Study of the deactivation of carbon-supported mono- and bimetallic catalysts used in the aqueous phase reforming of brewery wastewater

A.S. Oliveira, J.A. Baeza, L. Calvo, F. Heras, J.J. Rodríguez, M.A. Gilarranz
Department of Chemical Engineering, Universidad Autónoma de Madrid, 28049 Madrid, Spain

Catalyst deactivation in aqueous phase reforming (APR) is a common feature for all the systems investigated in the literature. In this work, APR of brewery wastewater was carried out with Pt and Pt-Re/C catalysts prepared by incipient wetness impregnation method using an activated carbon as support. This support was selected due to higher hydrothermal stability. The influence of the active phase, space velocity and carrier gas flow were studied. The experiments were carried out using a fixed bed reactor at 498 K, 28 bar, WHSV = 0.03-0.48 h^{-1}, Ar carrier = 5-40 mL/min. Monitored variables were: TOC and COD removal, carbon conversion to gas and H_2, and CH_4 yield. The fresh and used catalysts were characterized by N_2 adsorption/desorption, elemental analysis and TEM. The Pt-Re/C catalysts showed a better catalytic performance compared to Pt/C in terms of TOC conversion and H_2 production. Although both catalysts presented high deactivation after 5-6 h of reaction, the deactivation of Pt-Re/C was more accentuated. The carrier gas flow seems to be one of the key variables in controlling the catalyst deactivation. Thus, in the experiments that were developed at 40 mL/min Ar, the TOC conversion and the production of H_2 and CH_4 were less affected. The characterization of the catalysts used showed a significantly decrease of surface area and porosity measured. Changes in the elemental composition of the used catalysts were also observed. Carbonaceous deposits on the metal surface was considered as one of the main reasons for catalysts deactivation.

Keywords: Aqueous phase reforming, Pt and Pt-Re/C catalysts, deactivation, brewery wastewater.