Catalytic ethanol dehydration of ethanol to diethyl ether over ZSM-5 catalysts with different Si/Al molar ratios

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Abstract: In this present research, the catalytic ethanol dehydration to diethyl ether over ZSM-5 catalysts having different Si/Al molar ratios was investigated. First, the ZSM-5 catalysts were synthesized by the hydrothermal process with the desired Si/Al molar ratios of 20, 40, and 60 in an autoclave at 210°C for 24 hours. These catalysts were characterized by various techniques including N\textsubscript{2} physisorption (BET & BJH), X-ray diffraction (XRD) and ammonia temperature-programmed desorption (NH\textsubscript{3}-TPD). The catalytic dehydration of ethanol was carried out in a fixed-bed continuous flow microreactor made from a borosilicate glass with an inside diameter of 0.7 cm and length of 33 cm. To perform the reaction test, 0.05 g of ZSM-5 catalyst was packed in the reactor. Then, vaporized ethanol was fed at 60 CC/min under atmospheric temperature with the reaction temperature ranging from 200 to 400 °C. Ethanol conversion and product selectivity were analyzed with respect to reaction temperatures. The result showed that all Si/Al molar ratios of ZSM-5 catalysts were able to produce significant amounts of diethyl ether at low temperature (below 300 °C), whereas ethylene was a major product at higher temperatures (ca. 300 to 400 °C).

Keywords: Zeolite; ZSM-5; Ethanol dehydration; Diethyl ether; Ethylene