American Journal of Engineering Research. 2320-0847, pp 233-239
6. Salih N, Salimon J, Yousif E. Synthetic biolubricant basestocks based on environmentally friendly raw materials. Journal of King Saud University –Science 2011.
7. Mofijur M, Masjuki HH, Kalam MA et al. Palm Oil Methyl Ester and Its Emulsions Effect on Lubricant Performance and Engine Components Wear. Energy Procedia 2012; 14:1748-1753
8. Ponnekanti N, Kaul S. Development of ecofriendly/biodegradable lubricants: An overview. 2012.

AUTHORS PROFILE

H M GURUDATT obtained his bachelor's degree in Mechanical Engineering from PES College of Engineering Mandya, Karnataka, India and Master Degree in Machine Design from the same institute. He was the topper in the batch and Gold Medalist in both UG and PG. Currently he is working as Assistant professor in the department of Mechanical Engineering Vidyavardhaka college of Engineering Mysuru Karnataka India, Since July 2016 . His research interest is on Bio lubricants for bearings and IC Engines.

Dr. B Sadashivegowda obtained his bachelor's degree in Mechanical Engineering from AIT, Chickmagalur, Karnataka, India and Master Degree in Refrigeration and Air Conditioning from CIT Coimbatore Tamilnadu India. Later he obtained his doctral degree from prestigeous Indian Institue of Science Bangalore India, in the field of refrigeration. He is serving as Principal and Professor in the department of Mechanical Engineering Vidyavardhaka college of Engineering Mysuru Karnataka India, Since June 2007. Before joining Vidyavardhaka college of Engineering he served as Head in Department of Engineering and natural sciences, American Degree Program Taylor's College, Subang Jaya Selangor Darul Ehsan, Malaysia from 1999 to 2007. He has about 32 years of teaching experience. His research interest is Refrigeration and Air conditioning, Alternate fuels and IC Engines.