

Zeolite Catalysts: Improved Methanol-to-Hydrocarbon Performance

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There are three key properties of zeolite molecular sieves that make them useful in industrial chemistry: they are selective and strong adsorbers, they are selective ion exchangers and, when the cation is a proton or a metal, they are tunable solid acid and/or redox catalysts. However, due to diffusion limitations in conventional microporous zeolites, the large-scale utilization of these catalysts in industry has not been developed to explore their full potential. Recently, a new family of crystalline zeolitic materials has started to attract considerable attention, the so-called hierarchical zeolites. These new materials feature individual microporous zeolite single crystals with an additional non-crystalline mesopore system. The micro and mesopore systems are interconnected, resulting in a bimodal pore distribution. There are several ways these materials can be fabricated and recently attempts to categorize this field were published [1,2]. Here, this categorization of hierarchical zeolites is briefly introduced, and the potential advantages of hierarchical zeolite catalysts compared to conventional microporous zeolites are highlighted. In particular, it is emphasized how the catalyst life-time can be dramatically improved by the introduction of mesopores in some reactions that suffer deactivation by coking. The reason for this is that many more pore mouths need to be blocked in the hierarchical zeolites before the interior of the zeolite crystals are inaccessible. Special attention is given to a comparative evaluation of the performance of conventional zeolite catalysts and hierarchical zeolite catalysts in the conversion of methanol into hydrocarbons, i.e. alkenes and gasoline. It is shown how the use of various different alcohol feeds (methanol, ethanol, propanol etc.) influences the product distribution, and new insight into the hydrocarbon pool is obtained by analyzing the species retained in the zeolite pores during reaction.

1. Egeblad, K., Christensen, C.H., Kustova, M., Christensen, C.H., *Chem. Mater.* 20 (2008) 946.
2. Perez-Ramirez, J., Christensen, C.H., Egeblad, K., Christensen, C.H., Groen, J.C., *Chem. Soc. Rev.* 37 (2008) 2530