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Synthesis and Investigation Tactic of Biodiesel: A Review

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Abstract: ***There has been great development in the area of biodiesel production during recent time. Biodiesel is becoming popular as an alternative fuel with eco-friendly characteristic. There are a number of mitigating factors to be considered while assessing the sustainability of using biodiesel produced from various methods. Cost verses benefit is most common issue in the production of biodiesel. Problem faced during transportation and storage as biodiesel has inherent tendency of oxidation due to water contents and to maintain and monitor fuel quality as per standardization organizations. This paper aims to review the various synthesis and investigation procedure used during biodiesel production and after production.***
Keywords: Alternative fuel, Biodiesel, Synthesis, Trans esterification and investigation

I. INTRODUCTION

Requirement of alternative fuel is increasing day by day. Bio-diesel is a fatty acid alkyl (methyl or ethyl) ester. Efforts have been made by various researchers to produce biodiesel from different kind of oil by the use of transesterification. Processes applied to synthesize bio diesel are direct use and blending, micro emulsion process, thermal cracking (pyrolysis) and transeterification [1]. Various variables that influence the transesterifiacation process reported are reaction temperature, ratio of alcohol to oil, catalyst type and concentration, mixing intensity and purity of reactants [1]. Bio diesel comprises of Mono-alkyl esters of long chain fatty acids and produced from edible oil, non edible oil and animal fats by acid or by base catalyst transesterification with methanol or with ethanol[2].Biodiesel is also known as number 2 diesel and having properties of high Cetane number, low CO_2, low smoke, non-toxic, high viscosity, biodegradability and ease of blending[3] .Beside the advantageous properties bio diesel having disadvantages of low energy contents, start to crystallize at 0^{o} C require additives, less oxidative stable and limited supply[4] . Therefore it is essential to analyze the process of biodiesel production at all state.

II. SYNTHESIS OF BIO DIESEL

Following processes are reported to synthesize biodiesel.

A. Direct Use

Vegetable oils can directly be used as fuel but reports high viscosity. Short term blending with diesel having ratio of 1:10 to 2:10 reported successful result [1].

B. Micro Emulsion

Micro emulsion is defined as colloidal equilibrium dispersion of optically isotropic fluid. Micro emulsion biodiesel includes diesel fuel, vegetable oil, alcohol, surfactant and cetane improver in suitable proportions. Methanol and Ethanol are used as viscosity lowering additive and alkyl nitrates are used as cetane number improver [1].

C. Thermal Cracking (Pyrolysis)

Thermal cracking is defined as conversion of one substance into another by means of heat in the absence of air. Equipment requires oxygen removal and separate distillations. This process reported expensive and less eco-friendly due to high equipment cost and sulphur contents in produced biodiesel [1].

D. Transesterification

Transesterification is catalyzed chemical reaction involving oil and alcohol to produce fatty acid alkyl esters (FAAE) as biodiesel and glycerol as by-product. Reaction requires catalyst to improve reaction rate and strong alcohol to shift equilibrium to product side. 3:1 molar ratio of alcohol to triglycerides (TG) reported to complete the tranesterification reaction. The main factors affecting transesterification reported are temperature, amount and catalyst type, molar ratio alcohol to oil, mixing intensity, free fatty acid contents and moisture contents [1]. Various transestrification methods are outlined in Fig. 1

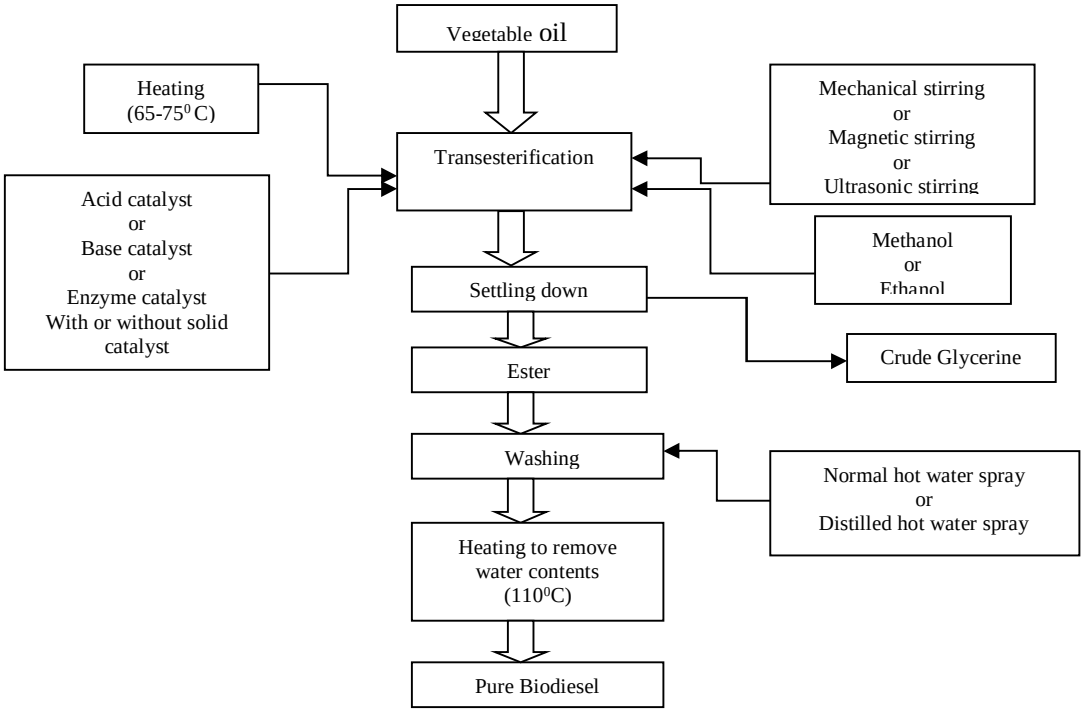

Fig.1 Synthesis of biodiesel by transesterification

III. INVESTIGATION OF BIO-DIESEL

After the production of biodiesel it is required to investigate the properties of produced biodiesel. Physical and chemical properties are investigated for the produced biodiesel for the use in diesel engine. Standard test methods are used to characterize the produced biodiesel. The standard values calculated and compared with the fixed standard of different country. Following are some standard for biodiesel

A. Free Fatty Acid Test (FFAT) of Oil

Free fatty acid test is performed to analyze the viability of oil to be used in transesterification process. Less than 3% FFA contents in oil needed in oil to carry out transestrification process if the FFA content higher than it requires more catalyst to neutralize FFA(8).

B. Water Content

It is critical parameter in predicting stability of bio -diesel for bulk storage and transportation purpose. Kari Fischer (KF) titration method is used for water content calculation. There are two types of KF titration method such as Coulometric KF and volumetric KF. Due to high accuracy coulometric KF mostly used in which iodine complex used with the supply of electric current (5).

C. Fatty acid composition of bio diesel

Gas chromatography mass spectroscopy technique with an inert mass selective detector reported for calculation of fatty acid composition of biodiesel (6**).**

D. Acid value

Titration method used .It is defined as the number of NaOH required to neutralize the free fatty acid present in 1 gm of sample(3).

$$AcidVale = \frac{5.61 \times V}{W}$$

Where, V= volume in ml of NaOH required
W= weight in gm of sample

E. Saponification value

A known amount of oil is refluxed with an excess amount of alcoholic KOH**.**

F. Iodine value

Generally the accepted parameter for expressing the degree of carbon to carbon unsaturation of oil or their derivatives called iodine value. Iodine value is defined as gm of iodine absorbed by100gm of oil (3).

$$Iodinevalue = \frac{112.7(B-S)N}{Weightofthesample(gm)}$$

Where, B= Volume of standard sodium thiosulphate solution required for blank (ml)
S= Volume of standard sodium thiosulphate solution required for sample (ml)
N= Normality standard sodium thiosulphate solution

G. Kinematic Viscosity

It is measured with the help of redwood viscometer**.** It is measured by following formula (3)

Where, t= time of flow

H. Specific Gravity

Pyknometer bottle is used to calculate specific gravity and calculated with the help of following formula (3).

$$specificgravity = \frac{A-B}{B-C}$$

Where A=weight of bottle with sample at 30^{o}C
B= weight of empty bottle
C= weight of bottle with distil water at 30^{o}C

I. Density

Relative density bottle is used to determine density of biodiesel and calculated with the following formula (3)

$$Density = \frac{W3-W1}{W2-W1} \times \rho$$

Where, W1=weight of empty bottle
W2= weight of empty bottle with water
W3= weight of bottle with sample
$\rho = densityofwater$

J. Flash Point

Flash point of fuel is defined as the temperature at which it ignites when exposed to spark. It is found with the help of pensky martens flash point apparatus (3).

K. Molecular weight (MW) of bio diesel

Average molecular weight of biodiesel calculated by using formulae (7)

$$MW = 56.1 \times 1000 \times \frac{3}{SV-AV}$$

Where, SV= Saponification value
AV= Acid value

IV. CONCLUSION

It concluded from study that synthesis of biodiesel involves much method but transesterification method is mostly used by many researchers. It is also required to investigate the properties of raw material as well as produced biodiesel.

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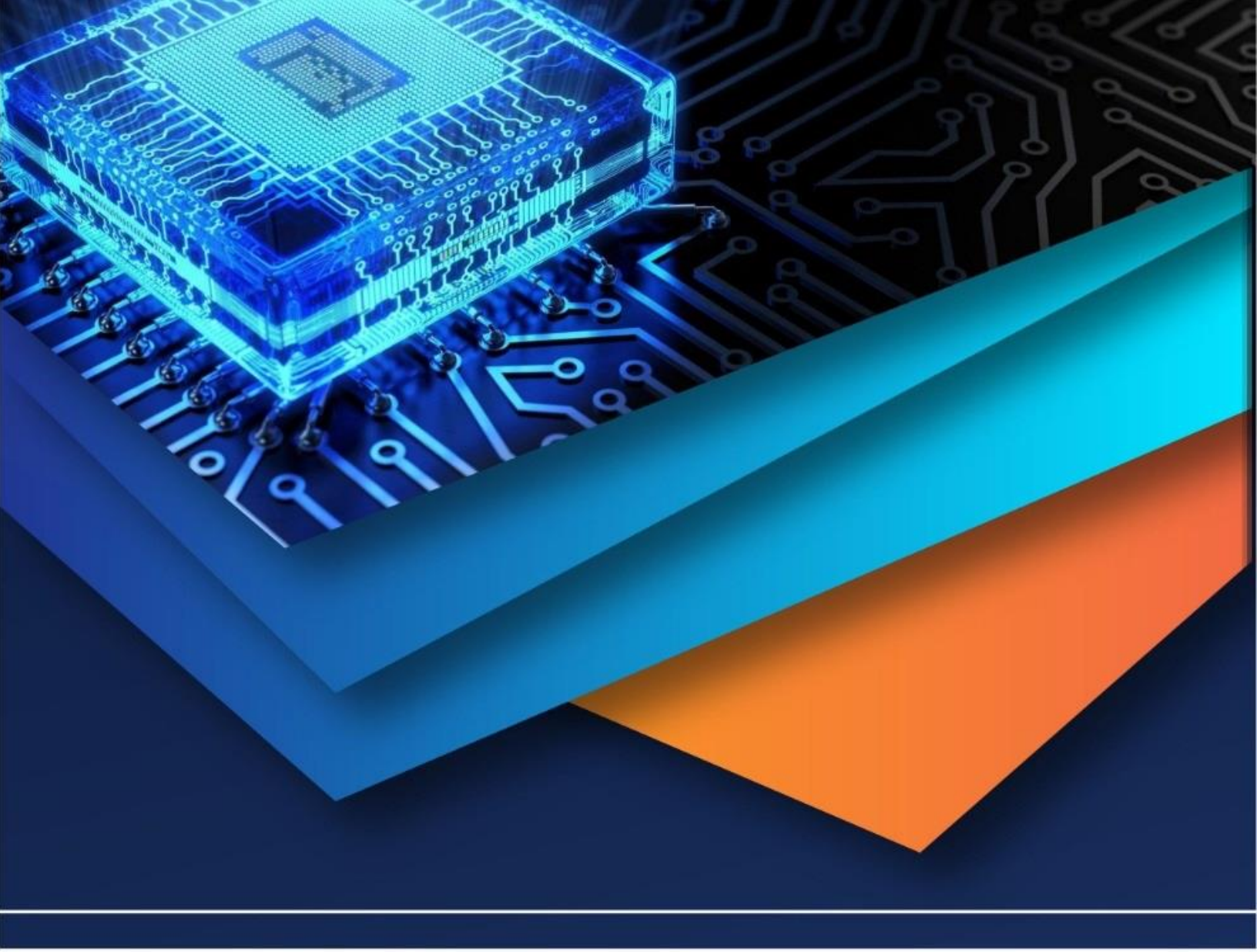

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