

High Severity Fluid Catalytic Cracking (HS-FCC™)

High Severity Fluid Catalytic Cracking (HS-FCC™) is a process that provides high light olefin yield (propylene) from a wide variety of hydro-treated feedstocks utilizing high severity reaction conditions and a novel down flow reaction system.

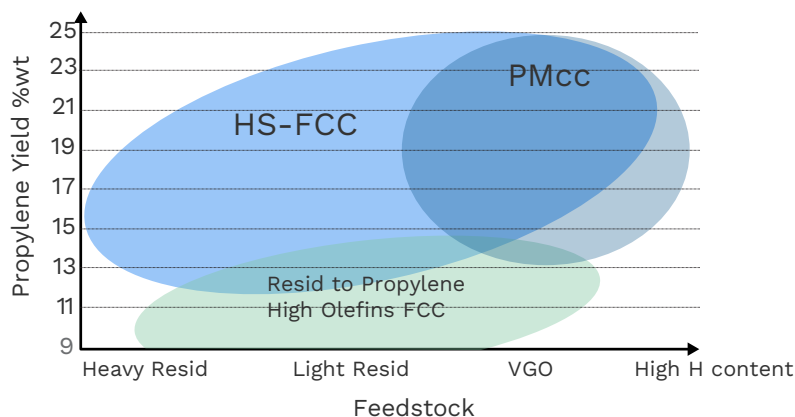
The technology was developed by combining the know-how and innovation from three entities: Saudi Aramco, JX Nippon Oil & Energy and King Fahd University of Petroleum and Minerals.

Their efforts culminated in a 3,000 bpd semi-commercial unit operated for four years in Japan. This team selected Technip Energies Process Technology and Axens to license HS-FCC.

HS-FCC in the Family of Catalytic Cracking Processes

The HS-FCC process expands the operating window of catalytic cracking to encompass heavier feeds and greater propylene potential. Commercial processes for high propylene production from light distillate feeds and residue feeds include PMcc™, High Propylene FCC (HP-FCC), and Resid to Propylene (R2P™). More severe conditions for residue feeds to attain higher propylene yield has proven challenging in the past due to undesired secondary reactions. High severity combined with an optimized catalyst system and a controlled short contact time Down Flow Reactor (DFR) system, allows the new HS-FCC technology to provide selective conversion with lower fuel gas production and greater olefin and petrochemicals yield even with heavy residue feeds. Indeed, the selectivity of the system presents opportunities to crack a wide range of conventional and unconventional feedstocks.

The technology mapping by severity and feedstock is shown below.



Features of HS-FCC

For HS-FCC, the objective is not only to improve the selectivity for normal fuels production, but also to maximize the potential of light olefin and petrochemical production at high severity. Similar to FCC, the HS-FCC process utilizes acidic zeolite catalysts to crack heavy hydrocarbons into lighter products, but under more severe conditions to maximize lighter olefins yields such as propylene and butylene (and to a lesser extent ethylene). High reaction temperature coupled with short contact time in a downflow reactor increases the primary reactions towards olefins while limiting the unwanted secondary reactions of hydrogen transfer and thermal degradation. Four key elements are required to attain this objective:

- Down Flow Reactor – Eliminates catalyst backmixing to reduce over cracking
- High Temperature – High conversion & olefins selectivity
- Short Contact Time – Reduced secondary reactions & thermal cracking
- High Catalyst/Oil – Increased catalytic cracking

Catalyst is specifically formulated to suppress hydrogen transfer and isomerization reactions to maximize olefins production. When coupled with ZSM-5, the increased olefins in the gasoline cut can be selectively cracked to further increase the propylene yield.

A consequence of the increased severity and short contact time is the need for higher catalyst circulation (Catalyst to Oil mass ratio or C/O) to provide the required heat to the reactor and sufficient catalyst activity to achieve high conversion at short contact time.

Down Flow Reaction System

In a traditional up flow FCC riser reactor system catalyst back-mixing and reflux along the walls limit the effectiveness of high severity and C/O preventing the preferred yield structure.

The down flow reactor system incorporate catalyst and feed flowing downward together. When plug flow conditions are achieved, more selective primary cracking results in greater selectivity.

HS-FCC TECHNOLOGY – CATALYST FEATURES

- Rare earth free catalyst
- Low acid site density
- Patented formula

UNIQUE REACTION SYSTEM

- Downflow reactor
- Tempest™ Separator
- Impact-type Injectors
- Optimized feed injection zone

HS-FCC FEED SOURCES

- Vacuum Gasoil (VGO)
- De-asphalted Oil (DAO)
- Atmospheric residue (AR)
- Vacuum Residue (VR)
- Heavy Coker Gasoil (HCGO)
- Optional (HD)

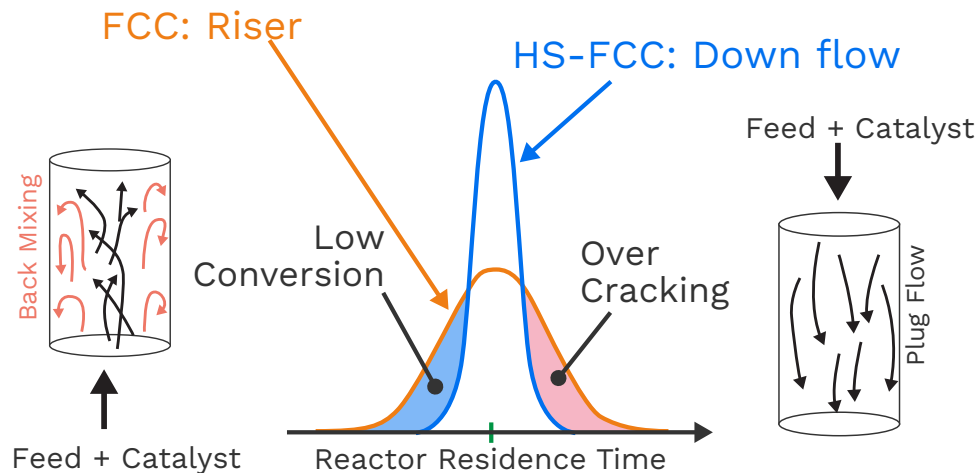


Fig. 2: Selectivity of a traditional riser compared to HS-FCC downflow.