Renewable and Sustainable Energy Reviews 56 (2016) 319–333

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Impact of alcohol on biodiesel production and properties

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ARTICLE INFO

Article history:
Received 17 August 2015
Received in revised form
2 November 2015
Accepted 19 November 2015

Keywords:
Alcohol
Biodiesel production
Biofuel
Cold flow
Oxidation
Stability

ABSTRACT

Due to rapid industrialisation and use of advanced technologies there has been increase in the consumption of fossil fuels, especially petroleum. Increasing needs are reciprocally proportionate to diminishing reserves of coal and petroleum. So, the exaggerated to be fulfilled and to curb the problem of increasing fuel prices; researchers are putting their efforts to produce an alternative fuel from replenish able resources on large scale. Biodiesel itself is proving to be a reliable and competent competitor to non-renewable petroleum which is being produced from commonly accustomed plants for instancerapeseed, soybean, sunflower and palm etc. But, complication is that it becomes a problem for in-availability of these oils for foods. Now non-edible raw materials oils such as Pongamia, Jatropha, Mahua, Moringa seed oil etc. have been used to raise the standard of these oils and being produced to complete the level of petroleum and be proven as the best resources for biodiesel production in all approaches both technically and economically. In this paper emphasis has been laid down to review the impact of higher alcohols, use of different raw materials for biodiesel preparation and effect of their composition on Oxidation Stability and Cold Flow properties. Moreover, various production technologies used to produce biodiesel were also reviewed and comparison was done among them for better yield. Further, an attempt has been made to investigate the effect of higher alcohols on biodiesel yield and its properties. The study concludes that oxidation stability depends upon unsaturation mainly linoleic acid and lenolenic acid. *Moringa olifera*, Moroccan frying oil, *Schleichera oleosa* L. oil, *Moringa peregeria* are prospective oils as per oxidative stability characteristics. In contrast to it, cold flow properties depend upon saturation and suggests that having more saturated fatty acids result in poor cold flow properties.

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http://dx.doi.org/10.1016/j.rser.2015.11.048
1364-0321/

1. Introduction

The major reason to be considered as driving force to look for alternative energy resources is environmental pollution. By igniting fossil fuels, several environmental complications like global warming, polluted air, acid rain, ozone layer exhaustion and excessive cut down of forests. Among the renewable energy resources like wind, solar, hydropower, geothermal, hydrogen & nuclear and biomass have evolved as potential alternatives to fossil fuels. Biomass and farm produced materials have been used as alternative energy sources and the use of biodiesel is growing increasingly now. This is due to its great contribution to the environment and to its role as a strategic source of renewable energy in substitution to diesel oil and other petroleum based fuel [1]. Instability of many export sources has led to increased prices of fossil fuels and its by-products. Also the CO_2 which is devastating cause of environmental destruction produced by combustion of fossil fuels has led to serious consideration of biofuel usage [2]. The consciousness of cleaner production technology is increasing globally. The need for an alternative to fossil fuels has engendered extensive research in recent years. Fossil fuels are non-renewable sources of energy which generate pollutants and are linked to global warming, climate change and even some incurable diseases. The impending challenges and the environmental implications of fossil fuels have been reviewed widely in the literature [3]. National bio diesel board formerly as National Soy diesel Development Board of United States introduced biodiesel in 1992 which boasted to have lesser exhaust emissions as compared to petroleum diesel and also was renewable and biodegradable in nature. It reduces the level of pollution causing agents in environment [4]. Biodiesel depends on crops that are compliant to a regional climate. For example in United States, major feedstock to produce biodiesel has been soybean oil. On the other hand, Europe has mostly preferred rapeseed (canola) oil and palm oil. A suitable source to produce Biodiesel should not competent with other applications that rise prices, for example pharmaceutical raw materials. But the requirement for pharmaceutical raw material is lower than for fuel resources. Biodiesel source that has low production cost but higher production quantity is supposed to be the best feedstock. Taking refined oil as example, production cost is on higher side but production scale is lower. In contrast to it, non-edible oil seeds, algae, sewerage have equally opposite criterion for feedstock production [5]. Transesterificaion reaction is the conventional method used to prepare biodiesel in which a monohydric alcohol and a catalyst chemically split the triglycerides to form alkyl esters. High viscosity is lowered to a value similar to that of D-2 while cetane number and heating value are saved through transesterification [6].

Till date most of the researchers have opted for methanol as alcohols in transesterification reaction. Methanol is derived from fossil resources, so biodiesel produced cannot be termed as renewable completely. To have completely renewable biodiesel, alcohols must be derived from bio-based resources. Ethanol, Butanol and Petanol are the alcohols of this type. In this paper, attempt has been made to investigate the impact of different higher alcohols on biodiesel production, yield and fuel quality of biodiesel.

2. Feedstocks used for biodiesel production

In available literature there are numerous feedstocks reported which can be used to produce biodiesel. Among them, soybean, palm, sunflower, rapeseed and peanut oils have been considered in earlier times but their negative impact on food crops have hindered their usage. The selection of raw material mainly depends upon the availability and cost. European communities for example are self-dependent in production of edible oil with surplus to export. As a result edible oils such as rapeseed is commonly used in European Nations' biodiesel. In America, soybeans are commonly used. Similarly, countries with coastal areas such as Malaysia, Indonesia and Thailand have surplus palm, coconut oils which are used for biodiesel. In Brazil, the mostly used oils are soybean, castor and palm kernel. In India, Jatropha and Karanja have been reported to be as prominent sources for biodiesel production [7].

Table 1 depicts the number of vegetable oil which can be potential source for biodiesel production. As it is seen, there are numerous non-edible oils which hold an advantage over edible oils of being not used in food crops. Using edible oils for biodiesel production in longer term will hamper the food crops and their conventional uses. This may lead to scarcity of food products. Moving further, there are some emerging feedstocks like microalgae, animal fats, fish oil, beef tallow oil etc. which can be utilised to produce biodiesel on large scale.

Fig. 1 shows the production capacity of some vegetable oil. It is observed that Waste Cooking oil in China is quite prominent source of biodiesel whereas India is rich in Jatropha and Karanja Oil. Similarly Palm, Coconut and Rubber Seed Oils are in other Asian Countries.

2.1. Edible oils (1st generation)

These oils are normally obtained from food crops and vegetable oils. Food crops like rice, wheat, potato wastes and sugarcane etc. have been used in past to produce alternative fuels. To a larger extent, first generation oils are derived from edible vegetable oils such as soybean oil sunflower oil, corn oil, olive oil, palm oil, coconut oil, rapeseed oil, mustard oil, castor oil. In addition to it, these oils face social, economic and environmental challenges because these are derived from food crop feedstocks. Their use leads to increased food prices and also creates pressure on land use which makes it unlikely to be sustainable [8].