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

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

REFINERY MODELING IN SYMMETRY

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

Symmetry’s Refinery is powered by our proprietary PIONA based molecular structure modeling (paraffins, iso-paraffins, olefins, naphthenes and aromatics) platform. 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 as well as being 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 non-reactive, enabling multi-unit refinery evaluations. The combination of these leading edge models empowers the simulation of complex plants containing multi-integrated units within a single, flexible flowsheet.

Symmetry 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
- The simulation is 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 types of catalysts and feedstocks
- Optimized flowsheet performance with Symmetry’s 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, how changing feed and process variables impacts operations including: RON, H2 and BTEX yields, and catalyst deactivation.

Highlights

- Capable of allowing 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 allowing automatic preheat temperature calculations
- Predict product yields and properties such as RON, BTEX wt, H2 wt
- Predict temperature, conversion, H2/HC, BTEX profiles and activity profile due to coking/ poising/sintering along the beds
- Detailed bi-functional catalyst deactivation model considering coking, poisoning, sintering on metal/acid sites including effect of H2, temperature and feed contamination
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 optimisation of propylene yield, gasoline yield + RON value and reducing emissions.

Highlights
- Capable of allowing different configuration based on FCC design including multi-diameter riser and MIP (maximum iso-paraffin) 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 are also 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
- Predict product yields, properties such as RON, Spent/Regenerated Catalyst Activity, Flue Gas Emission (CO, CO2, NOx, SOx) from regenerator for specified feed/catalyst properties, operating conditions and riser, stripper and regenerator geometry
- Predict temperature, pressure, conversion, process vs. catalyst velocity, deactivation rate and coke yield profiles in the riser

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 H2 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
- Predict product yields, properties such as desulfurization %, denitrogenation %, and H2 ratio
- Predict temperature, conversion, H2/HC and rigorous atomically balanced H2 yield and activity profiles with feed/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 bi-functional catalyst deactivation model tied to H2 amount, temperature, feed quality and contamination, including increased pressure drop calculations due to catalyst coking
**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 affect on H2 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 contains both simple once through and complete recycle configurations including hydrocracker, HP and LP separators, treating and recycle compressor and cooler
- Predict product yields, properties such as H2 ratio, WABT (weight average bed temperature) and final catalyst activity based on feed/catalyst specifications, operating condition, geometry specifications and hydrogen quench flow rate or interstage temperature set points
- Predict temperature, conversion, H2/HC, H2 yield profiles and activity profiles due to coking/poisoning/sintering along the beds
- Capable of setting the kinetic function of different catalyst types such as guard and main catalyst in each stage
- Precise bi-functional catalyst deactivation model including deactivation on both acid/metal sites

**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
- Predict off-gas fractionated yields and remaining pitch/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