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Quality Analysis of Bio Diesel produced from Waste soap and soap stocks (WSS)

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Abstract— Biodiesel is a fuel of future which may be produced by adopting different methods. To deal with the future rapid increasing demand of energy and to handle the toxic greenhouse gas (GHG) emissions, new ideas for the production of low cost biodiesel must be considered.
Waste soap and soap stocks (WSS) have been used to produce biodiesel. The price of the process is much lower and considerable in contrast to vegetable oils and other possible alternatives. In this research work, a sample product of biodiesel was obtained by using commercially available soap stocks and soap wastes. In the above process, acid catalyzed trans-esterification multi stage process was applied to achieve greater level of conversion. Finally, important and significant fuel properties like Flash point, Pour point, Cloud point and Fire point were performed according to ASTM procedural standards. The overall results in light of above mentioned tests displayed that the quality of produced diesel from mixture of waste soap and soap stocks (WSS) may serve the purpose and its properties are more likely to be comparable with Light Diesel Oil (L.D.O).

***Keywords*—** Biodiesel, Waste soap and soap stocks (WSS), Fuel Properties.

I. INTRODUCTION

Production of Bio-Diesel has been a subject matter as a cheap secondary fuel that may replace fossil derived fuels for several segments of daily life. Literature provides comprehensive and specific techniques about production of Biodiesel from different waste raw materials which are cheaper than fossil crude resources. [1] Bio-fuels have added advantage with lower Greenhouse gas emissions in comparison to fossil fuels. So, these fuels are environmental friendly, cheaper and sustainable in terms of dependability. In terms of chemical composition, Biodiesel has two components, free fatty acids (FFA) and esters which exhibit sustainability with environmental degradability. Bio-diesel can be produced from many raw materials. However, edible vegetable oils and animal fat have been widely reported in literature for low priced and economical manufacturing of Bio-diesel. [2]Haas et al. worked on soapstocks and investigated soapstocks as suitable for the production of Bio-diesel. Soapstocks were found to be effective and inexpensive origin for the production of free fatty acid.
Soap and soap stocks contain free fatty acid but due to higher viscosities they cannot be used as fuel. Fangrui et al. discussed and reviewed four important methods for the Bio-diesel production. These involved direct mixing of fatty acids in fossil refined fuels; emulsion formation, pyrolysis and the most widely adopted and considered Trans-esterification. [3] Bio-diesel is actually a renewable fuel, lower emissions is an added advantage with this type of fuel. This natural fuel is purely extracted from natural waste products. The cost of fuel is much cheaper than the commercially available fuels. Biodiesel enhanced the shear lubrication characteristics of the diesel when blended with derived fossil fuels. So it may solve the problem of engine wear and tear. [4] In this research Bio-diesel produced was blended with commercial diesel to estimate the improvements in characteristics.

II. MATERIAL AND METHODS

Waste soap and soap stocks were obtained from pan room of industrial unit. Methanol, Sodium hydroxide pellets, hydrochloric acid, Distilled water and silica gel. All these chemicals were of analytical grades.

A. Pre-treatment of waste Soap and Soapstocks

Waste soap and soap stocks were first dissolved in distilled water to make a solution. The mixture of distilled water and soap was continuously stirred for about 59 minutes. Further the solution obtained was filtered to remove any of the soap pellets and other impurities that were present in the solution.

B. Acidification

` Further the refined soap solution obtained from waste soap and soap stocks (WSS) was treated with different stoichiometric amount of Hydrochloric acid at a temperature of 65-70C with continuous stirring. The separating funnel was used to separate the fatty acid contents from the treated waste soap and soap stocks (WSS). The mineral acid was removed from the fatty acid by hot distilled water. To optimize the ratio of Free fatty acid (FFA), the different stoichiometric ratios of soap solution to hydrochloric acid was altered.

C. Esterification of free fatty acid (FFA)

After acidification of soap solution was completed. The next step was the treatment of Free fatty acid (FFA) with graded methanol at different temperature within range of 60-70^{O}C under reflux and controlled esterification reaction condition. Silica gel was employed to absorb water contents produced during esterification reaction due to its hygroscopic nature. All the reaction parameters were optimized by using known molar ratios of methanol. 500 ml of free fatty acid (FFA) was filled in a round bottom flask having attached condenser bath was also attached for reflux. Magnetic stirrer was used for continuous stirring of the solution. To note down the temperature of the system thermometer was used. Methanol and Sodium hydroxide was combined to obtain a mixture. This solution was further put together with Free fatty acid (FFA) at about 60^{O}C and the esterification reaction started. The flask was put on the magnetic stirrer to stir the reactants for about 99 minutes. The temperature of the mixture was maintained at about 60-65^{O}C, to prevent methanol from boiling due to its higher volatility.

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D. Bio-Diesel Settling and Separation

The mixture was allowed to settle for a day in separating funnel. So that mixture can be easily settled by means of gravity on the basis of phase equlibria. The unreacted methanol being the lighter phase separated from the bio-Diesel. The fresh product of Bio-Diesel was obtained through the bottom of the separating funnel. Finally the sample of Bio-diesel obtained was heated to 65-68^{O}C to remove

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excessive amount of moisture present in it. Bio-Diesel produced was further preserved in a flask to examine its further fuel properties and quality analysis.

III. Results and Discussions

A. Pre-treatment Quality Analysis and bio-diesel Characterization

Experiments were conducted to ensure the quality of obtained bio-diesel blended with known quantity of diesel in contrast with market available Diesel. For the sake of improvement in the process different test like Flash point, Pour point, Cloud point and Fire point was done on all samples both for biodiesel blend as well as for market available diesel.

B. Flash Point

Flash point is an important fuel property. The flash point was calculated and values fall in the specifications provided according to ASTM international accepted standards D 6751. The flash point for Biodiesel blends with 80% quantity of market available Diesel was analyzed.

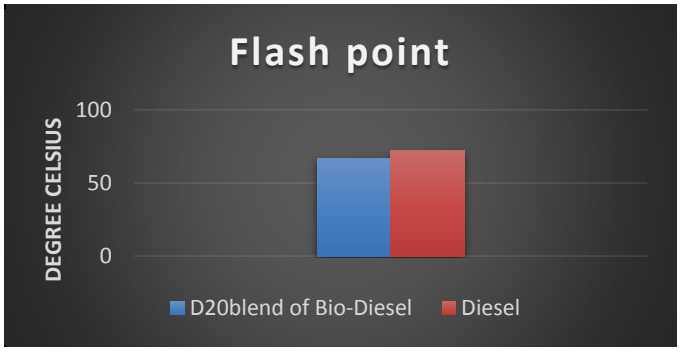

Fig.1. Flash point of Biodiesel obtained in comparison to Market available Diesel

C .Pour Point

The pour point values of the produced Biodiesel blend sample produced from Waste Soap Stocks (WSS) were checked. The pour point is an important fuel property which gives an idea about the fuel tendency to flow at minimum lowest temperature. After that temperature, fuel cease to flow.

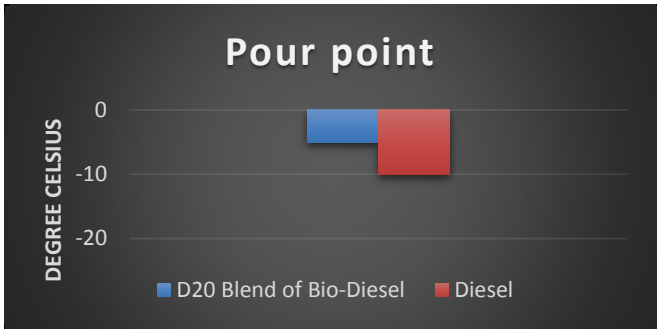

Fig.2. Pour point of Biodiesel blend obtained in comparison to Market accessible Diesel

Fig.2 indicated the pour point values of Biodiesel produced from Waste Soap Stocks. However; in that case the values obtained are lower in comparison to the market accessible diesel. The reason for the lower value of pour point may be the presence of longer ester chains within the structure of Biodiesel.

D. Fire Point

The fire point is significant fuel properties which give information about the ignition point of the fuel. The fire point was calculated for the prepared sample of biodiesel blend from soap derivatives. The comparison was conducted with diesel available commercially.

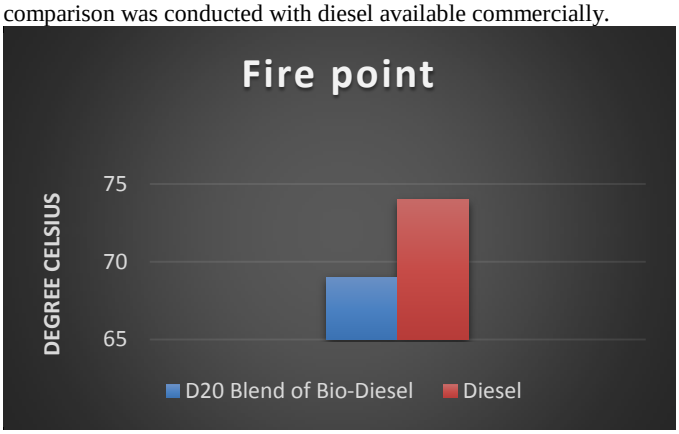

Fig.3. Fire point of Biodiesel blend obtained in comparison to commercially available Diesel

Fig.3 showed the fire point of Biodiesel blend; the values of fire point are lower than the Light Diesel oil. This may be the greater amount of unrecovered polyalcohols present in the produced Biodiesel sample from Waste Soap and soap stocks.

E. Cloud Point

The cloud point is meaningful fuel property which gives particular information about the fuel to be burnt at lower temperature. The cloud point of the biodiesel blend sample obtained from soap stocks and descendants was determined. The comparison was performed with diesel market accessible diesel.

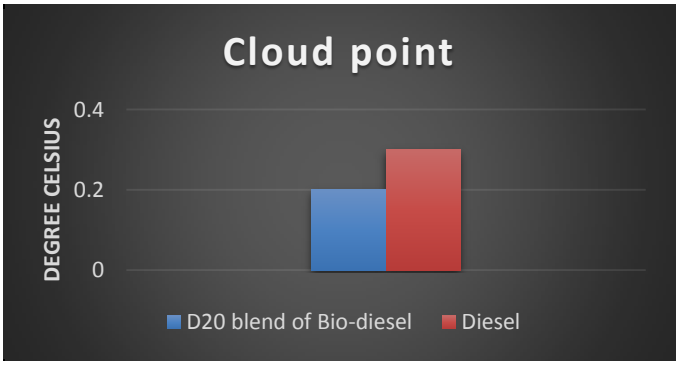

Fig.4. Cloud point of Biodiesel blend obtained in comparison to commercially available Diesel

The results are revealed (fig.4) which showed that the cloud point temperature of Biodiesel that has been yielded experimentally is much lower; it means that the produced sample can perform under cold temperature conditions. Actually at lower temperature, the engine filter may be jammed due to increase in resistance. This may cease the fuel to flow which may damage the carburetor of the engine. Therefore, it may be said that the sample obtained from Biodiesel has close resemblance with the properties of the Diesel provided in the market.

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IV. CONCLUSION

Now-e-days fossil fuel resources have been depleted around the globe. To meet with rapid increasing demand of fuels, the need of the day is to work on other alternative fuels which may compete in both cost and quality with commercially present fuels in the market. Bio diesel may be produced with different available waste resources. The current study utilized trans-esterification process on Soap stocks and soap wastes (WSS) from industrial samples which ultimately converted into biodiesel. Experimental studies revealed that the important fuel properties of blended samples of Bio-diesel with commercially available fuel, met with the properties of the market available diesel with minor differences. However, further investigation and technological progress is needed in the area.

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