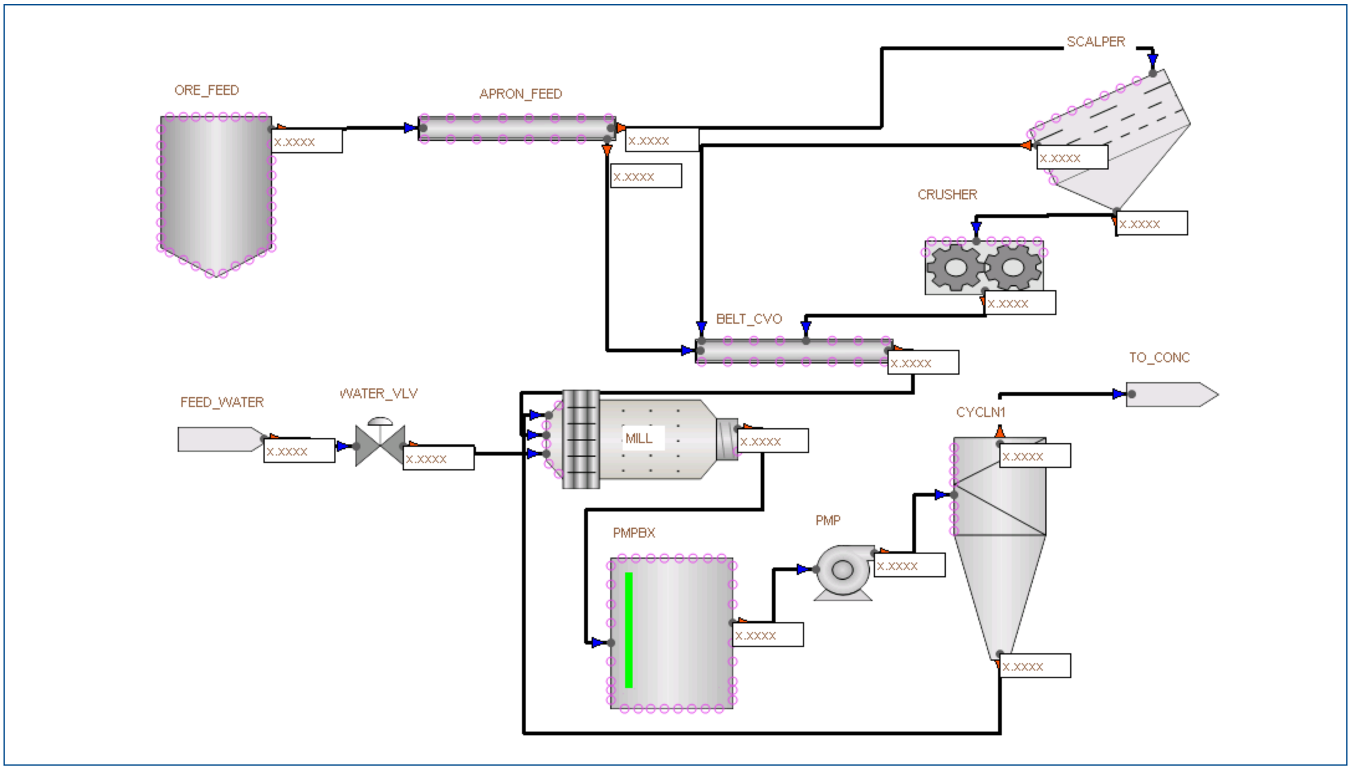
Mimic™ Advanced Modeling Objects - Solids



- Intuitive unit operation modeling
- Supports solid components in addition to the liquid and gas phases
- Accommodates changing distributions of solid sizes
- Provides online size distribution data for decision support

Introduction

The Mimic Solids Modeling Objects provide high fidelity dynamic models for unit operations commonly found in mineral processing plants as well as particle size distribution tracking and tunable breakage matrixes for communition operations.

The Solids 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.

Supports solid components in addition to the liquid and gas phases

Solid components are mapped into user-defined size categories with up to 20 size categories allowed per stream. Size categories are defined in the simulation in source blocks, or in any block which performs communition and alters the size distribution (such as screens or crushers). Initial distributions within the size categories will be defined in the source blocks as mass percentages.

Accommodates changing distributions of solid sizes

Mining unit operations that change the distribution of solid sizes have a consistent tunable communition or breakage matrix. The breakage matrix defines the distribution of particle size from inlet to outlet of the equipment and is tuned with the matrix variables and rate scalar for ore characteristics and hardness.

Provides online size distribution data for decision support

Included with flexible, powerful particle size distribution (PSD) in the Mimic Portage Mining Advanced Modeling Objects are tools to support better operations decision making for the mill manager or metallurgist. PSD View displays P30, P50 and P80 marks for each size distribution in process streams in addition to cumulative size distribution tracking. No configuration is required to use PSD View on the dynamic model of a mining process.

Product Description

The Mimic Solids Modeling Objects provide high-fidelity dynamic models for unit operations commonly found in mineral processing plants as well as particle size distribution tracking and tunable breakage matrixes for communition operations. These models use a combination of proven first-principle modeling methods as well as statistically grounded matrix operations for solving communition and mechanical characteristics of the installed mill equipment.

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

Bin

The Bin object represents an open to atmosphere storage container. It is designed to work with solid components. The initial distribution mechanism can be based on either Rosin-Rammler or Gates-Gaudin-Schuhmann models to assist with specification of the initial material.

Material placed in the Bin forms horizontal layers with each model scan. Material in a layer does not mix with neighboring layers. The number of layers in the Bin is determined dynamically, based on the volumetric flow into the Bin at each model scan.

The outlets from the object always draw from the bottom of the Bin, creating a first-in-first-out operation on the material layers. Outlet flow rates are determined by user defined external models, not the pressure-flow network. Any material entering the bin that does not fit in the configured volume is redirected to the SPILLAGE stream.

Conveyor

The Conveyor object represents a bi-directional, variable-speed, fixed-length belt conveyor. Material can be added to the Conveyor at multiple fixed points and will remain on the Conveyor until carried off of the front or end. The Conveyor is designed to work with solid components.

The Conveyor has two limits: maximum capacity, and maximum linear density. The maximum capacity is the total amount of mass that can reside on the Conveyor before its motor is overwhelmed. If the total mass on the Conveyor exceeds the maximum capacity, the Conveyor's speed will be set to zero. It will have to be reset before it will begin to move again.

The maximum linear density specifies how much mass per unit length the Conveyor can hold before material begins to spill off of the sides. The maximum linear density applies at each point along the Conveyor; it is not averaged across the entire length. If this limit is exceeded, the excess material will immediately exit the conveyor through the SPILLAGE output. Vapor material exits immediately through the SPILLAGE output. Liquids are carried along the conveyor, like solids.

The Conveyor object works with the Mimic Pressure/Flow Solver. The Conveyor is assumed to be open to atmosphere and will therefore have a pressure of 101.325 kPa. All elevation differences between the conveyor and upstream objects will be considered, as normally done by the solver.

The flow rate of the output streams (END_OUT, FRONT_OUT, SPILLAGE) is not calculated by the Mimic Pressure/Flow Solver. The flow rate is determined by the internal state of the conveyor (mass on belt and speed).

Compactor

The Compactor object represents a roller compactor with a force feeder. It is designed to work with solid components. The performance depends upon the feed temperature, the pressure applied to the rollers, and the cut size of the feed material. User configured Polynomials convert each of these parameters to a quality value of 0.0 to 1.0. A quality of 1.0 represents ideal condition, whereas compaction fails completely at a quality of 0.0. The three quality values are then weighted to produce a final quality value that determines the effectiveness of the compaction.

The feed cut size of the Compactor is the size such that a specific percentage of the feed particles are less than the given diameter. For instance, an 80% cut size of 1.5 mm describes a feed where 80% of the particles are less than 1.5 mm in diameter. In the Compactor model, the percentage is specified in the configuration. The cut size is then determined, dynamically, from the feed into the compactor. This cut size is then used to determine the cut size quality.

The inlet pressure is atmospheric (101.325 kPa), since the force feeder is open to atmosphere. The outlet stream flow rates from this object are determined by internal state, not by the Mimic Pressure/Flow Solver. Crusher - for modeling several different forms of crushers: jaw, cone, gyratory and High Pressure Grinding Roller (HPGR) crushers.

Crusher

The Crusher object represents several different forms of crushers: jaw, cone, gyratory and High Pressure Grinding Roller (HPGR) crushers. It performs size reduction based on a breakage matrix, and power estimation using several standard estimator functions. The crusher is designed to work with solid components.

The object also includes an integrated hopper, which simplifies feed control to the crusher. Material in the hopper is not subjected to crushing. Material flows from the hopper into the crushing segment at a rate configured as the crusher capacity.

The hopper is at atmospheric pressure for determining inlet flow rates. Stream outlet flow rates for this object are determined internally (holdup composition, crush rate).

Cyclone and Cluster Cyclone

The Cyclone object represents both hydro cyclones and dry cyclones. Depending upon the phase of its feed, the Cyclone will automatically adjust its calculations to handle the appropriate phase. The cyclone is designed to work with solid components. Cyclones Clusters of up to 100 units can be configured and are supported by the Mimic Pressure Flow Solver.

For either phase, the model finds, for each component, the diameter that would give a particle a 50% probability of exiting through either the top or bottom of the cyclone. This is the D50 for that component. A critical diameter is also configured for each component. Particles of that size or larger have a 100% probability of exiting through the underflow. The user can also specify a minimum probability that all particles, regardless of size or component, have of exiting through the underflow.

If a maximum inlet solid percentage is specified, the Cyclone will begin roping if the composition exceeds the configured limit. Furthermore, if the maximum inlet solid flow is exceeded while the Cyclone is roping, the Cyclone will plug. Once the Cyclone is plugged, all mass exits through the overflow. A plugged Cyclone can only be cleared through its reset. If the Cyclone has not plugged, roping can be cured by bringing the feed solid percentage back under the configured maximum.

The Pressure parameter is used for the downstream pressure in inlet streams to the Cyclone. Outlet stream flow rate is determined by the internal state of the Cyclone.

Mill

The Mill object represents ball mills, rod mills, autogenous mills (AG), and semi-autogenous mills (SAG). The outlet can either be an overflow or a grate. It performs size reduction based on a breakage matrix, and power estimation using several standard estimator functions. The Mill is designed to work with solid components. The initial distribution mechanism can be based on either Rosin-Rammler or Gates-Gaudin-Schuhmann models to assist with specification of the initial material.

For ball, rod, and SAG mills, the grinding media is tracked separately from the process material. The mass of media currently in the mill is available separately from the total mass, and media can be added separately as well. The grinding media is strictly an internal attribute of the Mill, so it does not appear in the component set. The media does not directly impact grinding performance. This can be managed by adjusting the Mill's rate scalar in a low-level model.

If the speed of the Mill is set too high, the holdup will begin to centrifuge. This happens when the Mill is rotating fast enough for material to stay pressed to the surface of the drum even at its top. If the Mill beings to centrifuge, several things will happen: the object will assert an error, the power requirement will drop, and the level will decrease. Slowing the Mill down will return it to normal operation.

Screen

The Screen object represents a stack of mesh screens. The number of screens can be configured, as well as the mesh-opening diameter, capacity, efficiency, and other parameters for each individual screen in the stack. The Screen is designed to work with solid components.

Undersized material passes through one screen to the next until it reaches a screen too fine to pass through. It then exits through that screen's oversized output. Each screen can be configured with a maximum retained liquid percentage. The output of that screen will never contain more liquid, by mass percentage, than the configured maximum. Excess liquids exit through the final underflow output. Vaporous mass always exits through the first oversized output.

Screens can also be configured to plug over time. This simulates particles obstructing the apertures in the mesh, preventing material from passing through. The effect is to lower the efficiency of the screen as time passes. Triggers can then be used to clean the screen, returning it to full efficiency.

The Screen is at atmospheric pressure. The inlet flow rates are solved by the Mimic Pressure/Flow Solver. The outlet flow rates are determined by the inlet flow rates, as this block has no holdup.

Centrifuge Decanter

A Centrifuge Decanter is a horizontal, continuous centrifuge that uses a screw to move centrifuged solids to a discharge. Clarified liquids are removed by overflowing a weir. The bowl of the Centrifuge Decanter only fills to the weir height. Separation is achieved through the screw moving solids toward one end, up a sloped surface until it is above the weir height, and out the discharge. Liquids simply overflow the weir.

The relative speed of the screw and the bowl determine the wetness of the solids discharge. A slower screw speed allows for more compaction, which results in a dryer solid discharge.

Flotation

Froth flotation is a physico-chemical separation process used in a wide variety of mining applications. The Flotation Object can be used to model cells or columns. The difference in surface properties of the raw materials plays a significant role in the process. Generally, the species comprising the raw materials are either hydrophobic or hydrophilic, while others can be chemically altered to become hydrophobic such that they float.

In Mimic, a flotation cell is a vessel containing a slurry (or pulp) with a mixture of particles with different surface properties with respect to water. When air bubbles are introduced into the pulp, the hydrophobic particles will attach to the buoyant bubbles and float away from the suspension to the froth layer at the top of the slurry where the particle-laden bubbles are collected as product. The hydrophilic materials or tailings settle to the bottom of the cell where they are removed and rejected. The initial distribution mechanism can be based on either Rosin-Rammler or Gates-Gaudin-Schuhmann models to assist with specification of the initial material.

Settling Tank

The Settling Tank object represents settling tanks, or thickeners without a rake. The Settling Tank is open to atmosphere. It is designed to work with solid components. The initial distribution mechanism can be based on either Rosin-Rammler or Gates-Gaudin-Schuhmann models to assist with specification of the initial material.

The tank is divided into horizontal layers, and particles are tracked as they fall under gravity from one layer to the one below it. As particles reach the bottom of the Settling Tank, they form a mud layer, whose overall density is specified during configuration.

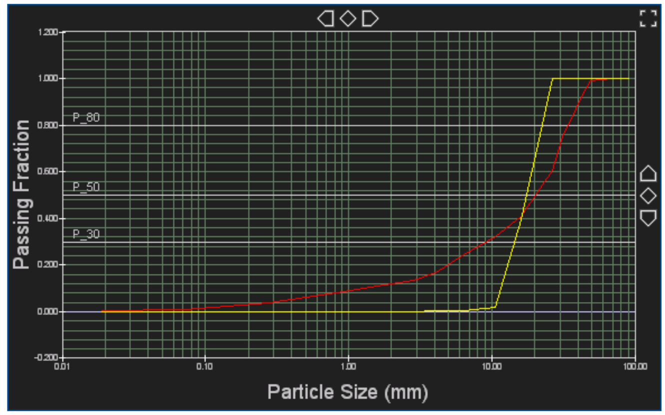
The Settling Tank can have an optional agitator. When present and enabled, the agitator inhibits settling.

Settled material can be drawn from the bottom of the settling tank, or out through side-draws. Liquids and floating material flow out from the top of the tank.

This object behaves as an open to atmosphere vessel in the dynamic flow solver, except for the OVERFLOW stream. When material reaches the top of the tank, it begins to overflow, whether or not there is a downstream block connected to the outlet stream. The mass balance of the tank determines the overflow rate.

Particle Size Distribution (PSD) View

The Particle Size Distribution (PSD) View application allows users to view size distribution data online for solids blocks. With data selected, the PSD View shows a plot of passing fraction versus particle size.



Ordering Information

The Mimic Solids 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 – Solids	MM3-7131

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