



Intelligent Simulation and Optimization of Steam Cracking Furnaces

Symmetry*, a process software platform, is a comprehensive simulator that empowers all aspects of your models from reservoir to product distribution.

The Symmetry platform's steam cracking furnaces are thermal cracking models that include rigorous kinetic reactions where a wide range of feeds—from light hydrocarbons, such as ethane, all the way to vacuum residues—are heated. The resulting changes in composition due to cracking and other reactions are tracked at every point of the coil(s), all while calculating coke growth rate simultaneously. Furnace simulation enables the optimization of ethylene production in the case of lighter feeds and rigorously predicts the effect of feed compositions and process conditions on coke formation and therefore service time runs.



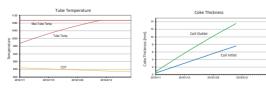
- Paraffins, isoparaffins, olefins, naphthenes, and aromatics (PIONA) molecular structure environment
- Feedstock selection and blending optimization
- Easy matching of plant operating data
- Seamless integration of cracking furnaces and product separation
- Geometry input for radiant box and convection sections
- User-friendly Excel interface
- Rigorous coke growth and service time prediction
- Multiple cracking furnace scheduling

User-Friendly Interface

Users can easily link the Symmetry platform to Excel using our built-in Excel Unit Operation which eliminates the need to write code.

Additionally, the Symmetry platform includes a Component Object Model (COM) link layer which provides a customizable interface that enables you to interact directly with the process simulator without the GUI. This can be used to link the Symmetry platform with any COM-compliant application such as Excel. Visual Basic, C++. Python, and many others.

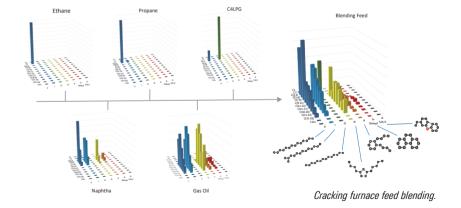
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PIONA Molecular Structure Technology

Hydrocarbon fluids are complex mixtures of many chemical species. This poses a challenge for characterization using conventional methods, where hypothetical components need to be created for each sample, blends, and product.

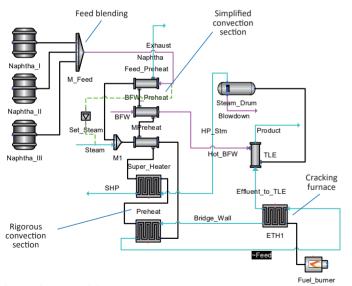
The Symmetry platform's PIONA molecular-structure-characterization approach represents hydrocarbon fluids in terms of chemical families and carbon number. We can rigorously capture the essential chemistry of the fluids and blends to calculate chemical and physical properties. This approach can also mechanistically predict kinetic rates using only a limited number of components. This enables you to perform highly accurate feed blending studies, including reaction kinetics prediction.

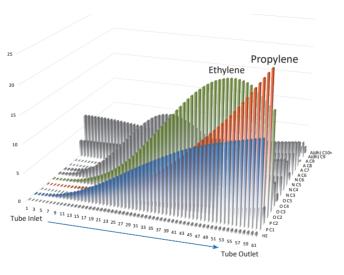


Service time study

Custom Furnace Geometry Input

The PIONA molecular-structure-characterization approach opens the door for rigorous reaction kinetics prediction. The cracking furnace's rigorous kinetic engine can describe any reaction pathway, including PIONA-based coke growth. Based on the detailed geometry input for both the radiant box and convection sections, the Symmetry platform will calculate the product yields, radiant/convection heat transfer, and pressure drop. This enables you to study and optimize the operation of cracking furnaces accounting for continuous coke formation across all furnace sections.



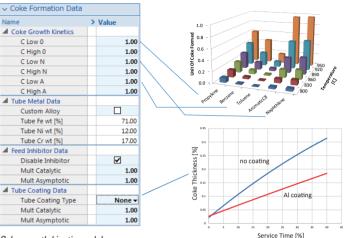


Naphtha feed molecular profiles.

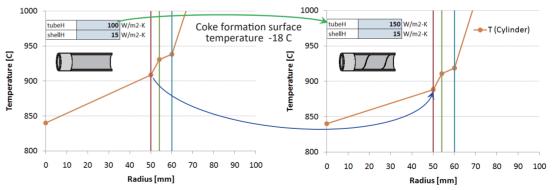
Cracking furnace in a full simulation environment.

Rigorous Coke Growth Prediction

The Symmetry platform's coke growth prediction accounts for the different factors that could cause reduced service run times over the lifespan of a coil. The cracking furnace unit considers reduced tube cross section, heat flux, and yield changes as coke is formed. Coke also causes an increase in pressure drop and metal tube temperatures, reducing service time.



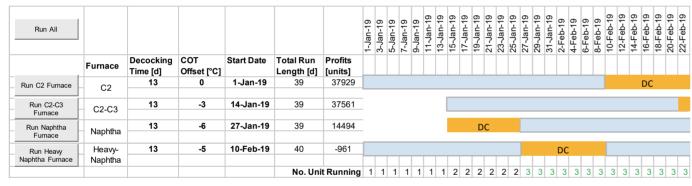
Coke growth kinetic model.



Heat transfer model.

Furnace Scheduling

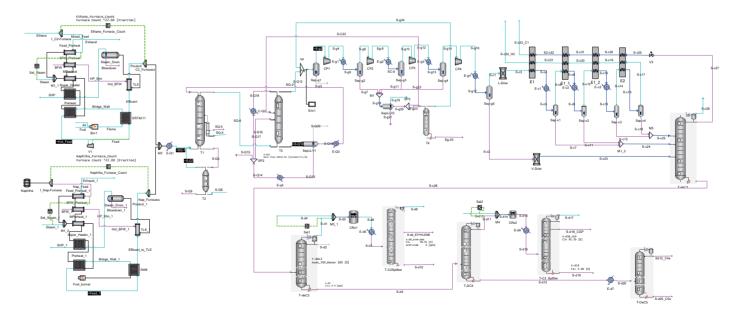
The Symmetry platform's rigorous yield prediction and simultaneous heat transfer and coke growth solution enables optimization studies on cracking furnace operation scheduling.



Scheduling of cracking furnace operations.

Total Ethylene Plant Model

The Symmetry platform's comprehensive and user-friendly process simulator enables seamless integration between different processes; it can model a complete ethylene plant in only one flowsheet. The use of rigorous thermodynamics enables proper hydrocarbon-water solubility trending in the quench section and also enables hydrate formation prediction in the cold-box section.



Ethylene plant example.

