Implementing advanced technologies for crude to chemicals projects

AXENS

According to the IEA, already a major component of the global energy system, the importance of petrochemicals is continuing to grow. Demand for plastics – the most familiar group of petrochemical products – has outpaced that of all other bulk materials (such as steel, aluminum or cement) and nearly doubled since 2000.[1] Oil and petrochemical players are now relying more on chemicals and less on refining for fuels to drive future growth.

Integrating refining and petrochemicals offers several advantages to oil companies by:

- Expanding into higher growth markets with a portfolio diversification, and conducting business in the coming years with flexibility and agility
- Mitigating risks related to raw material and product price variations
- Reaching the final step in chemistry by developing fine and specialty chemistry from oil along with a high value chemicals business
- Optimising the overall scheme with material and heat integration, and getting the most from intermediates.

Refiners are gradually assessing options to further upgrade their products into petrochemicals and more valuable chemicals by increasing conversion and implementing technologies.

Over time, chemical yields have improved from less than 15% before the 90s to the target of 40-80% with crude to chemicals projects. Reaching such levels requires the right and proven technology solutions to convert the low-value atmospheric and vacuum residue parts.

RESID CONVERSION TO OLEFINS

FCC units are converting residue fractions to light components, olefins and gasoline. Direct propylene production from FCC technologies is covering a third of the total worldwide propylene production. As a strong contributor to the global production of olefins, FCC technologies have evolved to tighten their operating conditions, adjust their catalyst formulation and thus go further in the production of chemicals.

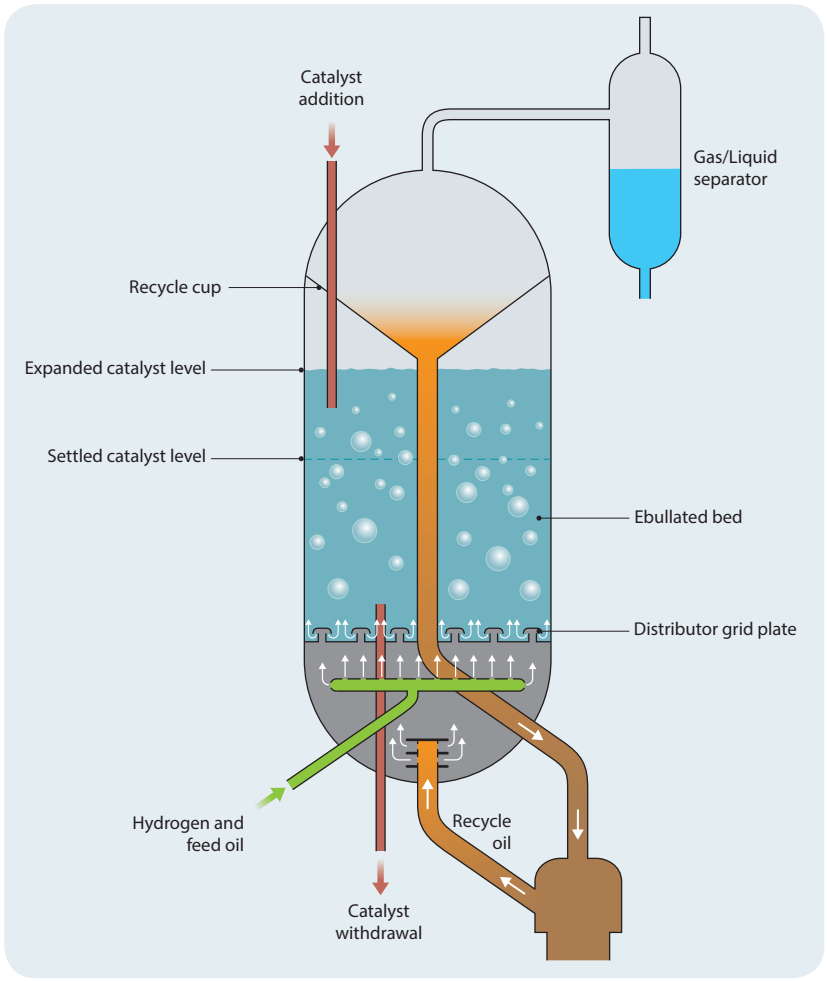
HS-FCC TECHNOLOGY

Reaching unrivalled propylene yield by converting heavy hydrocarbon feedstock, HS-FCC™ technology is an innovative downflow reactor under severe FCC conditions. This process has been co-developed with Saudi Aramco, King Fahd University of Petroleum & Minerals (KFUPM) and JXTG Nippon Oil & Energy, and is licensed by Axens and TechnipFMC.

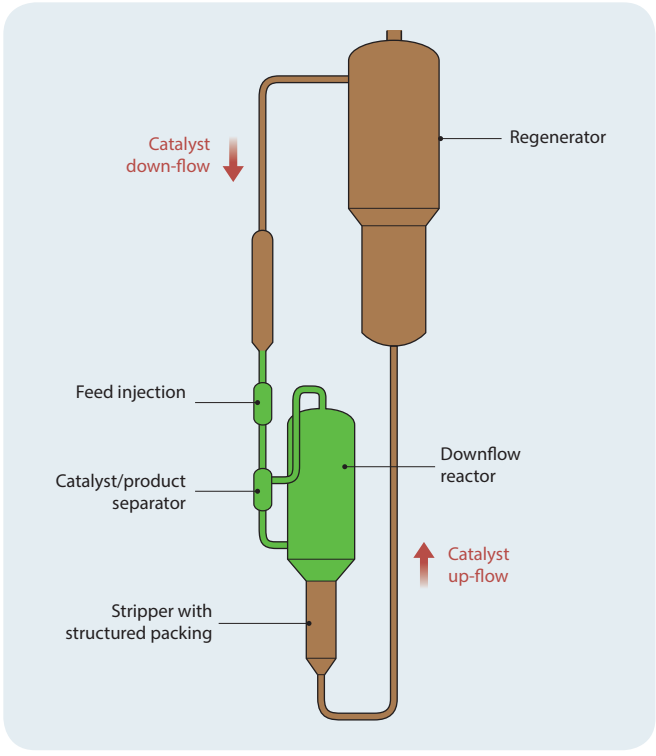
The main features of the process are:

- A downflow reactor to minimise back mixing and obtain a narrower distribution of residence times
- Higher reaction temperatures (550°C to 650°C) than conventional FCC units
- High catalyst to oil ratio (C/O), enhancing the contribution of catalytic cracking over thermal cracking
- Short contact time for light olefins selectivity and highly selective catalyst.

The first industrial-scale HS-FCC unit has been licensed by Axens and successfully started up at the S-Oil Onsan refinery.



<< H-Oil process



HS-FCC arrangement

RESID CONVERSION TO NAPHTHA

To get the most from the crude feedstock and especially from the residue part, the challenge lies in conversion to push toward naphtha.

Why is naphtha cut key in a crude to chemicals project?

Naphtha represents the gearing effect in a refining and petrochemical site, as light naphtha can be processed in a steam cracker, whereas the heavy part can be processed in the aromatic complex.

In a refinery, straight-run naphtha is directly available after the crude distillation unit combined with hydroprocessing treatment. To improve the balance towards naphtha, the stakes are on the conversion naphtha that comes either from thermal cracking such as the coker unit and even the FCC unit, or from different upgrading units such as:

- Diesel and vacuum gasoil (VGO) hydrocrackers (HyK™), especially in maximum selectivity towards naphtha production
- Resid hydrocrackers with high conversion ebullated bed units.

A great number of the latest oil to chemicals projects worldwide are based on the H-Oil® ebullated bed hydrocracker coupled with diesel and VGO HyK technologies licensed by Axens, which stands for the heart of the conversion in these schemes, converting the most refractory and lowest value cut – vacuum residue – towards naphtha and distillate. The full conversion of middle distillate and VGO in the hydrocracker section sustains the strategic naphtha intermediate cut for olefins/aromatics production.

AXENS H-OIL PROCESS

The H-Oil residue hydrocracking unit meets the challenge of converting heavy feedstock residues with high metals, sulphur, nitrogen, asphaltenes and Conradson carbon (CCR) contents to essentially distillate products, ranging from VGO to naphtha.

Naphtha from H-Oil, as a key component in the crude to chemicals scheme, is an excellent feed for reformer after pretreatment. It is also feedstock for the steam cracker unit for olefins application.

DID YOU KNOW NAPHTHA FROM H-OIL, AS A KEY COMPONENT IN THE CRUDE TO CHEMICALS SCHEME, IS AN EXCELLENT FEED FOR REFORMER AFTER PRETREATMENT?

Key features of the H-Oil technology are:

- Demonstrated high conversion levels: the conversion of vacuum residue is set between 75 and 95 wt% when production of a stable residual fuel oil is desired from the unconverted residue. Different leverages like LHSV use of dispersed catalyst maximise conversion
- No limitation on feed properties
- Mature and reliable technology more than 1 Mbpsd licensed capacity
- Availability higher than 96%
- Two new high conversion H-Oil units starting up in 2019.

Additional conversion up to ultimate VR conversion is added to the H-Oil unit thanks to unconverted oil from the H-Oil processed in a solvent deasphalting unit (H-Oil+). This section removes asphaltenes from the unconverted oil, giving significant gains in opex thanks to hydrogen and/or energy production from pitch valuation. Overall naphtha production is maximised by sending deasphalted oil with middle distillate and VGO to a hydrocracker.

These innovative technology features are gaining wide acceptance in industry. Many have expanded the slate of heavy crudes that can be processed in an H-Oil unit.

TAKE-AWAYS

Petrochemicals demand growth is higher than that of fuels. Crude to chemicals complexes offer many advantages such as expanding into higher growth markets, mitigating risks related to naphtha material and product price variations, and improving asset profitability. For both the olefins and naphtha routes, technologies benefit from continuous improvement and innovation to provide the maximum services and productivities.

Crude to chemicals projects implementing advanced technologies are a way to catch these opportunities. Axens is your key partner to provide advanced and innovative solutions for both grassroots and revamps projects.

1 The Future of Petrochemicals – Towards more sustainable plastics and fertilizers - OECD/IEA 2018.

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