



Water Removal from Crude Biodiesel using Microbubbles

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Abstract

Current production of biodiesel using transesterification .however, biodiesel is not yet available to the engine because there is contamination of the mixture. Therefore it is necessary to have a process that makes biodiesel purification. Washing biodiesel with water is the most common method of cleaning biodiesel. But the disadvantage of the process is high cost and longer manufacturing process. In this research, therefore, air bubbles at different sizes of diffusers (10-16 μm , 16-40 μm , and 40-100 μm) and air flow rates (100 cc/min, 200 cc/min, 300 cc/min) were used instead to remove water in biodiesel. The results show that the smallest size of bubbles with the highest air flow rate provided the highest removal rate of water. Using bubbling technique, can not only overcome those drawbacks suffering from the conventional processes. But also reduce the production cost

Keywords : Biodiesel; water removal; Air bubbles

Introduction

In recent years global warming and environmental pollution have become major global issues. The use of fuels coming from biomass such as biodiesel and bioethanol can help to mitigate such issues because of the renewable features of these energy sources. The above mentioned bioproducts are the most important biofuels employed up-to-date in the transport sector. Both can be utilized alone, in special motor engines or as additives in fossil diesel and gasoline blends. Actually, biodiesel exhibits many benefits as an alternative fuel: it is derived from a renewable source, its biodegradability and lower ecotoxicity contribute to its beneficial character compared to petroleum based diesel. Furthermore, biodiesel has a more favorable combustion emission profile, such as low emission of carbon monoxide, particulate matter and unburned hydrocarbons [1]. Current production of biodiesel using transesterification which can be produced by mixing vegetable oil, animal fat, alcohol and catalyst with Sodium hydroxide. The main products consist of alkyl esters (biodiesel) and glycerol [2].

Finally, biodiesel is stored and distributed to be sold [3]. Once stored, biodiesel can absorb more humidity than petroleum diesel since fatty acid methyl esters (FAMES) are hygroscopic compounds, making biodiesel much more hydrophilic than regular diesel [4]. Biodiesel clearly offers environmental, commercial and performance benefits, since biodiesel does not contain sulfur, aromatic hydrocarbons, metals or crude oil residues. However, it must be emphasized that biofuel's performance heavily depends on the purity of the final product and the complete absence of particulates or contaminants, e.g., water [5]. The free water content in biodiesel and diesel fuel promotes biological growth in storage tanks, which could

lead to corrosion of metals (copper, iron, steel and others) and formation of sludge and slime, thereby causing blockage of fuel filters and fuel lines, which could damage vehicle fuel injection systems. Washing biodiesel with water is the most common method of cleaning biodiesel. But the disadvantages of the process are high cost and longer manufacturing process. Therefore, this paper is interested in air bubbles to remove the water. Compared with conventional process, the advantages gained from this proposed technique are requirements of less space and less operating time. Also, it is a simple and cost effective method [6].

The objective of this research is to find relationship between pore size of diffusers, air flow rates and operating time for water removal in the bubble column.

Methodology

Biodiesel was prepared by transesterification process. The experimental setup is shown in Figure 1. A bubble column with a diameter of 50 mm was assembled with a diffuser connected to stainless tubes, a flow meter and an air pump. Bubbles were generated while air was flowed through the column. Bubble-sizes were varied depending on the diffuser used. Here, the diffusers are porous-glass discs with a diameter of 50 mm and have different ranges of pore sizes; P2 (40-100 μm), P3 (16-40 μm) and P4 (10-16 μm). The biodiesel of 50 mL was loaded into the bubble column. Air was then flowed from the air pump with different flowrates of 300, 500 and 700 cc/min through the diffuser and the biodiesel containing in the column. Samples were collected every 10 minutes for 1 hour. The concentration of water in biodiesel was analyzed using the coulometric Karl Fischer method. The reduction of water concentration in the bubble column with time was recorded in related to bubble-sizes and flowrates.

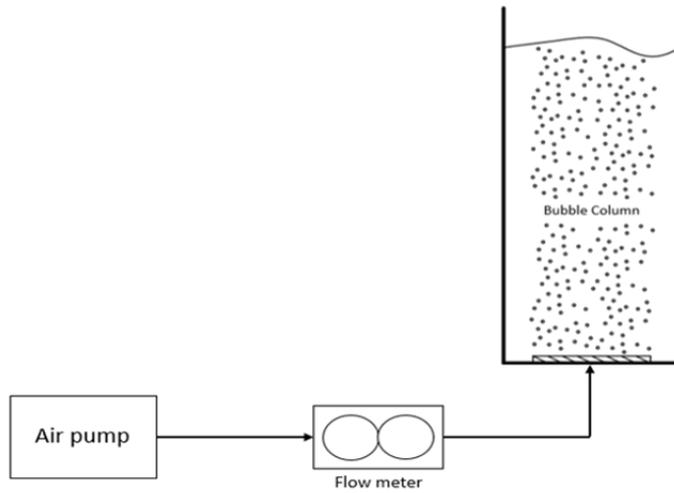
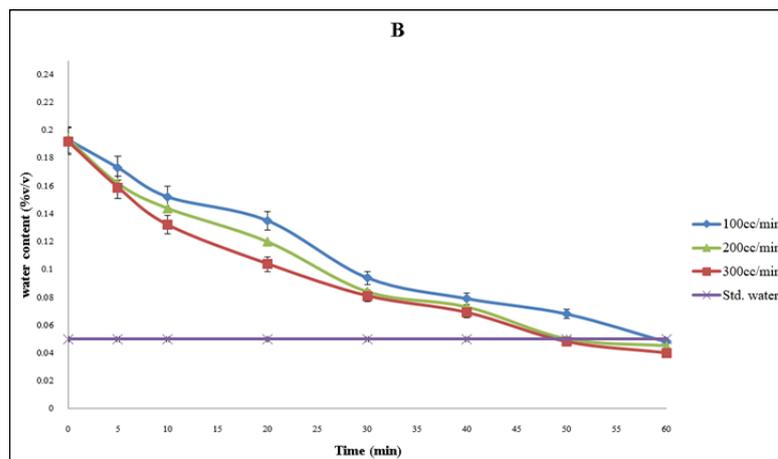
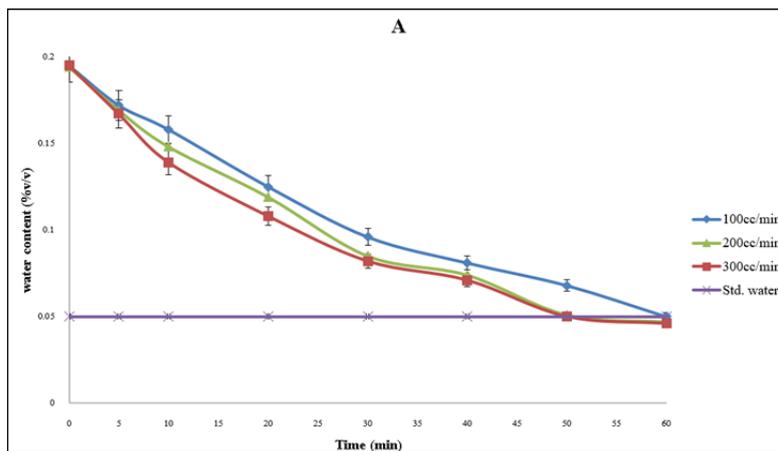


Figure 1 Experimental setup for water removal via bubbles. The inset is a photograph of the bubble column while flowing air with a flow rate 300 cc/min through a diffuser P2, P3, and P4.

Results and Discussions



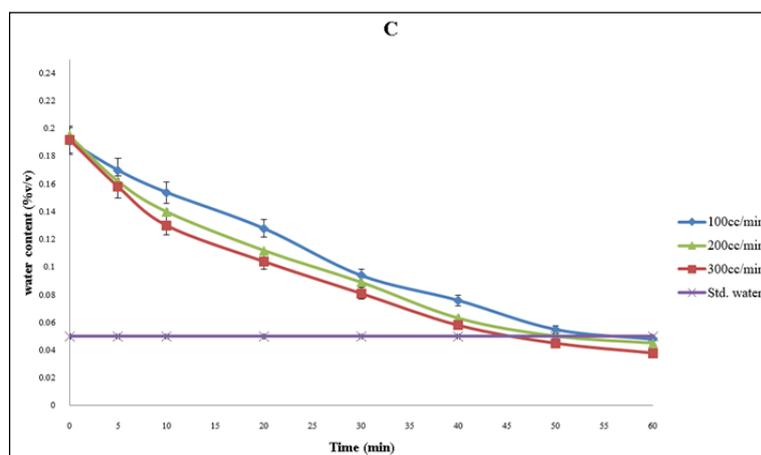


Figure 2 Remaining water content (%v/v) after air flowing for 60 minute through diffusers P2(A), P3(B), and P4(C) at air flow rates of 100, 200 and 300 cc/min.

A technique for water removal via air bubbles presented in Figure 1. The inlet temperature of air was set at room temperature. After bubbles formed, they float from the bottom to top of the bubble column. Water dissolved in biodiesel evaporates simultaneously into the bubbles leading to a reduction of water in the system.

The amount of water remaining in biodiesel at various bubbling times is shown in Figure 2. Overall, the concentration of water decreased rapidly within the first 5 minutes at all flow rates and diffusers. At air flow rate of 300 cc/min represented in Figure 2A, water content decreases from 0.195% to 0.05% (Standard ASTM D-2709) within 50 minutes, while longer bubbling time required at lower air flow rate. These characteristics were observed when the diffuser P3 and P4 were used as shown in Figure 2B and Figure 2C, respectively. At flow rate of 300 cc/min represented in Figure 2B, water content decreased from 0.194% to 0.05% within 52 minutes, whereas diffuser P4 represented in Figure 2C water content decreased from 0.195% to 0.05% within 45 minutes. This means that small pore size could reduce more amount of water than large pore size

at the same air flow rate according to the work done by William study [7].

Moreover, at the same air flow rate, the highest removal rate of water was observed at the highest air flow rate as shown in Figure 2 A-C. This means that the amount of water transferred into air bubbles is proportional to air flow rate.

Conclusion

This research presented a novel technique used for water removal from biodiesel using air bubbles. Bubble size and air flow rate are the main parameters that affect the removal rate. Higher water removal rate was observed when both smaller bubbles were formed and higher flow rate was applied. In addition, the amount of water in biodiesel is less than 0.05% within 45 minutes for P4 diffuser and flow rate of 300 cc/min.

Acknowledgement

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