Hydrogenolysis of alginic acid over mono and bimetallic ruthenium/nickel supported on activated carbon catalysts with basic promoters

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Algal biomass, also known as the third-generation biomass, is inedible, lignin-free, and shows rapid growth, and has significant advantages in biorefinery. As the main component of macroalgae, alginic acid is a good carbon source for the production of various value-added chemicals such as acids and alcohols. Hydrogenolysis of alginic acid over Ru, Ni, and Ru-Ni supported on activated carbon catalysts was performed in a batch reactor using NaOH, $CaCO_3$, $Ca(OH)_2$, and $Mg(OH)_2$ as basic promoters. Among the promoters used, NaOH provides the highest carbon efficiency and yield of glycols, such as ethylene glycol and 1,2-propanediol. In addition, various organic acids such as lactic acid, glycolic acid, and formic acid were produced in the form of salts. The hydrogenolysis of potential intermediates such as sorbitol, mannitol, lactic acid, and glycolic acid demonstrated direct conversion of alginic acid to glycols without sugar alcohols or organic acids as reaction intermediates. Furthermore, Ru-Ni bimetallic catalysts as a function of the Ni/Ru molar ratio were used to increase the yield and selectivity to glycols.