



Schlumberger



# Symmetry

Tailored workspaces—optimized facility

Process Software Platform Refinery Overview



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Tailored workspaces—optimized facility

Symmetry\* by VMG is a comprehensive simulator that empowers all aspects of your models from reservoir to product distribution.

The Symmetry platform uniquely integrates the modeling of fields, pipe networks, process plants, and flare systems, providing an unprecedented level of collaboration and cooperation that enables teams to seamlessly transfer knowledge and expertise and maximize the total value of the asset.

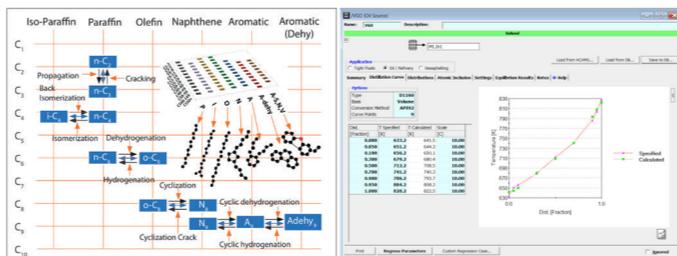
### Refinery Modeling in the Symmetry Platform

The advanced functionality and powerful capabilities of Symmetry's Refinery provides a comprehensive solution to address the complex needs of refinery modeling. Our technology enables users to fill gaps in their existing processes using unprecedented, predictive modeling capabilities on a unit or refinery-wide basis. This advanced technology also enables you to make use of any data from your production facility to tune and refine your models.

Symmetry's Refinery is powered by our proprietary PIONA-based molecular structure modeling (paraffins, isoparaffins, olefins, naphthenes, and aromatics). This unique approach uses a chemical family structure-based characterization with a rigorous reactor basis designed to provide the framework for predictive modeling from a property estimation basis. The approach is also able to investigate the intricacies of reactor

configuration details on the performance of the reactor unit. This allows for a single component slate to be used across multiple refinery units, both reactive and nonreactive, enabling multiunit refinery evaluations. The combination of these leading-edge models empowers the simulation of complex plants containing multi-integrated units within a single, flexible flowsheet.

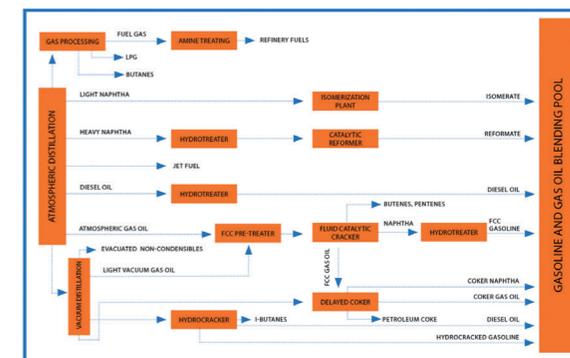
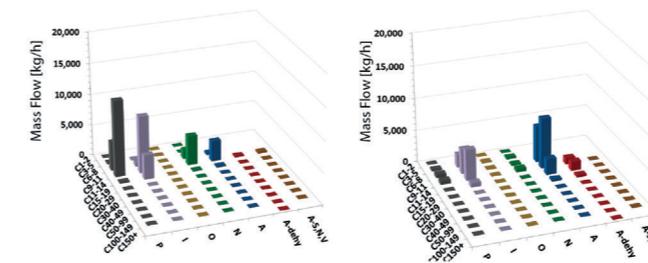
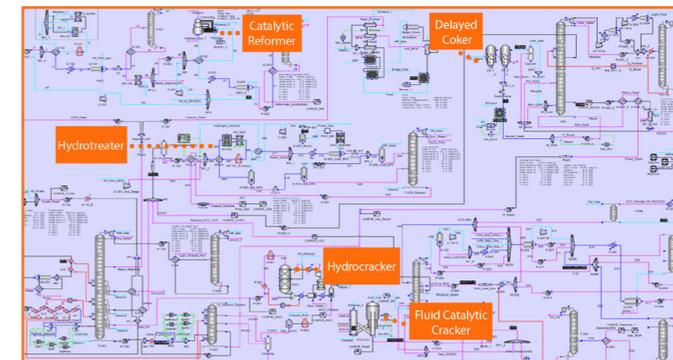
The Symmetry platform is the tool you need to improve your bottom line by providing accuracy to planning and process models that increase plant efficiency and profitability, answering design challenges and safely running operations.



## Full PIONA Refinery Molecular Modeling Simulation

Empowering Refinery Reactors Simulation

- Reaction kinetics based on PIONA molecular structure modeling to characterize any carbon number: light end, naphtha, kerosene, diesel, gas oil, vacuum gas oil, reformate, gasoline, coker gasoline, atmospheric residue, and vacuum residue
- Simulation atomically balanced at any point in the flowsheet
- Flexible catalyst kinetic adjustments to change product yields and properties to match plant data for specific catalyst performance
- Rigorous catalyst activity model for a variety of catalysts and feedstocks
- Optimized flowsheet performance with regression tools
- Flexible case study tools to investigate the effects of variables
- Providing distillation curve and product distribution of any stream in the flowsheet

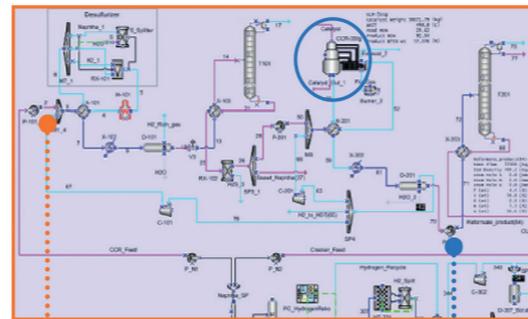


## Catalytic Reformer (CR)

The CR is a rigorous catalytic reformer model that includes kinetic reaction, heat balance, and catalyst deactivation. The simulation provides information about reformer fixed- or continuous-bed stages and how changing feed and process variables impact operations, including: research octane number (RON), H2 and BTEX yields, and catalyst deactivation.

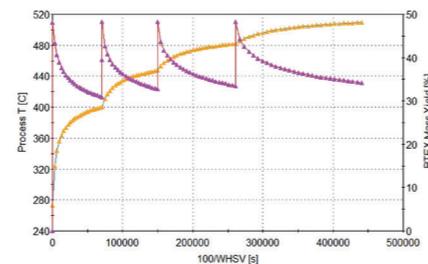
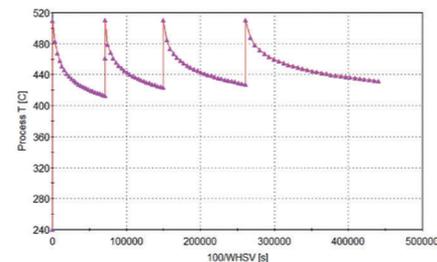
### Highlights

- Capable of enabling reformer design configuration based on number of stages for continuous or fixed-bed operation
- Specific atomic mass balance provides rigorous hydrogen balance across total reactor unit
- Input includes optional product RON specification enabling automatic preheat temperature calculations
- Product yields and properties such as RON, BTEX weight percent (wt), and H2 wt can be predicted
- Predictions of temperature, conversion, H2/HC, BTEX profiles, and activity profile due to coking, poisoning, or sintering along the beds
- Detailed bifunctional catalyst deactivation model considering coking, poisoning, sintering on metal-acid sites including effect of H2, temperature, and feed contamination



Heavy Naphtha

Reformate

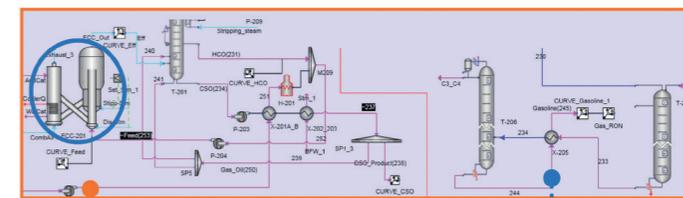


## Fluid Catalytic Cracker (FCC)

The FCC is a fluid catalytic cracker model, which provides information about the riser and regenerator interactions: kinetic reactions and heat balance, effect of altered feed and process variables on operations including RON, yields, and catalyst deactivation. FCC simulation enables optimization of propylene yield, gasoline yield plus RON value, and reducing emissions.

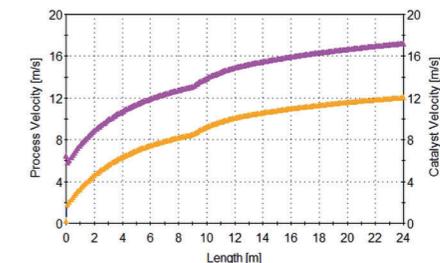
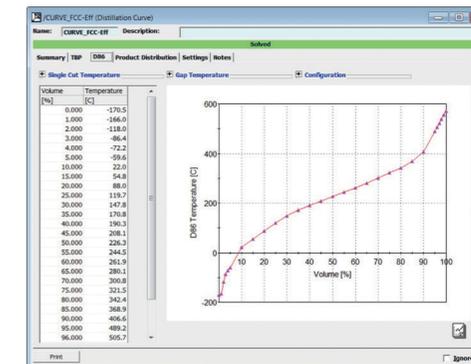
### Highlights

- Capable of allowing different configuration based on FCC design including multidiameter riser and MIP (maximum isoparaffin) technology
- Overall heat and pressure balance for catalyst circulation rate between riser and regenerator including an optional riser recirculation feature
- Catalyst activity model in the riser and catalyst burning in the regenerator tracked along with optional E-cat calculation
- Detailed effect of ZSM-5 bottom cracking additives on catalyst activity in the riser
- Detailed effect of regenerator additives
- Predictions of product yields, properties such as RON, spent or regenerated catalyst activity, flue gas mission (CO, CO2, NOx, SOx) from regenerator for specified feed or catalyst properties, operating conditions, and riser, stripper, and regenerator geometry
- Predictions of temperature, pressure, conversion, process vs. catalyst velocity, deactivation rate, and coke yield profiles in the riser



FCC Fresh Feed

FCC Gasoline

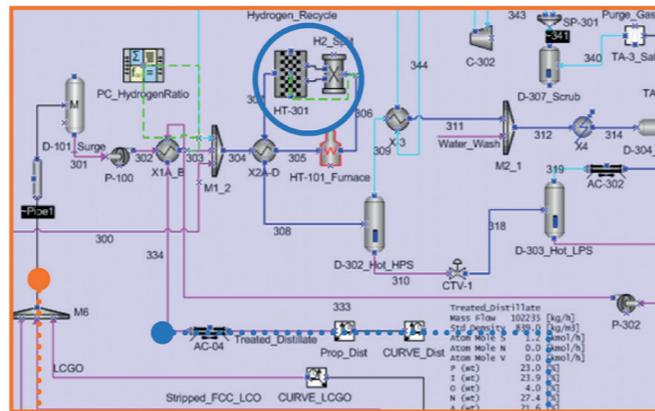


## Hydrotreater (HDT)

The HDT is a hydrotreater model that incorporates kinetic reactions and catalyst deactivation along with heat balance to remove sulfur, nitrogen, and in most cases aromatics through catalytic reactions. The goal of this process is to meet clean fuel specifications and to prevent catalyst deactivation in other downstream parts of the refinery. HDT simulation enables monitoring of the hydrotreating process, impact of changing the feed and process variables on H<sub>2</sub> consumption, and the extent of desulfurization and denitrogenation.

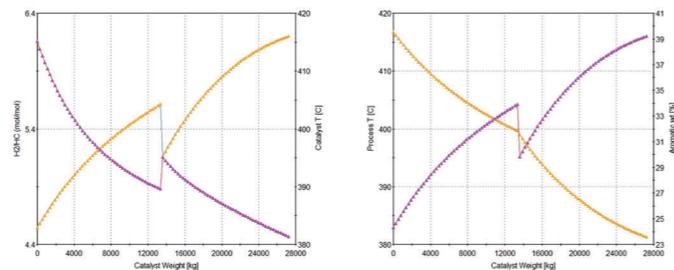
### Highlights

- Capable of allowing HDT design configuration based on number of stages
- Heat balance to calculate quench effect on each stage temperature
- Predictions of product yields, properties such as desulfurization
- Percent, denitrogenation percent, and H<sub>2</sub> ratio
- Predictions of temperature, conversion, H<sub>2</sub>/HC and rigorous atomically balanced H<sub>2</sub> yield and activity profiles with feed or catalyst specifications, operating condition, geometry specifications, and hydrogen quench flow rate or interstage temperature set points as input
- Capable of setting the kinetic function of different catalyst types such as guard and main catalyst in each stage
- Complete bifunctional catalyst deactivation model tied to H<sub>2</sub> amount, temperature, feed quality, and contamination, including increased pressure drop calculations due to catalyst coking



Combined Feed

Treated Distillation

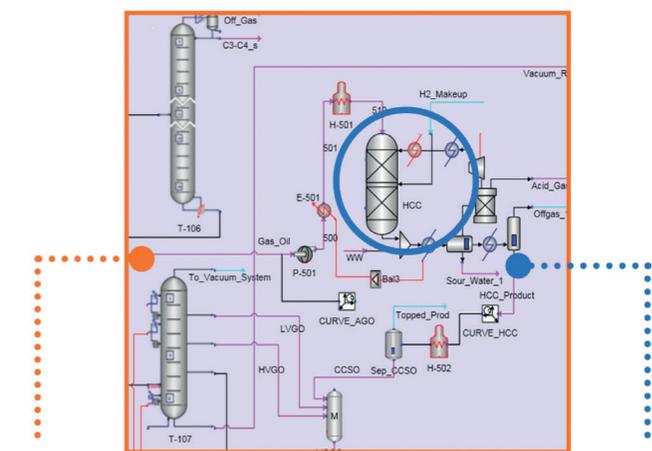


## Hydrocracker (HCC)

The HCC is a comprehensive hydrocracker model containing both simple once through and complete recycle configurations (hydrocracker/treating + recycle). This model enables monitoring of the hydrocracker process, the changing feed and process variable effect on H<sub>2</sub> consumption and diesel, kerosene, and other heavy product yields including optional product specifications.

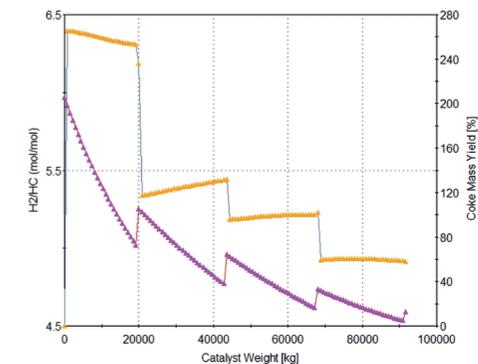
### Highlights

- Capable of allowing HCC design configuration based on the number of stages for continuous or fixed-bed operation including recycle gas loops
- Heat balance to calculate quench effect on each stage temperature
- HCC unit operation that contains both simple once through and complete recycle configurations including hydrocracker, HP and LP separators, treating and recycle compressor, and cooler
- Predictions of product yields, properties such as H<sub>2</sub> ratio, weight average bed temperature (WABT) and final catalyst activity based on feed or catalyst specifications, operating condition, geometry specifications, and hydrogen quench flow rate or interstage temperature set points
- Predictions of temperature, conversion, H<sub>2</sub>/HC, H<sub>2</sub> yield profiles, and activity profiles due to coking, poisoning, or sintering along the beds
- Capable of setting the kinetic function of different catalyst types such as guard and main catalyst in each stage
- Precise bifunctional catalyst deactivation model including deactivation on both acid-metal sites



Atmospheric Gas Oil

Liquid Product

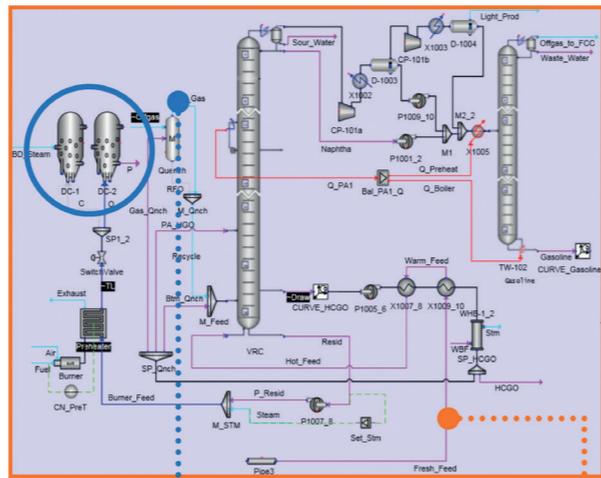


## Delayed Coker (DC)

The DC is a delayed coker model that includes precise kinetic reactions where residual and heavy hydrocarbons are cracked to lighter higher-value hydrocarbons such as gasoline, diesel fuel, and LPG with associated petroleum coke. A better understanding of process interactions helps maximize liquid yield recovery and furnace service time run length.

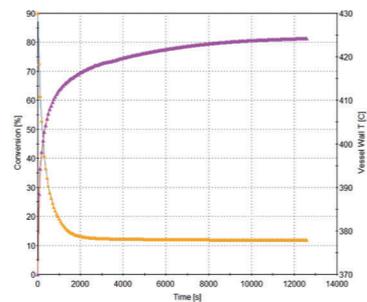
### Highlights

- Capable of providing delayed coker batch configurations for a variety of process schedules
- Input includes vessel size, metal weight, and optional steam injection rates
- Predictions of off-gas fractionated yields and remaining pitch or coke within the vessel at any point in the process time
- Easily include recycled material and rigorous delayed coking furnace unit within the process flowsheet to fully encompass reactive life cycle of feedstock
- Prediction of service time runs in the delayed coking furnace with rigorous coke growth internal reaction kinetics



Coker Off Gas

Vacuum Residue





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