Deep Catalytic Cracking (DCC)

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Abstract

The decreasing demand growth for transportation fuels coupled with an expectation for continued petrochemical demand growth will result in many refiners looking for options to increase conversion of crude oil to petrochemicals. Currently, fluid catalytic cracking (FCC) catalyst formulation and process technology improvements give refiners the flexibility to significantly increase propylene yields from that obtained in gasoline mode operation. Projected decrease in propylene supply growth from steam cracking, the primary source of propylene production, also opens potential opportunities for high-olefins FCC to help fill the propylene supply-demand gap.

Deep catalytic cracking (DCC) is a commercially well-proven FCC process for cracking a wide range of hydrocarbon feedstocks, such as gasoils and paraffinic residues to propylene, butylenes, high-octane aromatic-rich gasoline, and ethylene. The process allows enhancing propylene yield from 4–6 wt% obtained in the conventional FCC, operating in gasoline mode, to over 20 wt%.

PEP has, in the past few years, reviewed several such high-olefins FCC technologies. PEP Report RP195B covered in detail KBR MAXOFIN™, UOP PetroFCC™, and CB&I/Lummus Selected Component Cracking (SCC) processes. PEP Report RP195C covered Axens/TechnipFMC HS-FCC™, Lummus/IOCL Indmax (I-FCC℠), and Reliance MCC processes. While PEP had earlier reviewed the DCC process in 1999 in RW1997-7, we decided to update this review to cover recent developments in this technology and elucidate how it can fit in with evolving refinery needs to increase propylene and other base chemicals production directly from crude oil. The focus of this review is on the new DCC-Plus variant that maximizes propylene yield.

The review has five chapters starting with an introduction. Chapter 2 provides an executive summary. Chapter 3 looks at propylene market supply-demand trends and the contribution of high-olefins FCC units, such as DCC, on the global and regional production capacity of propylene. Chapter 4 gives an overview of high-olefins FCC technology and discusses process chemistry, catalysts used, developments in DCC catalyst, history of DCC technology development and commercialization, and the new DCC process variants. We present a detailed techno-economic evaluation of the DCC-Plus variant in Chapter 5. This includes a design basis, heat and material balances, process flow diagrams (PFDs), sized equipment list, inside battery limits (ISBL), outside battery limits (OSBL), and total fixed investment estimates, and polymer-grade propylene production cost via this route.

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