J. Chem. Chem. Eng. 8 (2014) 717-726

Biodiesel Production by Enzymatic Catalysis Process Using Two Analytical Ways: Gas Chromatography and Total Glycerol Determination

Ignacio Contreras Andrade[1], Jonathan Parra Santiago[2], José Ricardo Sodré[3], Joseph Sebastian Pathiyamattom[4] and Carlos Alberto Guerrero-Fajardo[5*]

1. Doctor Chemical Engineering, Universidad Autónoma de Sinaloa, Culiacan 80040, México

2. Chemical Engineering (C), Universidad Nacional de Colombia, Bogotá 11001, Colombia

3. Coordinator of the Postgraduate Program in Mechanical Engineering, Pontifical Catholic University of Minas Gerais, Belo Horizonte 30130, Brazil

4. Center forEnergy Research, Universidad Nacional Autonoma de México, Temixco 62580, México

5. Chemical Engineering and Mechanical, Universidad Nacional de Colombia, Bogotá 11001, Colombia

Abstract: Currently, biodiesel is presented as one of the best alternatives for gradually replacing the use of fossil fuels, but it has some factors that make it economically impractical if it does not have a government support. For this reason, research efforts focused on this area have been responsible for optimizing the process of biodiesel production by different catalytic routes to achieve greater efficiency at a lower cost. In this case, the biggest problem has been the high cost generated by an investigation, which in many occasions is the main factor to decide if an investigation could be carried out. Trying to reduce these costs, in the current study, we are using a technique of glycerol quantification by volumetric methods and comparing obtained results with the chromatographic method, which is conventionally used and comparatively much more expensive. Biodiesel employee was obtained by an enzymatic catalysis process varying one of three process variables:oil:alcohol molar ratio, temperature and proportion of catalyst. The numerical differences obtained between the two quantification methods generated relative errors lower than 10%, resulting in some occasions lower than 1%. By gas chromatography analysis the best yield was obtained at the same conditions of the volumetric method, a temperature of 45 ^{o}C, an oil:alcohol ratio 1:4 and 8 wt.% of catalyst, but a yield of 95.5% and 97.1%, respectively. Due to the high precision of gas chromatography, this method is used to carry out a surface response analysis obtaining as ideal operating conditions a temperature of 43.5 °C, 8.9 wt.%. of catalyst and an oil:alcohol ratio 1:4.

Key words: Biodiesel production, glycerol determination, gas chromatography, enzymatic catalysis.

1. Introduction

Biodiesel, a liquid fuel composed by a mixture of fatty acids methyl esters, which is produced by a transesterification reaction of triglycerides derived from vegetable oils, is receiving great attention as a petroleum diesel replacer gaining acceptance and market share in the United States and Europe [1]. It is a renewable, nontoxic and biodegradable resource, which can be produced locally to minimize its dependence on foreign countries and to get benefit in the internal market [2].

The transesterification reaction to produce biodiesel is commonly carried out using an alcohol with a short-chain length such as methanol, ethanol or butanol, and a feedstock with a high content of triglycerides in the presence of a catalyst [3]. This process produces a mixture of fatty acids esters and glycerol as product and by-product, respectively, and a small proportion between 2% and 5% of unreacted feedstock, and the catalyst. This mixture must be purified to obtain diesel

*Corresponding author: Carlos Alberto Guerrero-Fajardo, Ph.D., Associated Professor, research fields: oils fuel, renewable fuel and catalysis. E-mail: caguerrerofa@unal.edu.co.