



Sigmafine 4.3

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The issues with data validation

- Too much data
 - Thousands of data points
- Too many sources
 - Lab systems, DCS, manual entry
- Too many interactions
 - Transfers, flows, measurements
- Not much time...

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Bad measurement problems

- Poor estimation of key performance indicators
- Unaccounted valuable material loss
- Inconsistent information across the enterprise
- It is easy to make wrong operational decisions

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Sigmafine 4.3

- A product that enables data reconciliation and validation for any industrial process
 - Sigmafine key features
 - Using Sigmafine with other OSIsoft tools
 - New functionality to perform energy balance

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Agenda

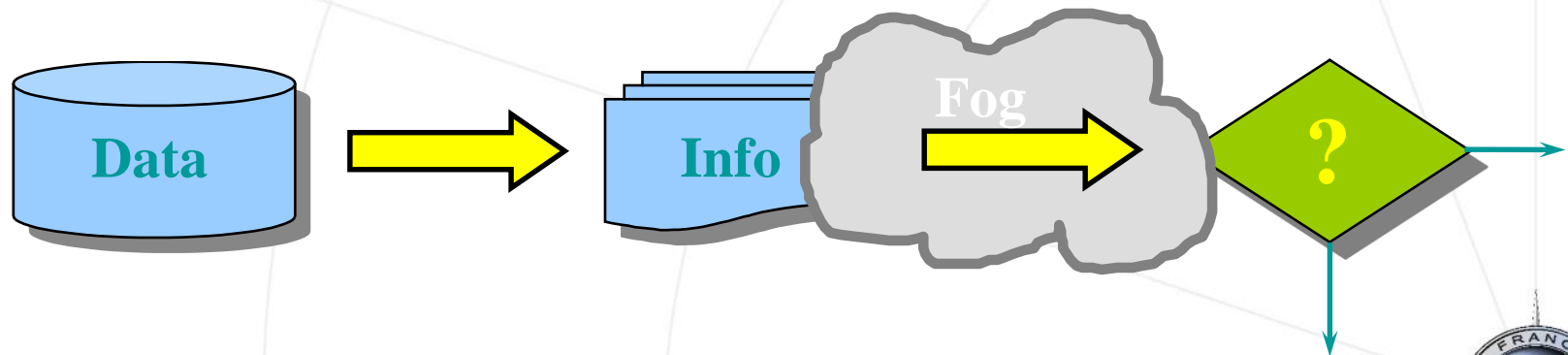
- Reconciliation needs by industry
- Data reconciliation using Sigmafine
- Using OSIsoft tools with Sigmafine
- **New** functionality in Sigmafine 4.3
 - Linear balance
 - Non-linear energy balance (mass & energy)

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Typical scenario without validation

- Some sort of local balance
- Some arbitrary and subjective corrections
- No agreement on data
- Difficult to detect measurement errors

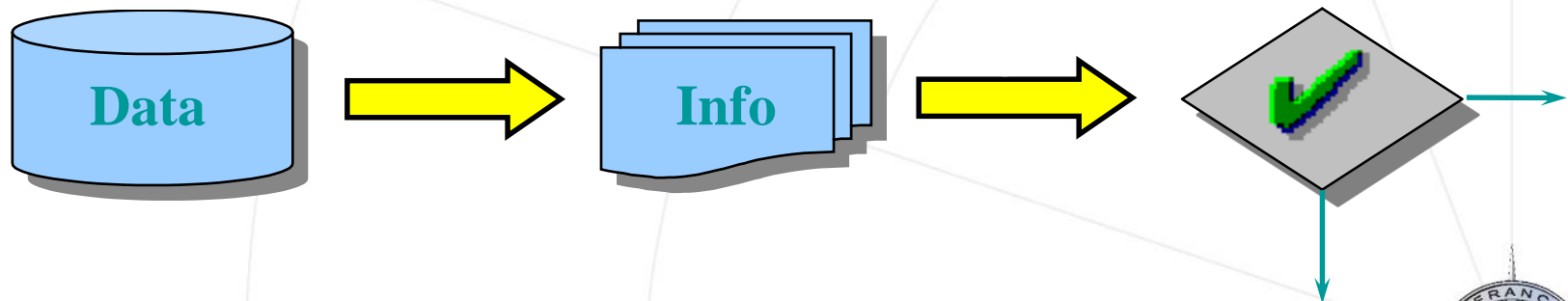


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Validation with Sigmafine

- A unique balance, valid for the whole operation
- Systematic and objective corrections
- Agreement on balanced data
- Easier to detect measurement problems

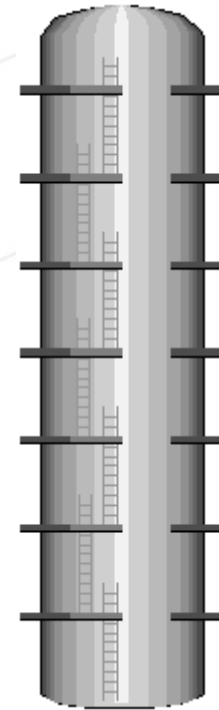


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Reconciliation challenges in refining

- Many products
- Topology changes
- Transfers and flows
- Large models (up to 5000 elements)
- Relatively large redundancy



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Reconciliation challenges in metals and mining

- Low redundancy
- Many analyzers
- Complex models
- Piles of materials that cannot be measured
- Material accounting per element

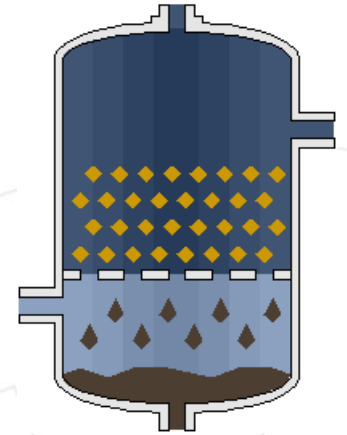


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Reconciliation challenges in the chemical industry

- Flows and transfers
- Component balances
- Process is fixed, not much topology change
- Middle size models (1000 elements)
- Component balance requires stoichiometric balance



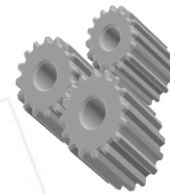
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How to solve these problems

Use Sigmafine to...

- Build and configure a model (once)
- Run the model using the appropriate analysis rule (frequently)
- Analyze results (frequently)



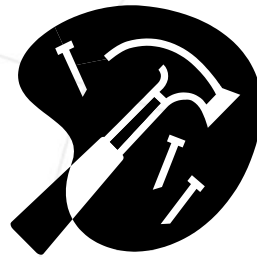
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Sigmafine model building (once)

Only during model creation

- AF Explorer to configure elements
- AF Configurator to configure elements using Excel
- ProcessBook to connect elements and model design

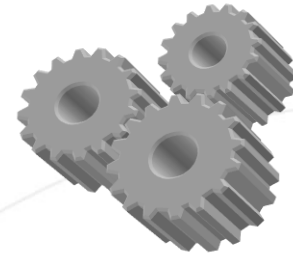


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Running the model (frequently)

- ProcessBook
- AF Excel Add-in
- Automatic scheduling using ACE
- AF Explorer during testing
- Create your own application



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Data analysis (frequently)

- AF Excel Add-in
- ProcessBook
- RtReports
- AF Explorer during testing
- Create your own application



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Benefits in refining

- Transfers are used to model receipts, shipments and movements
- Automatic inventory calculations
- Composition tracking of products stored in tanks
- Refining specific calculations, such as gross to net

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Benefits in the chemical industry

- Mass and component balance
- Reaction constraints allowed, a reaction editor allows the user to configure reactions
- Gas and liquid meter compensation
- Inventory calculations

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Benefits in metals and mining

- Component balance in inventories that are not typically measured
- Independent solvability of components
- Independent accuracies of measurements
- The common sparsity of the process measurement system is handled efficiently

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Sigmafine tools

- Data References
- Analysis Rules
- Data Loader
- Other OSIsoft tools
 - ProcessBook
 - AF Excel Add-in
 - RtReports

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What is a data reference?

- A component or module of the Analysis Framework that can perform the following tasks:
 - Read data from an external system
 - Write data to an external system
 - Can execute predetermined calculations

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Data references

- UOM is a class-to-class converter

The image shows three overlapping 'UOM Data Reference' dialog boxes, illustrating the steps to configure a conversion:

- Leftmost dialog:** 'Select the conversion type used to calculate. Then click "Next>".'
 - Conversion Type:
 - ☒ Mass to/from M
 - ☐ Gas Conditions
 - ☐ FDE
 - ☐ Mass to/from V
 - ☐ Physical Quant
 - Calculated Attribute
 - Calculated Attribute
 - Unit of Measure C
 - Element Name:
- Middle dialog:** 'Select the conversion type used to calculate. Then click "Next>".'
 - Select Conversion:
 - ☒ Volume to M
 - ☐ Mass to V
 - Calculated Attribute
 - Calculated Attribute
 - Unit of Measure
 - Element Name
- Rightmost dialog:** 'Select the attributes used for this conversion. Then click "Finish".'
 - Input Attributes:
 - Volume:
 - Density:
 - Calculated Attribute Information:
 - Calculated Attribute Name: MeasuredMass
 - Unit of Measure Class: Mass
 - Element Name: ME1
 - Buttons: < Back, Finish, Cancel

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Data references

- Gauge to Volume

Tank Volume From Gauge Data Reference

Calculation Type

☐ Strapping table calculation

☐ Polynomial equation

☒ Geometric calculation

Cylindrical horizontal tank

< Back

Ready...

Spherical Tank

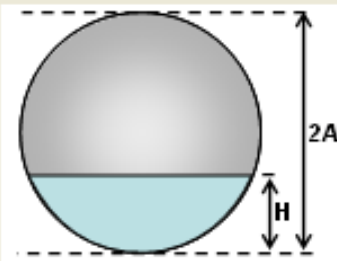
Geometric Properties

Inside vertical radius (A): m Geometric UOM:

Maximum capacity attribute:

Gauge attribute (H):

< Back Finish Cancel



The diagram shows a cross-section of a spherical tank. The total vertical radius is labeled as 2A. The liquid level is indicated by a horizontal line, and the height of the liquid from the bottom of the sphere is labeled as H. The liquid is shaded in light blue.

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Data references

- Components

Components Data Reference

Select the calculation type. Then click "Next".

Calculation Type:

☒ Analyzer Configuration

☐ Measurement Basis Conversion

Selected Attribute Information

Configured Attribute Name: ComponentData

Attribute Type: Data

Element: SF_ChocolateMilkAnal

Next >

Analyzer Configuration

Select the components measured in this analyzer. Then click "Finish."

Analyzer Configuration

Available components

Sugar

>

<

>>

<<

Component	Absolute T	Relative T	Default	Max.	Min.	Measu	Settings
Cocoa	0	2	0	1	0	<input checked="" type="checkbox"/>	ChocMilkAna.Compone
Milk	0	2	0	1	0	<input checked="" type="checkbox"/>	ChocMilkAna.Compone
Syrup	0	2	0	1	0	<input checked="" type="checkbox"/>	ChocMilkAna.Compone
*							

Attribute Information

Configured Attribute Name: ComponentData

Element Name: SF_ChocolateMilkAnal

☒ Allow Defaults When no PI Data is Available

☒ Normalize Data

< Back

Finish

Cancel

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Data references

- Sigmafine

The image displays three overlapping dialog boxes from the Sigmafine software, illustrating the steps to configure a data reference calculation.

Sigmafine Data Reference (Background):
Select the Calculation Category. Then click "Next."
Calculation Category:
☐ Meters
☐ Tank Inventory
Selected Attribute Information:
Calculated Attribute Name:
Unit of Measure Class:
Element Name:
Next

Tolerance (Middle):
Select the Calculation Type. Then click "Next."
Calculation Type:
☐ Tank Tolerance Based on
☒ Measurement Tolerance
Selected Attribute Information:
Calculated Attribute Name:
Unit of Measure Class:
Element Name:
< Back

Measurement Tolerance (Foreground):
Enter the Measurement Information used for this calculation. Then click "Finish."
Measurement Information:
Measurement: Unit-of-Measure
Relative Tolerance: %
Absolute Tolerance:
Selected Attribute Information:
Calculated Attribute Name: MassTolerance
Unit of Measure Class: Mass
Element Name: SF_MilkTank2
< Back Finish Cancel

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Data references from AF

- Formula DR for add hoc calculations

Formula Configuration: (Density)

Data Reference Configuration

Variable: U Attribute: Temperature Unit of Measure: K

Add to Definitions

P=Pressure;UofM=atm
Z=Z
W=MolecularWeight;UofM=lb/lbmol
T=Temperature;UofM=K

Remove Selected Remove All

☐ Default Values Allowed

Result
Unit of Measure: g/L
Minimum:
Maximum:

Formula Configuration

Click available buttons or operators.

Variables: A B C D E Operators: = + - * / Functions: abs acos asin atan ceiling

Formula

Add Formula to Calculation Sequence

Calculation Sequence:
R=0.082
Z*R*P/R/T

Remove Selected Remove All Edit Selected

Evaluate

0 g/L

OK Cancel

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Data references from AF

- PI Point data reference

PI Point Data Reference

PI Server: localhost

☒ Tag name: sinusoid

☐ Alias name:

☐ Attribute:

Value retrieval methods

By Time: Automatic

Relative Time:

By Time Range: Not Supported

Calculation basis: Time Weighted

Min percent good: 80

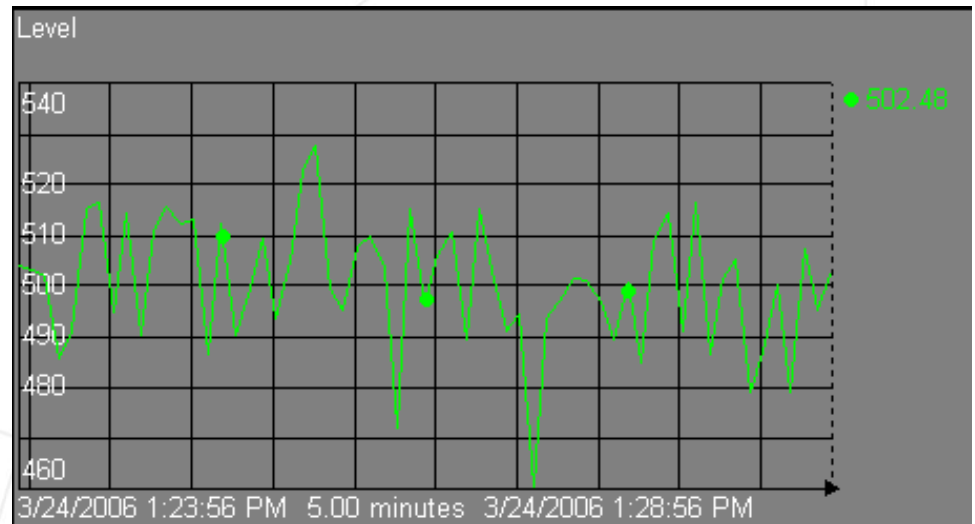
By Case: Automatic

Unit of Measure

UOM: lb

☒ Read only

OK Cancel



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Data References from AF

- Table Lookup

Table Lookup Data Reference

Table:

Result column:

Unit of Measure:

Where

Column: Operator: Attribute or Value:

Complete WHERE Clause:

General Table Define Table		
SF_Material table		
Material	Material Description	Material Gro...
MilkA	Whole Milk	MILKGROUP
MilkB	Skim Milk	MILKGROUP
MilkC	2% Milk	MILKGROUP
MIXA	Dark Chocolate Mix	MIXGROUP
MIXB	Dark Chocolate Mix	MIXGROUP
MIXC	Meduim Chocolate Mix	MIXGROUP
CHOCOLATE	Fine Chocolate Milk	FINALPRO...

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A tank farm example

- Inventory calculations for a tank farm
 - Level is a real time value from PI
 - Tank geometry is known (spheres)
 - Density is stored in a table in AF
 - Material is stored in AF as an attribute
 - Inventory will be calculated in mass

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Configuration of data references

- Configuration using AF Explorer

General Elements Attributes Ports							
TankC							
				Name	Value	Value Type	Data Reference
				Density	3 kg/L	Double	Table Lookup
				Level	0.662982861200968 ft	Double	PI Point
				Mass	5.83938132139628 t	Double	UOM
				Maximum	10000 US kgal	Double	<None>
				Product	MaterialC	String	<None>
				Volume	0.514200449391697 US kgal	Double	Tank Volume Fro...

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View inventories in ProcessBook


- Attributes from elements can be displayed in ProcessBook in different units of measure

AF Property

General Elements Attributes Ports

TankD ☐ Show (

	Name	Value
	Density	2 kg/L
	Level	0.301982549231822 ft
	Mass	0.809623758856 t
	Maximum	1000000 US kgal
	Product	MaterialB
	Volume	0.106939985007454 US kgal



TankA	TankB	TankC	TankD
0.30198 ft	0.26102 ft	0.66298 ft	0.30198 ft
0.80962 t	0.30251 t	5.83938 t	0.80962 t

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Summary of data references

- Configurable
- Chained automatically
 - Sequence is controlled by AF
- UOM conversions are handled automatically
- Some import information, others perform calculations

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What is an analysis rule?

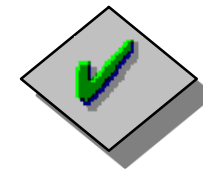
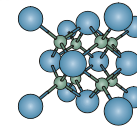
- A component or module of AF that has the ability to analyze a model by using some predetermined logic or algorithm
 - Collect information
 - Validate the model and data
 - Execute logic in the context of a model
 - Write results to a case

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Using analysis rules

- Sigmafine Balance
- Components Balance
- Energy Balance
- Composition Tracking
- Gross Error Detection



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Sigmafine balance analysis rule

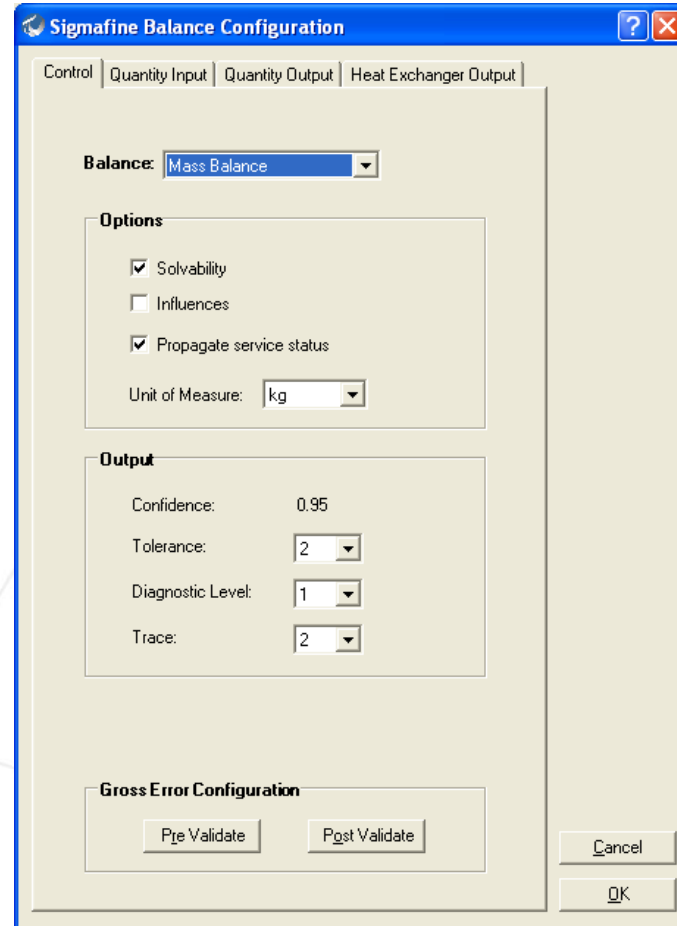
- Linear balance of any quantity type:
 - Mass
 - Volume
 - Standard gas volume
 - Normal gas volume
- Easy configuration with minimal definitions of element types (templates)

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Sigmafine balance analysis rule

- Any quantity that is conserved in a process can be balanced using this rule



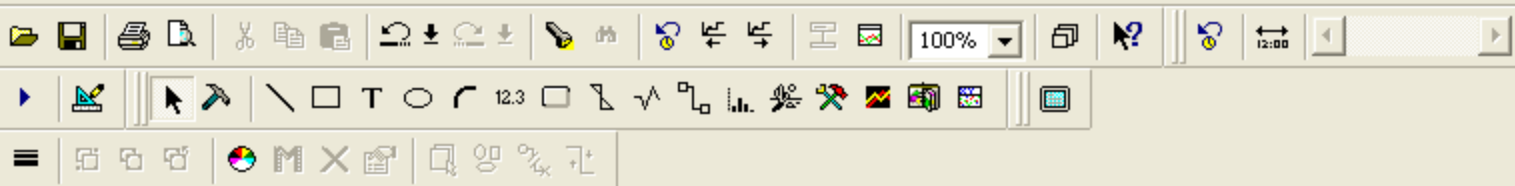
The screenshot shows the 'Sigmafine Balance Configuration' dialog box. It has a title bar with a question mark and a close button. Below the title bar are four tabs: 'Control', 'Quantity Input', 'Quantity Output', and 'Heat Exchanger Output'. The 'Quantity Input' tab is selected. The dialog is divided into several sections:

- Balance:** A dropdown menu showing 'Mass Balance'.
- Options:** A group box containing three checkboxes: 'Solvability' (checked), 'Influences' (unchecked), and 'Propagate service status' (checked). Below these is a 'Unit of Measure:' dropdown menu showing 'kg'.
- Output:** A group box containing four settings: 'Confidence:' set to '0.95', 'Tolerance:' set to '2', 'Diagnostic Level:' set to '1', and 'Trace:' set to '2'.
- Gross Error Configuration:** A group box containing two buttons: 'Pre Validate' and 'Post Validate'.

At the bottom right of the dialog are three buttons: 'Cancel', 'OK', and a button with a question mark.

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Components analysis rule

- Mass and component balance, simultaneously
- Applications of this rule
 - Gas plants
 - Metals and mining
 - Tracing of impurities in refining

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Components analysis rule

- Component tracking in inventories
- Analyzers are configurable to handle different component lists
- Normalized constraints in sections of the model
- Independent solvability per component

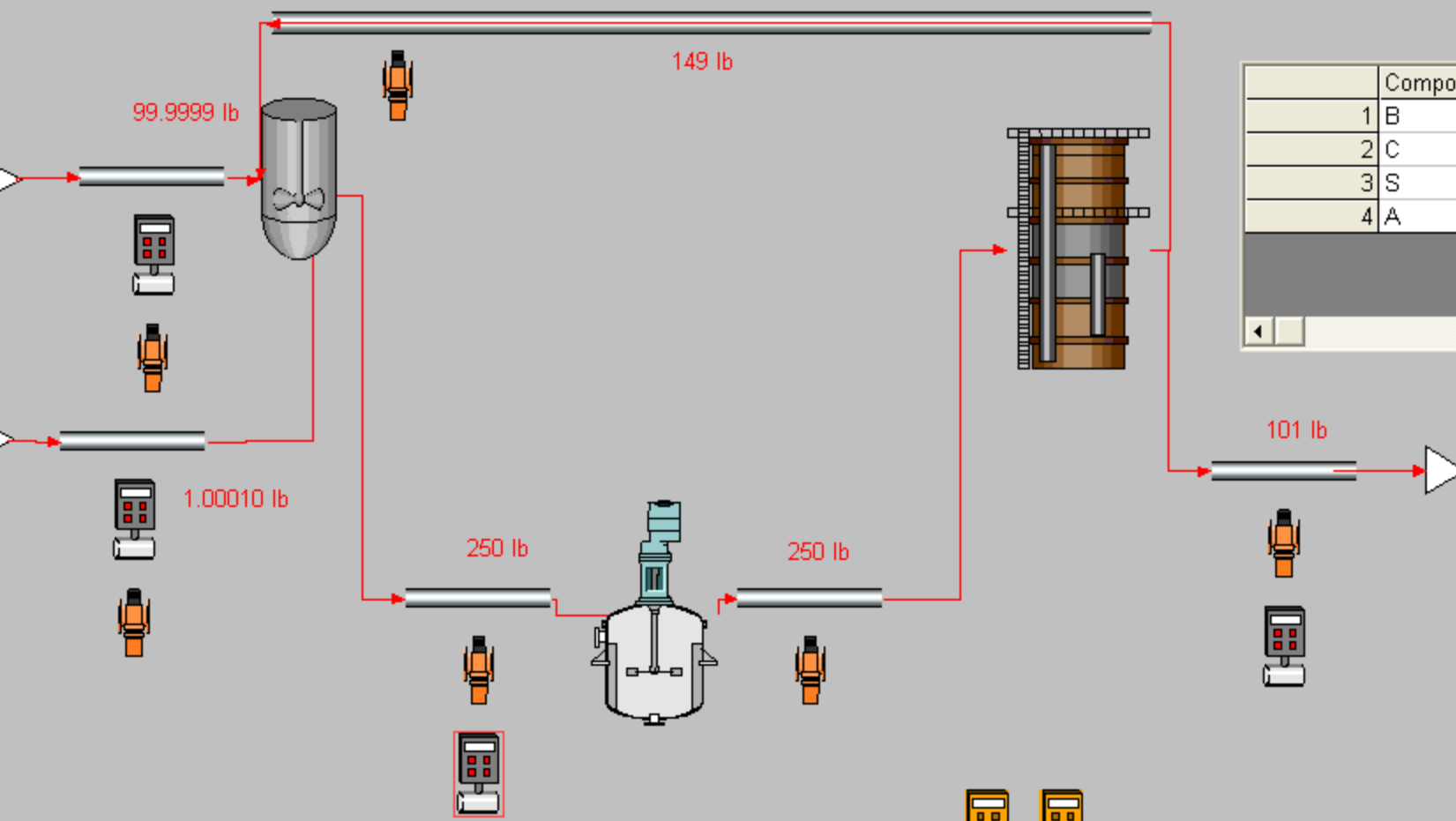
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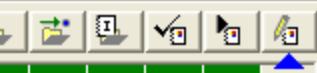


Validate: Pending.

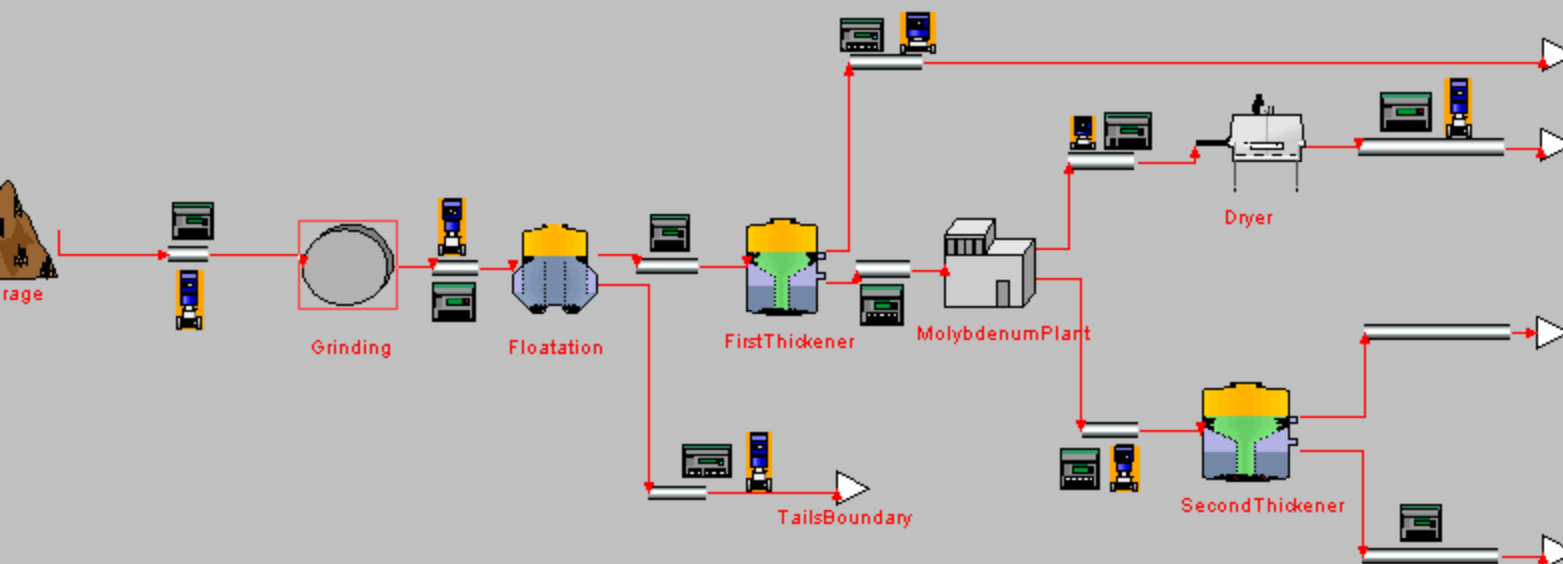
Component and Stoichiometry Balance Case 5/5/2005 11:00:00 AM - 5/5/2005 12:00:00 PM



	Component	Value	Tolerance
1	B	0.00	
2	C	0.00	
3	S	0.40	
4	A	0.60	



Daily Balance Case 11/19/2005 4:13:34 PM - 11/20/2005 4:13:34 PM



Case 11/19/2005 4:13:34 PM - 11/20/2005 4:13:34 PM

Name	Value
WetMolybde...	<Data Table>
WetMolybde...	<Data Table>
SecondThic	31456050719 0562 lb

Log Results Adjustments Layers Elements Connections Report

Data Table Edit

Component Name	Solvability	Reconciled	Reconciled T
Cu	R	0.0006800	0.00089443
Mo	R	0.5352383	0.00706985
*			

Show Categories

CAP

Energy Balance

- Due to high energy prices, companies are monitoring closely their energy utilization
- Validation of energy measurements is needed for efficiency calculations
 - Process networks don't have all measurement required to estimate efficiencies
 - The use of reconciliation provide the estimates for further analysis

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Energy balance analysis rule

- Physical quantity and energy properties are balanced simultaneously
- Different combinations of extensive and intensive properties are allowed
- Measurements are classified as quantity, specific energy, and total energy

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Results of energy balance rule

- Initial imbalances of both quantities and energy properties
- Measurement statistics
- Best estimates of reconciled properties
- A set of data that satisfies both quantity and total energy balance

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EnergyBalance Case 3/26/2006 8:27:11 PM - 3/26/2006 9:00:00 PM

AF Property

General Elements Attributes

Name: HeatExchangerM

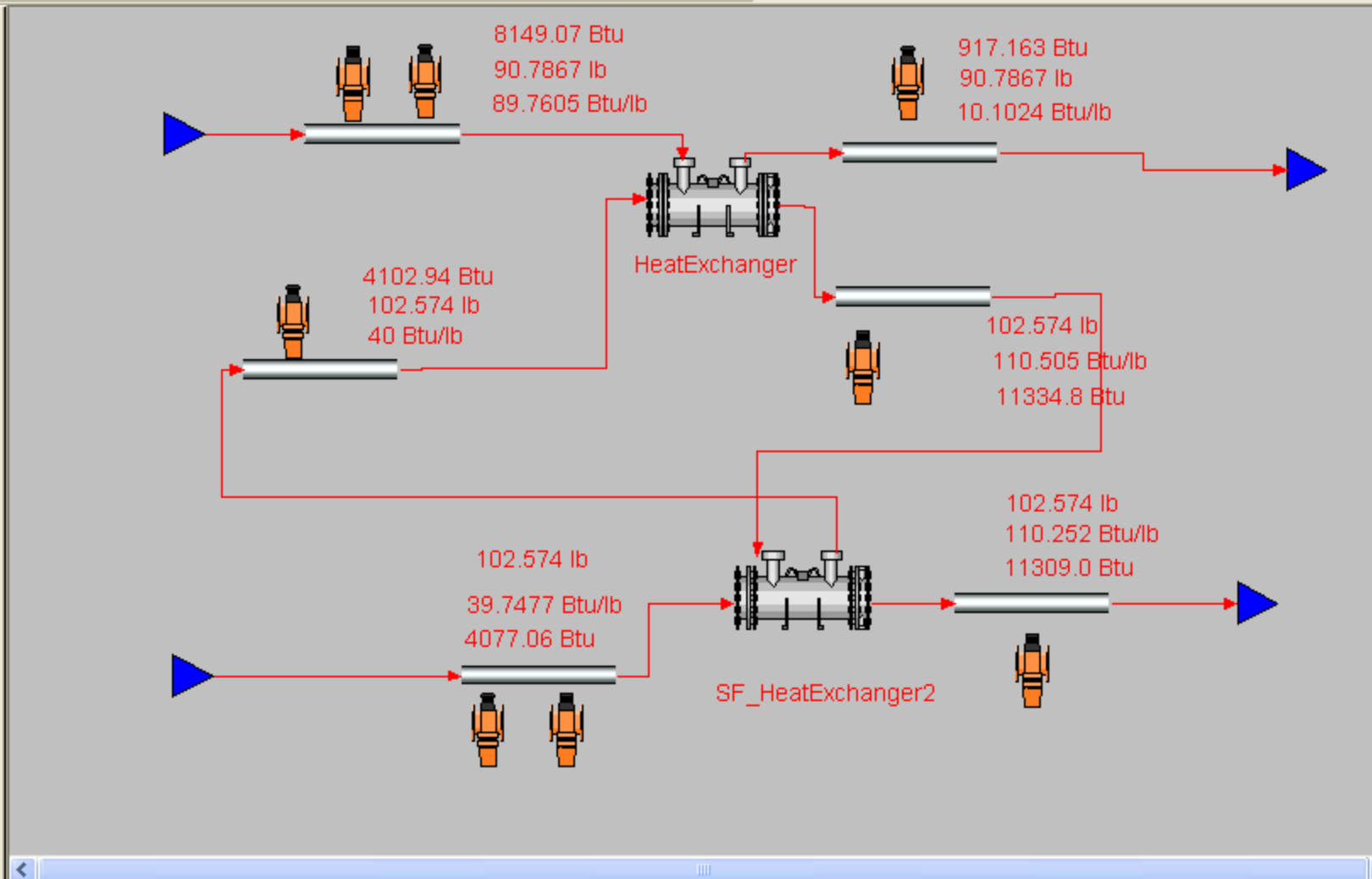
Description: Sigamfine Model

Template: SF_SigamfineMoc

Categories: SF_SigamfineMoc

Revision: 18771

Connections... Layers...



Summary of analysis rules

- They contain the logic that understands the model and its data
- They are used for different types of balances: mass, components and energy
- They produce results for the case of analysis

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Data Loader Utility

- Allows you to import data for elements:
 - Tanks, meters and analyzers
- Supports different formats:
 - csv and xls file formats
- Can send data to PI or AF cases directly
- Creates transfers

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Development Roadmap

- PR 1 “High Availability (HA)” (7/1/06 – 9/1/06)
 - Sigmafine 4.3 and AF will benefit from HA and replication support
- PR 2 “Data Directory and PIANO” (12/1/06 – 2/1/07)
 - Sigmafine will be recompiled to make use of the new Foundation Data Directory. Sigmafine will take advantage of the Notification support delivered in PR 2.
- PR 3 “Enterprise Platform” (9/1/07 – 11/1/07)
 - Sigmafine 5.1 will benefit from a expanded scope of the Data Directory, such as the Scheduler from PIANO

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Conclusions

- Sigmafine can be applied to any industry
- Validated data is available to make better business decisions
- No process model required to derive value from Sigmafine
 - The use of data references does not require a model

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Good data for good business decisions

- “You can't manage what you can't control, and you can't control what you don't measure.” – Tom DeMarco
- Sigmafine increases confidence of what you measure and estimates what you don't measure, which helps you to make better business decisions

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Thank you!

- Please visit the demo session
- Any questions?

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