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Synthesis and Stability Characteristics of Blend of Waste Mustard and jatropha Biodiesel

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Abstract:- **This paper assesses the trans-esterification process for the production of Biodiesel (fatty acid monoalkayl ester) from waste mustard and jatropha oil mixed with methanol (CH3OH) using potassium hydroxide (KOH) as a catalyst at a temperature of 60˚C.As it is a sustainable alternative not only economically, but also environmentally and ecologically to replace petroleum diesel fuel. The most promising alternative fuel will be the fuel that has the greatest impact on society. The major impact areas include well-to-wheel greenhouse gas emissions; non-petroleum feed stocks, well-to-wheel efficiencies, fuel versatility, infrastructure, availability, economics, and safety. Compared to some of the other leading alternative fuel candidates biodiesel appears to have the largest potential impact on society, and should be considered as the fuel of choice for eliminating the dependency on petroleum. With increase in the demand of petroleum products the prices of petrol & diesel are increasing worldwide. Hence biodiesel is alternative sources of energy for running our generators; automobiles etc. are being considered worldwide. In this study, the properties of the waste mustard and jatropha biodiesel produced were compared with ASTM standard and found to be within the limits. Primarily, the utilization of these waste mustard and jatropha oil for biodiesel production will reduce dependency on foreign oil and secondly, this will remove disposal problem of waste sand make environment safe from pollution. The process involves heating of oil followed by titration, then setting and seperation and finally washing.base catalyzed transesterification process is applied.**

***Index Terms*— Transesterification; Biodiesel; Methanol; Alternate energy resource.**

I.INTRODUCTION

It Due to the devastation of world petroleum reserves and the increased environmental concerns have spirited the search for alternative sources for petroleum based fuel, including diesel fuels [1]. And with increasing demand on the use of fossil fuels, stronger portent to clean environment is being posed as burning of fossil fuels is related with emissions like carbondioxide, carbon mono-oxide, sulphurdi-oxide, nitrogen di-oxide and particulate matter which are currently the assertive global source of emissions [2]. The exhaust emissions from the engines which are harmful, rapidly increasing in the price of petroleum products, the increasing fuel prices and uncertainties of their supply have jointly created renewed interest among researchers to search for correct alternative fuels [3]. Therefore, there is a growing interchange of fossil fuels with fuel produced from renewable resources [4]. This replacement requires increased efforts in the research and development of producing these fuels from different renewable resources [5]. This is the case the largest possible source of suitable oil comes from oil crops such as jatropha, mustard [6]. Most biodiesel produced at present is produced from waste mustard oil sourced from restaurants, chip shops, industrial food producers such as Birdseye etc. Waste vegetable oil can often be sourced for free or sourced already treated for a small price [7]. The concept of using vegetable oil as an engine fuel likely dates to when Rudolf Diesel (1858-1913) developed the first engine to run on peanut oil, as he demonstrated at the World Exhibition in Paris in 1900. It has been recognized that Germany is the largest manufacture and consumer of biodiesel fuel in Europe. In south eastern Asia, Malaysia and Indonesia manufacture biodiesel fuel from palm oils, and the Philippines manufacture biodiesel fuel from coconut oils. The Environmental Protection Agency reported that non-road diesel engines have a substantial role in contributing to the nation's air pollution and therefore stricter emission standards were imposed with regards to the amounts of particulate matter, nitrogen oxides and sulphur oxides [8]. This causes the analysis of biodiesel emissions to ensure compliance with current Environmental Protection Agency regulations [9]. Vegetable oil based fuels are sustainable sources of fuel because as long as they are produced in an ecologically sustainable way, they will not run out [10]. Depending upon the climate and soil conditions, different countries are looking for different types of vegetable oils as substitutes for diesel fuels [11]. Vegetable oils also have high viscosity (11 - 17 times higher than diesel fuel) and lower volatility that results in carbon deposits in engines due to incomplete combustion [12]. However, the high viscosities and low volatilities of this oil have been reported to make them inefficient for most combustion engines and thus the need to get them chemically altered or transesterified to obtain alkyl esters of the oil (biodiesel) [13]. Besides all the above, vegetable oils contain polyunsaturated compounds [14]. Transesterification has been tested to be

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one of the chemical modifications to overcome these problems caused by the use of vegetable oils [15]. The transesterification reduces the molecular weight of vegetable oils and also reduces the viscosity and improves the volatility [16]. The product of the reaction is biodiesel, glycerol, alcohol and catalyst (KOH).In transesterification reaction, tri-glycerides react with an alcohol producing a mixture of fatty acid alkyl esters (FAAE) and glycerol; in the presence of a catalyst (KOH) [17]. The stoichiometric equation requires one mole of tri-glyceride and three mole of alcohol (CH3OH). However, excess alcohol(CH3OH) is required to drive the reaction close to completion [18].The advantages of biodiesel over conventional diesel fuels are biodiesel is lower toxic, high biodegradable, substantial reduction in SOx emissions, considerable reduction in carbon monoxide (CO), poly-aromatic hydrocarbons, smoke and particulate matter [19]. In addition, heat value of biodiesel is very high, oxygen content is also high (10% - 11%) and due to its carbon closed cycle does not contribute to global warming [20]. in this paper studies on binary blends of waste mustard and jatropha biodiesel fuel have been investigated. Biodiesel reduces net carbon dioxide emissions by 78% and it has also been shown to have dramatic improvements on engine exhaust emissions. Combustion of neat biodiesel decreases carbon monoxide (CO) emissions by 46.7%, particulate matter emissions by 66.7% and unburned hydrocarbons by 45.2% [21]. When blended with diesel fuel the designation indicates the amount of B100 in the blend, e.g. B20 is 20% B100 and 80% diesel. Biodiesel is often used as a blend B20 rather than using B100 [22]. These low-level blends generally do not require any engine medications [23]. Higher blends, even B100, can be used in many engines built with little modification [24].Therefore the main objective of this study was to produce waste mustard biodiesel & jatropha biodiesel from waste mustard and jatriopha oil and the stability charactristics of binary blends of this biodiesel [25].

II. MATERIALS AND METHOD

A.Material

Required quantity of waste mustard and jatropha oil are purchased from local restaurants and oil mill near Amritsar, Punjab State, India. All chemicals such as methanol (99.5% purity), H2SO4 (99% purity), KOH pellets had purchased from renewable energy laboratory, Amritsar college of Engineering and technology, Amritsar, Punjab State, India. All chemicals were of analytical grade. For the determination of acid number, Isopropyl alcohol was used in which Phenolphthalein was used as an indicator in the titration.

B. Equipments

- Magnetic Stirrer hot plate,
- Digital heater,
- Filter,
- Condenser,
- Thermometer,
- Gas chromatography mass spectrometer

C. Process of Biodiesel Fuel Production by Transesterification of Sample

In chemistry, acid value is the mass of potassium hydroxide (KOH) in milligrams that is required to neutralize one gram of chemical substance. The acid value of any oil calculated by using formula

Acid number =0.1N*molecular weight of catalyst *volume of catalyst used/mass of sample oil.

The acid values (KOH mg/g) were determined by a titration method. The molecular weight of the waste mustard and jatropha oil was calculated from its acid number and aponification value. The experimental result shows that the acid number is 2.35 for waste mustard oil and for jatropha acid number is 2.88.Hence the both are suitable for production of biodiesel then the oil was taken. The oil was poured in a beaker and heated to 60 degree centigrate by using digital heater. In the meantime 2% potassium hydroxide (KOH) and 15% methanol was poured in other beaker and stirred to make it perfect solution. After this the solution was poured in oil and heated at constant temperature of 60 degree centigrate for one hour. After one hour this solution was poured in seperation flask for 12 hours undisturded.The seperation of methyl esters and glycerine takes place. After which glycerine and methyl esters were seperated. The water at 45 degree centigrate was poured in methyl esters for 2-3 hours for washing process. This process was repeated for 5-6 times in order to remove all the impurities. The obtained methyl esters were heated at 110 degree centigrate in order to evaporate the excess methanol and water from the solution.

III. CHEMICAL REACTION

Transesterification, also called as alcoholises is the displacement of alcohol from an ester by another alcohol in a process similar to hydrolysis except that an alcohol (Ethanol and methanol are utilized most frequently) is worked instead of water. This has been

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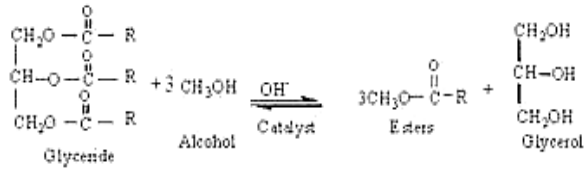
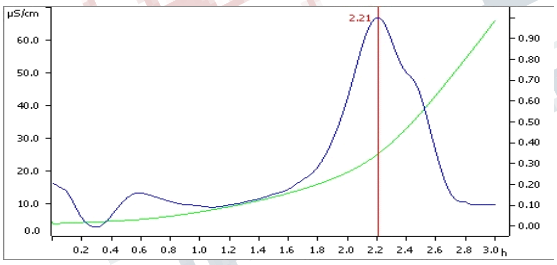
widely used to reduce the viscosity of the triglycerides. Thus fatty acid methyl ester (also known as biodiesel) is obtained by transesterification. The transesterification is expressed by the following reaction.



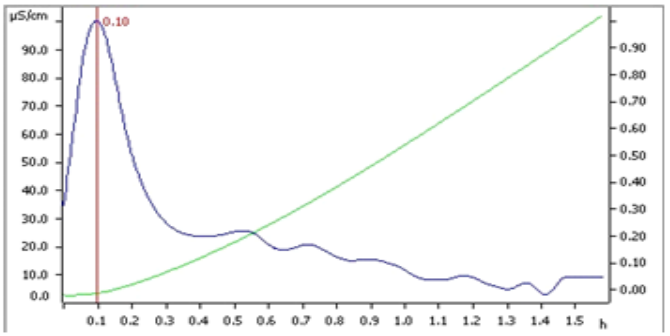
Fig; 1 Transesterification reaction.

IV. RESULT

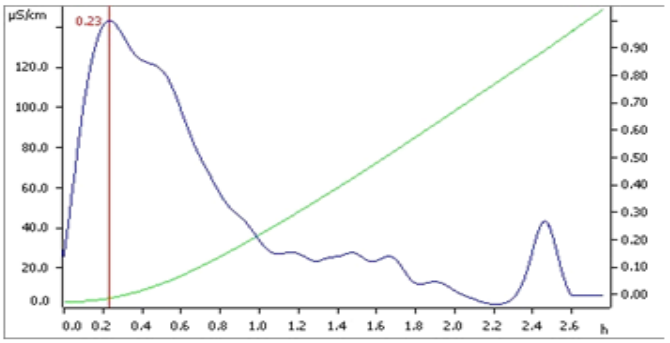
The waste mustard methyl ester and jatropha methyl ester was synthesized from waste mustard oil and jatropha oil respectively and blending of these two methyl ester then its stability characteristics were studied using professional Biodiesel Rancimat 893.After the process of Rancimat, the time versus conductivity graphis obtained, which shows that stability of waste mustard biodiesel derived from waste mustard oil is 2.21Hours is shown in graph 1 , jatropha biodiesel derived from jatropha oil is 0.10 hours is shown in graph 2 and blending of both biodiesel is 0.23 hours is shown in graph 3 this shows that the blending biodiesel exhibits good oxidation stability as per as oxidation of biodiesel is concerned.



Graph 1.The graph showing oxidation stability of waste mustard biodiesel as 2.21 h



Graph 2.The graph showing oxidation stability of jatropha biodiesel as 0.10 h



Graph 3.The graph showing oxidation stability of blending of waste mustard and jatropha biodiesel as 0.23h

V.CONCLUSION

In this experiment, the waste mustard and jatropha oil was used as feedstock and waste mustard and jatropha Methyl ester was obtained by the Transesterification of waste mustard and jatropha Oil respectively .we use renewable sources because of the decreasing trend of economical extracted oil reserves and the environmental problems caused by the use of fossil fuel. The Oxidation Stability of waste mustard and jatropha Biodiesel was tested in Professional Biodiesel Rancimat 893 and it is concluded that

- Biodiesel can be produced from waste mustard and jatropha oil using transesterification reaction.
- Waste mustard biodiesel showed the Oxidation Stability of 2.21 hours.
- Jatropha biodiesel showed the oxidation stability of 0.10 hours.

- Blend of waste mustard and jatropha biodiesel showed the oxidation stability of 0.23 hours.
- The Oxidation Stability of waste mustard and jatropha Methyl Ester can be increased by using Artificial Antioxidants like TBHQ, TBHT, PG, PY, BHT and BHQ.
- This experiment also motivates to use natural resources which are less expensive, easy available and Environment Friendly.
- It is possible to run diesel engine with biodiesel blends.
- It has become clear that when it manages to integrate the production of biodiesel with the other value-added products and integrating with other pollutants and hotel, resturant with large oil wastes, could bring significant economic benefits.
- It emits less pollution compare to fossil fuel.

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