

Light olefins focused crude oil to chemicals complex

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Abstract

A Crude Oil to Chemicals (COTC) project is often defined as a refinery complex configured to shift the production from transportation fuels to produce greater than 40% chemicals per unit weight of oil. A world scale single COTC complex starting from 20 million tons per year (or 400 KBPD) of crude oil can produce more than 8 million tons of chemicals. The scale of these projects means that a COTC project will exert a significant impact on the regional or even world supply of produced chemicals. PEP has analyzed several crude oil to chemicals projects including Hengli (PEP report 303), Zhejiang Phase-1 (PEP report 303A), and Shenghong (PEP report 303C). These projects were configured to maximize para-xylene (PX) product. Hengli and Zhejiang Phase-1 have started operation while Shenghong is began trial operation in 2022. Each project also includes a world scale steam cracker producing 1.4-1.5 MMtpa of ethylene. The chemical conversion of these projects ranges from 42% to 56% per ton of crude oil.

In contrast to the above-mentioned p-xylene focused COTC projects, a new project, Shangdong Yulong Integrated Petrochemicals Phase-1, is light olefin focused with two trains of world scale mixed-feed steam crackers. The project is being designed to product 3 MMtpa ethylene, 1.3 MMtpa propylene, 3 MMtpa of mixed xylenes, and 0.86 MMtpa benzene. The refinery section in this project produces about 8 MMtpa of hydrocarbon feeds for the associated two mixed feed steam crackers. This requires a significantly different refinery configuration from those in the COTCs analysed earlier by PEP. The project started construction in October 2020 and will have a design crude capacity of 20 MMtpa. Chemicals yield will be in excess of 50% of feed crude oil.

This report examines the configuration of the Shangdong Yulong COTC complex Phase-1 refinery, aromatics, steam cracker, and petrochemical sections. Processing/production capacities of all major units in the complex along with product yields from units are provided. This is used to develop a full material balance of the complex. Detailed unit level utility consumption data for all the major units in the complex are provided and used to develop the overall utility balances and OSBL unit capacity requirements. ISBL, OSBL and total fixed capital investments required for the complex are presented. Production economic analysis estimates the margins and return on investment for the project. A sensitivity analysis of the impact of crude price variation in the 40-100 \$/BBL range on project economics is done.

A carbon footprint analysis of the COTC is included with a breakdown of the major processing blocks and source types.

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