

## **Zeolite Based Technologies to Meet Evolving Societal Needs**

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### **Abstract**

Zeolite-based catalytic and separation technologies continue to play a critical role in meeting today's consumer demands and the evolving societal needs to develop approaches to fulfill these needs in an environmentally friendly and responsible manner. Many key conversion technologies in the refining and petrochemical space rely on the versatile properties of zeolites and other microporous materials which facilitate development of processes efficient consumption of natural resources and allow ever improving energy efficient production. Notable zeolite based processes have included fluidized catalytic cracking and hydrocracking to produce fuels and petrochemical feedstocks as well as environmental technologies for the clean-up of auto exhaust emissions. Zeolites are also critical in separation processes where precise control of their pore opening dimensions facilitates a critical role in, e.g., separation of xylene isomers for the production of PTA and derivative chemical products.

Key to past and future success in deployment of zeolites in industrial processes has been the understanding of the relationship between fundamental properties to performance attributes. To facilitate this understanding the industrial scientist increasingly relies on application of modern characterization tools to probe key properties and, especially, to exploit this knowledge in choosing secondary synthesis approaches to tailor porosity and framework composition in a suitable manner for directing chemical pathways to achieve high levels of activity and selectivity to desired products. More recently, zeolites have been extensively investigated in the development of novel approaches to use bio-renewable feeds to produce chemicals and fuels in an environmentally manner. This new demand will require development of suitable stabilization techniques to allow them to withstand the challenging processing environment.

Continued developments in the field require the enhanced ability to make a precise assessment of predominant reaction pathways prevailing at the various process conditions, and to understand and control the interplay between catalyst properties and process conditions to achieve product objectives. Such tools have helped guide catalyst and process design strategies and have enabled a molecular level approach to accelerate development. In fact, such fundamentals are key to the pivoting of established, zeolite-based, technologies towards a more precise molecular tailoring to make specific molecules for petrochemical feedstocks.

This overview will attempt to provide a survey of successful application of zeolites in traditional and forward looking processes. In addition, it will illustrate the great deal of benefit that has been derived from advance characterization tools to help better determine

with great specificity the structural and compositional properties required for good performance.