Lab #3: Esterification Reaction

By Jesse Peters, Connor Ortman, and Gabrielle Barefield

Abstract: the esterification reaction can be taken from its most classic format through an acid catalyzed reaction with a carboxylic acid and alcohol then going through a substitution. This experiment was conducted with waste vegetable oil and propanol instead of methanol to successfully make biodiesel.

Background: This experiment focuses on the production of biodiesel through esterification of free fatty acids and the transesterification of glycerides. Implementing the use of 1-propanol, allowing for decreased rection time, showing that greener properties are being implemented within the Fischer Esterification reaction: “an acid-catalyzed reaction between a carboxylic acid and alcohol, which undergoes nucleophilic acyl substitution” (Bladt, D. et al.2011) which can be seen in Figure 3. This experiment also includes La Chatliers principle that allows reaction to be reversed from where the starting material is an ester rather than an aldehyde, ketone, or acyl halide

Fig.1: burning esterified biodiesel on the left and vegetable oil on the right.

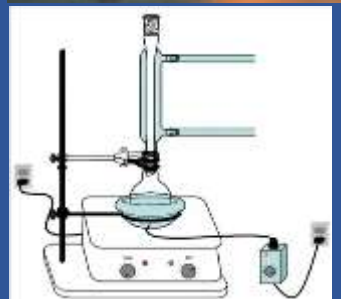

Fig.2: reflux reaction . In this case propanol, sulfuric acid, and waste vegetable oil are refluxed for an hour before biodiesel is drain for analyzing

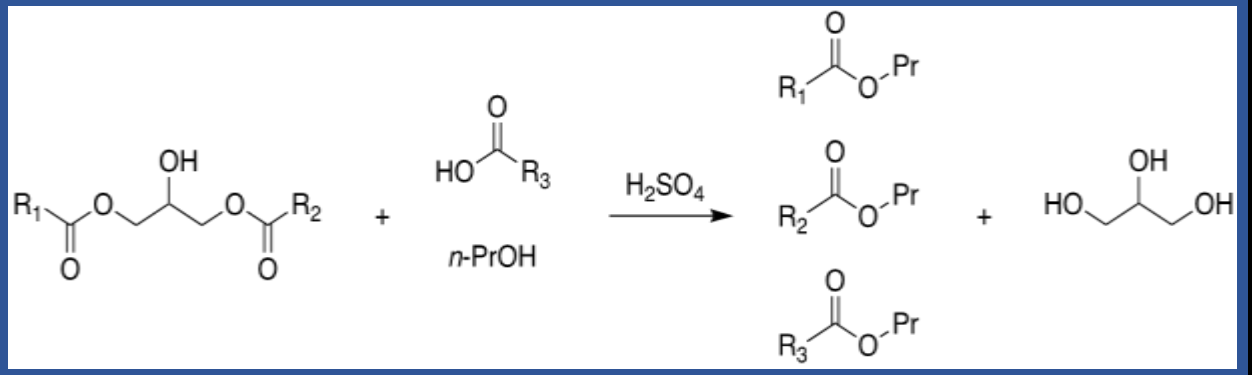

Fig. 3: Fischer esterification of free fatty acids and trans esterified triglyceride with 1-propanol and sulfuric acid to produce glycerol and three esters.

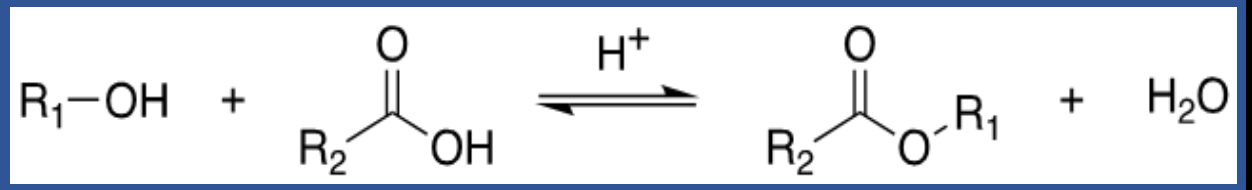

Fig.4: traditional acid-catalyzed Fischer esterification reaction. Chemicals used: Methanol and a carboxylic acid.

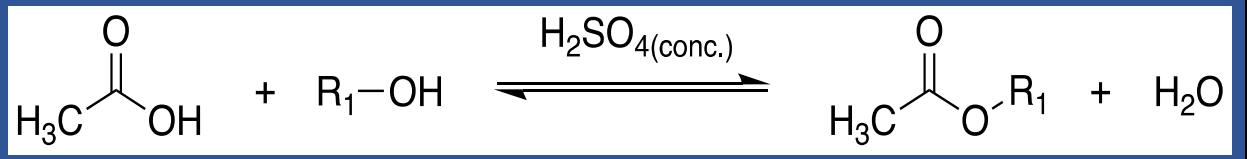

Fig.5: traditional esterification reaction with sulfuric acid. Showing the reaction with a concentrated solvent .

Acid-Catalyzed Preparation of Biodiesel from Waste Vegetable Oil: An Experiment for the Undergraduate Organic Chemistry Laboratory, J. Chem. Educ. 2011, 88, 201–203.

Procedure:

Experiment

1) add 1-propanol(8.0ml) sulfuric acid(0.15ml) in a 125ml reaction flask with stir bar. Stir for 2min.
2) Add waste vegetable oil (20ml) reflux for 1hr. Transfer to separator funnel.
3) Drain brown bottom layer washing with 45ml of 1M NaCl solution. Make sure PH is neutral (green).

Analysis

1)Create two lamps for biodiesel and vegetable oil light and time burns.
2)Fill Pasteur pipettes and time draining.

Analysis: Biodiesel burned for 3min and 22.98 second's while vegetable oil burned for 7 minutes and 3.69 seconds (Fig.1). The viscosity of the substances were also tested: Biodiesel flowed at 4.63 seconds and vegetable oil flowed at 1 minute and 10.12 seconds.

Discussion: Biodiesel was successfully made after conducting the esterification and transesterification process. Analyzing the biodiesel and comparing it to the vegetable oil it was observed that it burned much faster and that it was more viscos than the vegetable oil. When conducting this experiment, a large number of washes were needed to get the biodiesel to a neutral PH. Future work could be done to see how PH levels affects burning and viscosity .