Study of the hydrogen production by aqueous phase reforming of glycerol over Ni-based catalysts

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OBJECTIVES

Three different Ni-based catalysts were prepared by the co-precipitation method described by Raso et al. [3], keeping the Ni content constant at 28 mol % and changing the molar ratio of AlFe or AlCa from 1.0 to 3.1 or 13.3, respectively. The catalysts were named Ni/Al, Ni/AlFe1, and Ni/AlCa1, and calcined at 500 ºC for 3 h.

INTRODUCTION

Nowadays, the high production of biodiesel is due to an increase in the environmental crisis caused by the high consumption of fossil fuels in the last decades. The transport sector accounts for around 60 % of global oil consumption and produces one-fifth of global CO2 emissions. Biodiesel production generates glycerol as a by-product, which could negatively affect its economy. Therefore, several processes have been investigated to valorize glycerol. In this context, hydrogen production from aqueous phase reforming (APR) of glycerol is a promising method to improve the economic viability of biodiesel industries [1-2].

EXPERIMENTAL

The gas stream was analyzed online by an Agilent 490 Micro-GC equipped with thermal conductivity detectors (TCD). The liquid products were analyzed offline using total organic carbon (TOC) equipment.

RESULTS AND DISCUSSION

➢ Gas composition: adding Fe or Ca to the Ni/Al catalyst

H2 and CO2  \(\uparrow\)  \(\downarrow\) CH4  \(\downarrow\) C2H6 and C3H8  Practically not found CO

➢ The carbon yield to gas and the \(H_2\) yield were higher for all catalysts when chemical glycerol was fed than when bio-glycerol was provided.

➢ The Ni/Al13.3Ca1 catalyst showed the lowest carbon yield to gas, while the Ni/Al13 catalyst indicated the highest \(H_2\) yield.

CONCLUSIONS

- Adding Fe or Ca to the Ni/Al catalyst favored the reduction (NO to N2) at low temperatures.
- The chemical composition of the catalyst and glycerol impurities influenced the \(H_2\) production by APR of glycerol.
- The \(H_2\) yield decreased in the following order: Ni/AlFe1 > Ni/Al13Ca1 > Ni/Al.