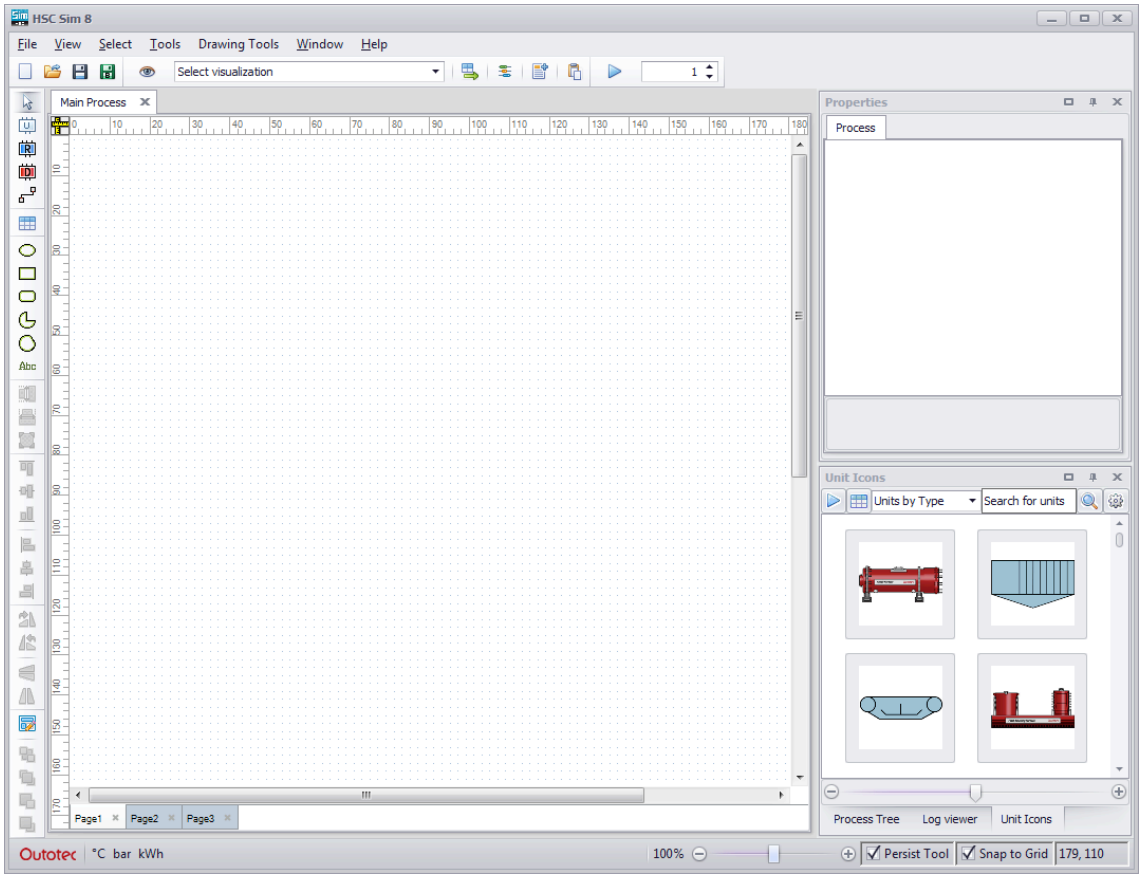
Research Center, Pori / Petri Kobylin, Lauri Mäenpää, Matti Hietala, Jussi-Pekka Kentala

40. Sim Module - Common Tools



40.1. Drawing flowsheets and adding tables to flowsheets

This chapter explains how to draw and add tables to a flowsheet. In addition to the instructions chapter, the user should also read unit-specific Chapters 41-47 of this manual before running the simulations (41- 42 Distribution Units, 43-44 Reactions Units, 45-46 Minerals Processing Units and 47 Converter Units, which are needed if different units are combined in the flowsheet).

The most important icons for drawing are:

Fig. 1. Icons for drawing Units and Streams, where the first icon is Select, U = Generic Units, R = Reactions Units, D = Distributions Units, and the last icon is Streams.

40.1.1. Drawing units

Select the unit by left-clicking the unit icon. The cursor shows the user which icon is active. Move the cursor to somewhere on the flowsheet and draw a unit by a) holding down the left mouse button b) moving the mouse to increase the size of the unit c) releasing the button to stop drawing, see **Fig. 2**. The user can change the size of the units later.

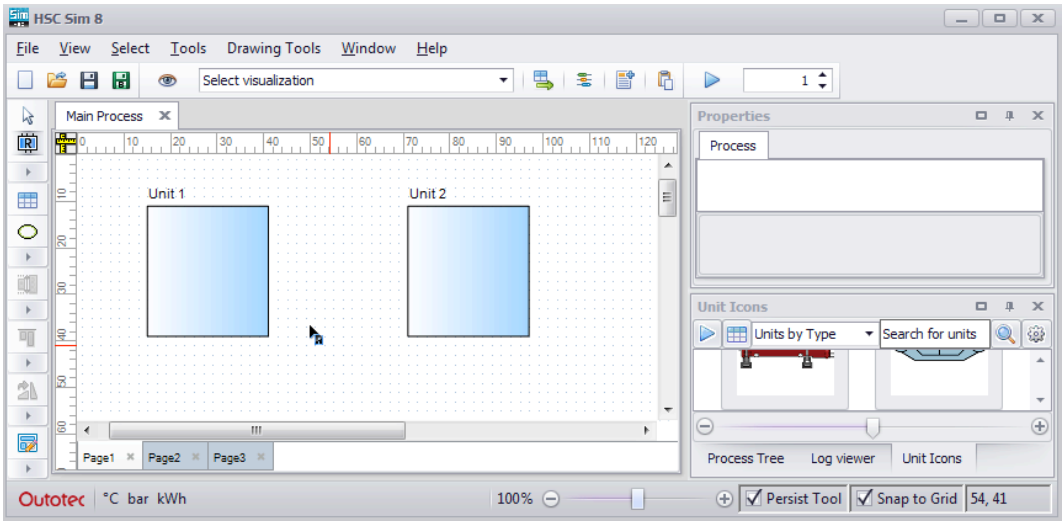


Fig. 2. Drawing two Reactions (Hydro) units. The Reactions unit is the active icon in this figure, see the mouse cursor.

40.1.2. Drawing streams

Select the stream icon with the mouse (left button). Move the cursor to somewhere on the flowsheet and click the mouse (left button) to start the stream. The user can add a corner to the stream with another click and double-click (left button) to end the drawing of the stream, see **Fig. 3**.

Editing Streams

How to a) make a corner on the stream b) change the angle of the stream and c) remove the corners of the stream d) change the input and output units of the stream e) check the connection of the streams.

a) Choose the Select icon and by holding down the **shift** + **left mouse button,** the user can make corners on the streams by moving the mouse.

b) Choose the Select icon and click the stream to see the nodes (blue squares). Hold down the mouse button on a node and move the mouse to change the angle of the stream.

c) Choose the Select icon, select the stream, then select one stream node (blue square), move one node on top of another node to remove a stream corner.

d) Choose the Select icon and move the beginning or end of the stream to a new unit or out of the unit. HSC8 Sim will suggest a new connection to the stream that the user can accept (OK) or Cancel.

e) When the flowsheet is ready, check that the streams are connected to the correct units. The user can check connections visually, see **Fig. 4**. A white circle or arrow means that the stream source or destination is unknown (a gray arrow means it is known). Blue stream means input, black stream is between two units and red stream means output. It is also possible to click the **Tools** menu to show the **process tree**. The most time-consuming task is selecting streams one by one and looking at the **properties** (process sheet) to see the source and destination of the stream.

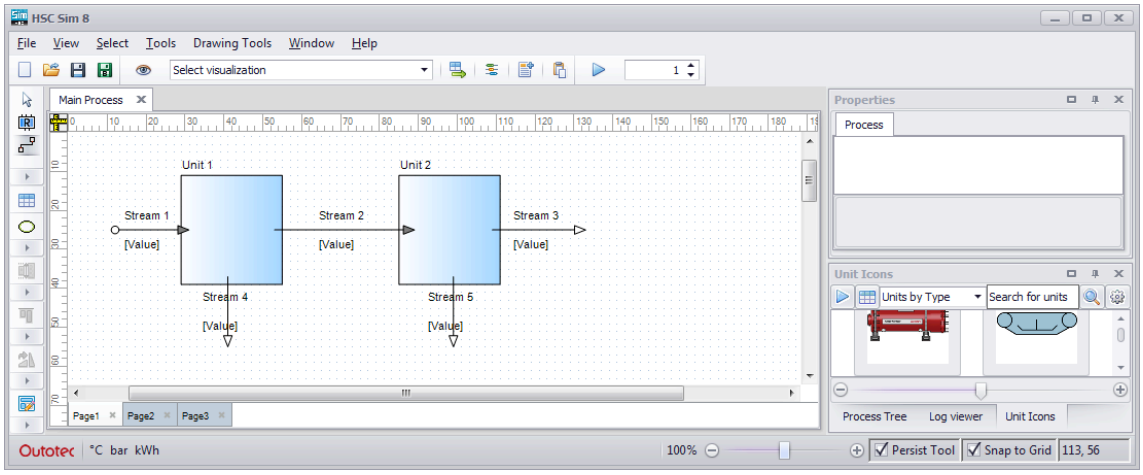


Fig. 3. Drawing streams.

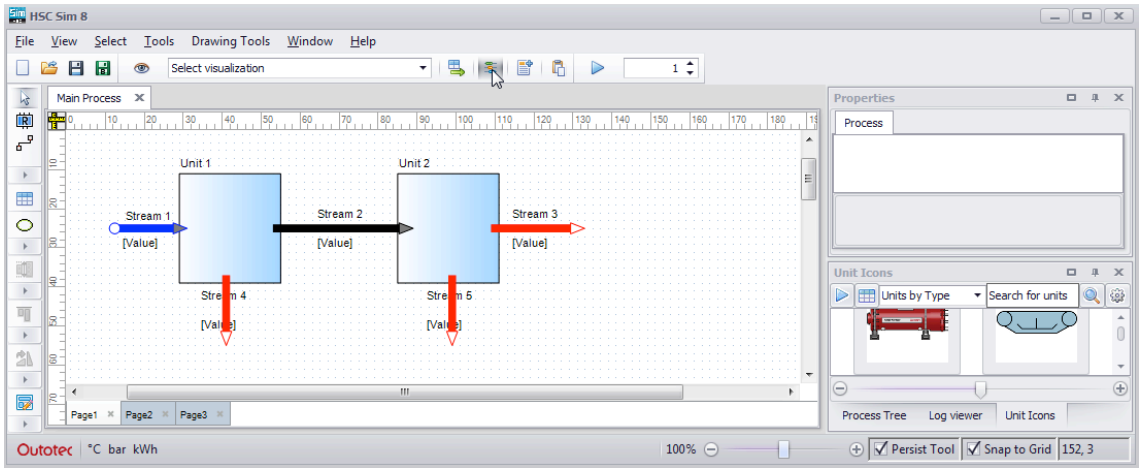


Fig. 4. Visualizing stream connections.

40.1.3. Renaming units and streams

Choose the Select icon and rename units and streams by double-clicking the name or click the name label and edit properties (process sheet) - NameID cell, see **Fig. 5**.

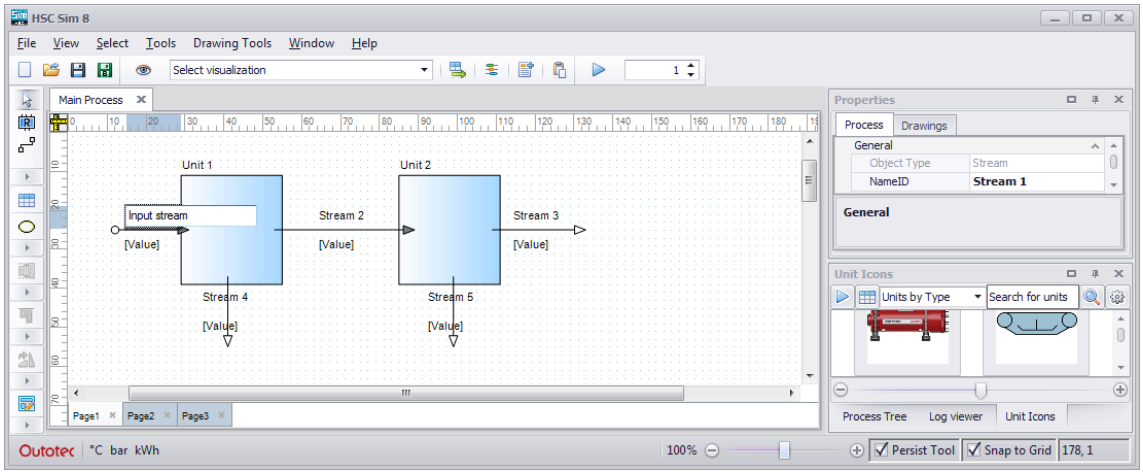


Fig. 5. Renaming units and streams.

40.1.4. Inserting tables and stream tables (typically done after simulations)

The user can add **tables** to visualize important parameters of the results. Choose the Table icon and draw the table in the same way as you draw the units. The user can open table editor by double-clicking the table, where the user can add more rows and columns. It is important to uncheck **Size lock** when adjusting the table size. It is typical to use this table to show a summary of the results. The user can insert header labels and add results as cell references in this table (copy cell reference from the unit sheets and paste cell reference in the table), see **Fig. 6** and **Fig. 7**.

The user can also insert **stream tables** by clicking the Stream Table Editor icon, which will open the editor where the user can add variables (by double-clicking). A visible variable list can be sorted by dragging the variables up and down in the list, see **Fig. 8**. The user can check which stream tables can be visible or invisible in the editor or does that later from **View Menu**...stream tables...show/hide all.

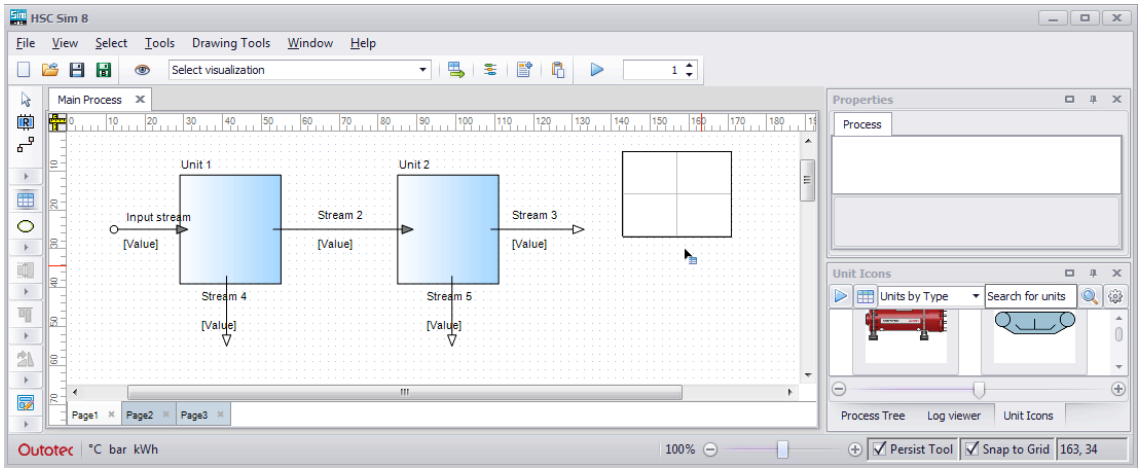


Fig. 6. Table added to the flowsheet.

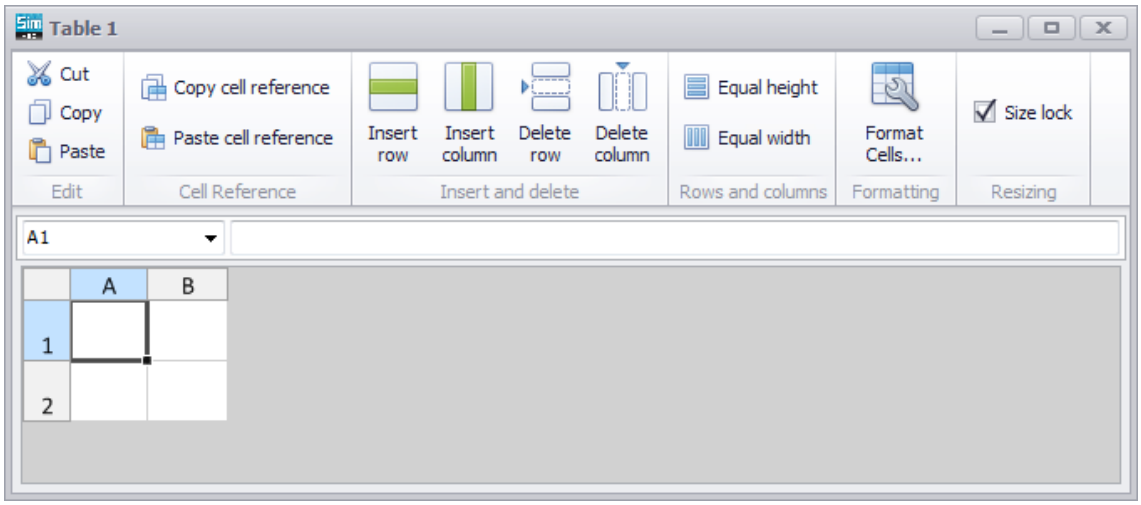


Fig. 7. Table editor, remember to uncheck **Size lock** when inserting rows and columns.

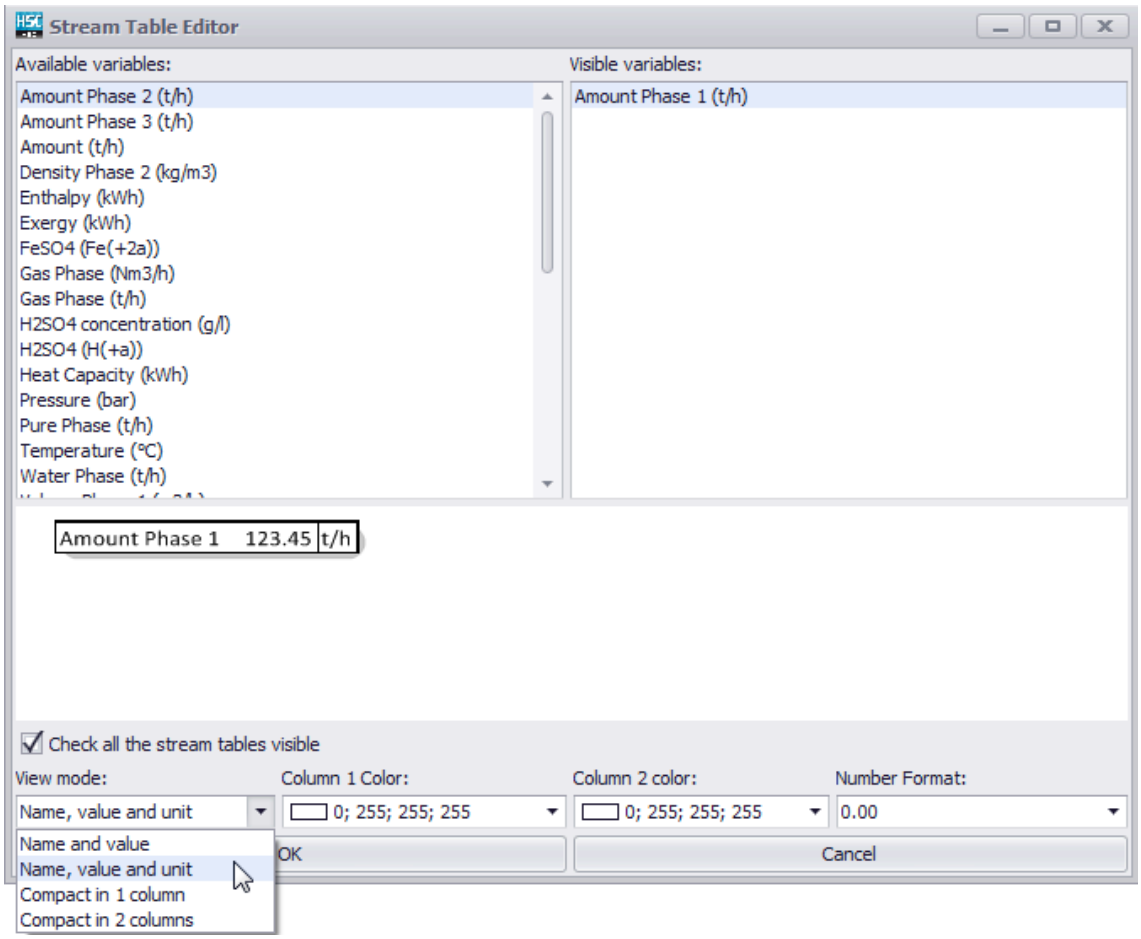


Fig. 8. Stream tables editor for adding stream tables to the flowsheet. Add and remove variables by double-clicking.

40.1.5. Editing a flowsheet

Sometimes the user wants to edit a flowsheet later and add new units. Adding a new unit (Unit 3) in the middle of a stream (Stream 1) connected to two units (Unit 1 and Unit 2) is explained here. First, draw a new unit (Unit 3) and connect Stream 1 from Unit 1 to Unit 3. Then add a new stream (Stream 2), which starts from Unit 3 and ends at Unit 2, see **Fig. 9** - **Fig. 11**. Information in Unit 1 and Unit 2 is automatically updated so the user only needs to make changes in Unit 3 and Stream 3 to run the simulation.

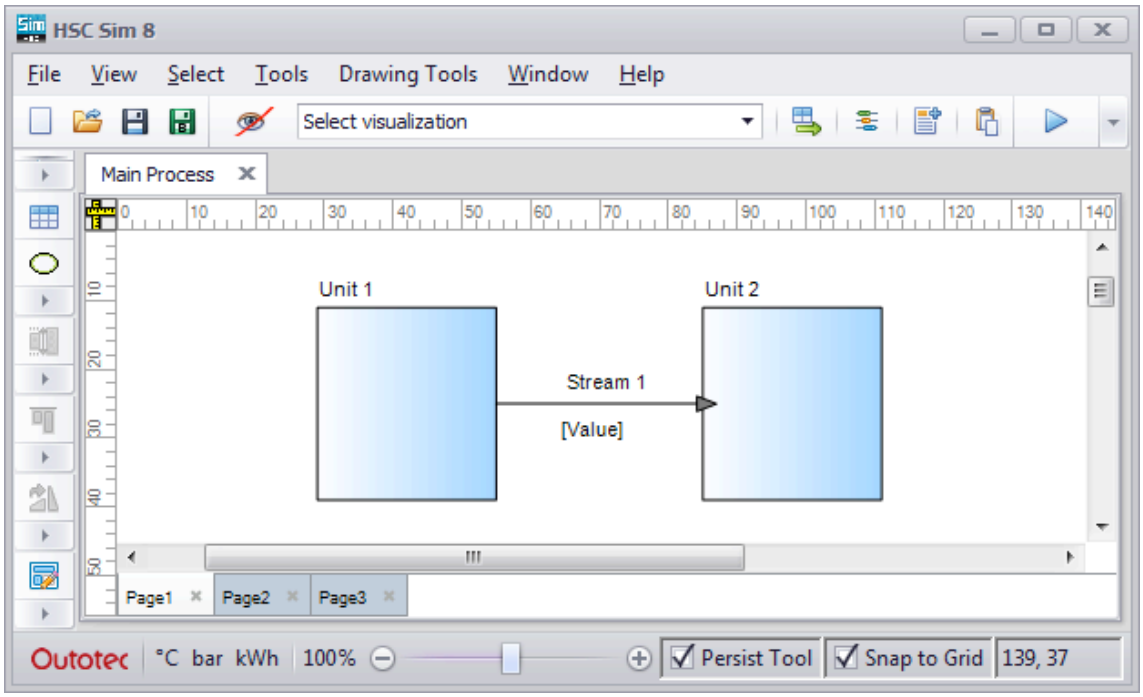


Fig. 9. Adding a unit to a stream between two units, starting situation.

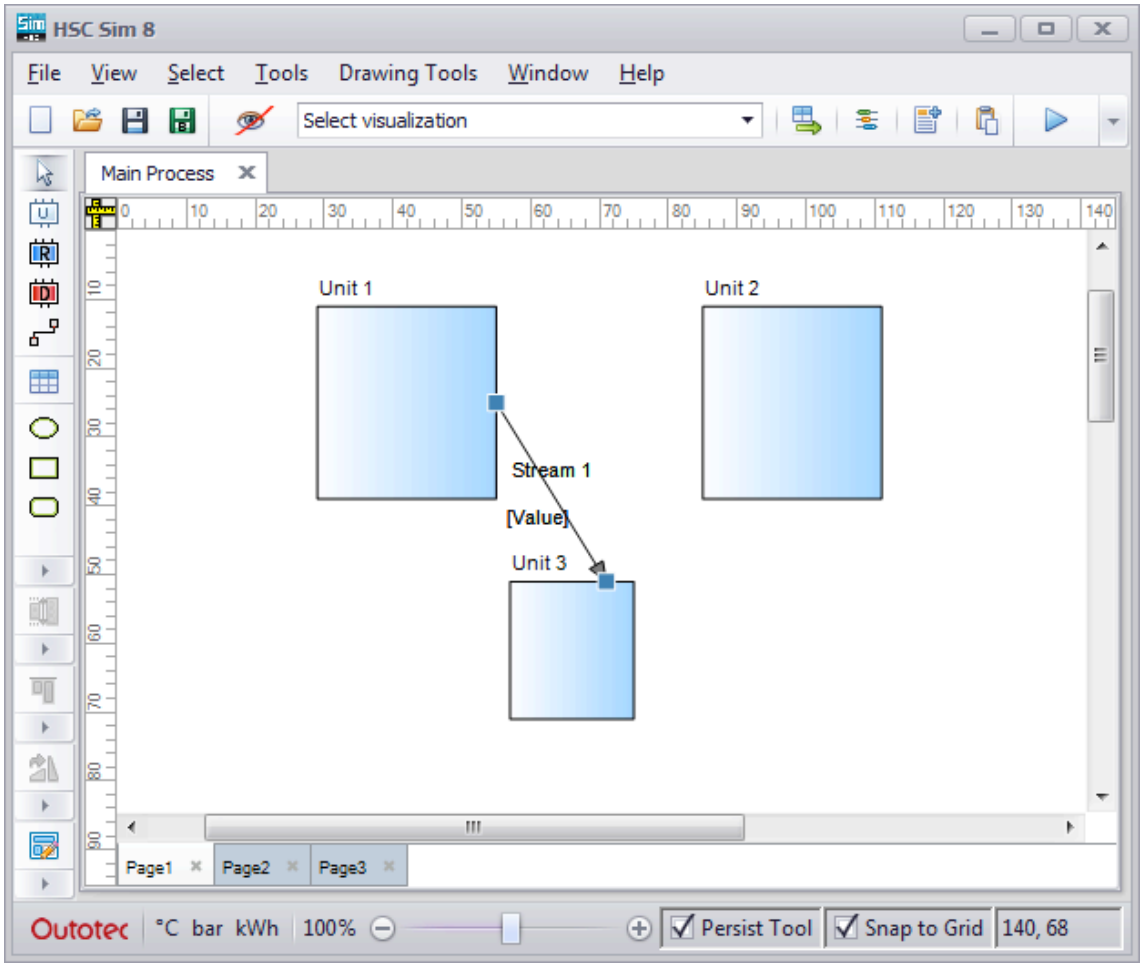


Fig. 10. Adding a unit to a stream between two units, add new unit and change stream connection.

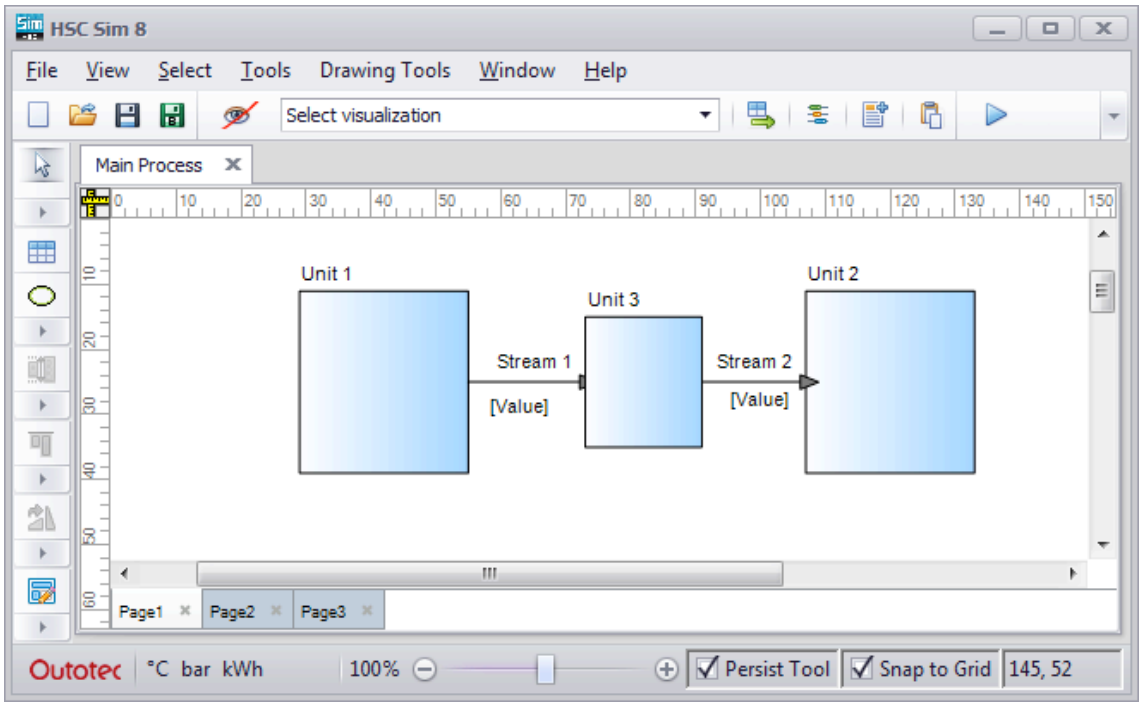


Fig. 11. Adding a unit to a stream between two units, final situation.

40.2. Menus in the flowsheet window

In this section, the Sim flowsheet menus (File, View, Select, Tools, Drawing Tools, Window and Help) are introduced.

File menu

This menu is similar to many other programs where the user can (see also **Fig. 12**):

1. Start **New Process…**which opens an empty flowsheet.
2. **Open Process…**which is a *.Sim8 (HSC8) or *.fls file (HSC6 or HSC7 flowsheet).
3. **Save Process**…quick save process (overwrites previous version)
4. **Save Process as…**save process with the file name and location given by the user
5. **Save Backup…**process should be saved first before a backup can be made. It is recommended to save a backup from time to time during the simulation.
6. **Backups…**If the user has saved backups, they can be managed (checked, restored, deleted) here.
7. **Recent Processes…**shows the 10 most recent simulations made by the user
8. **Export Flowsheet Image…**The user can export the flowsheet as an image (png, vdx, pdf, svg, dxf) or copy a flowsheet picture to the clipboard to use it in reports and presentations.
9. **Print flowsheet…**prints the flowsheet
10. **Exit HSC Sim…**will close the Sim program

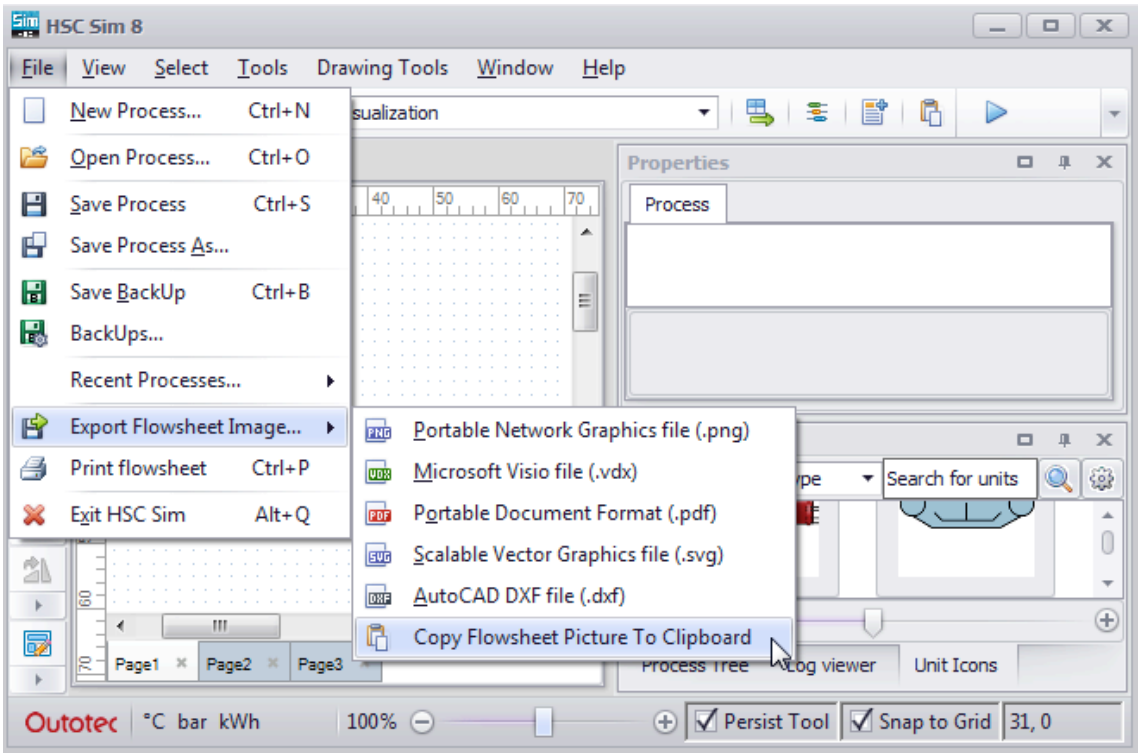


Fig. 12. File menu.

View menu

In the View menu the user can: (see also **Fig. 14**)

1. View and edit **Flowsheet settings**, where the user can change or **restore default** settings of the flowsheet. Exit saves the settings and leaves this editor, see **Fig. 13**.

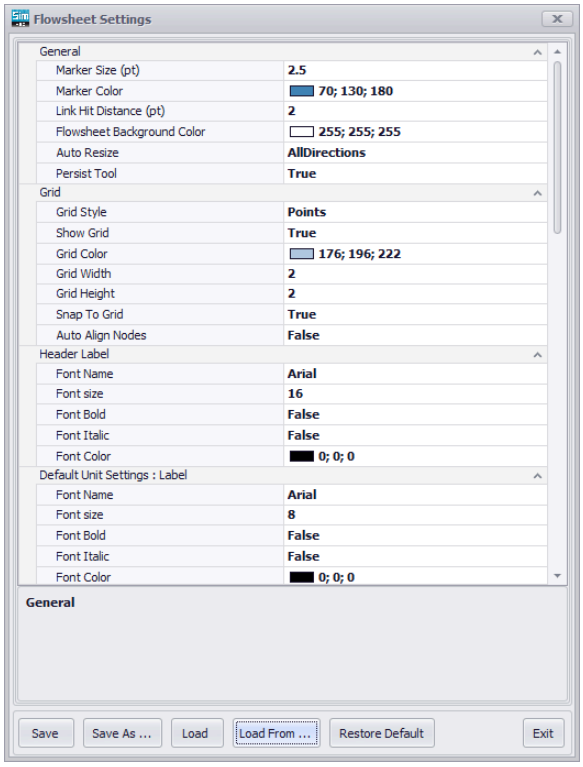


Fig. 13. Flowsheet settings.

2. Show and hide the flowsheet **Name labels, Value labels and Stream tables**.
3. Check and uncheck all **Toolbars**, which are explained in section 40.3.

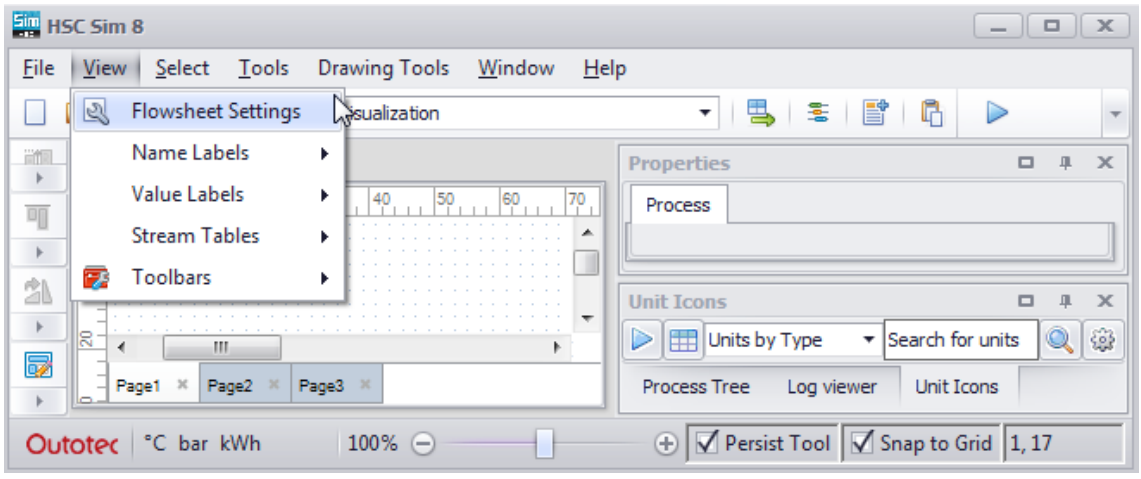


Fig. 14. View menu.

Select menu

The Select menu is typically used to edit or move many properties at once. Here the user can: (see **Fig. 15** below)

1. Select all **Units** on the flowsheet.
2. Select all **Unit Name Labels** on the flowsheet.
3. Select all **Streams** on the flowsheet
4. Select all **Stream Name Labels** on the flowsheet.
5. Select all **Stream Value Labels** on the flowsheet.
6. Select all **Stream Tables** on the flowsheet.
7. Select all (unit and stream) **Name Labels** on the flowsheet.
8. Select all (unit and stream) **Value Labels** on the flowsheet.
9. Select all **Other Text Labels** on the flowsheet.
10. Select **All Labels** on the flowsheet.
11. Select all (not including stream tables) **Tables** on the flowsheet.
12. Select all **Other Drawing Objects** on the flowsheet.
13. Select **All Items** on the flowsheet.

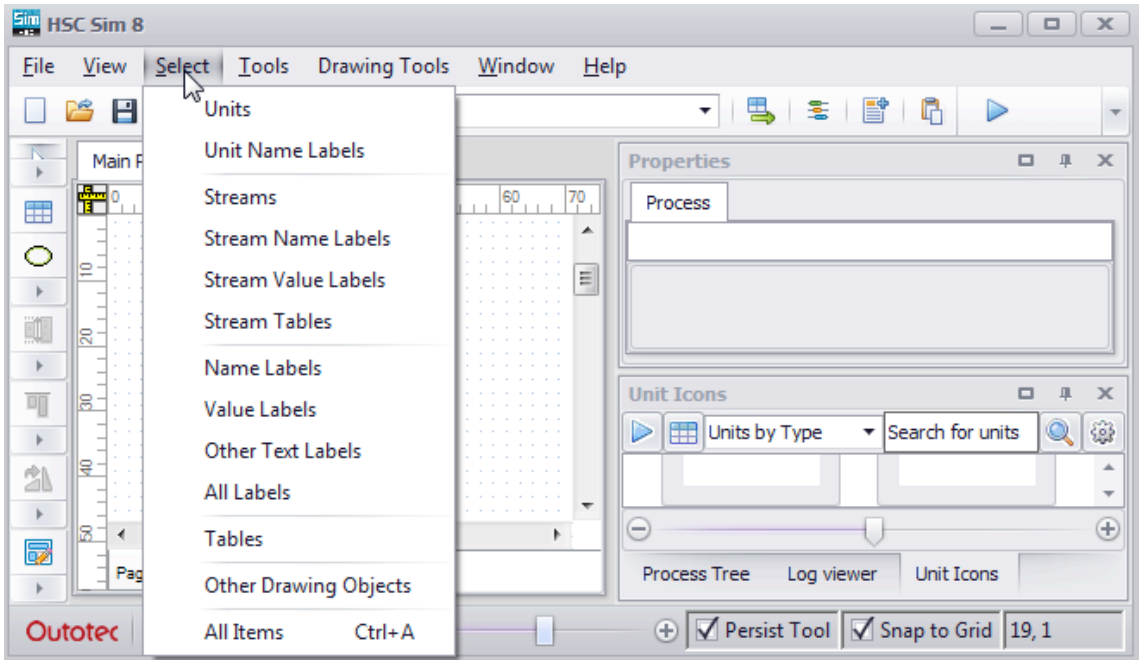


Fig. 15. Select menu.

Tools menu

The Tools menu includes many advanced options that may be needed in flowsheet simulation. The user needs detailed instructions on how to use those tools. Some tools are explained here and others in different chapters, see the list below. The Tools menu includes: (see **Fig. 17**)

1. Process information

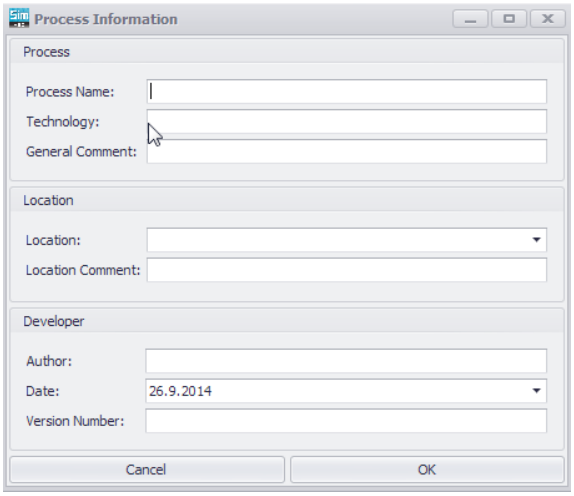


Fig. 16. The user can add Process Information to this sheet.

2. LCA Evaluation (see Chapter 49)
3. Mass Balancing (see Chapters 51 and 52)
4. Reports (see section 40.2.1)
5. Select Unit Models (see section 40.2.2)
6. Scenario Editor (see section 40.2.3)
7. Show the process tree (see section 40.2.4)
8. Errors in flowsheet (shows possible errors in the flowsheet)

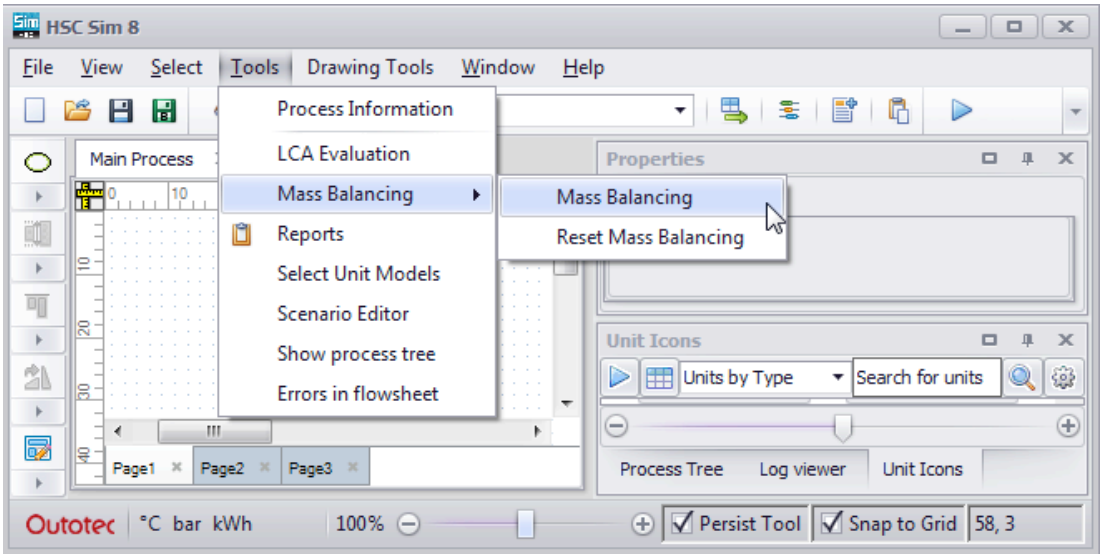
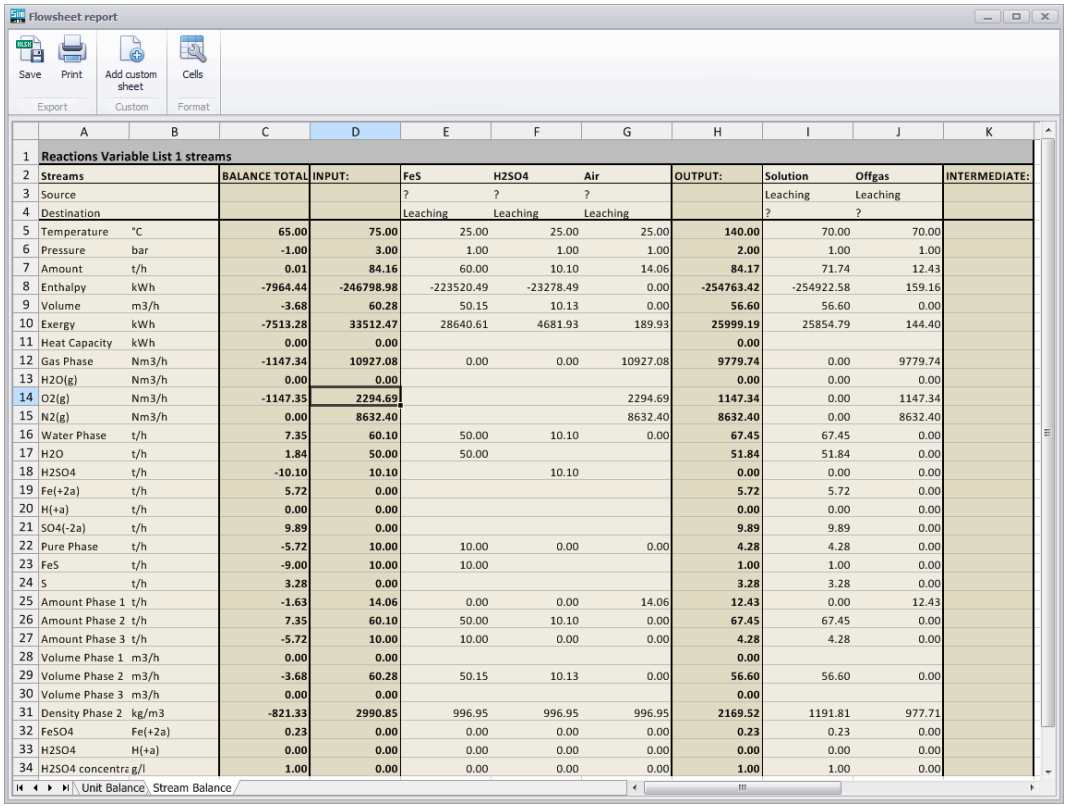


Fig. 17. Tools menu options.

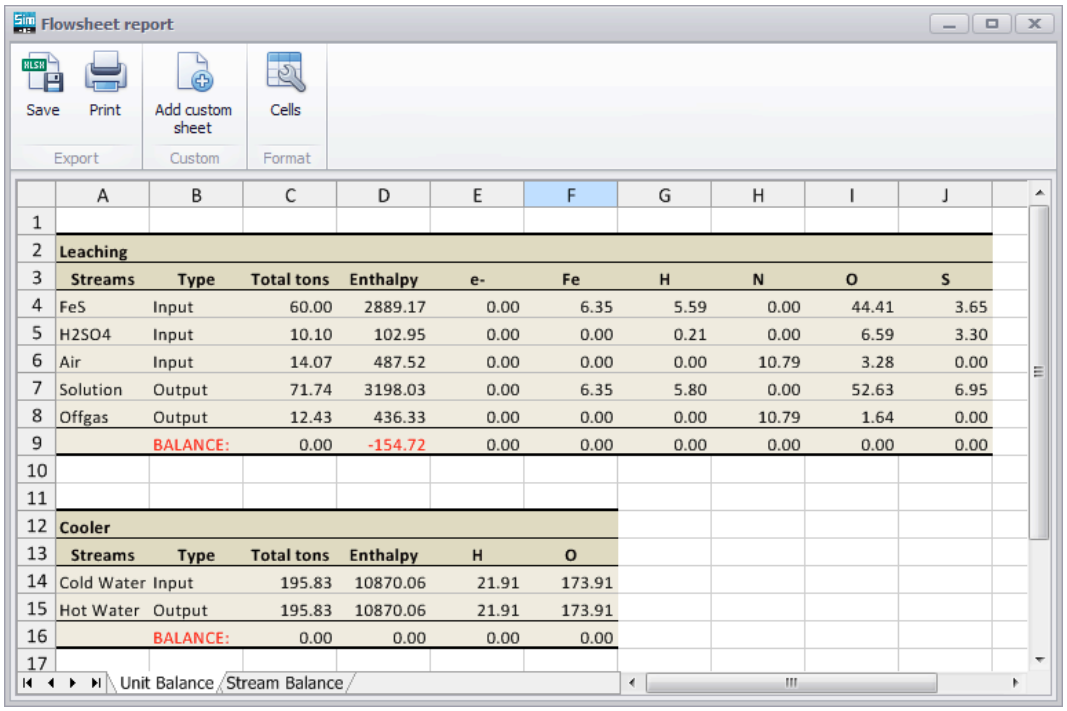
40.2.1. Reports

A summary of flowsheet results can be saved and printed here. There are two pages in this report sheet: one for units and one for streams. This report uses Hydro_example3.Sim8.



	A	B	C	D	E	F	G	H	I	J	K
1	Reactions Variable List 1 streams										
2	Streams		BALANCE TOTAL	INPUT:	FeS	H2SO4	Air	OUTPUT:	Solution	Offgas	INTERMEDIATE:
3	Source				?	?	?		Leaching	Leaching	
4	Destination				Leaching	Leaching	Leaching		?	?	
5	Temperature	°C	65.00	75.00	25.00	25.00	25.00	140.00	70.00	70.00	
6	Pressure	bar	-1.00	3.00	1.00	1.00	1.00	2.00	1.00	1.00	
7	Amount	t/h	0.01	84.16	60.00	10.10	14.06	84.17	71.74	12.43	
8	Enthalpy	kWh	-7964.44	-246798.98	-223520.49	-23278.49	0.00	-254763.42	-254922.58	159.16	
9	Volume	m3/h	-3.68	60.28	50.15	10.13	0.00	56.60	56.60	0.00	
10	Exergy	kWh	-7513.28	33512.47	28640.61	4681.93	189.93	25999.19	25854.79	144.40	
11	Heat Capacity	kWh	0.00	0.00				0.00			
12	Gas Phase	Nm3/h	-1147.34	10927.08	0.00	0.00	10927.08	9779.74	0.00	9779.74	
13	H2O(g)	Nm3/h	0.00	0.00				0.00	0.00	0.00	
14	O2(g)	Nm3/h	-1147.35	2294.69			2294.69	1147.34	0.00	1147.34	
15	N2(g)	Nm3/h	0.00	8632.40			8632.40	8632.40	0.00	8632.40	
16	Water Phase	t/h	7.35	60.10	50.00	10.10	0.00	67.45	67.45	0.00	
17	H2O	t/h	1.84	50.00	50.00			51.84	51.84	0.00	
18	H2SO4	t/h	-10.10	10.10		10.10		0.00	0.00	0.00	
19	Fe(+2a)	t/h	5.72	0.00				5.72	5.72	0.00	
20	H(+a)	t/h	0.00	0.00				0.00	0.00	0.00	
21	SO4(-2a)	t/h	9.89	0.00				9.89	9.89	0.00	
22	Pure Phase	t/h	-5.72	10.00	10.00	0.00	0.00	4.28	4.28	0.00	
23	FeS	t/h	-9.00	10.00	10.00			1.00	1.00	0.00	
24	S	t/h	3.28	0.00				3.28	3.28	0.00	
25	Amount Phase 1	t/h	-1.63	14.06	0.00	0.00	14.06	12.43	0.00	12.43	
26	Amount Phase 2	t/h	7.35	60.10	50.00	10.10	0.00	67.45	67.45	0.00	
27	Amount Phase 3	t/h	-5.72	10.00	10.00	0.00	0.00	4.28	4.28	0.00	
28	Volume Phase 1	m3/h	0.00	0.00				0.00			
29	Volume Phase 2	m3/h	-3.68	60.28	50.15	10.13	0.00	56.60	56.60	0.00	
30	Volume Phase 3	m3/h	0.00	0.00				0.00			
31	Density Phase 2	kg/m3	-821.33	2990.85	996.95	996.95	996.95	2169.52	1191.81	977.71	
32	FeSO4	Fe(+2a)	0.23	0.00	0.00	0.00	0.00	0.23	0.23	0.00	
33	H2SO4	H(+a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
34	H2SO4 concentra	g/l	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	

Fig. 18. Stream balance sheet of the report file.



	A	B	C	D	E	F	G	H	I	J
1										
2	Leaching									
3	Streams	Type	Total tons	Enthalpy	e-	Fe	H	N	O	S
4	FeS	Input	60.00	2889.17	0.00	6.35	5.59	0.00	44.41	3.65
5	H2SO4	Input	10.10	102.95	0.00	0.00	0.21	0.00	6.59	3.30
6	Air	Input	14.07	487.52	0.00	0.00	0.00	10.79	3.28	0.00
7	Solution	Output	71.74	3198.03	0.00	6.35	5.80	0.00	52.63	6.95
8	Offgas	Output	12.43	436.33	0.00	0.00	0.00	10.79	1.64	0.00
9		BALANCE:	0.00	-154.72	0.00	0.00	0.00	0.00	0.00	0.00
10										
11										
12	Cooler									
13	Streams	Type	Total tons	Enthalpy	H	O				
14	Cold Water	Input	195.83	10870.06	21.91	173.91				
15	Hot Water	Output	195.83	10870.06	21.91	173.91				
16		BALANCE:	0.00	0.00	0.00	0.00				
17										

Fig. 19. Unit balance sheet of the report file.

40.2.2. Select Unit Models

The user can choose different models for the units. The Select Unit Models window can be opened from the Tools menu or by right-clicking if the cursor is on top of one of the units, see **Fig. 20**. On the left side of the window is the list of units on the flowsheet. In the middle part the user can select a unit model from the Reactions, Distribution, Particle and Others sheet (and in the HSC8 update also 'Import own unit models'). **Double-click** the unit to select it and then click OK. Most of the units are dll type but there are still some Excel Wizards available for the Reactions units. If Excel Wizards are chosen, the user needs to check the stream names. Information about the units can be found on the right side of the selector window. Empty Reactions or Distributions units are the same as R and D unit Icons on the main flowsheet DrawBar, see **Fig. 1**.

In the HSC8 update (November 2014), there will be instructions on how users can make their own dll units (Chapter 50). User-made units can be imported using the import sheet.

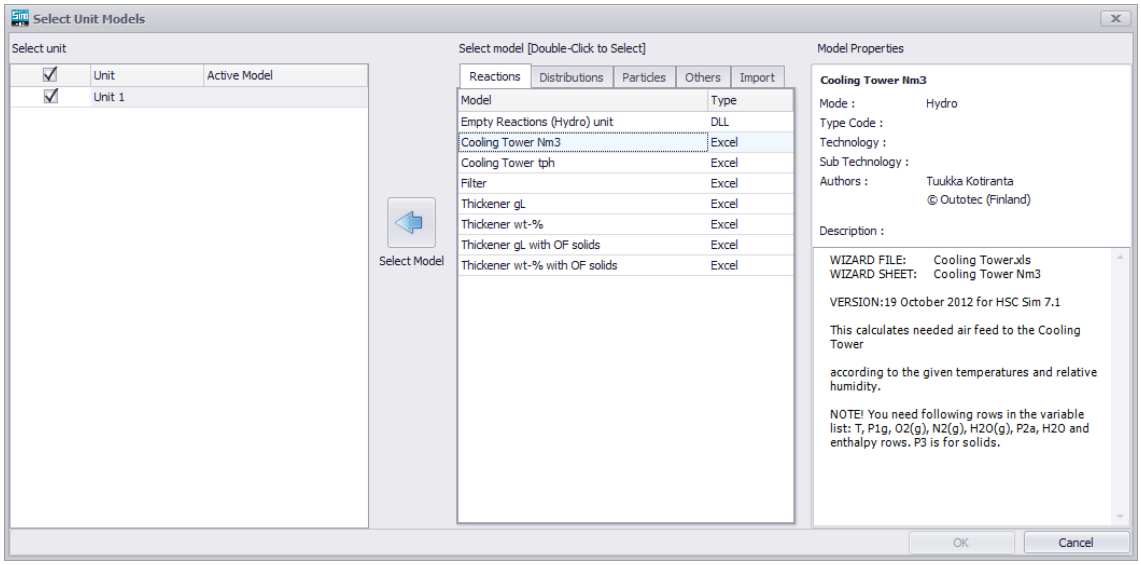


Fig. 20. Select Unit Models window.

40.2.3. Scenario Editor

The Scenario Editor lets you run your process model with different operating parameters and see how they affect process variables. The calculated results can then be collected in the charts.

To use the Scenario Editor, first select the processing parameter that you want to regulate and copy its cell reference from the appropriate cell. Next, open the Scenario Editor and paste the cell reference in the first SET/GET column (**Fig. 21**). Then you can add a name and measurement unit for this variable, but most importantly you should specify whether the variable will be a regulated (SET) or a calculated variable (GET) (**Fig. 22**).

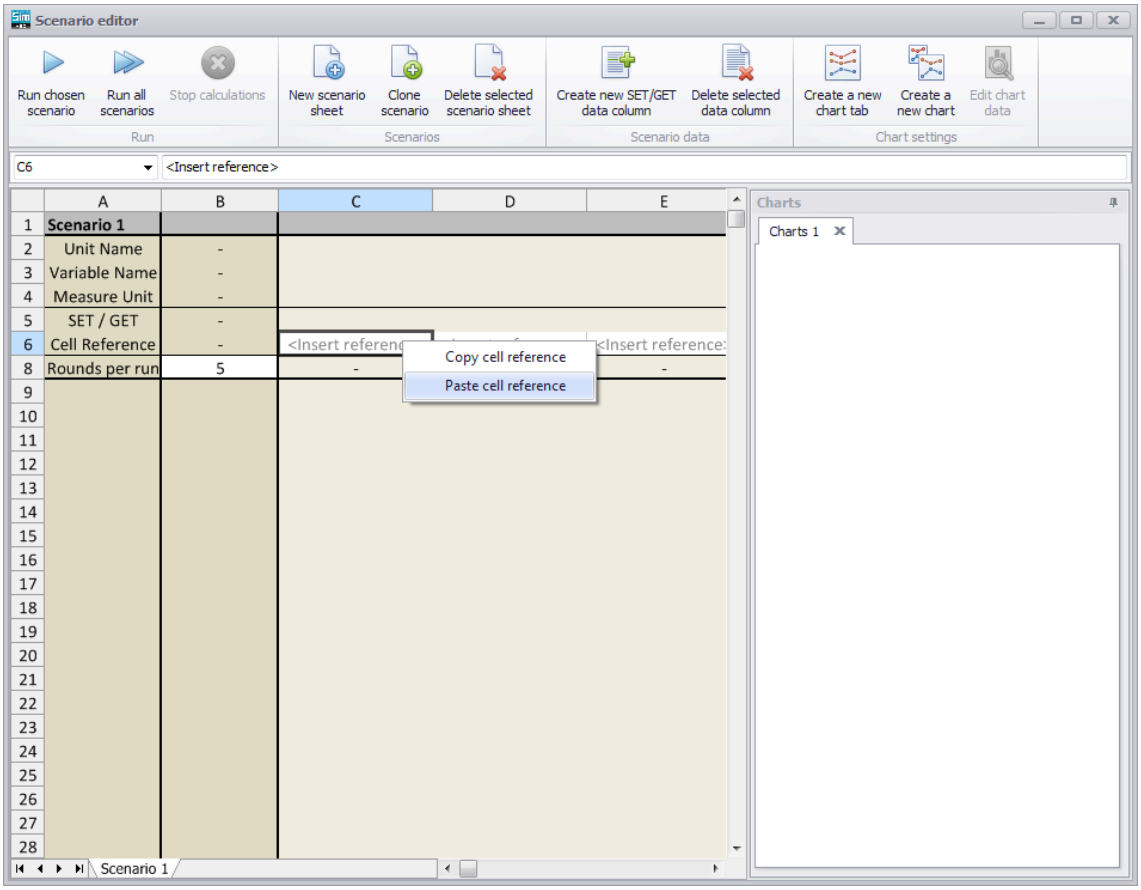


Fig. 21. Add variables to the Scenario Editor by pasting the cell reference of the variable cell.

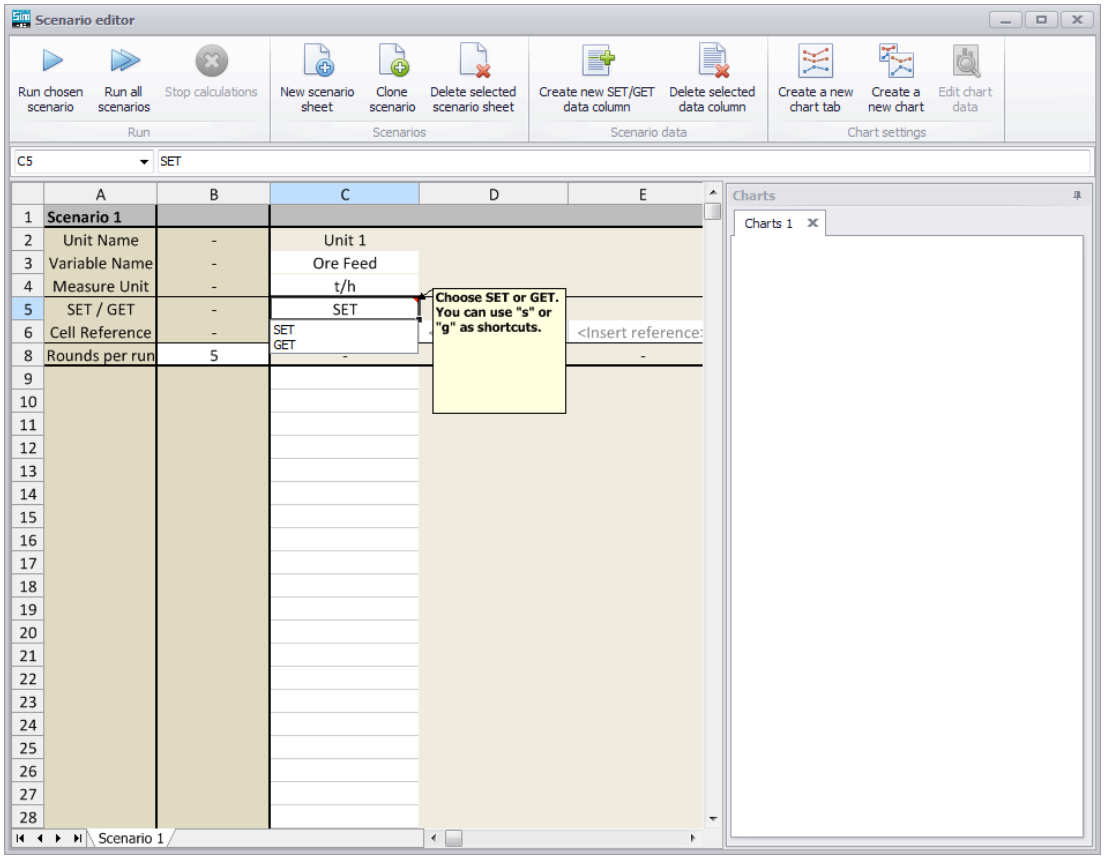


Fig. 22. Specify the SET/GET value for the variable.

After adding enough variables, specify the parameter values for the SET columns, add some charts, and finally run the scenario (**Fig. 23**).

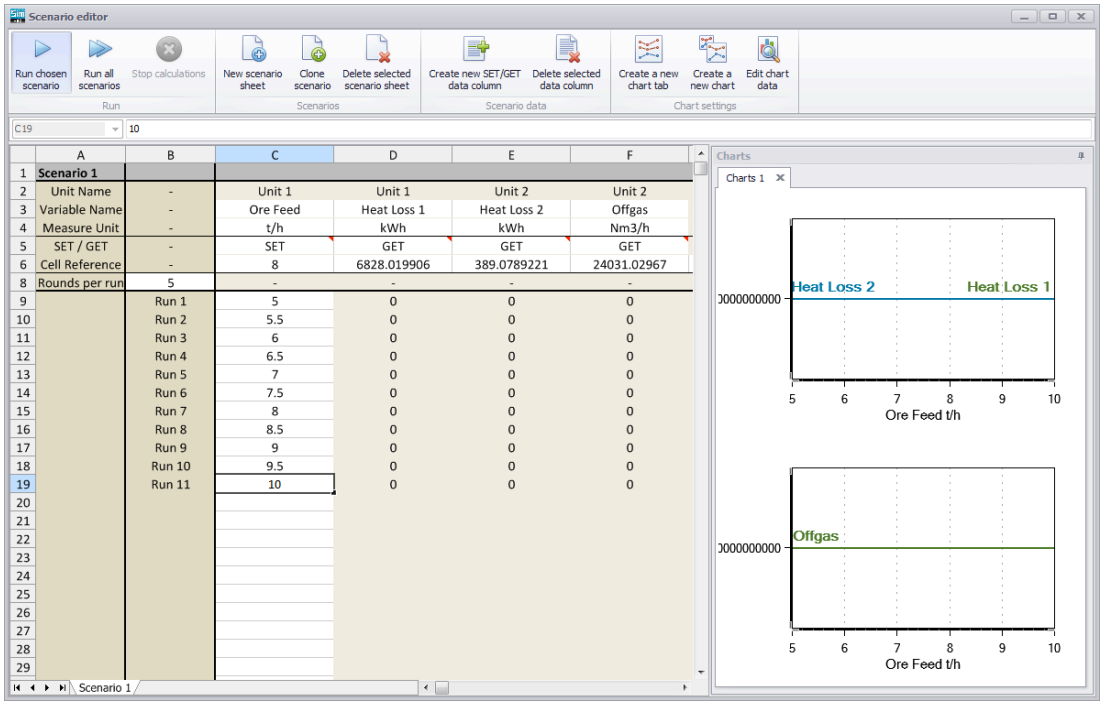
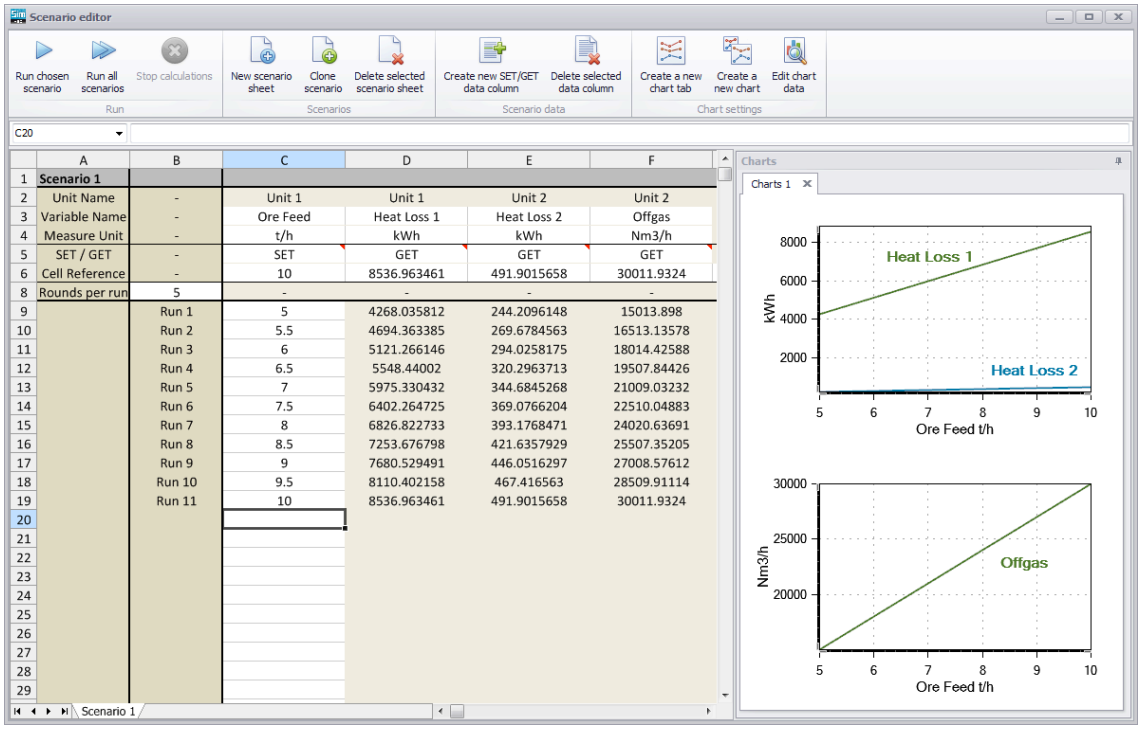


Fig. 23. After specifying the variables, enter the SET variable values, add charts, and run the scenario.

The calculation results will then be presented in the spreadsheet as well as in the charts (**Fig. 24**).



	A	B	C	D	E	F
1	**Scenario 1**					
2	Unit Name	-	Unit 1	Unit 1	Unit 2	Unit 2
3	Variable Name	-	Ore Feed	Heat Loss 1	Heat Loss 2	Offgas
4	Measure Unit	-	t/h	kWh	kWh	Nm3/h
5	SET / GET	-	SET	GET	GET	GET
6	Cell Reference	-	10	8536.963461	491.9015658	30011.9324
8	Rounds per run	5	-	-	-	-
9		Run 1	5	4268.035812	244.2096148	15013.898
10		Run 2	5.5	4694.363385	269.6784563	16513.13578
11		Run 3	6	5121.266146	294.0258175	18014.42588
12		Run 4	6.5	5548.44002	320.2963713	19507.84426
13		Run 5	7	5975.330432	344.6845268	21009.03232
14		Run 6	7.5	6402.264725	369.0766204	22510.04883
15		Run 7	8	6826.822733	393.1768471	24020.63691
16		Run 8	8.5	7253.676798	421.6357929	25507.35205
17		Run 9	9	7680.529491	446.0516297	27008.57612
18		Run 10	9.5	8110.402158	467.416563	28509.91114
19		Run 11	10	8536.963461	491.9015658	30011.9324

Fig. 24. Results of the scenario.

40.2.4. Show Process Tree

With this option the user can see the flowsheet information and connections of the process streams with colors. If a stream is not connected to the unit, it will not be visible in this process tree.

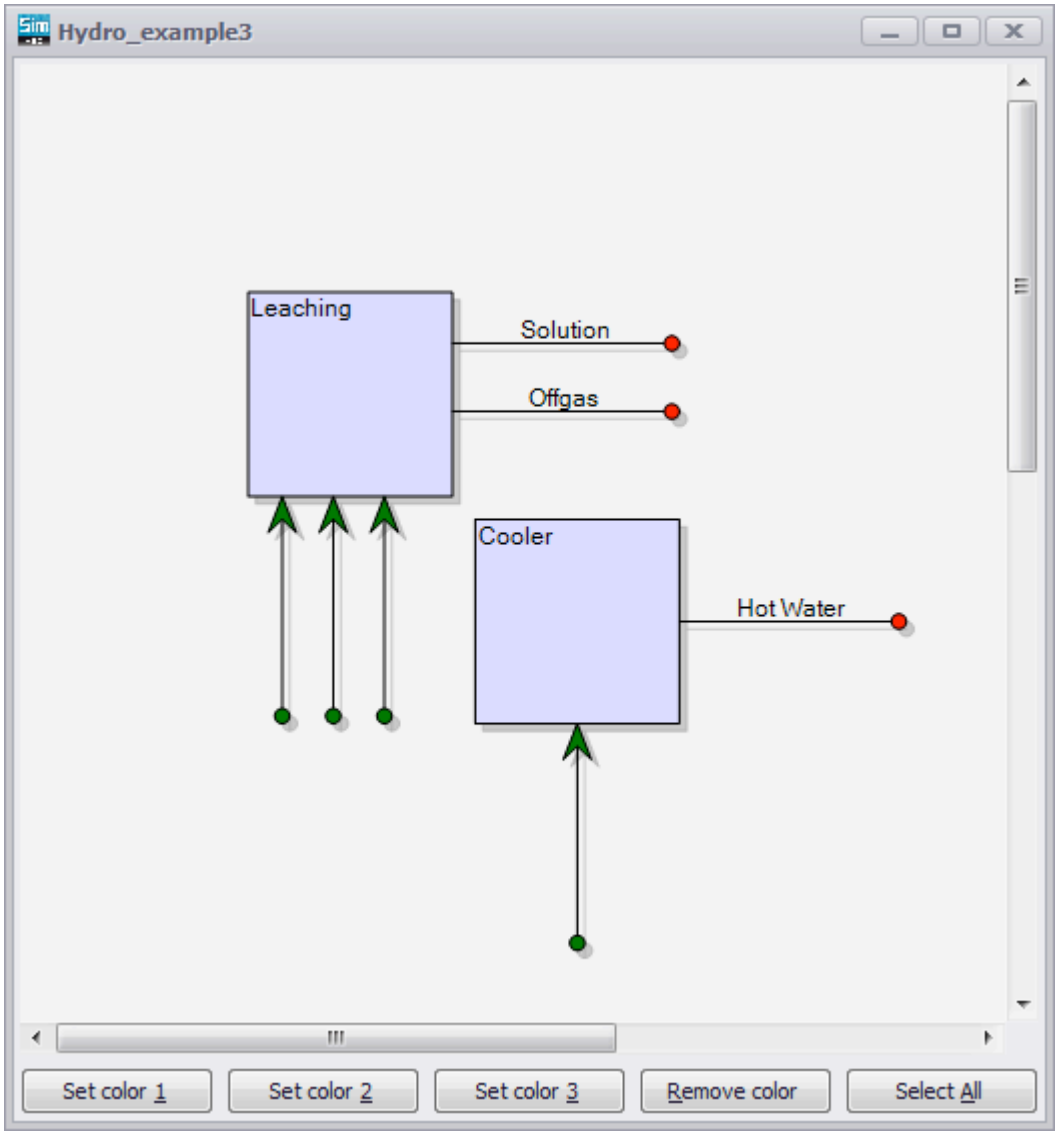


Fig. 25. Show process tree.

Drawing Tools menu

The user can edit the flowsheet using Drawing Tools by aligning, sizing, rotating, grouping, and drawing, see **Fig. 26**.

One handy way of editing the flowsheet is Edit Pages and Layers where you can set layers and properties which are visible or invisible on your flowsheet, see **Fig. 27**.

The user can find more details about Drawing Tools in section 40.3.

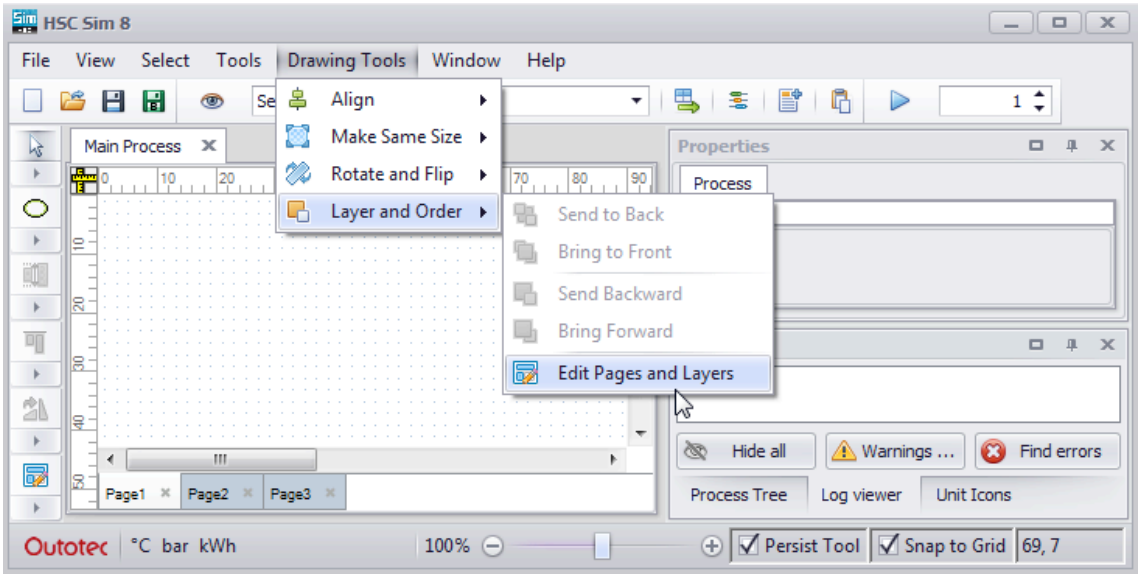


Fig. 26. Drawing tools.

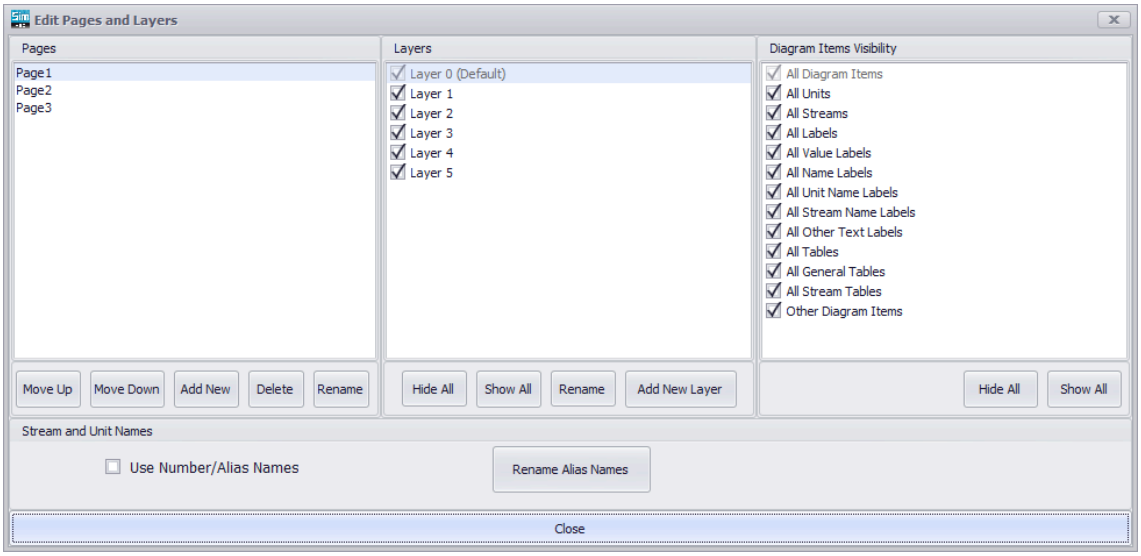


Fig. 27. Edit Pages and Layers window.

Window and Help menus

The Window menu shows the user the name of the flowsheet, see **Fig. 28**.

The Help menu shows a list of software developers and technical advisors and a link to the Sim manual, see **Fig. 29** and **Fig. 30**.

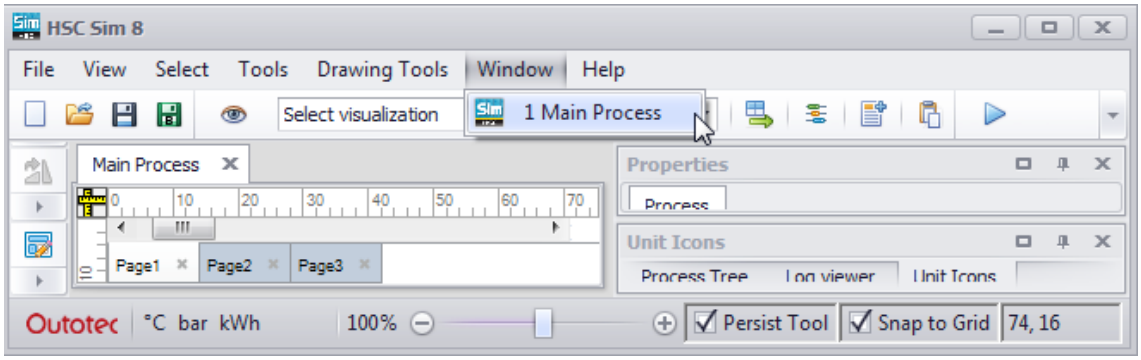


Fig. 28. Window menu.

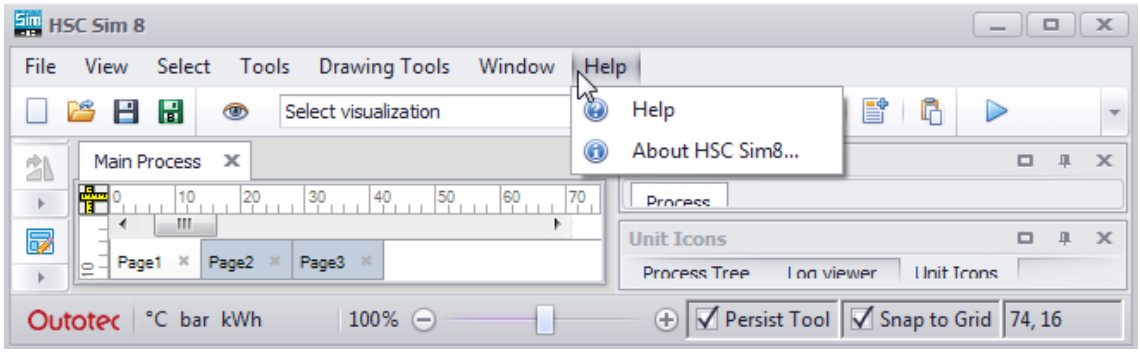


Fig. 29. Help menu.

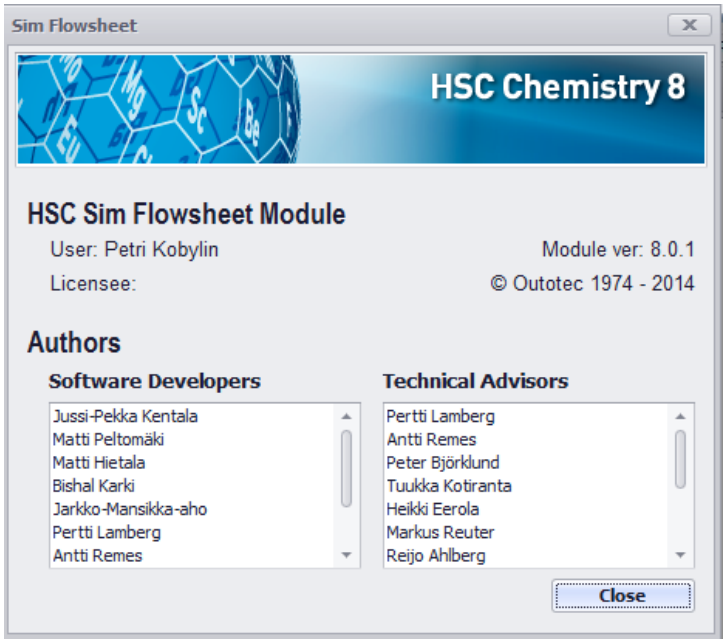


Fig. 30. About HSC8 Sim.

40.3. Toolbars

In the View Toolbars menu, the user can check and uncheck toolbars. It is also possible to reset docking bar positions back to their default places. Toolbars are divided into two lists: Docking bars and Drawing toolbars, see **Fig. 31**.

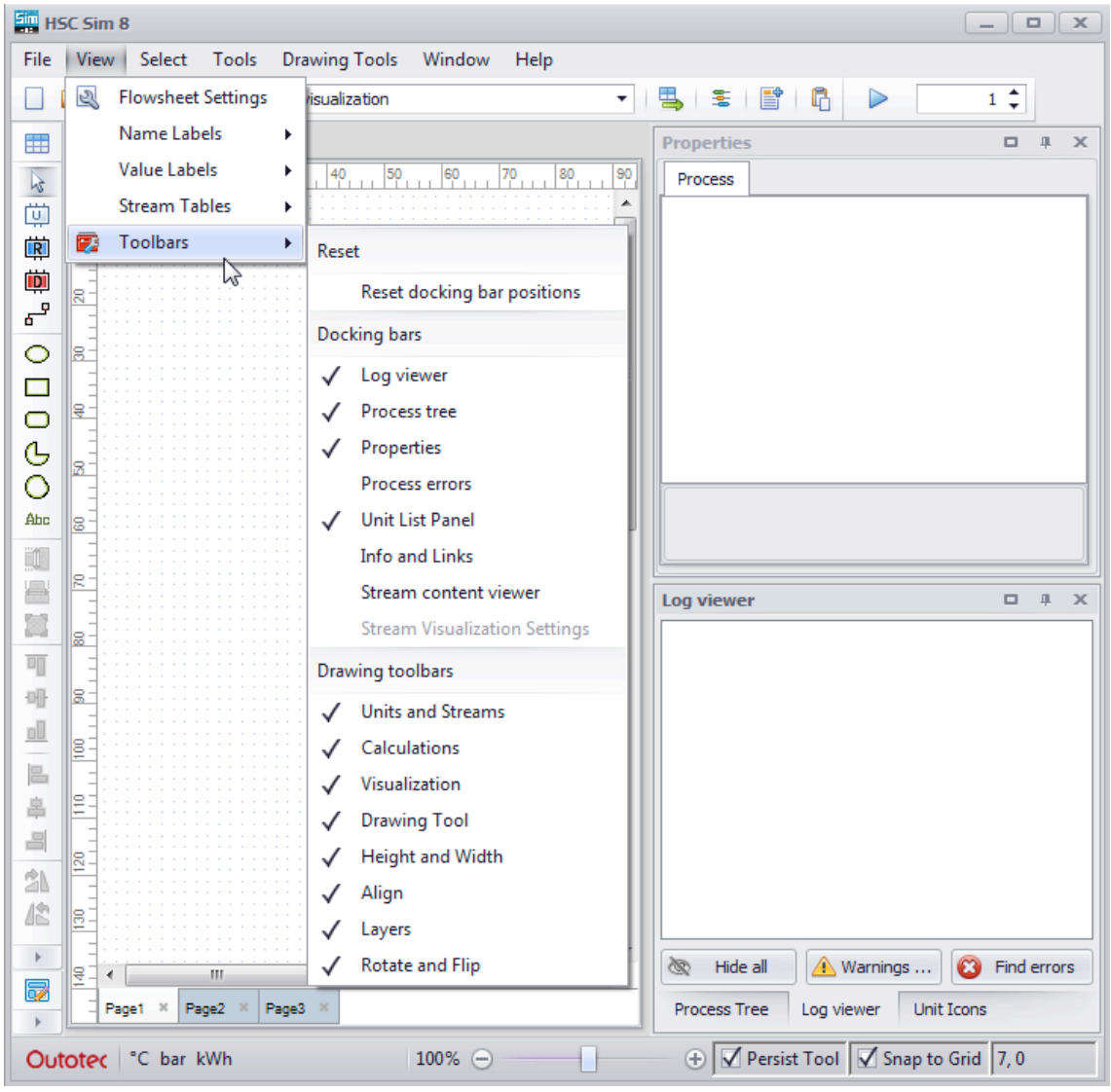


Fig. 31. List of toolbars.

40.3.1. Drawing toolbars

The Drawing toolbars are listed and guidance on their usage briefly described in **Fig. 32** - **Fig. 42**. Many drawing options can be later edited from docking toolbar **Properties** after they have been drawn (section 40.3.2).

Fig. 32. Units and streams (DrawBar). Select or Draw Units or Draw Streams (see also section 40.1).

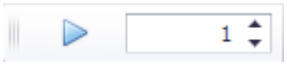


Fig. 33. Calculations (SimulationBar). Simulate and give iteration rounds for calculations.

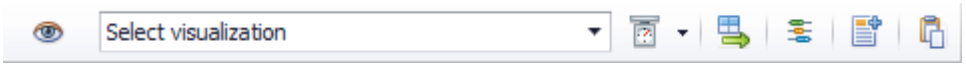


Fig. 34. Visualization (VisualizeStreamContentsBar). Select or unselect visualization mode and select the stream property that is visualized. The user can also change measurement units, open the Stream Table Editor, visualize stream connections, add a header and copy the flowsheet picture to the clipboard using this toolbar.

Fig. 35. Drawing tool (DrawingToolsBar). With this toolbar the user can add shapes like an ellipse, rectangle, rounded rectangle, pie and chord. It is also possible to add a textbox.

Fig. 36. Height and Width (SizeBar). With this toolbar the user can make the size of the selected units equal.

Fig. 37. Align (AlignBar). With this toolbar the user can align selected units in many ways, thus making it easier to draw professional-looking flowsheets.

Fig. 38. Layers (LayersBar). With this toolbar the user can edit pages and layers (**Fig. 27**) or change the position of overlapping units.

Fig. 39. Rotate and Flip (RotateAndFlipBar). With this toolbar the user can rotate or flip units.

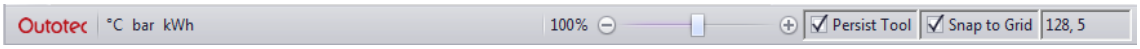


Fig. 40. Status bar. With the status bar the user can zoom the flowsheet and check and uncheck the Persist Tool and Snap to Grid options. The **Persist Tool** remembers the last used drawing tool so that the user does not have to select the same tool again separately. The **Snap to Grid** option aligns the streams and units according to the grid on the flowsheet, thus making it easier to draw professional-looking flowsheets.

Fig. 41. FileBar. The user can start a new, open an old, save the current process and save a backup of the current process using this toolbar.

Fig. 42. TableBar. The user can insert a table using this toolbar (see also section 40.1.4).

40.3.2. Docking bars

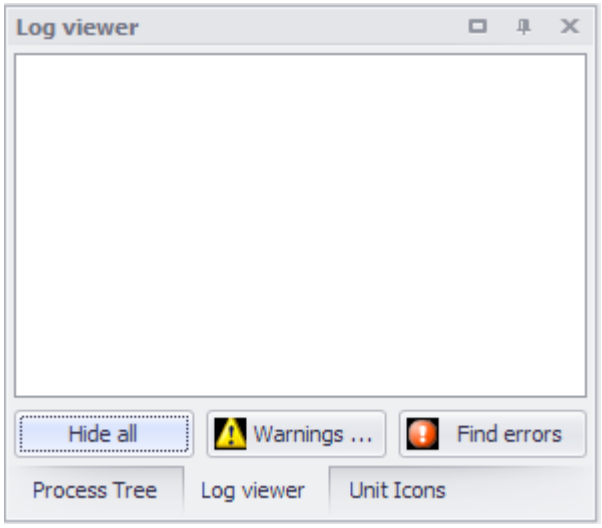


Fig. 43. Log viewer. This docking bar shows the user possible warnings and errors found during the simulation.

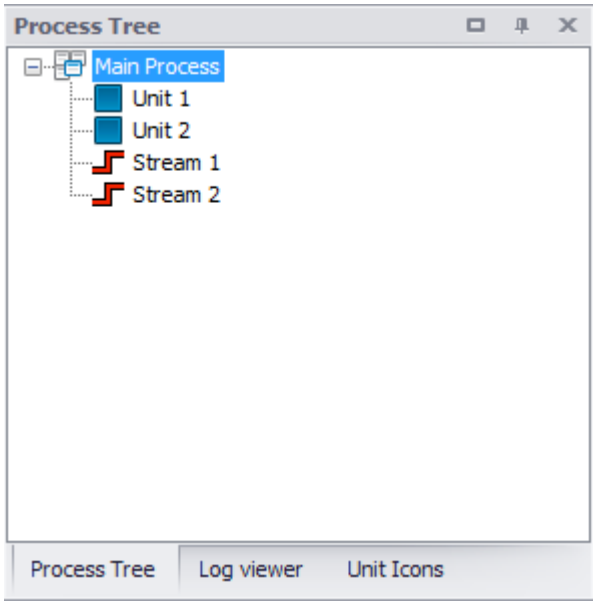


Fig. 44. Process Tree. In this docking bar the user sees the flowsheet as a process tree.

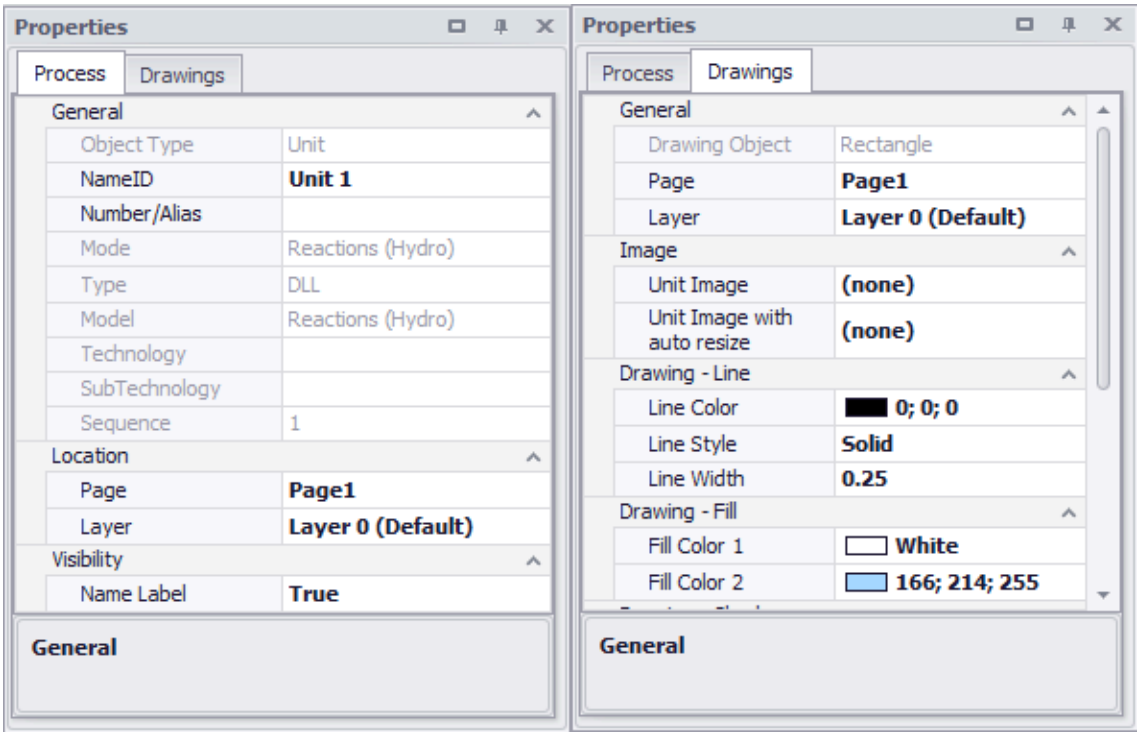


Fig. 45. Properties - **Unit** Process and Drawings.

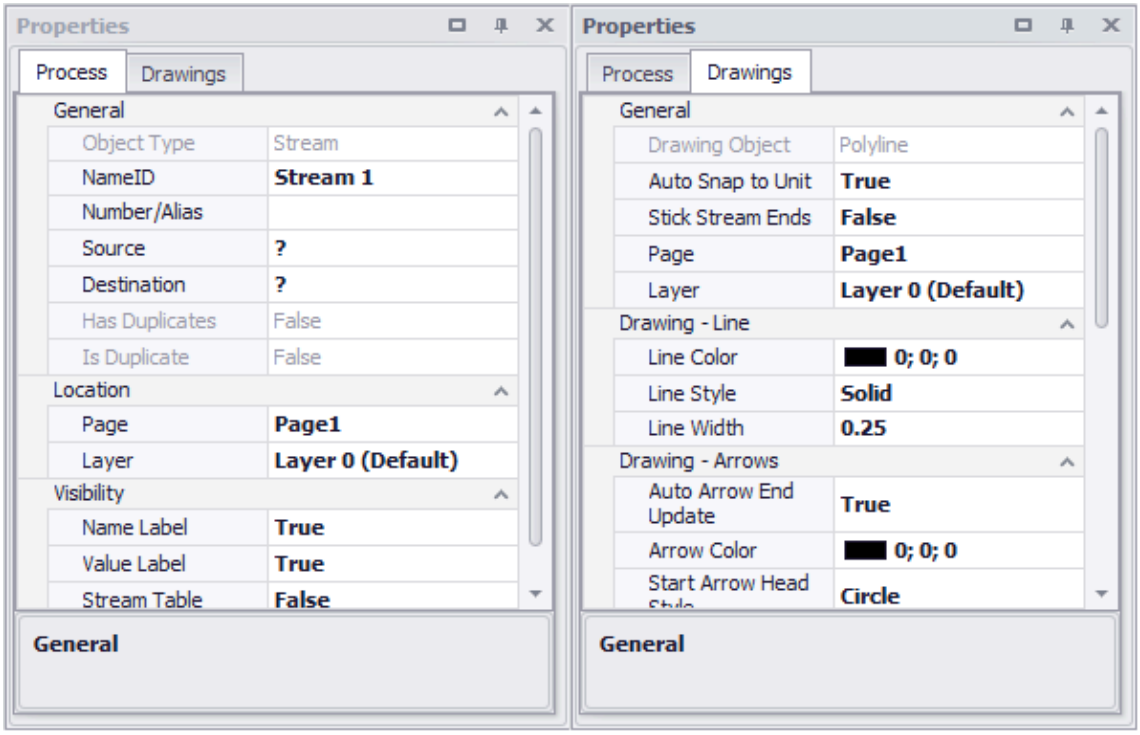


Fig. 46. Properties - **Stream** Process and Drawings.

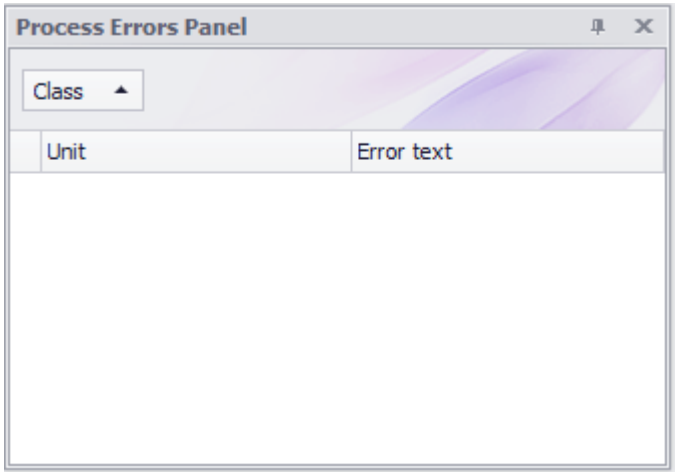


Fig. 47. Process Errors.

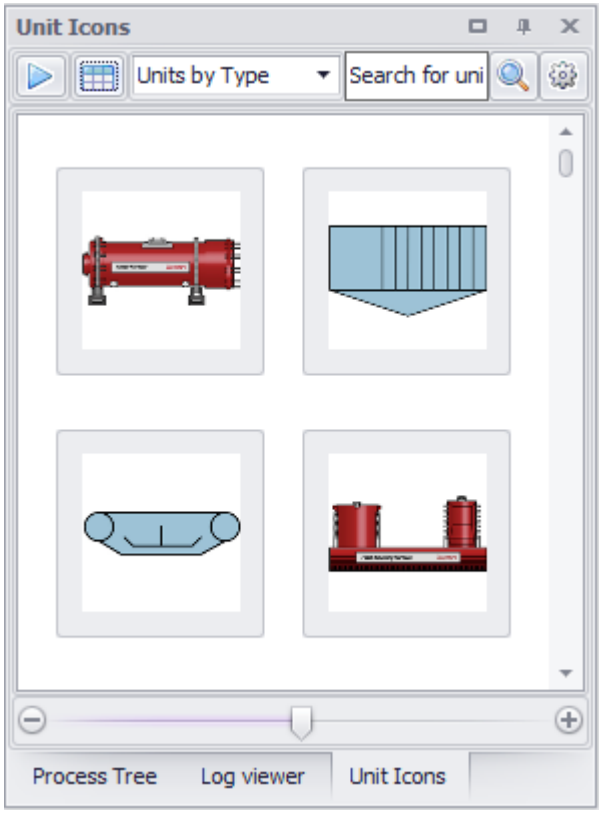


Fig. 48. Unit Icons (Unit List Panel). With this docking bar the user can add Unit pictures to the flowsheet. The unit pictures are of generic type (see section 40.2.2). The user can switch the view, browse picture location, search by name, or change unit directory (top bar) or zoom icons (bottom bar).

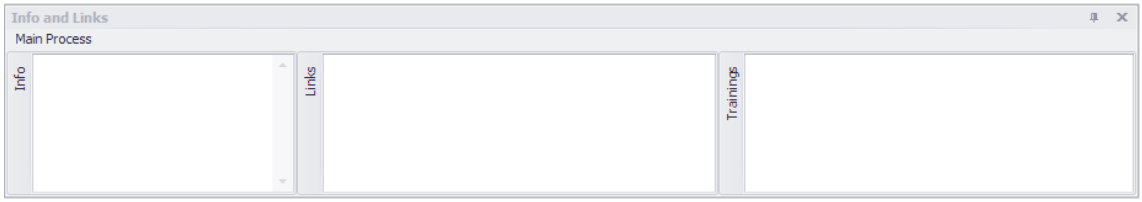


Fig. 49. Info and Links. The user can add for example instructions on how to use the flowsheet here.

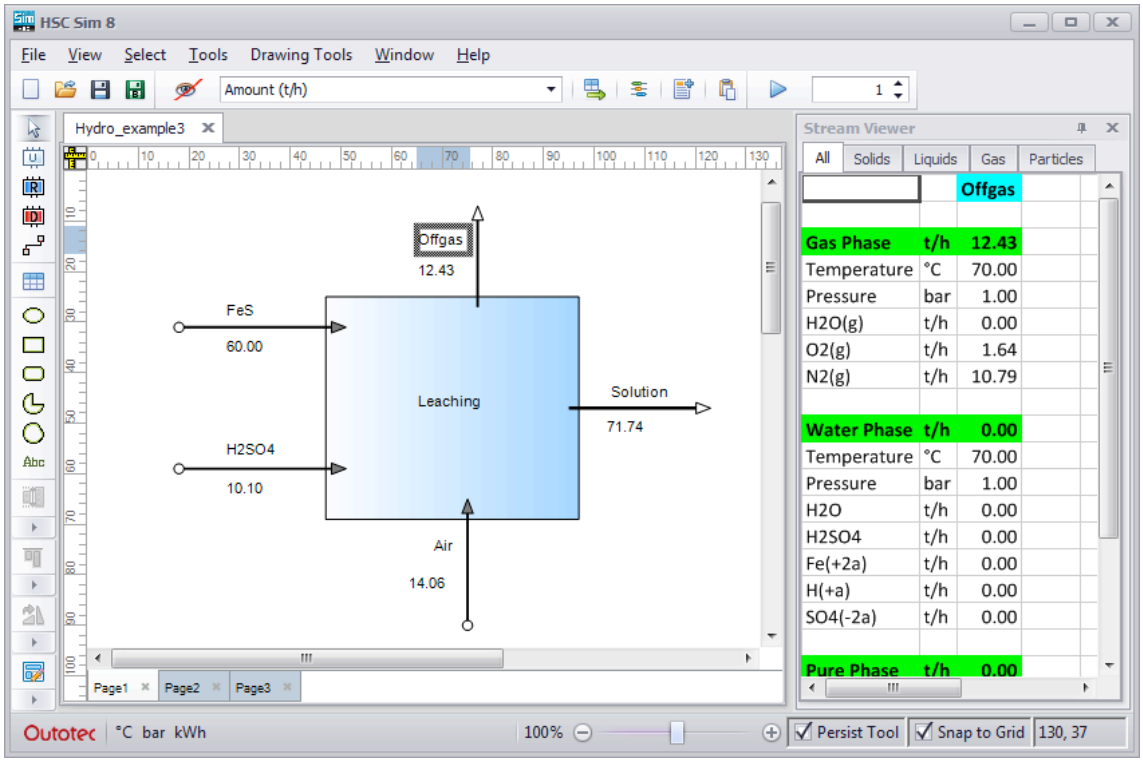


Fig. 50. Stream Content Viewer. In this docking bar the user can see a tabulated summary of the stream properties.

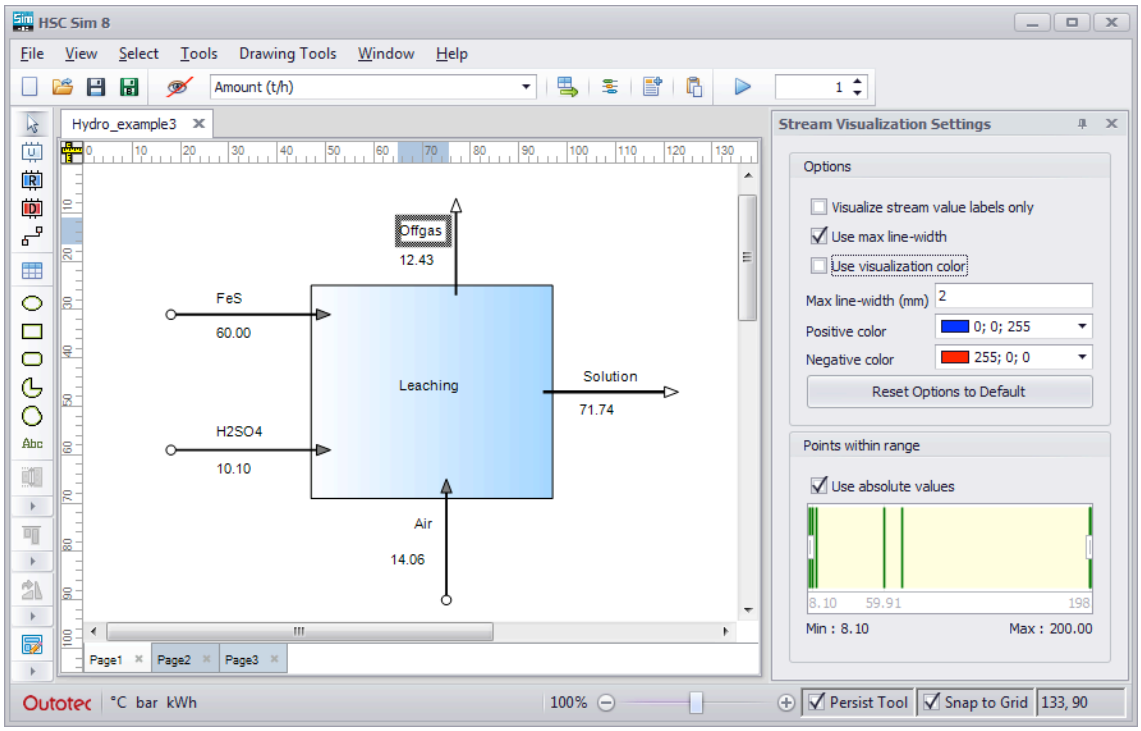


Fig. 51. Stream Visualization Settings. In this docking bar the user can change the settings of the Sankey diagram (thickness of the stream shows where most of the material goes).

40.4. Importing HSC Sim 7 models (HSC Sim 6 models are not supported)

In HSC Sim 8 there is a built-in support for importing HSC Sim 7 models and then using them in Sim 8. However, there are some points and limitations that the user should take into consideration when importing Sim 7 models into Sim 8. If points listed here do not help please contact the developers.

Major points:

- Sim 8 calculations have dramatically stricter error checks than Sim 7. When the user imports an old model and tries to run it, often the calculation will notify of an error in the flowsheet. The user can locate the errors using the log viewer and then fix them manually.
- There are some changes in the Sim 8 hydro variable list logic when compared to Sim 7. If the imported model variable list contains species not found in the database, the user needs to go through them case by case in the Sim 8 variable list editor. The user can add entries to the database, use a different database entry, or delete the species from the variable list to fix this (see Chapter 43, section 43.2.1).
- Sim 7 solvent extraction hydro Excel Wizards are no longer supported in Sim 8. If the imported model contains them in Sim 8, the user will not be able to run the model successfully.
- There is a completely new DLL unit operation system in Sim 8, which has been implemented for some Mineral Process unit operation models. Sim 8 has partial support for using old Sim 7 minpro Excel Wizard models and the user should be able to run calculations for the imported Sim 7 minpro Excel Wizards. However, the user cannot currently edit or make the Excel Wizards for the old minpro models. If users want to edit their old mineral process models, they should replace the old minpro Excel Wizards with the new DLL models.

Minor points:

- Sim 8 uses different Stream Tables than Sim 7. Because of this, users cannot edit Sim 7 Stream Tables in Sim 8 but they can make new ones using Sim 8 tools.
- The visibility of the connected streams is forced on for input and output streams in Sim 8. If there are any such streams hidden in the imported Sim 7 model, they will appear in Sim 8.
- A few drawing objects like a Bézier curve are not supported in the first version of Sim 8.
- In some rare cases, Sim 8 does not recognize Sim 7 stream connections correctly. Information about this will be given in the import log. Afterwards the user should manually confirm the notified stream connections.
- In Sim 7, the user had the possibility to encrypt some units. This function is no longer supported in Sim 8, which means those units will not be loaded during the import.
- External workbook references work differently in Sim 7 and Sim 8. When you import a Sim 7 model, all external references are changed and will include “REF” at the beginning of the reference.
- Sim 7 used automatically safe division for all division operations in the workbook. This meant that, for example, 0/0 did not give an error as the answer. Sim 8 adds the “safediv” function to division operations.
- Sim 8 will change the sheet names of the workbook if the sheet contains illegal characters like “/”.