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Electrochemical Synthesis of Biodiesel Fuel by Using Sodium Chloride

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Summary

Transesterification of triglyceride was carried out in an electrolysis cell without membrane, with platinum electrodes and NaCl as the supporting electrolyte. The addition of tetrahydrofuran as a cosolvent of corn oil and methanol resulted in a significant increase in electroconductivity. In addition, a small amount of water was added into the electrolyte. Water decomposition occurred at the start of electrolysis. As a result, pH value of the electrolyte became above 12 in about 5 minutes. At the same time, transesterification progressed. When the electrode area of cathode was larger than that of anode, yield of fatty acid methyl esters (FAME) attained 100% in 120 minutes. Next, electrochemical transesterification of corn oil containing 0.5, 1 and 5 wt % oleic acid was performed. High FAME yields were obtained up to 1 wt % oleic acid content. It was found that the electrolysis cell without membrane could apply to the electrochemical transesterification of waste cooking oil containing water and fatty acid. However, no FAME was found in the electrolyte after the esterification of oleic acid due to the interference of saponification. It was found to be effective to narrow the distance between cathode and anode for reducing the total electrolysis voltage. Solid polymer electrolyte type electrolysis cell with cation exchange membrane was used for the electrochemical transesterification of corn oil. When the mixture of corn oil and methanol was filled in cathode and anode side, no current could flow. Even when aqueous NaCl solution was filled in the cathode side to supply water to cation exchange membrane, FAME yield was only 2.6 % in 120 minute. This is caused by the low reaction rate of the acid transesterification. In order to form the OH^- ion during the electrochemical transesterification, anion exchange membrane was used. However, the electrolysis was halted due to the corrosion of the stainless steel feeder in the cell.