An Ultrasound-Assisted System for the Optimization of Biodiesel Production from Chicken Fat Oil using a Genetic Algorithm and Response Surface Methodology

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ABSTRACT

Biodiesel is a green (clean), renewable energy source and is an alternative for diesel fuel. Biodiesel can be produced from vegetable oil, animal fat and waste cooking oil or fat. Fats and oils react with alcohol to produce methyl ester, which is generally known as biodiesel. Because vegetable oil and animal fat wastes are cheaper, the tendency to produce biodiesel from these materials is increasing. In this research, the effect of some parameters such as the alcohol-to-oil molar ratio (4:1, 6:1, 8:1), the catalyst concentration (0.75,1 and 1.25% w/w) and the time for the transesterification reaction using ultrasonication on the rate of the fatty acids-to-methyl ester (biodiesel) conversion percentage have been studied (3, 6 and 9 min). In biodiesel production from chicken fat, when increasing the catalyst concentration up to 1%, the oil-to-biodiesel conversion percentage was first increased and then decreased. Upon increasing the molar ratio from 4:1 to 6:1 and then to 8:1, the oil-to-biodiesel conversion percentage increased by 21.9% and then 22.8%, respectively. The optimal point is determined by response surface methodology (RSM) and genetic algorithms (GAs). The biodiesel production from chicken fat by ultrasonic waves with a 1% w/w catalyst percentage, 7:1 alcohol-to-oil molar ratio and 9 min reaction time was equal to 94.8%. For biodiesel that was produced by ultrasonic waves under a similar conversion percentage condition compared to the conventional method, the reaction time was decreased by approximately 87.5%. The time reduction for the ultrasonic method compared to the conventional method makes the ultrasonic method superior.

KEYWORDS: Numerical modeling; Safety procedures; Scanning electron microscopy

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