

PREPARATION, CHARACTERIZATION, AND APPLICATION OF SiO_2/PO_4 CATALYST FOR THE REACTION OF ETHANOL DEHYDRATION TO DIETHYL ETHER (DEE)

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ABSTRACT

Preparation, characterization and application of SiO_2/PO_4 catalyst for conversion of ethanol to diethyl ether has been done. This research was aimed to study the effect of catalyst concentration, calcination temperature of catalyst, and temperature for ethanol dehydration to diethyl ether. In other hand, the purpose of this research was to study activity and selectivity of SiO_2/PO_4 catalyst in ethanol to diethyl ether dehydration.

The SiO_2/PO_4 catalysts prepared using wet sol–gel from TEOS precursor and phosphoric acid with variation of concentrations (1, 2, 3, 4 M) and calcination temperatures (400, 500, and 600 °C) in order to obtain catalysts with the highest total acidity. Catalysts were characterized using Fourier Transform Infrared (FTIR), X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM–EDS), Surface Area Analyzer (SAA), Thermogravimetric–Differential Thermal Analyzer (TG–DTA), and gravimetric acidity test with pyridine. SiO_2/PO_4 catalyst with the highest acidity applied in the dehydration reaction of ethanol to diethyl ether (DEE) at temperatures of 175, 200, and 225 °C. The liquid product was analyzed by gas chromatography (GC) to see the selectivity of the catalyst.

Characterization result showed that SiO_2/PO_4 catalyst treated with H_3PO_4 4 M (v/v) and calcined at 400°C was the catalyst with highest total acidity 1.22 (g/mmol), amorphous structure, mesoporous system, with a diameter of 4.72 nm and surface area of 1.81 m^2/g . The SiO_2/PO_4 catalyst has the highest activity and selectivity in the catalytic reaction of ethanol at temperature 225 °C, with a mixing product ethanol and anonymous compound yield of 58% and a selectivity of 3.71%. The result of catalytic reactions with SiO_2/PO_4 catalyst showed that DEE compound was not formed.

Keywords: ethanol dehydration, diethyl ether, silica phosphate, TEOS