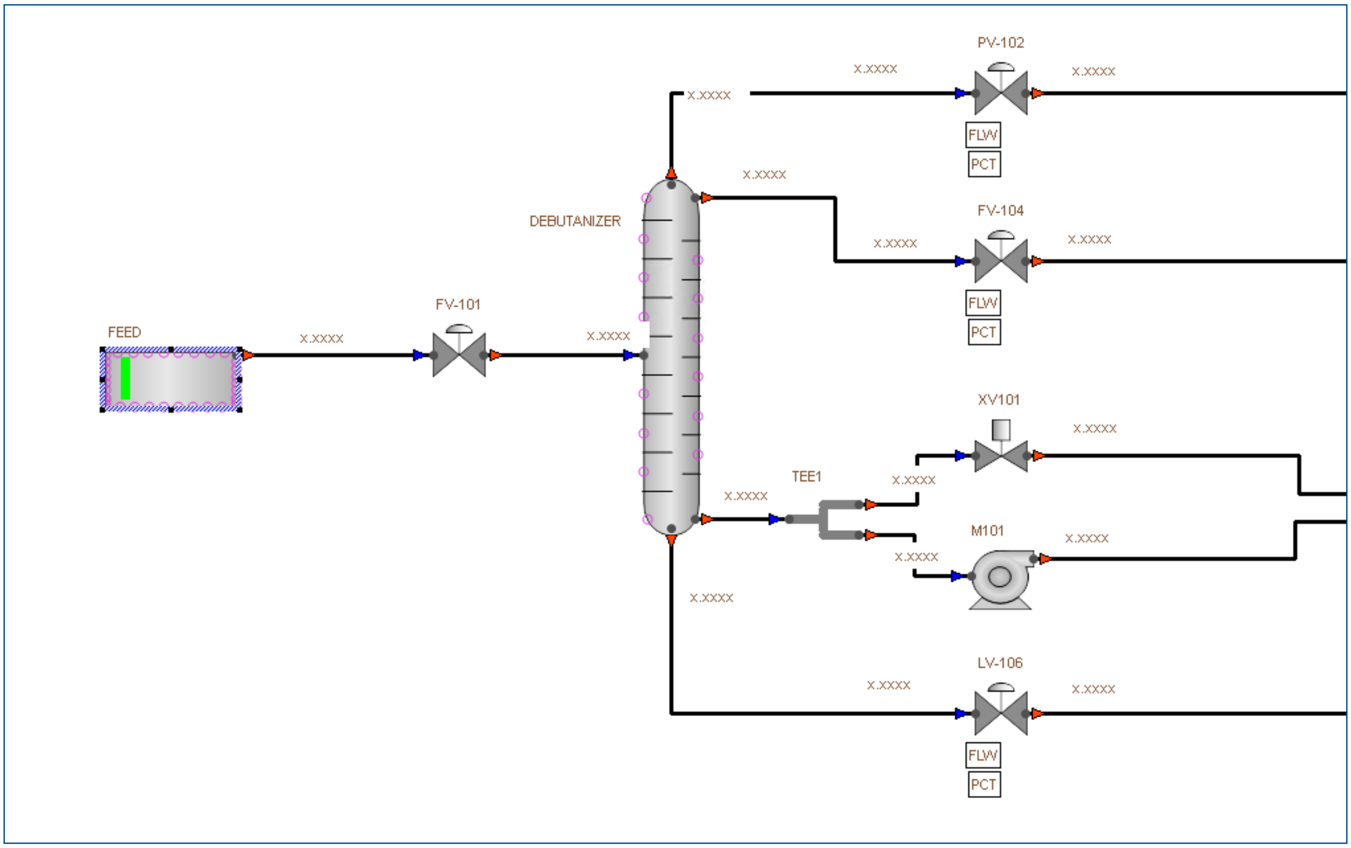
Mimic™ Advanced Modeling Objects - Separations



- Intuitive unit operation modeling
- Supports the use of material thermodynamic properties and vapor-liquid equilibrium equations
- Scalable model complexity using unit operation configuration parameters
- Reduces model tuning requirements with advanced thermodynamics methods

Introduction

The Mimic™ Separations Modeling Objects provide high fidelity dynamic models for unit operations commonly found in the petrochemical, chemical, oil and gas, and refining industries.

The Separations Modeling Object Package is an add-on to the Mimic Advanced Modeling Objects package that includes sophisticated modeling objects into the Mimic Simulation Studio modeling palette. These objects can be used on Mimic systems for application software testing, operator training, and process or operation improvements.

Benefits

Intuitive unit operation modeling

These modeling objects come with modeling infrastructure that makes the development of accurate models quick and easy. Models are configured with actual plant design specifications resulting in accurate dynamic response.

Supports the use of material thermodynamic properties and vapor-liquid equilibrium equations.

The Separations modeling objects calculate the separation of inlet components into vapor, liquid, and heavy liquid, with optional additions of jacket or coil heat exchangers and column reboilers. Using the same properties and equations, the objects can also calculate the temperature and phase change of inlet components.

Scalable model complexity using unit operation configuration parameters

Dynamic models of separations unit operations can be implemented with different options depending on needs and scope of the particular simulation. You can control the level of the model complexity by means of physical settings, composition, sources, and more.

Reduces model tuning requirements with advanced thermodynamics methods

Included in this add-on are advanced thermodynamic capabilities designed to reduce the time and effort when building high fidelity simulations. To guide you through method and data collection, use intuitive wizards when selecting binary interaction parameters.

Product Description

The Mimic Separations Modeling Objects provide high-fidelity dynamic models for unit operations commonly found in a wide range of petrochemical, chemical, oil & gas, and refining plant configurations. The objects include:

- Separator
- Vessel (VLE)
- Surface Condenser
- Jet Condenser
- Stripper
- Distillation Column
- Advanced Thermodynamics

Each modeling object in the Mimic Power Modeling Package includes specific parameters designed for quick configuration.

Separator

The Separator Object simulates a vessel with up to 5 (five) Inlet material streams and up to 4 (four) Outlet material streams.

- Vapor Product stream
- Vapor Vent stream
- Liquid (or Light liquid) product stream
- Heavy liquid stream (if Object is specified as Two Liquid Separator)

External Heat Input to Separator can be specified by the user, and the Heat losses to ambient can optionally be calculated by the Object. The heavy liquid stream contains only one heavy component (usually, water) that must be specified by user. An additional Vapor Vent stream can be specified optionally.

Each of the Inlet /Outlet Streams can contain up to 20 components. The Object uses the material and energy balances, component thermodynamic properties, and Vapor-Liquid Equilibrium (VLE) equations to calculate pressure and temperature in the vessel, the separator vapor and liquid phase compositions, the volumes of vapor and liquid, and the levels of liquid and heavy liquid (if specified).

Vessel (VLE)

The Vessel (VLE) Object simulates a vessel with up to 8 (eight) Inlet material streams and up to 8 (eight) outlet material streams. Additionally, there is an internal heat exchanger that can be used to simulate a jacket or coil.

Each of the inlet and outlet streams can contain up to 20 components. The object uses the material and energy balances, component thermodynamic properties, and Vapor-Liquid Equilibrium (VLE) equations to calculate pressure and temperature in the vessel, the vapor and liquid phase compositions, the volumes of vapor and liquid, and liquid level.

Surface Condenser

The Surface Condenser simulates a vessel with up to 8 (eight) Inlet material streams and up to 8 (eight) Outlet material streams. Additionally, there is one Coolant inlet and one Coolant outlet stream. Each of the Inlet /Outlet Streams can contain up to 20 components.

The Object uses the material and energy balances, component thermodynamic properties, and Vapor-Liquid Equilibrium (VLE) equations to calculate pressure and temperature in the condenser, the vapor and liquid phase compositions, the volumes of vapor and liquid, and condensate level.

Jet Condenser

The Jet Condenser Object simulates a vessel with up to 8 (eight) Inlet material streams and up to 8 (eight) Outlet material streams. Inlet Streams carry vapor to be condensed and coolant which is sprayed over the vapor space.

Each Inlet /Outlet Stream can contain up to 20 components. The Object uses the material and energy balances, component thermodynamic properties, and Vapor-Liquid Equilibrium (VLE) equations to calculate pressure and temperature in the Condenser, the vapor and liquid phase compositions, the volumes of vapor and liquid, and the level of condensate.

Stripper

The Stripper object provides a dynamic model for a full-scale stripper configuration, including the column and reboiler sections.

Distillation Column

The Distillation Column provides a high-fidelity dynamic model for a wide range of the distillation column configurations. Features supported in this modeling object include:

- **Multi-sectional columns**: Three column sections (in current design version) with different tray/column diameters, tray spacing, and weir heights. 75 trays can be configured per column section.
- **Multiple feeds and side withdraws**: Five feed streams and five side draw streams per column.
- **Total condenser and partial condenser**: Automatic switching between the modes depending on current operational conditions.
- **Choice of the Reboiler**: Reboiler heat exchanger with a heating agent (steam) flow, controlled by valve, or an external reboiler heater (for instance, fired heater) with manipulated heat duty.
- **One or Two liquid phases in the Reflux Drum**: Option with two liquid phases pro-vides simulation of separation of the light and heavy liquids in the Drum and knocking out the heavy liquid from the process.
- **Flexible configuration** of the column over-head section, matching to most of the connection schemes for the condenser and reflux drum (reflux receiver).

Advanced Thermodynamics

Used to configure and utilize rigorous thermodynamic model methodologies. This expanded modeling capability stems from the broad addition of two classes of functionality:

1. Cubic (van der Waals like) Equation of State Models
These Equation of State models can be used to calculate compressibility and enthalpy departure. The most widely used EOS types are included:

- Peng-Robinson (PR76)
- Peng-Robinson (PR76 - Boston Mathias)
- Peng-Robinson (PR78)
- Peng-Robinson (PR78 - Boston Mathias)
- Predictive Peng-Robinson by Jaubert and Mutelet (PPR78)
- Soave-Redlich-Kwong (SRK)
- Soave-Redlich-Kwong (SRK - Boston Mathias)
- Predictive Soave-Redlich-Kwong by Jaubert and Privat (SRK-JP)

Equations of State utilize one empirical binary interaction parameter (BIPs) for each binary pair in a mixture. These parameters characterize the nonideality of interaction between component pairs, with a value of zero indicating negligible interaction. Advanced Thermodynamics contains two methods for leveraging BIPs in EOS models:

- Constant values of BIPs, defined by the approximation of experimental data for each binary pair in a mixture for the PR76, PR78, and SRK models (as well as their Boston Mathias modifications);
- Temperature dependent values of BIPs, calculated by a group contribution method for the binary pair in a mixture by application of the predictive models PPR78 and SRK-JP.

2. Non Random Two Liquid (NRTL) equations for the liquid phase. The vapor phase is based on the Ideal Gas EOS in this Mimic version. The NRTL model is applied for the calculation of liquid phase activity coefficients as well as excess enthalpy (enthalpy of mixing).

Thermodynamic model details are configured in the Component Set. Users can select from a list of the following:

- **Core Thermo**: The default model for new Component Sets, this model is the thermodynamic method that has been used prior to Mimic 3.7.0 (as enumerated above).
- **Core Thermo Plus**: This model is designed to increase fidelity of the Core Thermo.
- **Cubic Equation of State**: Choosing Cubic Equation of State (EOS) allows the user to choose from a variety of cubic equations of state.
- **NRTL Activity Model**: Choosing this model leads to dynamic calculation of the activity coefficients based on NRTL.

Ordering Information

The Mimic Separations Modeling Objects can be added to any Mimic system by first adding the Advanced Modeling Objects - Core license.

Description	Model Number
Mimic Advanced Modeling Objects - Core	MM3-7111
Mimic Advanced Modeling Objects - Separations	MM3-7121

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