© September 2021| IJIRT | Volume 8 Issue 4 | ISSN: 2349-6002

Production of Biodiesel from Waste Cooking oil and Testing it's Performance Characters

Vishwa B Kori[1], Kartik P[2], Praveen Honaguntikar[3], M C Navdagi[4]
[1]*M.Tech student, Department of Mechanical Engineering, PDACE, Kalaburagi, India*
[2]*Asst. Professor, Department of Mechanical Engineering, PDACE, Kalaburagi, India*
[3,4]*Professor, Department of Mechanical Engineering, PDACE, Kalaburagi, India*

***Abstract* - Biodiesel can be used directly in engines without any engine modification, as biodiesel has high cetane number. Biodiesels are often produced from the domestic oil resources like oil , tallow, animal fats and waste vegetable oil by transesterification process at ambient pressure and temperature. In this study, production of biodiesel was administered during a small batch reactor by transesterification of waste vegetable oil with potash catalyst. The washing of biodiesel was administered by two methods i.e. washing with water and washing with vinegar. Titration of waste vegetable oil for locating the free carboxylic acid contents and their reduction with the glycerolysis in presence of catalyst to reinforce the transesterification were investigated. The results of this study suggest that the assembly of biodiesel are often administered with a high yield of 92%. Results obtained were found like pure biodiesel.**

***Index Terms* - Waste cooking oil; catalyst; transesterification; Biodiesel; Performance; Emissions.**

I.INTRODUCTION

The world is facing energy crisis all around and consuming energy on a daily basis which produces from the utilization of fuel that's oil, coal, and gas . consistent with us energy information administration report on major power consumption which reported that the foremost popular energy consumption sources are the fossil fuels (oil, coal, and natural gas)[1]. The depletion of fossils fuels is clear predication from the scientific community alongside environment concerns. Therefore, it's very imperative to seem for the alternate source of energy which is environment friendly, having greater or equal efficiency than the fuel . Alternative new and renewable fuel has the power to offer an answer to social problems concern to toddies fuel. Among these renewable energy sources biodiesel is one among the simplest sources to use it in diesel engines with none modification[2, 3]. Biodiesel is environment friendly fuel and may extend the lifetime of diesel because, it's more lubricant than the petro diesel [2-5]. Biodiesel brings down the emission of CO2 by 78%, and CO emissions by about 50% and also completely eliminates sulphur emissions[5, 6]. it's estimated that each 5 gallons of B20 use in vehicles replace 75 gallons of petroleum . it's perceivable that mixing of fifty of biodiesel fuel to the petro diesel oil can save 623 million dollars per year[7]. Biodiesels are often produced from different mechanisms like direct use or blending in diesel oil , thermal cracking of oil and transesterification[8]. during this study the transesterification is concentrated . Transesterification is common process for the assembly of biodiesel and during this process the ester compound is exchange by an alcohol in alkyl group[2, 9]. Biodiesels are often produced by transesterification of triglyceride with alcohol and a catalyst. This reaction occur stepwise with mono and diglycerides as intermediate product. Selecting low-cost feed stock for producing biodiesel can effectively reduce the entire cost to 60-70%. the first aim of this study was to research the assembly rate, yield, effects of staple on the transesterification. This work describes the optimum condition for biodiesel production. The KOH was selected as catalyst for the transesterification because it dissolved with ethanol extremely very faster than the other catalyst like NaOH and therefore the KOH based glycerin is extremely easy to handle.

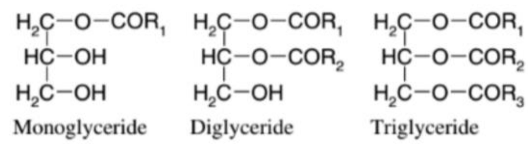

Figure 1. Structure of mono, di, and triglycerides, where the R1, R2 and R3 represent the fatty acids

chain

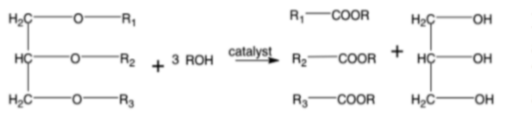

Figure 2. Transesterification reaction

Many researchers have successfully converted waste cooking oil (WCO) to biodiesel through transesterification reaction[4].

II. MATERIAL AND METHODS

WCO samples were collected from BUITEMS cafeterias. Different samples were blended. Ethanol was selected to be a reacting reagent and KOH was selected as catalyst for transesterification reaction. For reducing free fatty acids (FFAs), glycerolysis process of WCO was administered with ZnCl as catalyst. The produced biodiesel was then washed with two different agents i.e. water and ethanoic acid .

III. PRE-TREATMENT OF WCO

The quality of waste vegetable oil determines the standard of biodiesel[10]. Repeatedly frying can cause a rise the FFA contents. If the FFA contents increase (3%w/w) then extra care on WCO must be taken because an unwanted side reaction can happen and can never proceed to transesterification reaction[11]. Glycerolysis of WCO reduces the FFA contents in it and direct results in the formation of monoglycerides and enhance the transesterification reaction[12]. For this purpose 13g/100g WCO glycerol was added to WCO in presence of ZnCl catalyst. Determination of FFA contents by Titration. so as to seek out the FFA percent titration process is used[13]. A sample of waste cooking was titrated 3 times . Titration solution was prepared by adding 1 gram of potash to 1 liter of water . during a small beaker 1 ml of waste vegetable oil was added to10ml of ethanol and was stirred well to urge a mix . A gram of phenolphthalein powder was added as an indicator to mixture. KOH solution was poured drop in drop in a burette to the mixture until it turns into a pink solution. the quantity of ml of titration solution wont to turn the mixture pink gives the amount of KOH to be used per liter of WCO and percent FFA. an equivalent process of titration was repeated for 2 samples. for every three samples three different values of titration were recorded (T1, T2, and T3), the ultimate value was selected by taking average of the three values i.e. T1=2.1 ml, T2= 1.8 ml, T3=1.7 ml

Tf = 1.86 For 0% FFA contents KOH required per liter oil is 7g [16]. From the purity of KOH which is 90% pure, the additional amount are going to be required is 7/0.90=7.7g and therefore the oil was titrated at 1.86 so additional amount of KOH required to process the biodiesel were 1.86+7.7=9.56g and had 1.25% FFAs as illustrated in Table1.Table 1.

FFA information from Titration

ml Titration	%FFA	KOH (grams) per liter WCO
0	0	7.00
0.5	0.36	7.50
1	0.72	8.00
1.5	1.07	8.50
2	1.43	9.00
2.5	1.86	9.50
3	2.14	10.0
3.5	2.50	10.5
4	2.86	11.0
4.5	3.22	11.5
5	3.57	12.0

IV. TRANSESTERIFICATION PROCEDURE

For proceeding transesterification reaction ethoxide was prepared first prepared by adding 9.56g of KOH to 200 ml of ethanol. the quantity of ethanol used 20% of the quantity of the waste vegetable oil . Ethoxide is toxic in nature and its vapors are even more dangerous so goggles and gloves were used as safety measures. The ethoxide was then added to at least one liter of waste vegetable oil during a jar and was placed on the mixer for mixing them aggressively to steer the method to biodiesel production. the blending was run after every interval for about 80 minutes to avoid the side reaction due to high release of warmth . After mixing the mixture was left undisturbed in warm place for twenty-four hours for phase separation. In phase separation the biodiesel gets separates from glycerol phase[4, 5].Glycerol is heavier than the biodiesel it had been settled down at rock bottom thanks to gravity. Separation funnel was wont to drain the glycerol from biodiesel. The conservation of biodiesel decided as follow.

Yield (%) = [Amount of biodiesel produced/Amount of oil feed× 100] ____ (1)

V. EFFECT OF THE CATALYST LOADING

This study investigated that catalyst loading effect the conversion of the triglycerides into monoglycerides. The quantity of WCO was fixed 25 ml and therefore the experiment was administered by using different amount of catalyst. The curve shows high yield of about 88% at 7g catalyst .It was found that further increase in amount from 7g haven't any effect on the conversion of triglyceride.

VI. CHARACTERIZATION OF BIODIESEL

Samples of biodiesel were subjected to series of tests so as to work out if the biodiesel produced met the specification standards.

i) Density at 15ºC the density of biodiesel produce from the waste cooking which is that the mass of the biodiesel compared to water at constant temperature of 15 ºC. The density of sample of biodiesel was measured with hydrometer. The density of biodiesel was measured 0.87 g/ml. consistent with the ASTM standard, the worth of density for biodiesel is 0.875 g/ml. These values of prepared biodiesel meet the density value of the pure biodiesel.

ii) Kinematic viscosity at 40ºC Kinematic viscosity of biodiesel corresponds to its informal conception of thickness. Kinematic viscosity of prepared biodiesel was measured with the assistance of viscometer. The kinematic viscosity of biodiesel was measured 5.20 Cst. The viscosity value for biodiesel ranges from 1.9 to 6.0 Cst.

iii) Flash points The flash point of biodiesel decided by open cup flash point test method. The flash point of biodiesel was measured 160 ºC .

VII. RESULTS AND DISCUSSIONS

i) Effect of waste cooking-oil blends on specific fuel consumption

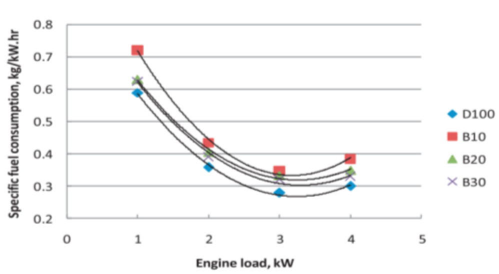

Fig. 1. Variation of specific fuel consumption with engine load for tire oil blends.

Variation of specific fuel consumption with engine load for die-sel, waste cooking-oil blends (B10, B20 and B30) is shown in Fig. 1.Specific fuel consumptions for waste cooking-oil biodiesel blends are above diesel oil . Biodiesel blends showed increase in fuel consumption approximately proportional to the quantity of biodiesel blended to diesel oil . just in case of biodiesel blends, diesel consumes more fuel than diesel fuel at an equivalent power.

ii) Effect of waste cooking-oil biodiesel blends on thermal efficiency

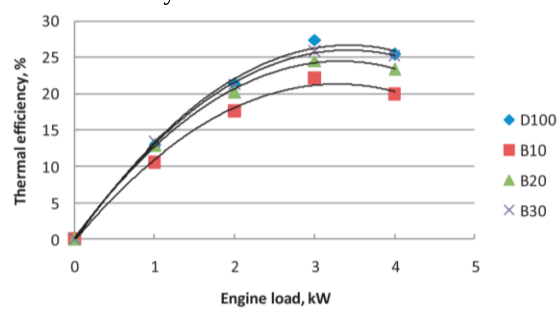

Fig. 2. Variation of thermal efficiency with engine load for waste cooking-oil biodiesel.

Fig. 2 showed the thermal efficiency for waste cooking-oil bio-diesel blends with engine load as compared to diesel oil . Thermal efficiencies are slightly lower for biodiesel blends compared to diesel oil in the least engine loads. The decrease in thermal efficiency for biodiesel blends was thanks to the poor combustion characteristics and volatility of waste cooking-oil biodiesel compared to diesel oil . Density of waste cooking-oil biodiesel was above diesel oil . Calorific value of WCO biodiesel is less than diesel.

iii) Effect of waste cooking-oil biodiesel blends on CO_2 emissions

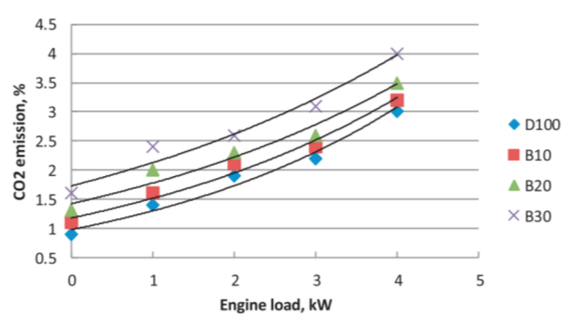

Fig. 3. Variation of CO_2 ratio with engine load for waste cooking-oil biodiesel blends.

Fig. 3 showed the variation of CO2 emission with engine load for waste cooking-oil biodiesel blends. CO2 emission is more for biodiesel and its blends than that for diesel oil . The rising trend of CO2 emission with engine load was thanks to the upper fuel entry because the load increased. CO2 emissions for diesel-biodiesel blends were above diesel fuel and it's increased with the rise in blend proportion. CO2 emission increase was thanks to higher oxygen content in biodiesel blends.

iv) Effect of waste cooking-oil biodiesel blends on CO emissions

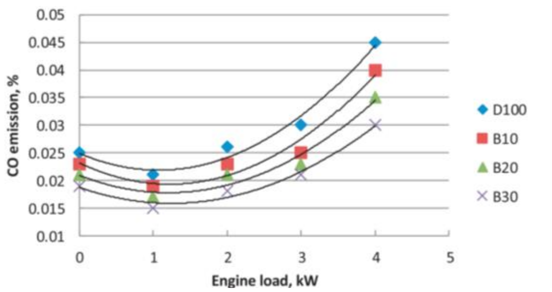

Fig. 4. Variation of CO emission with engine load for waste cooking-oil biodiesel blends.

CO emissions variations with engine brake power are shown in Fig. 4. CO emissions decreased with increasing of engine brake power at lower loads then increased at higher loads. Decreases in carbon monoxide gas emission for biodiesel blends were thanks to more oxygen molecules and lower carbon content in biodiesel blends as compared to diesel oil which cause better combustion. The presence of oxygen in waste cooking-oil biodiesel blends is useful for better combustion and reduction of CO emissions.

v) Effect of waste cooking-oil biodiesel blends on NOx emissions

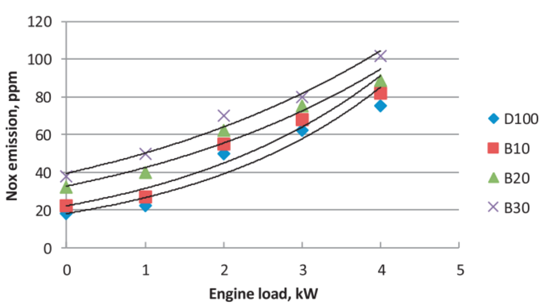

Fig. 5. Variation of NOx emission with engine load for waste cooking-oil biodiesel blends.

NOx emissions increased with the rise in engine load for all fuels thanks to increase of fuel burned and therefore the cylinder temperature which is liable for thermal (or Zeldovich) NOx formation. Rate of NOx emissions formation in diesel engines may be a function of adiabatic flame temperature which is closely associated with the height cylinder temperature.

vi) Effect of waste cooking-oil biodiesel blends on HC emissions

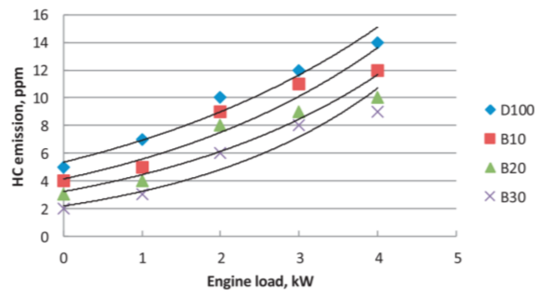

Fig. 6. Variation of HC emission with engine load for waste cooking-oil biodiesel blends.

This variation of HC emissions with reference to engine load for waste cooking-oil biodiesel blends. HC emission is lower at engine part load and increases with increase of engine load. this is often thanks to the presence of fuel rich mixture and lack of oxygen resulting from engine operation. Biodiesel blends with die- sel fuel produced lower HC emissions in the least engine loads compared to diesel.

VIII. CONCLUSION

This paper presents a review about production of Biodiesel by waste cooking oil. And further discussed about its character parameters compared to diesel fuel.

REFERENCES

[1] R.B. Sharma, Amit Pal, Juhi Sharaf, Production of biodiesel from waste cooking-oil, J. Eng. Res. Appl. 4 (6) (2013) 1629–1636.

[2] E.M. Shahid, Shah A.N. Jamal, N. Rumzan, M. Munsha, Effect of used cooking-oil methyl ester on compression ignition engine, J. Quality Technol. Manage. VIII (II) (2012) 91–104.

[3] Pedro Felizardo, M. Joana Neiva Correia, Idalina Raposo, Joao F. Mendes, Rui Berkemeier, Joao Moura Bordado, Production, of biodiesel from

waste frying oils, Waste Manage. J. 26 (3) (2006) 487–494.

[4] Osmano Souza Valente, Vanya Marcia Duarte Pasa, Carlos Rodrigues Pereira Belchior, Jose Ricardo Sodre, Exhaust emissions from a diesel power generator fuelled by waste cooking-oil biodiesel, Sci. Total Environ. J. 431 (2012) 57–61.

[5] K. Nantha Gopal, Arindam Pal, Sumit Sharma, Charan Samanchi, K. Sathyanarayanan, T. Elango, Investigation of emission and combustion characteristics of a CI engine fueled with waste cooking-oil methyl ester and diesel blends, Alex. Eng. J. 53 (2014) 281–287.

[6] Tushar R. Mohod, Prashant C. Jikar, Vishwanath S. Khobragade, Experimental investigation of a diesel engine fueled with waste cooking-oil ethyl ester, Int. J. Res. Eng. Technol. (IJRET) 2 (5) (2013) 240–244.

[7] C.C. Enweremadu, H.I. Rutto, Combustion, emission and engine performance characteristics of used cooking-oil biodiesel-A review, Renewable Sustainable Energy Rev. 14 (2010) 2863–2873.

[8] B. Ghobadian, H. Rahimi, A.M. Nikbakht, G. Najafi, T.F. Yusaf, Diesel engine performance and exhaust emission analysis using waste cooking biodiesel fuel with an artificial neural network, Renewable Energy 34 (2009) 976–982.

[9] Ozer Can, Combustion characteristics, performance and exhaust emissions of a diesel engine fueled with a waste cooking-oil biodiesel mixture, Energy Conversion Manage. 87 (2014) 676–686.

[10] Yage Di, C.S. Cheung, Zuohua Huang, Experimental investigation on regulated emissions of a diesel engine fueled with ultra-low sulfur diesel fuel blended with biodiesel from waste cooking-oil, Sci. Total Environ. J. 407, (2009) 835– 846.

[11] Yuan-Chung Lin, Kuo-Hsiang Hsu, Chung-Bang Chen, Experimental investigation of the performance and emissions of a heavy-duty diesel engine fueled with waste cooking-oil biodiesel/ultra-low sulfur diesel blends, Energy 36 (2011) 241–248.

[12] K. Muralidharan, D. Vasudevan, Performance, emission and combustion characteristics of a variable compression ratio engine using methyl esters of waste cooking-oil and diesel blends, Appl. Energy 88 (2011) 3959–3968.

[13] A. Abu-Jrai, Jehad A. Yamin, Alaa H. Al-Muhtaseb, Muhanned A. Hararah, Combustion characteristics and engine emissions of a diesel engine fueled with diesel and treated waste cooking-oil blends, Chem. Eng. J. 172 (2011) 129–136.

[14] Rasim Behcet, Recep Yumrutas, Hasan Oktay, Effects of fuels produced from fish and cooking-oils on performance and emissions of a diesel engine, Energy 71 (2014) 645–655.