OLD DOMINION UNIVERSITY

Announcement of Ph.D. Dissertation Oral Defense

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Building: Kaufman Hall **Room:** 136

Day: December 2 **Time:** 3:30 pm

Dissertation/Thesis Title:

CATALYTIC TRANSFER HYDROGENATION REACTIONS OF LIPIDS

Abstract:

Catalytic transfer hydrogenation (CTH) of lipids was investigated using 2-propanol as hydrogen donor for producing liquid hydrocarbons e.g. jet fuels. The main source of lipid selected in this study was waste cooking oil (WCO) and oil-laden algae-derived biofuel intermediate (BI). Two different catalyst were employed in this study, namely activated carbon and trimetallic-doped zeolite.

CTH reaction between WCO and 2-propanol in a continuous flow reactor over a packed-bed activated carbon at near atmospheric pressure. Results revealed high level of alkenes and aromatics compounds, which are not stable and environmentally unfriendly. To reduce these compounds in the liquid fuel, trimetallic catalyst was prepared and repeated the reaction by optimizing the reaction variables (temperature, pressure, weight hourly space velocity, and oil-2-propanol ratio). Results from the second study was better than that of the first as the level of aromatics and alkenes was lower in the second study. However, the amount of branched and cyclo-alkanes (high octane rating compounds) was insignificant.

Lipid from algae-derived oil-laden BI was extracted by 2-propanol and without evaporation of alcohol, the pregnant 2-propanol was subjected to CTH over the prepared trimetallic catalyst in a batch reactor. The liquid fuel product from this third study produced significant branched and cyclo-alkanes (serendipity).

Finally, technoeconomic analysis (TEA) and life cycle assessment (LCA) of CTH reaction was conducted. The results were compared with conventional hydroprocessed renewable jet fuels (HRJ) process. Results showed that the economic performance of CTH was lower than that of HRJ due to large volume of 2-propanol employed in the CTH. However, the environmental performance of CTH was very impressive compared to that of HRJ.

Chapter 1 of this study described the rationale for selecting WCO and 2-propanol as the potential hydrogen donor.

In Chapter 2, 2-propanol was used the react with waste cooking oil by considering four reaction parameters: temperature, oil flow rate, WHSV, and pressure. Finally, kinetics of the reaction was ascertained to estimate reaction order, activation energy, and kinetic rate constant.

Chapter 3 employed commercial catalyst doped with transition metals, which catalyzed the reaction between waste cooking oil and 2-propanol. Optimization of the reaction was studied by varying temperature, WHSV, pressure, and oil-2-propanol ratio. The percent of transition metal employed remained constant.

Chapter 4 on the other hand explored the possibility of using oil-laden biofuel intermediate from flash hydrolyzed algae. The purpose was to utilize 2-propanol as oil extract and hydrogen donor in CTH reaction of the oil.

Finally, Chapter 5 thoroughly treated technoeconomic and environmental performance of the CTH reaction of waste cooking oil and 2-propanol.