Production of Biodiesel from WVO Using Small Scale Continuous Ultrasonic Processor

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Background

There is a need in the USA to decrease dependency on fossil fuels. One alternative fuel that has gained much popularity in the past few years is biodiesel. Biodiesel can be produced using vegetable oil, waste vegetable oil (WVO), animal fat and yellow grease as raw materials. However, the process of converting a batch of WVO into usable biodiesel is time consuming, requires a human operator to run the system, and necessitates the performance of a chemical titration for each batch of biodiesel produced.

Purpose

The ultimate goal of this project is to significantly increase the production capacity and product quality while reducing cost and human interaction.

Design/Method

In the first phase of this project, the processor was designed and built by the senior design students utilizing a programmable logic controller (PLC) in conjunction with pumps, valves, temperature sensors, etc. to completely handle the production of biodiesel with minimum operator interaction. This was the first step toward continuous flow processor and the elimination of the titration process. In the second phase of this project, the students integrated a small Hielscher Ultrasound continuous processing unit to the automated system. This paper presents the newly developed system and demonstrates the design aspects of the automated biodiesel production processor using a PLC and ultrasonication (continuous processing) as well as how the chemical titration procedure for each batch is eliminated

Results

Our results are a greatly reduced reaction time of approximately 1 hour using ultrasonication compared with 4 hours by using traditional means. Also, the settling period has been reduced from 12 hours to less than 2. Small batches were titrated and reacted by traditional means for comparison and 27/3 tests were performed on both these and the ultrasonified fuel. The use of sonochemistry provided B100 of even greater quality with more yield quantities than all previous tests.

Conclusions

The conclusion of the senior project work is an automated processor that is capable of producing biodiesel with very limited operator interaction. For the system operators, a set of complete work instructions have been written to go along with the processor. The produced biodiesel was analyzed by the chemistry department and we believe it does meet the ASTM standards. It was used successfully in running an AMICO diesel engine AD 186FE.

Also the processor was created to be a more efficient and effective way of converting WVO to a burnable energy resource. Implementing automation and ultrasonic technology has proven to be one of the most efficient ways of processing biodiesel. This allows for cutting the processing time by 75% compared to conventional agitation and mixing.