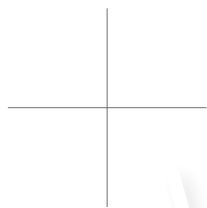


SULZER



White Paper

January 2024

Combining Prime-G+[®] and
GT-BTX PluS[™] to upgrade
a refinery with crucial
operating flexibility

Combining Prime-G+[®] and GT-BTX PluS[™] to upgrade a refinery with crucial operating flexibility

The landscape of the petroleum refining industry has undergone a significant transformation in the aftermath of the global pandemic. The volatile and unpredictable nature of market demands post-pandemic has underscored the critical importance of adaptability for refineries. In this rapidly evolving environment, the ability to swiftly adjust production focus to meet changing market requirements has become paramount. The integration of Prime-G+[®] and GT-BTX PluS[™] technologies offers refineries a unique solution to address these challenges by providing built-in operating flexibility.

Author: Charlie Chou, Sulzer Chemtech

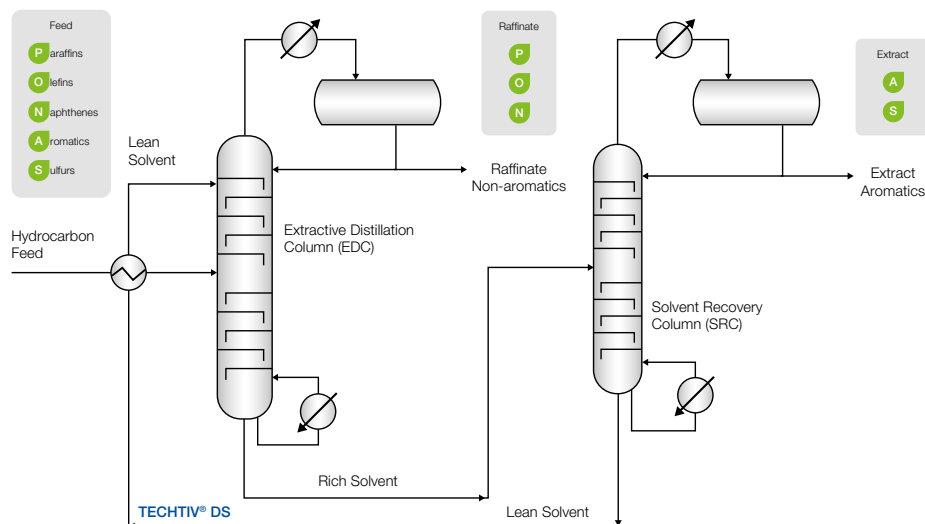
Challenges of current refineries

Modern refineries are divided between those that emphasize fuel production, particularly gasoline, and those that prioritize the maximization of petrochemicals output. For gasoline-focused refineries, the octane number is a key determinant of profitability, with even marginal improvements translating to substantial gains. In developing countries, refineries are compelled to elevate gasoline specifications to meet Euro-5 standards while simultaneously reducing sulfur levels to <1ppm. The challenge lies in maintaining octane numbers while achieving such stringent sulfur reduction. Meanwhile, petrochemical-centric refineries seek efficient ways to convert gasoline into high-value petrochemical products while minimizing investments.

Combined technology in gasoline mode for gasoline production with max profitability

The amalgamation of Prime-G+[®] and GT-BTX PluS[™] technologies introduces an innovative approach that yields impressive benefits. This combination entails the installation of a new GT-BTX PluS[™] unit alongside an existing Prime-G+[®] unit, if present; or grassroots of both technologies if there is no FCC gasoline hydrotreating yet. The GT-BTX PluS[™] unit, a cost-effective two-column extractive distillation system, facilitates the extraction of sulfur from the FCC gasoline, preserving olefins in the Raffinate stream with less than 10ppm sulfur. The indicative configuration of GT-BTX PluS[™] unit is illustrated in the Figure 1.

Figure 1.
GT-BTX PluS[™]
simplified process
scheme



To implement the combined technology, a middle cut of FCC gasoline MCN that contains high-octane olefins and high sulfurs is purposely fractionated after Prime-G+[®]'s selective hydrotreating unit (SHU), leaving light cut LCN that has high-octane olefins but low sulfurs, and heavy cut HCN that has low olefin content but high sulfurs. Such fractionation is illustrated in the Figure 2.

With such fractionation, the high-octane olefin-rich and low-sulfur LCN will be sent to the gasoline pool. The high-olefin and high-sulfur MCN will be processed in the GT-BTX Plus[™] unit where the sulfur and olefin components will be separated to the Extract and Raffinate respectively

as illustrated in Figure 1. At the combined technology's gasoline mode, the preserved Raffinate can be blended into the gasoline pool, contributing to the retention of olefins and octane numbers, even in compliance with Euro-5 ultra-low sulfur standards. Meanwhile the Extract with concentrated sulfurs but nearly no olefins will be combined with HCN to be hydrodesulfurized by Prime-G+[®]'s HDS without worrying olefin saturation. The configuration this combined technology is shown in Figure 3. Notably, this configuration virtually eliminates octane loss while significantly reducing hydrogen consumption, culminating in a refinery's peak profitability in Euro-5 gasoline production.

Figure 2. Fractionation of FCC gasoline for the combined technology

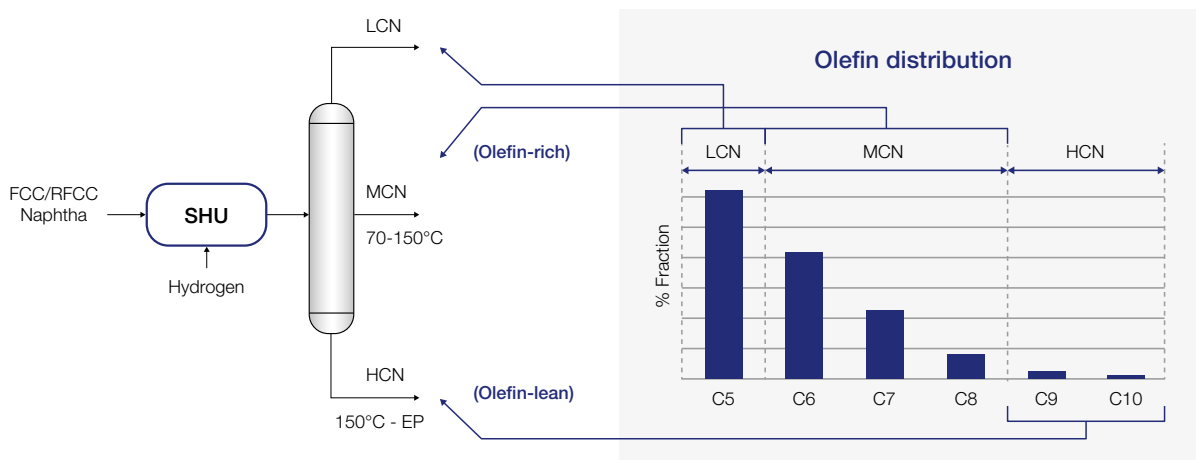
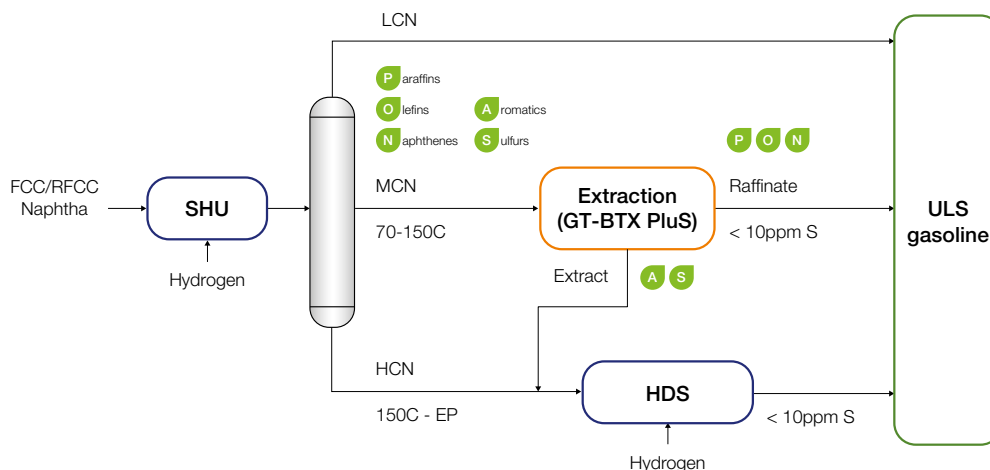


Figure 3. Configuration of the combined Prime-G+[®] and GT-BTX Plus[™] technology in gasoline mode



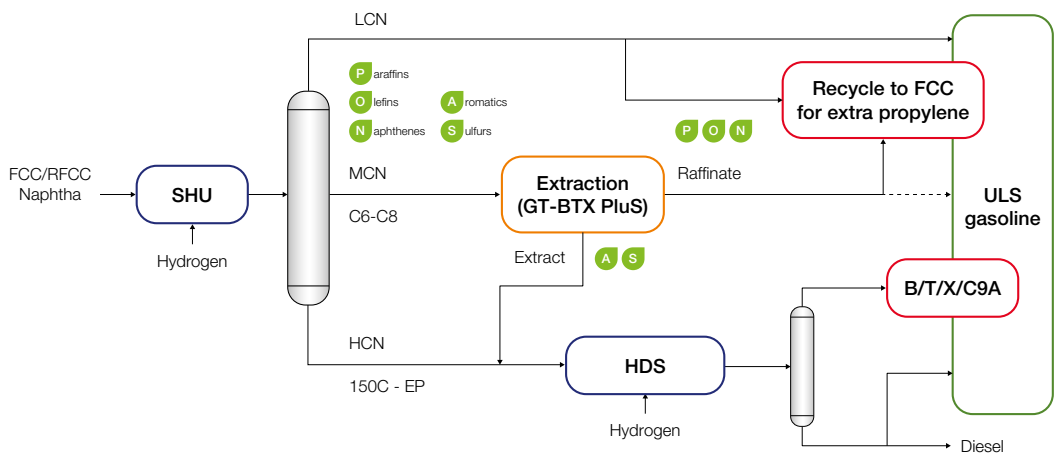
Combined technology in petrochemical mode for gasoline-to-petrochemicals

The same combined technology of Prime-G+® and GT-BTX Plus™ unveils an avenue for converting gasoline into valuable petrochemical products. In its petrochemical mode with the same configuration, the GT-BTX Plus™ Extract, a nearly pure aromatic stream with sulfur being the only impurities, undergoes intensified hydrodesulfurization (HDS) in the Prime-G+® unit, culminating in a high-quality petrochemical BTX product (benzene, toluene, xylenes). Furthermore, the olefin-rich non-aromatics Raffinate stream derived from GT-BTX Plus™

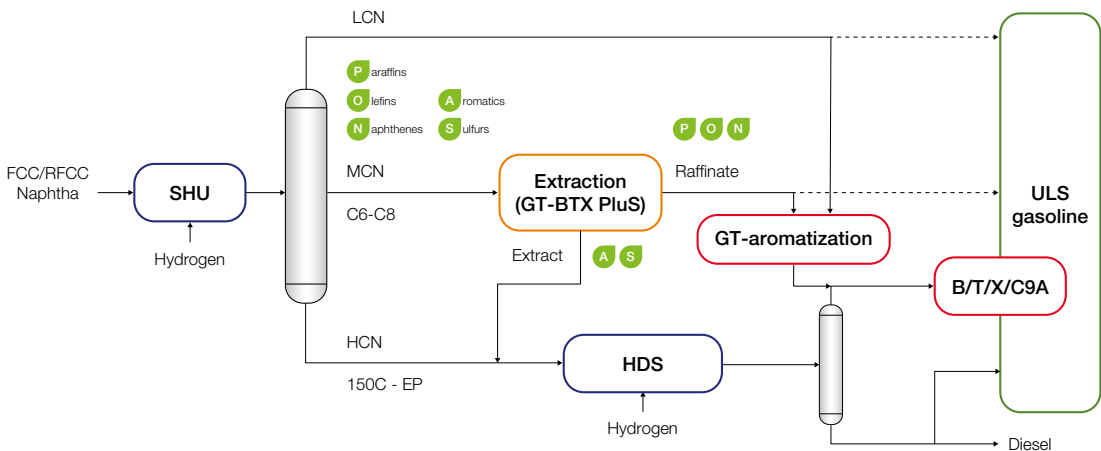
proves invaluable for FCC recycling, producing significantly additional propylene and enhancing the FCC propylene yield. Alternatively if aromatics is the focused product, this Raffinate can be routed to a fixed-bed GT-Aromatization™ unit, coupled optionally with LCN, driving substantial BTX production. The Figure 4 shows the mentioned two options of combined technology in the petrochemical mode for converting significant portion of FCC gasoline into petrochemical products.

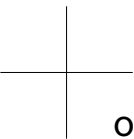
Figure 4. Configuration of the combined Prime-G+® and GT-BTX Plus™ technology in petrochemical mode

Option of BTX and propylene production



Option of only BTX production





Operating flexibility of the combined technology

The true strength of the Prime-G+® and GT-BTX PluS™ integration lies in its exceptional operating flexibility. Refineries can seamlessly switch between gasoline-focused and petrochemical-centric modes of operation. This adaptability is crucial as market demands oscillate, necessitating rapid shifts in production focus. By adopting this combined technology, refineries across diverse regions gain the agility to swiftly align their production strategy with prevailing market requirements.

Summary

Incorporating the combined Prime-G+® and GT-BTX PluS™ technologies is a transformative investment for refineries. This single investment affords refineries the dual capability to optimize both gasoline and petrochemical production, irrespective of ever-fluctuating market dynamics. The intrinsic operating flexibility enables refineries to pivot their focus instantly, whether the demand is for gasoline or petrochemicals. In an industry where adaptability is synonymous with success, the Prime-G+® and GT-BTX PluS™ integration emerges as an indispensable asset for all FCC-equipped refineries. By embracing this cutting-edge technology, refineries can confidently navigate the intricate landscape of post-pandemic refining, reaping unparalleled benefits and securing a competitive edge.

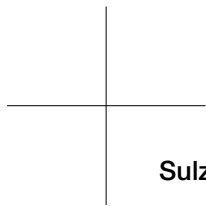
For any inquiries please contact us:

Sulzer Chemtech
Neuwiesenstrasse 15
8401 Winterthur
Switzerland
Tel: +41 (52) 262 3722
sulzer.com

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