Optimization of ZSM-5 Zeolite Synthesis for Dehydration of Methanol to Dimethyl Ether

Samaneh Hosseini\textsuperscript{a}, Majid Taghizadeh Mazandarani\textsuperscript{a}, Ali Eliassi\textsuperscript{b}

\textit{a) Chemical Engineering Department, Babol University of Technology, P.O. Box 484, 4714871167 Babol, Iran}

\textit{b) Chemical Technologies Research Department, Iranian Research Organization for Science and Technology (IROST), Tehran, Iran}

\texttt{m_taghizadehfr@yahoo.com}

Dimethyl ether (DME), as an important chemical material and a clean fuel, is prepared by dehydration of methanol using solid-acid catalysts such as \(\gamma\)-alumina, \(\text{Al}_2\text{O}_3\cdot\text{B}_2\text{O}_3\) and zeolites materials (chabazites, mordenites, \(\text{SAPOs}\), \(\text{H-ZSM-5}\), \(\text{H-Y}\), ...), in a temperature range of 250–400 °C and pressures up to 18 bar [1,2].

The present work investigates the catalytic activity of different ZSM-5 zeolites in the catalytic methanol dehydration process using a fixed-bed flow reactor. Nanocrystalline ZSM-5 zeolites with different Si/Al molar ratios (100, 125, and 150) and temperatures (170, 180, and 190°C) have been prepared by a hydrothermal crystallization method [3]. The catalysts were characterized by BET, XRD, \(\text{NH}_3\)-TPD, TGA/DTA, and SEM techniques. The experiments have been designed by full factorial design (FFD), and the effects of synthesis conditions and their interactional effects on the yield of DME as the response variable have been determined. Analysis of variance showed that two variables and their interaction significantly affected the response. Figure 7 shows the effects of Si/Al molar ratio and temperature on the performance of various catalysts for methanol dehydration to dimethyl ether.

\textbf{Figure 7.} Variation of the yield of DME over ZSM-5 catalysts at different Si/Al molar ratios and temperatures (T = 300 °C, P = 1 atm, and WHSV =26.07 h\(^{-1}\)).

The optimized catalyst for highest DME Yield, was at 170°C and Si/Al=100 molar ratio, so that the yield of DME reached 89.9% under these conditions.

\textbf{REFERENCES}