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Perovskite-based catalysts for tar removal by steam reforming: Effect of the presence of hydrogen sulfide

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ABSTRACT

One of the greatest problems in biomass gasification processes is the conditioning of the produced synthesis gas, which contains various contaminants, including tar and hydrogen sulfide. Nickel catalysts, designed for steam reforming of aliphatic hydrocarbons (natural gas and nafta), are usually deactivated by coke deposition and sulfur poisoning. In this work, nickel and/or manganese catalysts derived from perovskites were prepared by the citrate method and characterized by X-ray diffraction, N_2 physisorption and temperature programmed reduction. The catalysts were evaluated in the steam reforming of toluene, used as tar model compound, in the absence of H_2S at 700 °C and in the presence of 50 ppm H_2S at 800 °C. $LaNi_{0.5}Mn_{0.5}O_3$ catalyst showed higher activity and stability in the absence of H_2S. $LaMnO_3$ catalyst, although less active in the absence of H_2S, showed increased stability in the presence of H_2S, with conversion of about 60%. H_2 production was only observed in the absence of H_2S.

Introduction

Gasification is an interesting technology to convert carbonaceous material (ex.: biomass and residues from agricultural industry) to combustible gas. However, the raw gasifier gas must be cleaned in order to meet the quality criteria for the various applications [1]. Among the contaminants generated are: tar, hydrogen sulfide, ammonia, metals and furans. The nature and quantity of the contaminants are related to the type of biomass and the process conditions [2].

Tars are aromatic hydrocarbons quite refractory to thermal cracking that can lead to blockage in fuel lines, filters and engines, and also deposition on catalyst surfaces. The composition of tar is a function of gasification technology (fixed or fluidized bed) and operational conditions (mainly temperature and gasification agent) [3,4]. Tars can be removed by physical and catalytic processes. Most studies use steam reforming for tar removal, because of high temperature of gas (above 750 °C) and high amount of steam (20–60 wt%) [5–7], but catalysts containing nickel as the active metal are deactivated by coking and poisoned by H_2S [2].

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