Refinery Configurations for Maximizing Crude Oil to Chemicals Production

PEP Report 303B

September 2020

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Abstract

There is a growing consensus across the global energy and chemicals industry that in the coming years, crude oil refineries will be configured for significantly higher conversion of crude to chemicals than has been done in the past. This has been driven by the relatively slower growth rate in global demand for refinery fuels such as diesel, jet, and gasoline relative to petrochemicals. Refinery margins have been poor and are increasingly at the mercy of crude oil price fluctuations and geopolitics. Margins of integrated refinery-petrochemical complexes are expected to be higher and more predictable in the coming decades.

Several large projects have recently been commissioned or are in conceptual/feed engineering/construction stage that have configured the traditional crude oil refinery to increase chemicals production for eventual production of petrochemicals. These complexes plan to use a mix of medium and heavy crude oils and employ various combinations of bottoms upgrading process technologies to increase feedstock conversion to light olefins and naphtha range products. Naphtha thus produced are used to feed steam cracker and aromatics complexes for conversion to light olefins and BTX aromatics. Gasoline, jet, diesel, and fuel oil productions from such complexes are significantly reduced from that in traditional fuels producing refineries.

In the report, PEP provides a brief overview of refinery configurations for fuels production and discuss the major routes that are being used to reconfigure fuels refineries globally to make more chemicals. Global and regional trends using various types of refinery conversion units and overall refinery integration levels are presented.

The core of the report evaluates three mega refinery-petrochemical projects that are prime examples of refinery reconfiguration for chemicals production. The first is Reliance's Jamnagar India based COTC project that plans to more than double crude conversion to chemicals at the world's largest refinery. The project will convert the sites entire FCC capacity to Petro-FCC, and will add large naphtha catalytic cracking, steam cracking, and aromatics blocks to raise chemicals conversion to over 35% for the Jamnagar supersite.

The second project PEP evaluated is S-OIL Ulsan (S.Korea) RUC-ODC project that has recently built the world's first commercial high severity FCC (HS-FCC) unit coupled with heavy oil hydrodesulfurization and associated units to reduce high sulfur fuel oil production at the world's fifth largest crude refinery. The project has raised crude conversion to chemicals from 8% to 13% for the refinery.

The third project evaluated is Kuwait KNPC/KIPIC Al-Zour Refinery and Petrochemicals. The refinery is presently under construction while the PRIZe petrochemicals project is in FEED engineering stage. The original refinery was designed to be a purely fuels producing refinery. However,

the subsequent reconfiguration and PRIZe projects will allow the complex to convert 13.5% of its 615,000 BPD crude capacity into chemicals.

For each of these projects, PEP presents its understanding of the refinery configurations that have been built or are planned with detailed unit level block flow diagrams, description of each of the major process units and technology used, unit level and overall complex product yields, hydrogen and utility balances, ISBL and OSBL investment costs, production economics, and margin analysis.

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