Fluid Catalytic Cracking (FCC) is an important step in the conversion of crude oil to valuable fractions such as gasoline and propylene. The process is guided by choice of catalyst and additives to maximize yields of the most profitable products. For example, in addition to the usual Y zeolite, ZSM-5 zeolite can be used to enhance gasoline octane and increase propylene yields. Other additives are used to control feedstock quality and reduce emissions.

X-ray diffraction is a valuable tool to characterize materials throughout the entire process from research and development to catalyst production to forensic process evaluation. Some of the most common applications are phase identification, unit cell size determination, crystallinity measurement, crystallite size determination and quantitative phase analysis.

Hydrothermal conditions in the FCC refining unit will, over time, cause dealumination of the zeolite framework, resulting in “deactivation” of the catalyst and reduction in yields. Phosphorus added as a stabilizer can extend the useful life. Measurement of unit cell volume by Rietveld refinement is shown to correlate with dealumination, phosphorous addition and yields.

As most crystalline catalyst components are present in low concentrations, density separation will increase concentrations and allow for more accurate analytical characterization. XRD analysis of the various density fractions provides valuable insight into the performance of a FCC refining unit.