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Various adsorbents to improve the filterability of biodiesel

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ABSTRACT

Cold flow properties are the primary drawback to the common usage of biodiesel as an alternative fuel to diesel. Biodiesel's cold flow behaviour is discovered for the main reasons of presence of precipitant or crystal initiate by minor components such as monoglycerides and steryl glycosides. The ASTM test for this precipitant is 'The Standard Test Method for Determination of Fuel Filter Blocking Potential of Biodiesel (B100) Blend Stock by Cold Soak Filtration Test (CSFT)'. Therefore, in this study, the performance of commercial activated carbon, silica and beach sand as adsorbent is studied in improving the filterability of two different level of refined biodiesel. The adsorbents were used to treat the biodiesel by removing the impurities present in the biodiesel such as the monoglycerides and steryl glycosides compound from biodiesel using adsorption technique. The efficiency of the adsorbent is determined by performing the cold soak filtration test. Based on the cold soak filtration test, precipitate is not visible and the CSTF is within the 360 s limit for the both refined level of biodiesel. However, treatment of these biodiesel with commercial activated carbon, silica and beach sand resulted in further reduce in CSFT. Commercial activated carbon found to be the most effective adsorbent, followed by silica. This is because both adsorbents possessed high surface area of 657.0420 m^2/g and 320.2724 m^2/g respectively and high pore volume of 0.379097 cm^3/g and 0.952320 cm^3/g respectively which further enhance its potential as an excellent adsorbent to improve the filterability of biodiesel compared to beach sand which possessed lowest surface area and lowest pore volume of only 1.2630 m^2/g and 0.001751 cm^3/g respectively.

1. Introduction

It is known that fossil fuels are finite and consume them for long enough as a global resources will eventually run out. Since fossil fuels have limited availability, the world has been switch to a more secure alternative fuel sources, renewable energy. One of the most common renewable energy used is biodiesel due to its advantages such as non-toxic, biodegradable and environmental friendly over petrol diesel (Zahan and Kano, 2018).

Biodiesel are produces from vegetable oil and animal fats through transesterification process of triglyceride in presence of alcohol and catalyst (Degfie et al., 2019), (Yesilyurt et al., 2020). It is also could be produced from others feedstock such as algae (Unpaprom et al., 2015), (Saengsawang et al., 2020) and waste (Al Hatrooshi et al., 2020; Blinová et al., 2017; Touqeer et al., 2019).

The most common vegetable oils used to produce biodiesel are rapeseed, palm, soybean and coconut (Knothe and Razon, 2017). Different countries use different feedstock. In Malaysia, palm oil is the most common oil used in the production of biodiesel due to its availability and accessibility as Malaysia is the main producers and exporters of palm oil. Moreover, non-edible palm oil such as the waste oil from palm industry and used cooking oil is used in the production of biodiesel (Mat Yasin et al., 2017).

Besides its numerous advantages, one disadvantage of biodiesel is the properties and performance of alkyl esters at cold temperatures. Higher pour and cloud point causes fuel freezing during cold weather, which causes the appearance of white solid precipitates in biodiesel during storage (Manaf et al., 2019). Further usage of this biodiesel may cause filter plugging in engine systems and formation of precipitate on the engine injectors. Therefore, the formation of precipitate above the cloud point temperature limits the acceptance of biodiesel especially in cold countries.

The most efficient technique to remove steryl glucosides in biodiesel is by using the vacuum distillation however there a few drawbacks for this technique such as the process is energy extensive and this technique results in significant reduction of natural antioxidant content, which

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