Slurry Module

Steady-state hydraulic analysis of settling and non-settling slurries, non-Newtonian liquids and pulp stock: pressure drop, flow distribution, deposition behavior, slurry-pump performance and connected equipment duties.

1 FUNCTIONAL DESCRIPTION

The module classifies the service as a settling slurry, a non-settling slurry or pulp stock. That classification sets the fluid definition, the pressure-drop method, the deposition assessment and the pump corrections applied across the network.

2 CALCULATION BASIS

Analysis	Steady-state
Fluid	Settling and non-settling slurries, non-Newtonian liquids and pulp stock
Pipe condition	Can model clean and aged pipes
Networks	Series, parallel, branching, open and closed-loop

3 NON-NEWTONIAN

Rheology models	Power Law; Bingham Plastic; Herschel-Bulkley; Casson
Non-Newtonian friction	Darby (1992) for Power Law and Bingham Plastic; composite Rabinowitsch-Mooney and Wilson-Thomas (1985) otherwise
Pulp stock	TAPPI stock types or Moller K fiber data

4 SETTLING SLURRY

Friction loss approach	Empirical, formula-based; separate horizontal and vertical methods, with inclination adjustments on some correlations
Horizontal friction loss	Durand; Wasp; Liu Dezhong; Sellgren-Wilson; WASC; Vsm; V50; 4CM
Vertical friction loss	WASC loss; 4CM; Spelay (2017) collisional stress model
Deposition velocity	WASC generalized relationship; particle-size function; GIW VSCALC
Deposition velocity pipe orientation correction	Wilson-Tse 1984 and Extended Wilson-Tse

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5 MODELING ELEMENTS

Categories	Pipes; boundaries; boosters; valves; controllers; check valves; general resistances; size changes; relief devices; heat exchangers
Database	Performance, pressure-loss and solids property data held in the database, so definitions can be reused and shared
Defaults	Default values applied on placement and customizable
Non-standard	General Resistances model non-standard piping equipment

7 MODELING WORKFLOW

- Classify the service: settling slurry, non-Newtonian slurry, or pulp and paper stock.
- Open a new flowsheet (File menu or CTRL+N).
- Place boundary nodes and define their conditions, setting the fluid type for settling slurry or pulp and paper stock.
- Place equipment from the Component Palette and connect with the selected pipe material.
- Define pipe, node and equipment data in the Input Editor.
- For centrifugal pumps, disable the viscosity correction with non-Newtonian liquids and apply a derating method to the performance curve.
- Run the calculation (toolbar or CTRL+F8).
- Review results and messages in the Data Palette.
- View component charts in the Data Palette, or create component and flowsheet charts as required; charts can be placed on the flowsheet.

6 MODEL INPUTS

Non-Newtonian slurry	Fluid defined as a non-Newtonian liquid with fluid property data, applying the applicable rheology model at the inlet boundary
Settling slurry	Inlet boundary set to Heterogeneous / Settling, with defined solids, solids concentration and particle size
Pulp and paper	Inlet boundary set to Pulp / Paper stock, which introduces the pulp weight % dry concentration fields
Centrifugal pump	A derating method can be applied when working with non-Newtonian or settling slurries
Note	*All other inputs are as for liquid models. Simultaneous input definition across selected elements; default input data can be customized*

8 DESIGN CHECKS AND WARNINGS

Deposition	Operating velocity compared with the calculated deposition velocity; a blockage warning is generated where pipe velocity falls below it
Convergence	Messages tab reports convergence issues, data warnings and engineering hints
On flowsheet	Flow-direction arrows; red markers on warnings and errors

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9 OUTPUTS AND REPORTING

Results	Mixture properties, velocity and deposition velocity
Charts	Rheology fit and pump curves from the Chart tab; component, flowsheet and composite charts
Messages	Convergence issues, data warnings and engineering hints

10 APPLICATIONS

- Mining and metals: tailings, concentrate pipelines, ore hydro-transport and paste systems
- Chemical and process plant: non-Newtonian transfer, catalyst and precipitate handling
- Pulp and paper: pulp-stock transfer using TAPPI types or Moller K fiber inputs
- Dredging and wastewater: settling-slurry transfer driven by deposition and pipe inclination
- Food and general processing: non-Newtonian or homogeneous fluids from measured rheology

11 DEPENDENCIES AND LICENSING

Requires	Liquid Module, active
Included	Heat transfer and Scripting, at no additional cost
Licensing	Per seat

12 CAPABILITIES

- Fit rheology to measured data — model constants from shear data, with visual and statistical fit indicators.
- Automatic rheology-specific pressure loss methods — the friction method follows the rheology model selected.
- Configurable horizontal and vertical pressure loss methods — eight settling correlations horizontally, three vertically.
- Assess deposition velocity — three methods, including GIW VSCALC.
- Model pipe orientation impact on deposition velocity — Wilson-Tse and Extended Wilson-Tse corrections.
- Calculate pulp-stock pressure loss — from TAPPI pulp types or Moller K fiber data.
- Accurately model pump performance with derating effects — five derating methods for solids and non-Newtonian viscosity.
- Size pumps and assess variable speed — operating point from corrected curves, with VFD affinity laws.

13 SCOPE AND EXCLUSIONS

General settling and non-settling slurry, non-Newtonian liquid and pulp-stock systems. Slurry lines can sit in models that also contain single-phase liquid and gas sections when those modules are active.

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