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Preparation and Optimization of Biodiesel Production from Mixed Feedstock Oil

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Abstract In this paper, production of biodiesel from mixed feedstock oil (MFO) by three-step method and optimization of the process were studied by using regressive analysis. The random mixer of different oil was used for biodiesel preparation. The MFO contains 12 wt% free fatty acid (FFA) and its viscosity was 67.5 mm^2/s. Because of higher FFA content transesterification method can't be applied, so three-step method was conducted for biodiesel preparation. In the three-step method, the first step was saponification of the oil followed by acidification to produce FFA and finally esterification of FFA to produce biodiesel. In the saponification reaction, various reaction parameters such as oil to sodium hydroxide molar ratio and reaction time were optimized. Produced sodium soap was acidified with excess molar ratio of HCl to produced FFA. In the esterification reaction, produced FFA was reacted with methanol in presence of acid catalyst and the FFA content was reduced to 0.98wt%. A factorial design was studied based on viscosity for esterification reaction and developed to obtain the higher yield of biodiesel. Finally various properties of biodiesel such as FFA content, viscosity, specific gravity, cetane index, pour point etc. were measured and compared with biodiesel and petro-diesel standard.

Keywords: *mixed feedstock, FFA, esterification, factorial design, biodiesel*

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1. Introduction

Presently the world's energy needs are met through non-renewable resources such as petrochemicals, natural gas and coal. Since the demand and cost of petroleum based fuel is growing rapidly, and if the present pattern of consumption continues, these resources will be depleted in few years. Hence, efforts are being made to explore for alternative source of energy. An alternative fuel must be technically feasible, economically competitive, environmentally acceptable and readily available [1].

Energy consumption in developed countries has been increasing continuously over the past decades and is set to continue in the future. One possible alternative to fossil fuels is the use of fuels of plant origin [2]. Such fuels allow for a balance to be sought between agriculture, economic development, and the environment. Their undoubted advantages include maintaining cultivation croplands that otherwise would be abandoned, potentially developing new industrial activates, reducing dependence on oil. There is increasing interest in developing alternative energy resources. An immediately applicable option is replacement of diesel fuel by biodiesel, which consists of the simple alkyl esters of fatty acids. Without modification, diesel engine vehicles can use biodiesel fuels [3,4].

Biodiesel, defined as monoalkyl fatty acid ester (preferentially methyl and ethyl esters), presents a promising alternative fuel for use in compression-ignition (diesel) engines [5]. Fatty acids esters are formed by transesterification, also called alcoholysis, of vegetable oils. This process has been widely used to reduce the viscosity of triglycerides, thereby enhancing the physical properties of renewable fuels to improve engine performance [6]. It has been proven that biodiesel fuels have viscosities close to those of diesel. In addition, although the volumetric heating values are a little lower, they have high cetane numbers and flash points [6]. Biodiesel is a strong candidate to replace petroleum diesel, as their characteristics are generally similar in addition to the many attractive advantages of biodiesel over petroleum diesel. These advantages include the following: it is plant oil rather than petroleum-derived and as such it is less toxic and comes from renewable sources; it is biodegradable; and relative to conventional diesel, its combustion products have reduced levels of particulates, carbon oxides, sulfur oxides, and under some conditions, nitrogen oxides [6,7].

In Bangladesh the potentiality of producing oil source is investigated and it is found that the production potential is not too high. As we have a very large population, the edible oil sources cannot be employed for the biodiesel production. Moreover we have extreme limitation of land. So additional land acquiring is also impossible for the