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FROM TRIGLYCERIDES-BASED FEEDSTOCKS TO GREEN DIESEL: TOWARDS HYDROLYSIS-REFORMING-HYDROGENATION-DEOXYGENATION IN ONE-POT

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Studies using heterogeneous catalysts for the hydrolysis reaction of edible oils still are in early stage. Recently, it was found that the aqueous solution of glycerol, formed after the hydrolysis, may suffer the reaction of aqueous phase reform (APR) producing H2 and CO2. The H2 can be used in the hydrogenation of unsaturated free fatty acids formed, allowing to obtain a specific fatty acid of higher added value. The present work demonstrates that you can tune in the final product by choosing the appropriate sequential catalyst system as shown in the figure below. In the first step, in a batch or tubular reactor at 250 oC and 25 bar, the hydrolysis of soybean oil proceeds is carried out by using acid catalysts, such as Al2O3 producing a mixture of glycerol, free fatty acids, mono and di glycerides. However, if Ni-Sn/Al2O3 catalyst is used at the same reaction condition in an appropriate amount, you can produce a mixture of unsaturated and saturated fatty acids, since the catalyst can perform the hydrolysis, convert the glycerol to CO2 and H2 and enable the hydrogenation of the unsaturated fatty acids simultaneously, as shown in the table. Table - Results of catalytic soybean oil hydrolysis at 250 oC and 25 bar after 2h NiO-110 NiO-300 NiO-400 NiO-500 NiSn-300 TG conversion (%) 89.0 74.9 73.6 74.3 95.1 Final (MG + DG) (%) 71.6 58.6 65.6 56.7 12.2 Total FA (%) 16.5 16.4 7.8 17.7 81.9 Saturated FFA (%) 37.9 53.4 35.5 35.4 28.9 Insaturated FFA (%) 61.9 46.6 63.1 64.6 71.1 Final free C18:0 (g) 3.19 6.11 1.19 2.77 13.85 The fatty acids formed can further being deoxygenated at the same reaction condition by using a Pd/C catalyst producing alkanes/olefins (green diesel) and CO2/CO. Figure. Stearic acid (SA) deoxygenation: Batch reactor (500 mL), 25 bar, 250 oC,