A New Process for the Production of Biodiesel from Used Vegetable Oil

A.Balasundaram, A.Cyril

Abstract: ***Production of biodiesel from triglycerides (vegetable oil) is usually done through transesterification with alcohols in the presence of acid or base catalyst. When this oil contains free fatty acid of more than 5 percent due to repeated use for frying, the transesterification process can not be used to produce biodiesel. In this paper, a new method for producing biodiesel even for used vegetable containing higher or any amount of free fatty acid is discussed. This method involves complete saponification of the triglycerides and free fatty acids (FFA) by reacting it with sodium hydroxide solution to give sodium salt of fatty acid (SOAP). This soap when treated with a mineral acid, separates into four layers, the top layer which is also the primary layer is the free fatty acid (FFA), the second layer is the glycerol, the third layer is the water layer, and the bottom layer is the residue of solid sodium salt. The top layer free fatty acid(FFA) is easily separated and then esterified with ethanol in the presence of a mineral acid as a catalyst to get the biodiesel (ethyl ester of FFA). The product obtained by the above process is analyzed and confirmed by FT-IR spectra. This process does not involve high temperature and pressure. The advantages of this new process are that it is much environmentally friendly compared with any other methods of production of biodiesel with less processes time. Since the washing of biodiesel to remove the soap formed due to the presence of free fatty acid content in the feedstock is completely eliminated, there will be no effluent discharge to the environment and at the same time resulting in more yield. The significance of this method is that it can be used to obtain biodiesel from used vegetable oils, raw vegetable oil and tallows and especially for any feedstock material which contains any amount of free fatty acids.***

Keywords: Biodiesel, esterification, Triglycerides, Free fatty acids.

I. INTRODUCTION

All vegetable oils and animal fats containing triglycerides and fatty acids, which can be converted into biodiesel (FAME or FAEE) have been an excellent alternative to the diesel derived from fossil fuel. Bio-diesel is a renewable source of energy and also reduces the net production of the greenhouse gas CO_2 when used as a fuel in compression ignition engines. Because of these advantages and the rising fossil fuel prices, biodiesel produced from vegetable oils and animal fats has gained tremendous attention and use in the past few years. Transesterification is a general chemical process which converts one form of an ester to another form of an ester, here in biodiesel production the triglycerides, which is the ester of glycerol and higher fatty acids are converted into ethyl or methyl ester of fatty acids. There are many ways of producing biodiesel from vegetable oils (triglycerides), but all these processes involve the conversion of triglycerides to ethyl are methyl esters of fatty acids. The transesterification processes are classified on the basis of catalytic and non-catalytic conversion as a) Alkali catalyzed transesterification. b) Acid-catalyzed transesterification. c) Acid and alkali catalyzed two-step transesterification.d) Enzyme catalyzed transesterification and e) Non-catalytic supercritical transesterification. In alkali catalyzed transesterification, the most common method, in which the triglycerides present in the vegetable oils or fats react with alcohol(ethanol or methanol) using NaOH or KOH as a catalyst in a molar ratio of 3:1 to give the fatty acid methyl or ethyl ester(biodiesel) and glycerol. Since the reaction is reversible, excess of alcohol is usually used to get more products [1-4] (biodiesel). Bradshaw [2] carried out the transesterification process using 1.6 times the theoretical amount of methanol, which contained 0.1 to 0.5 % of sodium hydroxide to oil at 80^0 C and got 98% yield, he also observed that the presence of water and free fatty acid inhibit the reaction and decrease the yield. Sprules [3] and price in their patented process had used a higher molar ratio of 45:1, mainly when the triglycerides contained a large amount of free fatty acids. The main feature of using an alkali catalyst is the shorter reaction time at a relatively low temperature with less amount of catalyst, and because of these reasons, more than 60 % of the industrial plats use this catalyst [4]. But if the raw materials used for biodiesel production contain any water content [5] and free fatty acid of more than 1 %, soap formation will happen, and it will interfere with glycerol separation due to the formation of emulsion and also decrease the yield of biodiesel production. Heterogeneous catalyst such as MgO [6] and mixed oxides have also been used for the transesterification but with the yield of around 60 % at 130^o C. Acid-catalyzed transesterification [7] is the process in which the triglycerides present in the oils and fats are treated with alcohol in the presence of inorganic acids such as sulphuric acid, hydrochloric acid, and nitric acid. Nye et al. [8] transesterified the used frying oil with methanol, ethanol, propanol, and butanol using both sulphuric acid and KOH as a catalyst, and the result

Revised Manuscript Received on August 25, 2019

A.Balasundaram, Assistant Professor, Department of Chemistry, Arumugam Pillai Seethai Ammal College, Research Scholar, Alagappa University, Karaikudi. TN, INDIA.

A.Cyril, Head & Assistant professor, PG & Research Department of Chemistry, Raja Doraisingam Government Arts College Sivganga ,TN, INDIA.