IDEAS Simulation Software

IDEAS BRONZE MINERAL PROCESSING TUTORIAL

ENGINEERED SUCCESS

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SECTION 1. INTRODUCTION

The IDEAS™* Bronze Tutorial has been designed to give the user an overview of the key concepts of the IDEAS simulation software. Step-by-step exploration of these concepts allows the user to move confidently from the tutorials to designing new high-fidelity models utilizing IDEAS objects from those at the Bronze (Steady-State) level to those at the Gold (Fully Dynamic) level. The various levels of the basic IDEAS application are named and described as:

- IDEAS Bronze: Steady-state modeling (also called 'macro' level modeling)
- IDEAS Silver: Partially dynamic modeling (includes tank residence time and controller dynamics)
- IDEAS Gold: Fully dynamic modeling (includes full pressure-flow dynamics)

1.1 CREATING A FOLDER

On the hard drive of your PC, create a new folder (e.g., IDEAS Tutorial) that will be used whenever any file is saved throughout this tutorial.

1.2 THE PROBLEM

The IDEAS Simulation Software is used in a wide variety of industries including general chemical, oil and gas, pulp and paper, oil sands, mining and minerals, and pharmaceuticals. This tutorial is a simple mining process example requiring the IDEAS Mineral Processing Library.

The model will include two (2) sections. The processes are **High Pressure Acid Leach** and **Counter-Current Wash** and will be modeled in separate sections of the model. We are also going to see how to combine both sections. The Process Block diagrams and specifications are given below. This tutorial is a step-by-step guide for the modeling process.

Based on the Process Flow Diagrams (PFDs) (Figure 1 and Figure 2) and specifications given below for each diagram, the modeler is expected to calculate the Acid Flow rate of H_2SO_4 for H_2SO_4 content in the stream produced from the first two processes to be 75 g/L. Another variable to find is the Counter-Current Wash process's wash flow to produce the desired product. The main goal is to produce a stream in which the H_2SO_4 content should not exceed 75 g/L and to wash the stream in a Counter-Current Wash process using water.

Design the model so that various "what-if" scenarios can be developed and the effects of changes to the following variable values can be studied easily:

- Process Stream Flow Rate
- H_2SO_4 Content (Percent in Aq. Phase)
- Autoclave Outlet Temperature
- Acid required for the Autoclave
- Steam Required

1.3 PROCESS OUTLINE

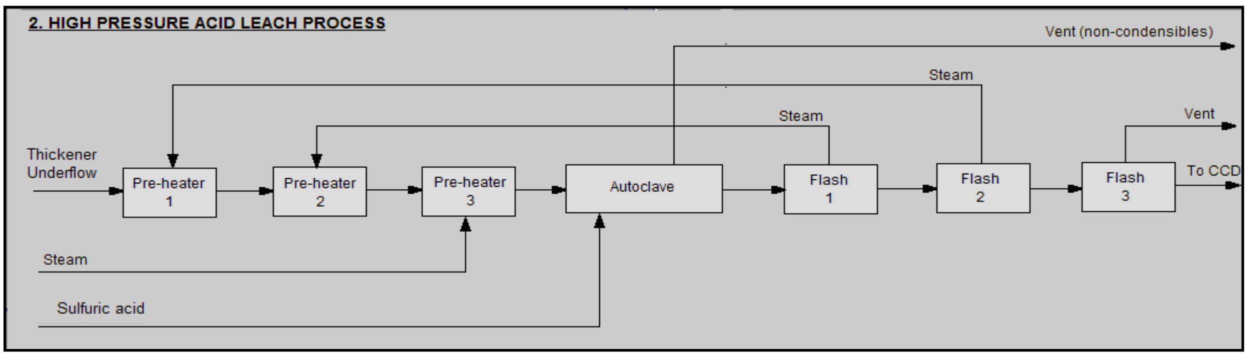


Figure 1: High Pressure Acid Leach Process (PFD)

General Process Goal
Transfer valuable metals from solid to aqueous phase

Process Specification

Leach Temperature:	261°C
Leach Pressure:	4400 kPa
Final H_2SO_4:	75 g/L

Preheater Pressures

Preheater 1:	1100 kPa
Preheater 2:	2200 kPa
Preheater 3:	4400 kPa

Flash Pressures

Flash 1:	2200 kPa
Flash 2:	1100 kPa
Flash 3:	101.3 kPa

Reactions in the Autoclave

```
1 Al2O3_s + 3 H2SO4_aq = 3 Water + 1 Al2(SO4)3_aq (80% Conversion
1 Fe(OH)3_s + 1.5 H2SO4_aq = 3 Water + 0.5 Fe2(SO4)3_aq (95 % Conversion)
1 Ni(OH)2_s + 1 H2SO4_aq = 2 Water + 1 NiSO4_aq (90 % Conversion)
1 Goethite_s = 0.5 Water + 0.5 Fe2O3_s (100 % Conversion)
1 Chlorite_s + 6 H2SO4_aq = 10 Water + 4 Quartz_s + 6 MgSO4_aq (75 % )
(6)1 MgCO3_s + 1 H2SO4_aq = 1 Water + 1 MgSO4_aq + 1 CO2_g (94 % Conversion)
```

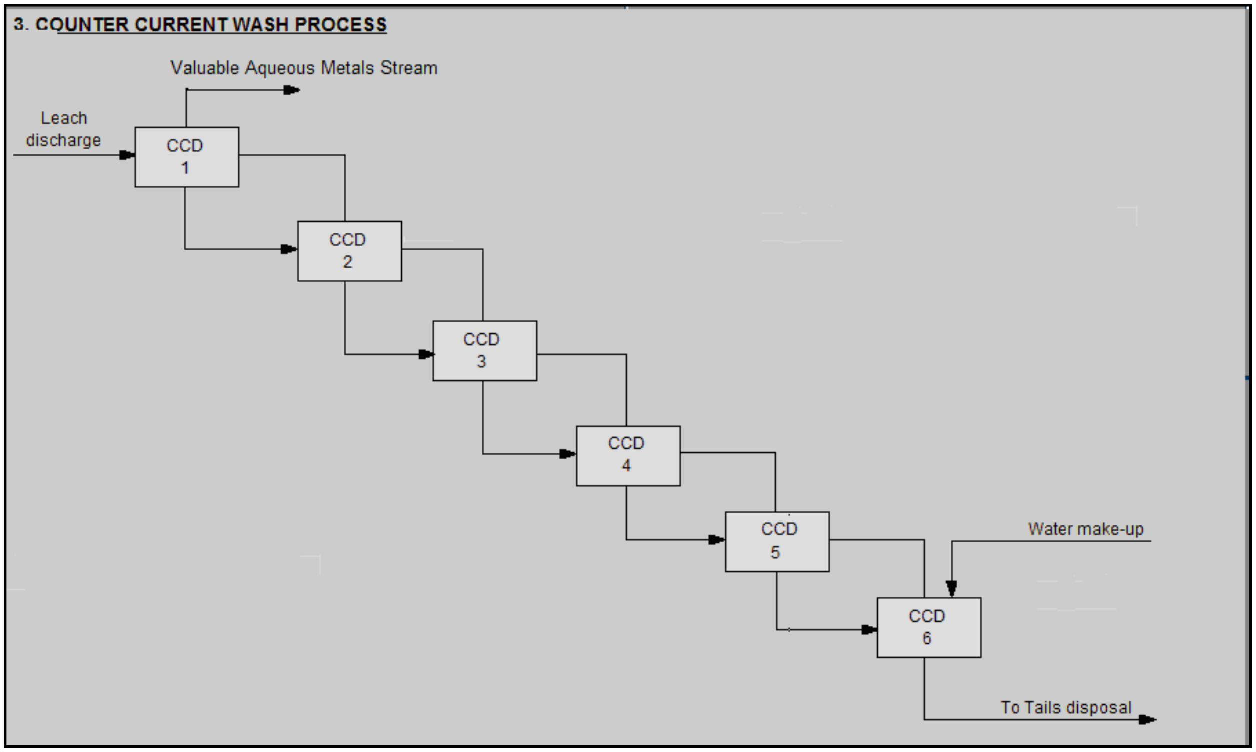


Figure 2: Counter-Current Wash Process (PFD)

General Process Goal

Separate solids from valuable aqueous metals stream

Process Specification

Underflow Density: 35%
Stage Mix Efficiency: 99%

SECTION 2. STARTING THE IDEAS APPLICATION

Section Concepts:

- Start IDEAS Application
- Open the Worksheet
- Save the Model

2.1 OPENING IDEAS

First, locate the IDEAS application using the Windows Start Menu. From the Windows Start Menu, choose All Programs → Andritz → IDEAS.exe (this path may differ slightly depending on the installation). Launch the application by clicking on the IDEAS icon. Alternatively, the user can navigate to C:\Andritz\IDEAS2024 to launch the application using “IDEAS.exe” shortcut.

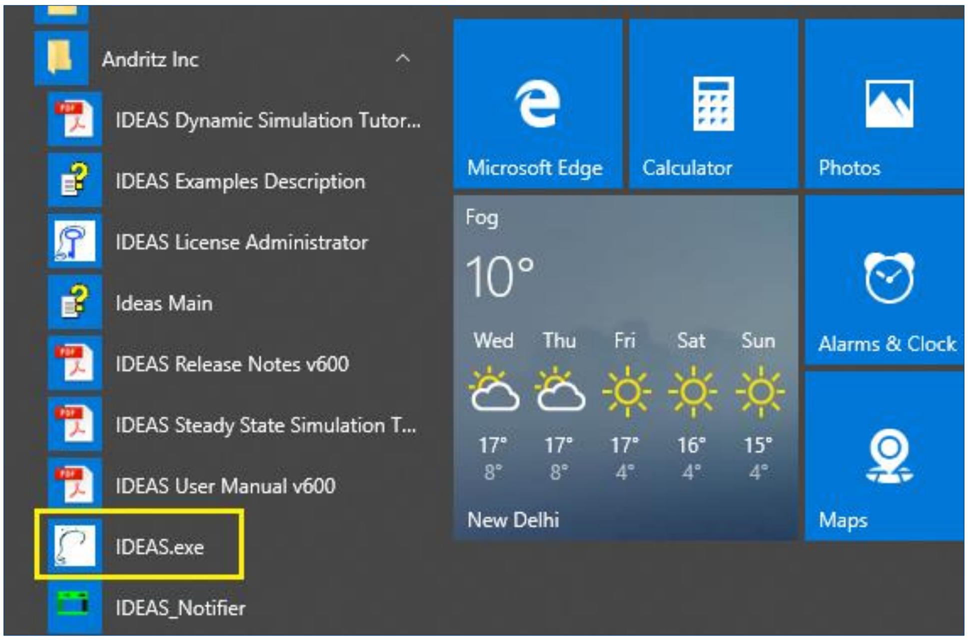


Figure 3: IDEAS XXX Location

2.2 OPENING WORKSHEETS

Once the IDEAS window opens, go to **File** menu and select **New Model**. A blank worksheet named **Model-1** appears. Enlarge the worksheet to fill the entire screen (see Figure 4) if desired.

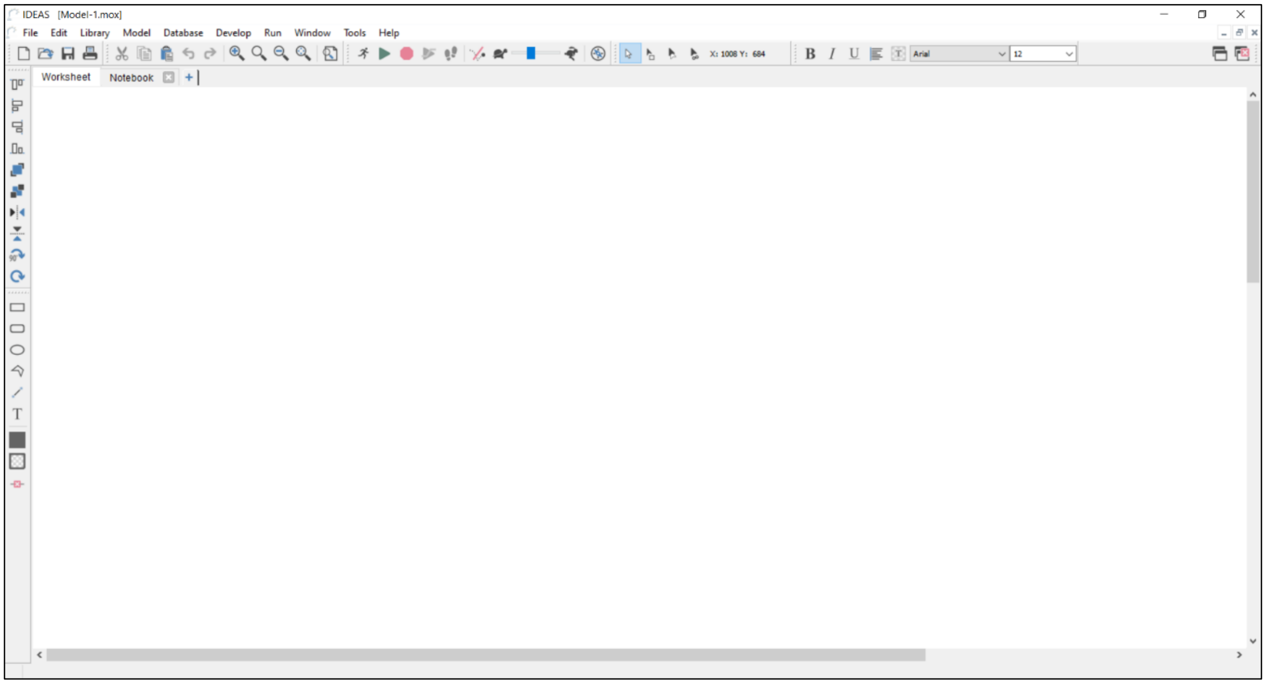


Figure 4: Model-1 Worksheet

2.3 SAVING THE MODEL

Select '**Save Model as**...' under the **File** menu. When the **Save File As** dialog box appears, navigate to the folder created at the beginning of this tutorial (click on the box labeled **Save In:** with the ▼). In the **File name** field, type *Bronze_MineralProcess* and click on the **Save** button. If a dialog box opens asking *Replace existing 'Macro Worksheet?* click on the **Yes** button (see Figure 5).

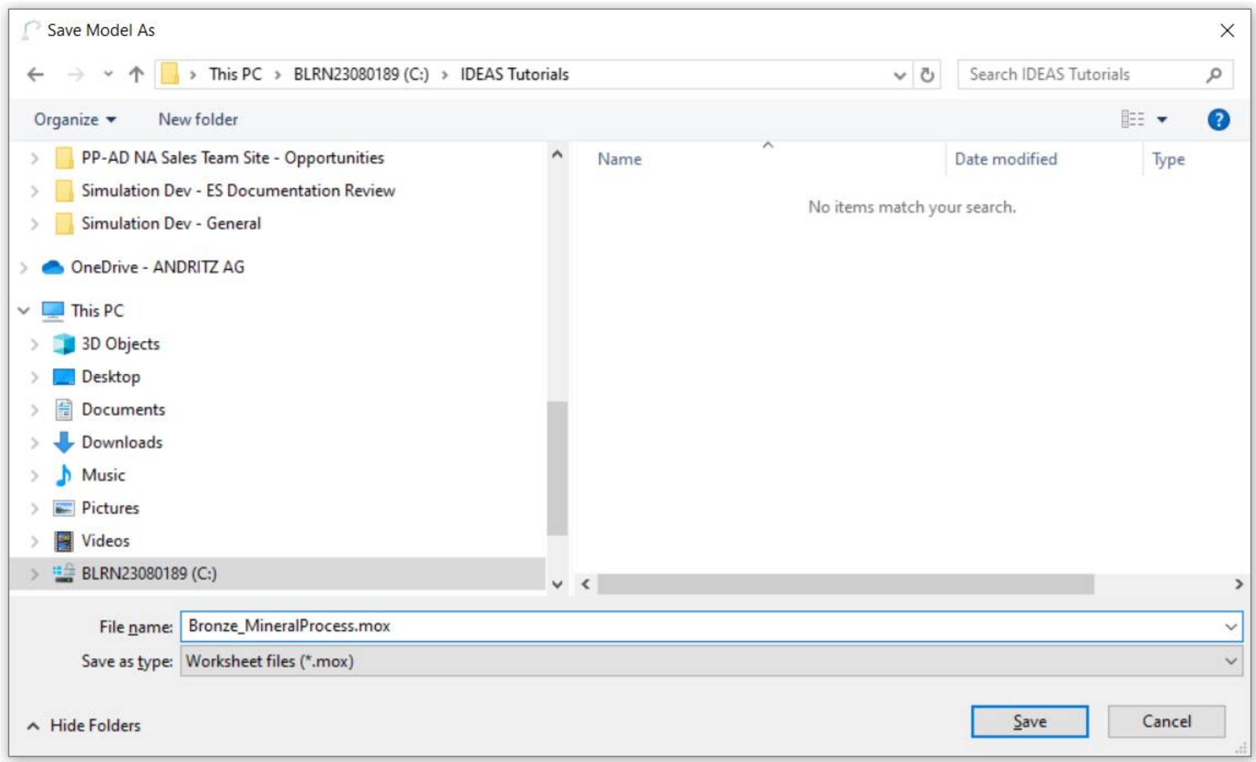


Figure 5: Save File As Dialog Box

Note: Make sure that you save the model often throughout this tutorial. You may not be reminded again to save your model during the course of the tutorial.

SECTION 3. OPENING LIBRARIES

<u>Section Concept:</u>

- Opening Libraries

3.1 PROCESS FOR OPENING LIBRARIES

On the IDEAS Menu bar, go to **Library** and **Open Library** (Ctrl +L) as shown below. When the **Open Library File** dialog box appears, navigate to the folder containing the libraries; typically, this folder will be **IDEAS XXX\Libraries**. This folder will display all the available libraries (as shown in Figure 6 below). Depending on the IDEAS product you have purchased, your list of libraries may vary from the list shown in Figure 7).

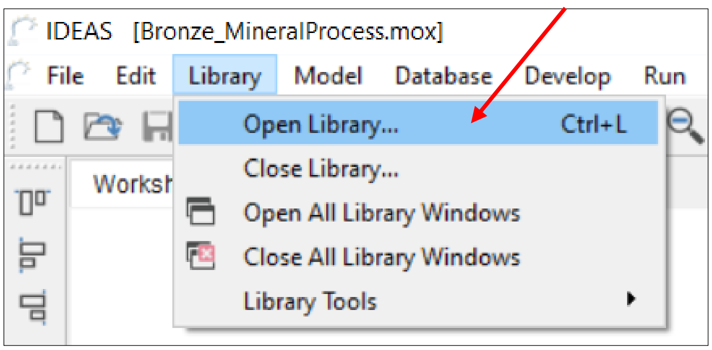


Figure 6: Opening Libraries from Menu

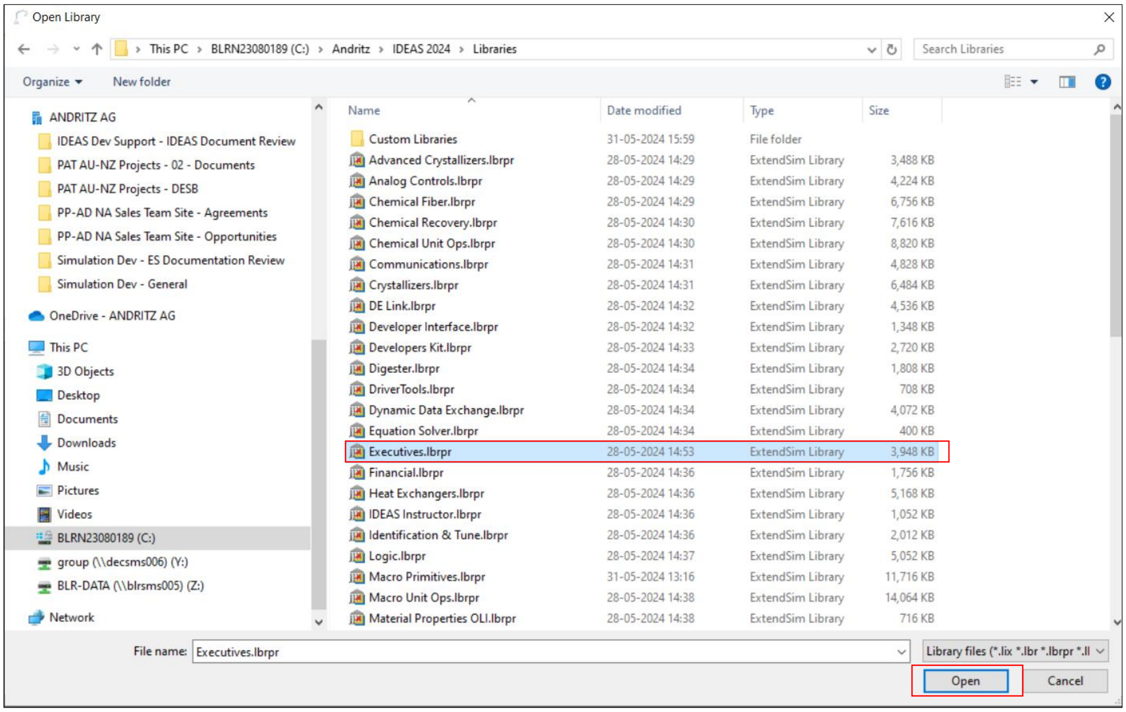


Figure 7: Location of Libraries

To open a particular library, select the library name and click on the **Open** button or double-click on the selected library name.

Open the following libraries using the steps mentioned above, which will be used in this Tutorial.

- EXECUTIVES
- MACRO PRIMITIVES
- MACRO UNIT OPS
- MATERIAL PROPERTIES
- DYNAMIC DATA EXCHANGE
- MINERAL PROCESSING-B
- PLOTTERS
- TOOLS
- TOOLS_UTILITIES
- TRANSMITTERS

SECTION 4. ADDING IDEAS ADMINISTRATIVE OBJECTS TO THE MODEL

Section Concepts:

- Placing Administrative Objects
- Setting Global Units

4.1 PLACING THE DISCRETE/CONTINUOUS EXECUTIVE OBJECT ONTO THE WORKSHEET

Place the **Discrete/Continuous Executive** object from the EXECUTIVES library onto the worksheet by selecting the EXECUTIVES library from **Library** on the menu bar. This is done by moving the mouse over to EXECUTIVES and clicking on **Discrete/Cont. Executive** when the submenu opens to the right of the main menu (see Figure 8).

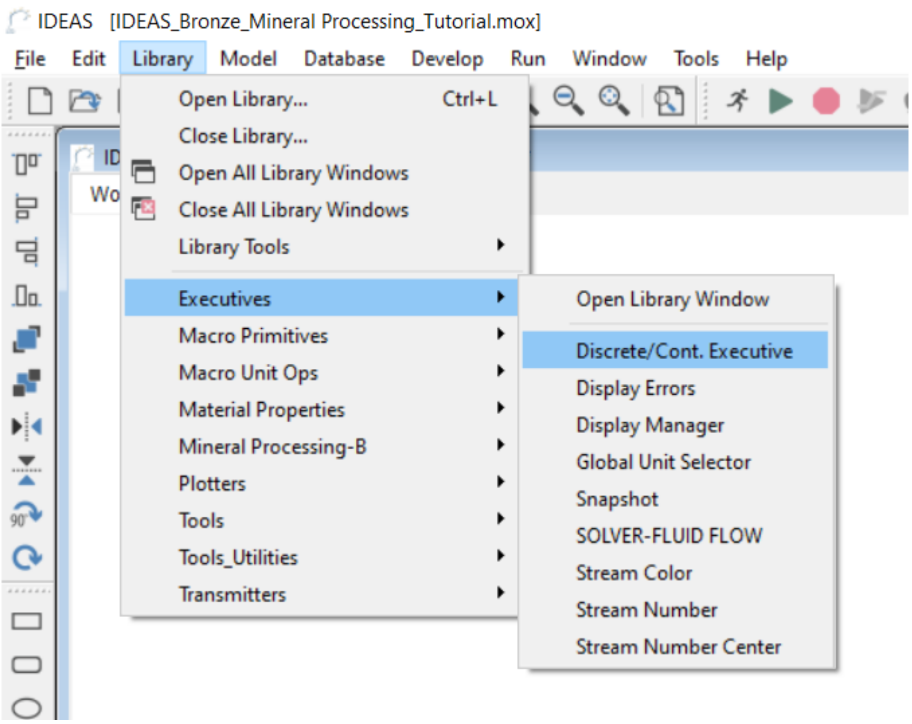


Figure 8: Placing Objects on the Worksheets

An alternative method for adding objects to a model: Click on ***Open Library Window*** (see Figure 8) on the submenu. A new window opens up on the worksheet containing all objects of that particular library (see Figure 9). This library window shows each object's name, icon, and possibly additional details.

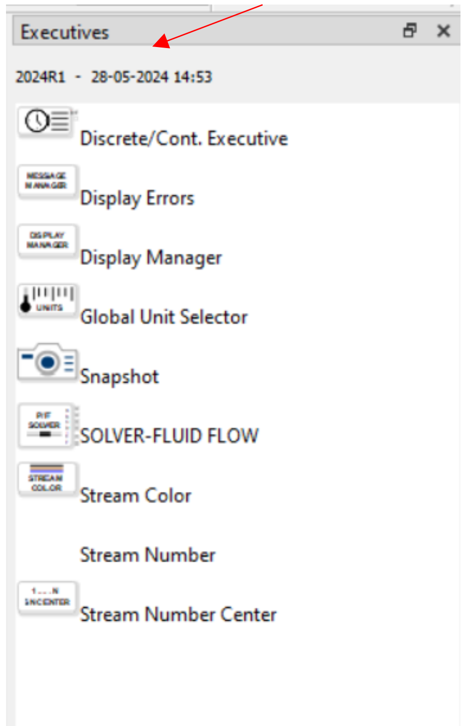


Figure 9: Alternative Method for Object Addition to Model

To select an object from this window, click-and-place the object with the mouse to the desired location on the worksheet. The object will move to a default location – all administrative objects have a default location and should not be moved from this location.

To view all the open libraries from the Library Window, under the Library menu select Open All Libraries Windows. All the open libraries will show as tabs on the right side of library windows (see Figure 10). There are two buttons as a quick option to open all library windows for open libraries or close all library windows at the top-right of the application screen (see Figure 11).

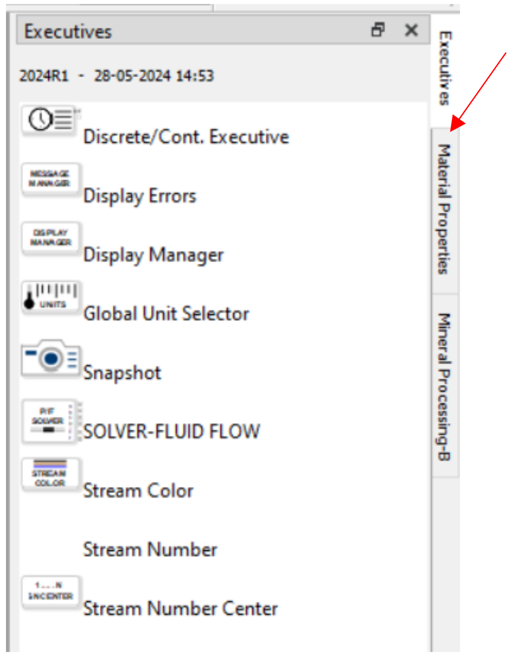


Figure 10: Tabs to View Opened Library Windows

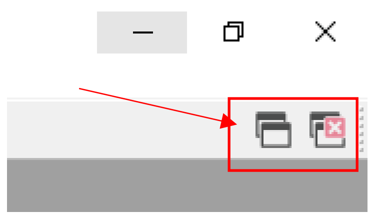


Figure 11: Open (Left) or Close (Right) Library Windows for Open Libraries

All such menus as shown in Figure 11 with dotted lines are tear-away menus that can be relocated, so top right is only the default location, and only if the menu is made visible from the Tools menu selection – under Tools this menu is “Library Window”. The Tools menu recommended selection is depicted in Figure 12Figure 12.

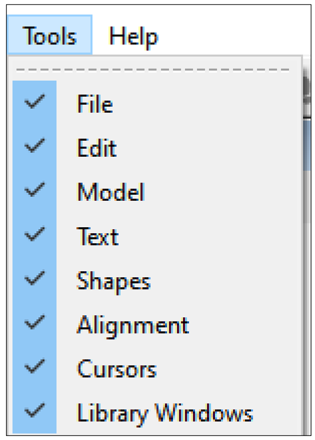


Figure 12: Tools Menu Recommended Selection for Visible Menus

Users can check and uncheck menus as needed; Icon menu is needed during Hierarchical Block creation (further discussed in the IDEAS User Manual).

4.2 PLACING OTHER ADMINISTRATIVE OBJECTS ONTO THE WORKSHEET

Place the **Display Errors** and the **Solver-Fluid Flow** objects from the EXECUTIVES library onto the worksheet. The **Display Errors** object defines how errors and other messages are reported to the user. The **Solver-Fluid Flow** object performs flow calculations throughout the model for many of the objects with process stream flow. As noted earlier, allow these objects move to their default location. Do not move them from those default locations.

4.3 SETTING THE GLOBAL UNIT SELECTOR OPTIONS

Using the same procedure, place the **Global Unit Selector** object from the EXECUTIVES library onto the worksheet. Double-click on the **Global Unit Selector** object to open the **Global Unit Selector** object's dialog box.

Under the **Primary Selection** tab, select **Metric**, and change the **Select Industry** dropdown selection from **Generic** to **Mining**&**Metallurgy**. Select Flow Units as *mass* units and *tonnes (t)* per *hour (h)* with the help of pull-down menus listed next to **Flow Units** description. Click on the **Accept Primary Units** button (see Figure 13 and Figure 14). Go to the **Secondary Selection** tab. Click on the box to the right of the words **Flow Units** and change the setting from *Mass* to *Volume*. Proceed to the next two boxes and change them to *liters (L)* and *minutes (min),* respectively (see Figure 13 and Figure 14). Click on the **Accept Secondary Flow Unit** button. Click **OK** to close the dialog box.

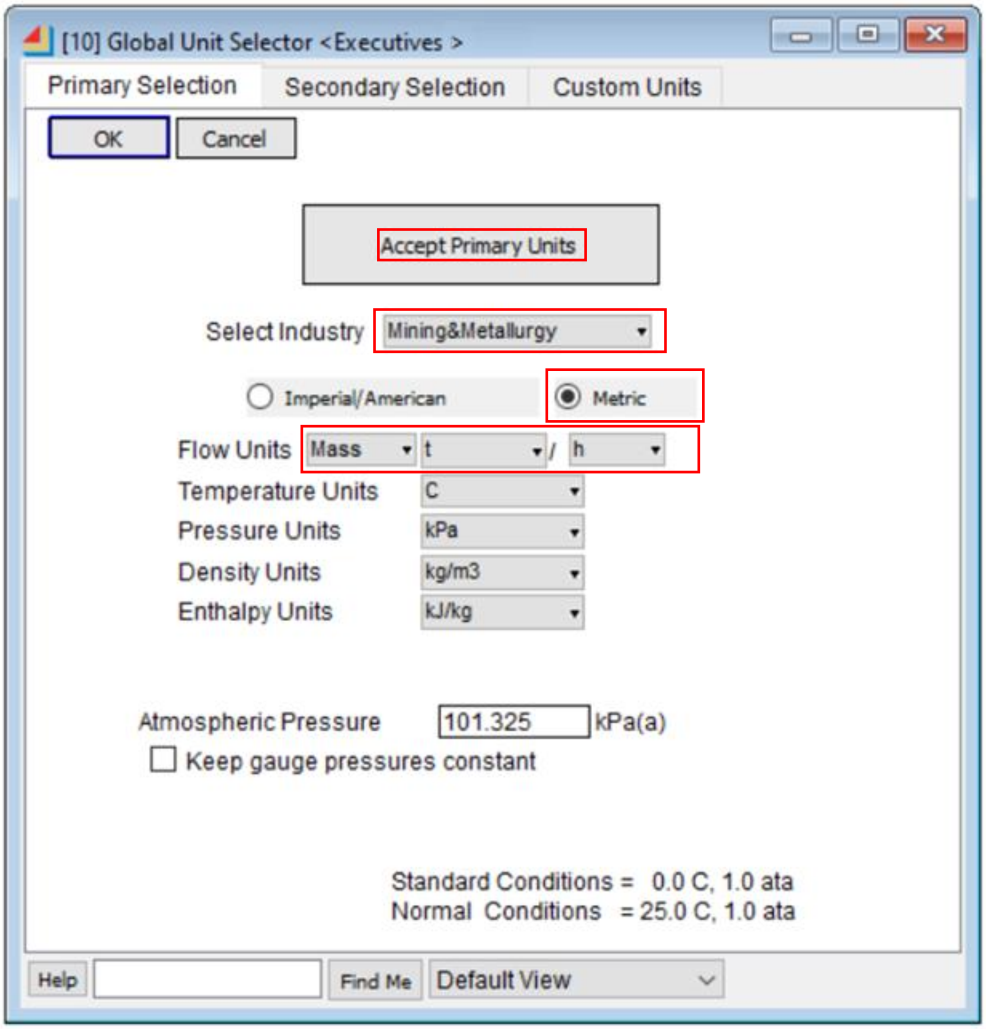


Figure 13: Global Unit Selector Dialog Box

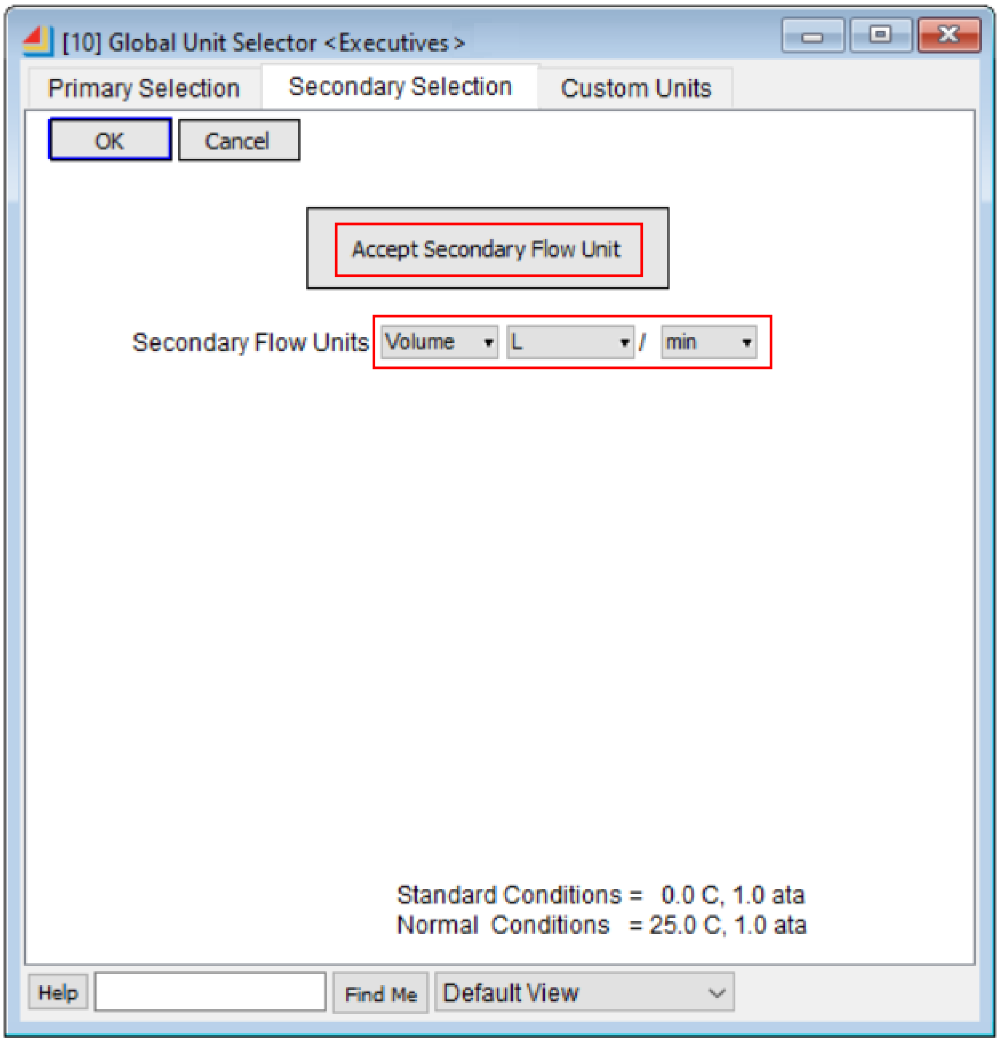


Figure 14: Secondary Flow Unit Selection

SECTION 5. ADDING A MATERIAL PROPERTIES OBJECT TO THE MODEL

Section Concepts:

- Placing Material Properties Object
- Selecting Components
- Creating Components
- Defining Default Liquid and Gas Components to the Model

5.1 MATERIAL PROPERTIES OBJECT

Next, we will select the materials/chemicals/components for this model. Select the **Material Properties** object from the MATERIAL PROPERTIES library. When the **Material Properties** object is placed onto the worksheet, its dialog box automatically opens. Also, the **Select IDEAS Components** window opens prompting you to select the components that you would like to load. Loading a component loads the physical properties of that component into the **Material Properties** object, making that component available for use in the model. Navigate through the **Select IDEAS Components** window to see the available components (see Figure 15). *Water* and *Steam* are selected by default. Press **OK** in the **Select IDEAS Components** window. Then press **OK** in the **Material Properties** object dialog box.

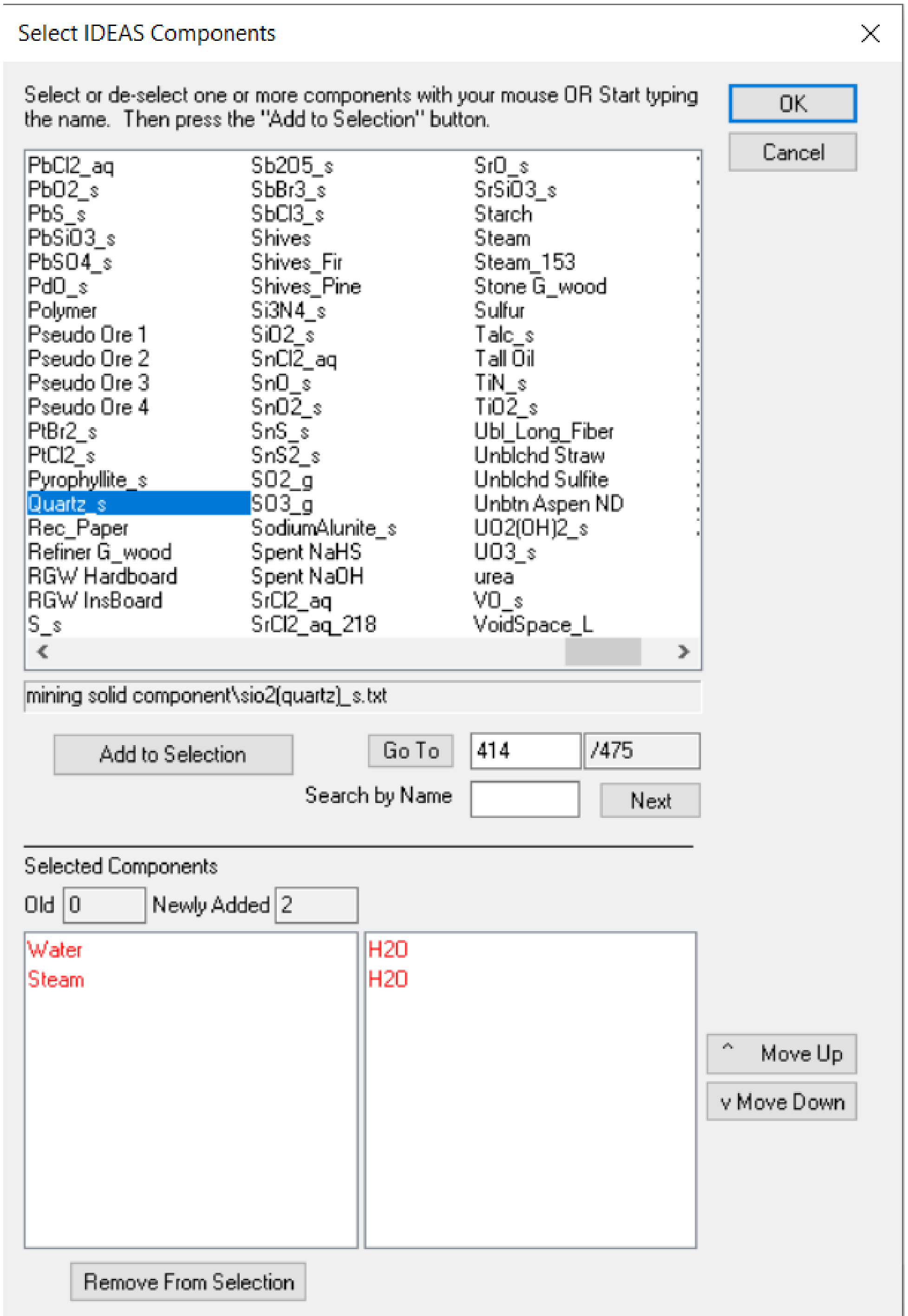


Figure 15: IDEAS Component Section Window

5.2 CREATING A CUSTOM COMPONENT

IDEAS includes thousands of available components, available either directly in IDEAS or through one of our supplemental products or links. However, in rare cases, users may want to create their own component. To demonstrate this capability, we will create a new component, chlorite.

Our **Material Properties** object already includes water and steam in its current components list. After we create chlorite, we will add the remainder of the components needed for this tutorial.

Add the **MP Assembler** object from MATERIAL PROPERTIES library under **MP tools** submenu (see Figure 16).

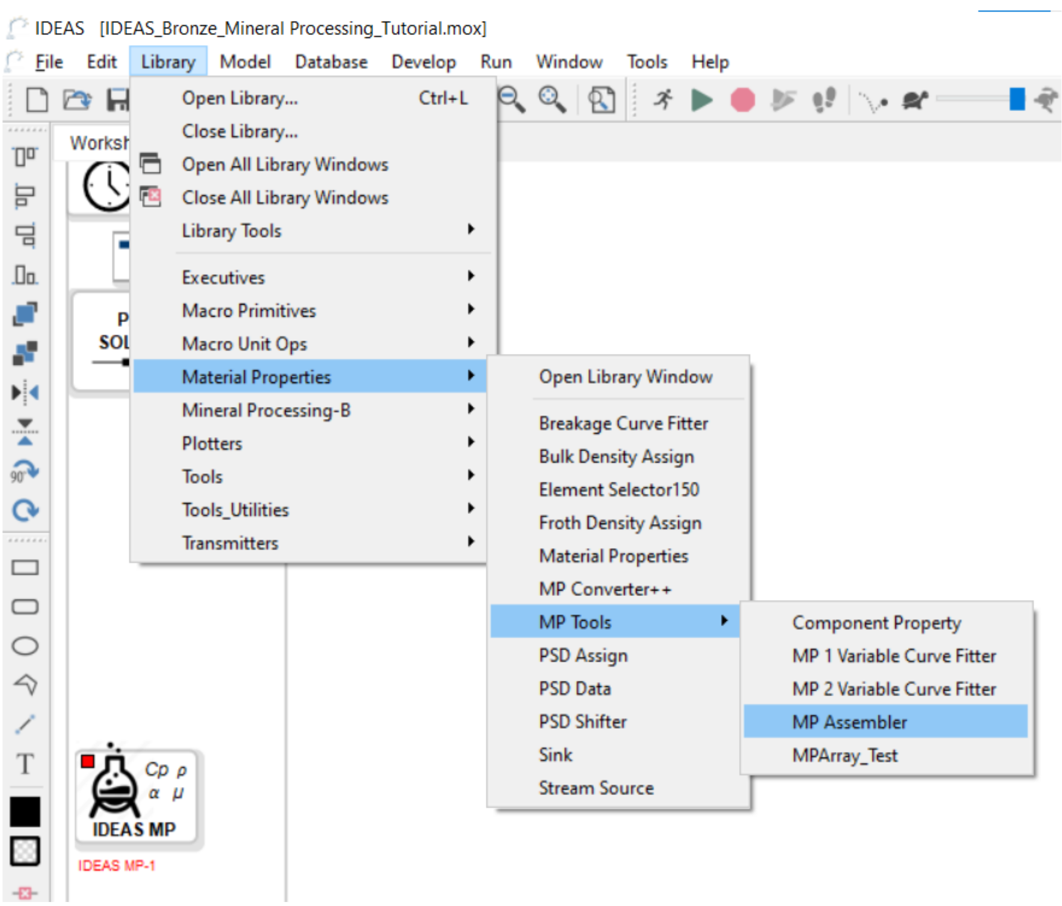


Figure 16: IDEAS MP Assembler Object Location Section Window

Double-click to open its dialog box. Enter Component Name as *Chlorite_s* and Component Formula as *H8Mg6O18Si4*. In the **Value** column, enter the below data (Table 1) row-wise.

Table 1: Properties for Chlorite_s Component

Row No	Value
1	1
2	554.2247
3	0.805551361
4	0.805551361
7	3210
9	3210
15	0.000993
18	0.000993
27	20.13878401
89	-15498.468960929

The dialog box of MP Assembler object is in Figure 17.

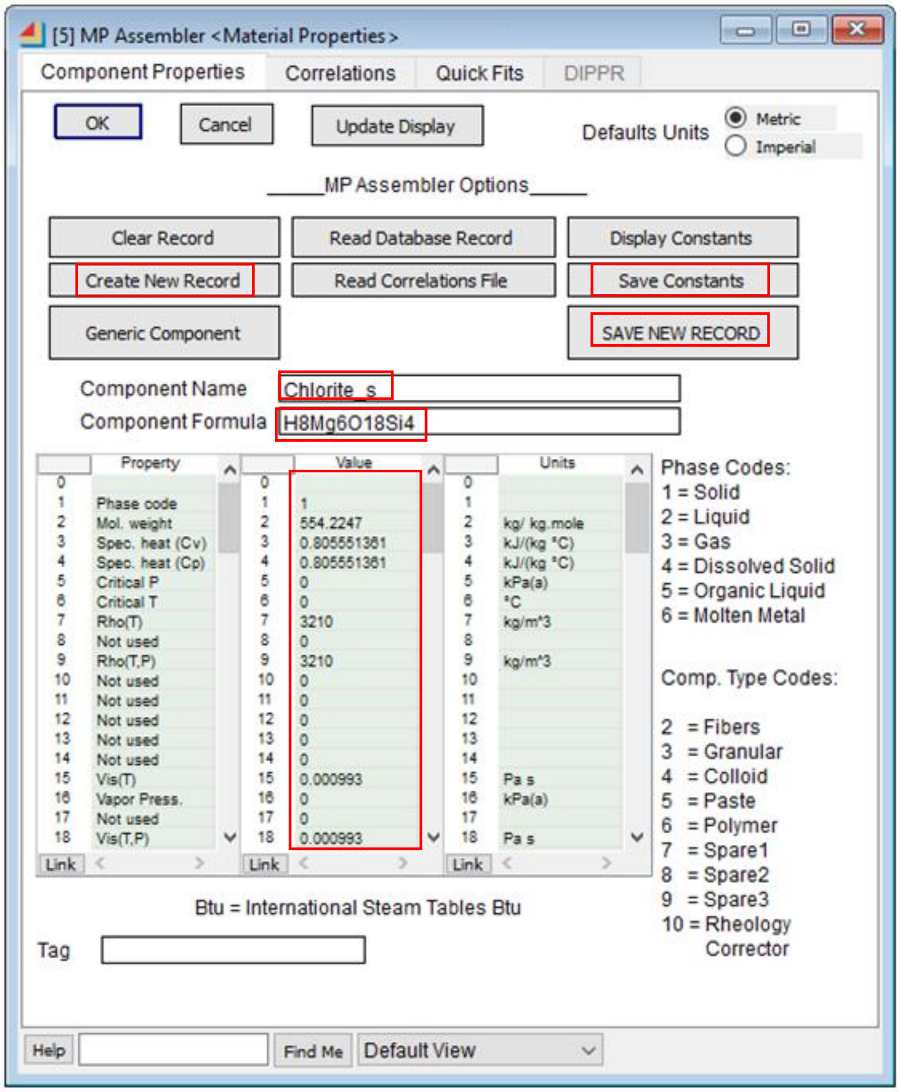


Figure 17: MP Assembler, Component Properties Tab

Press **Create New Record** button after entering the data and then **Save Constants** button. Now press **SAVE NEW RECORD** button to save the properties in a text file for use. It will open a window asking the name of the file and location of the file to save. Name the file as ***Chlorite_s*** and save it at the following location. Click **OK** to close the Dialog box.

C:\Andritz\IDEASXXX\Component Records\Mining Solid Component

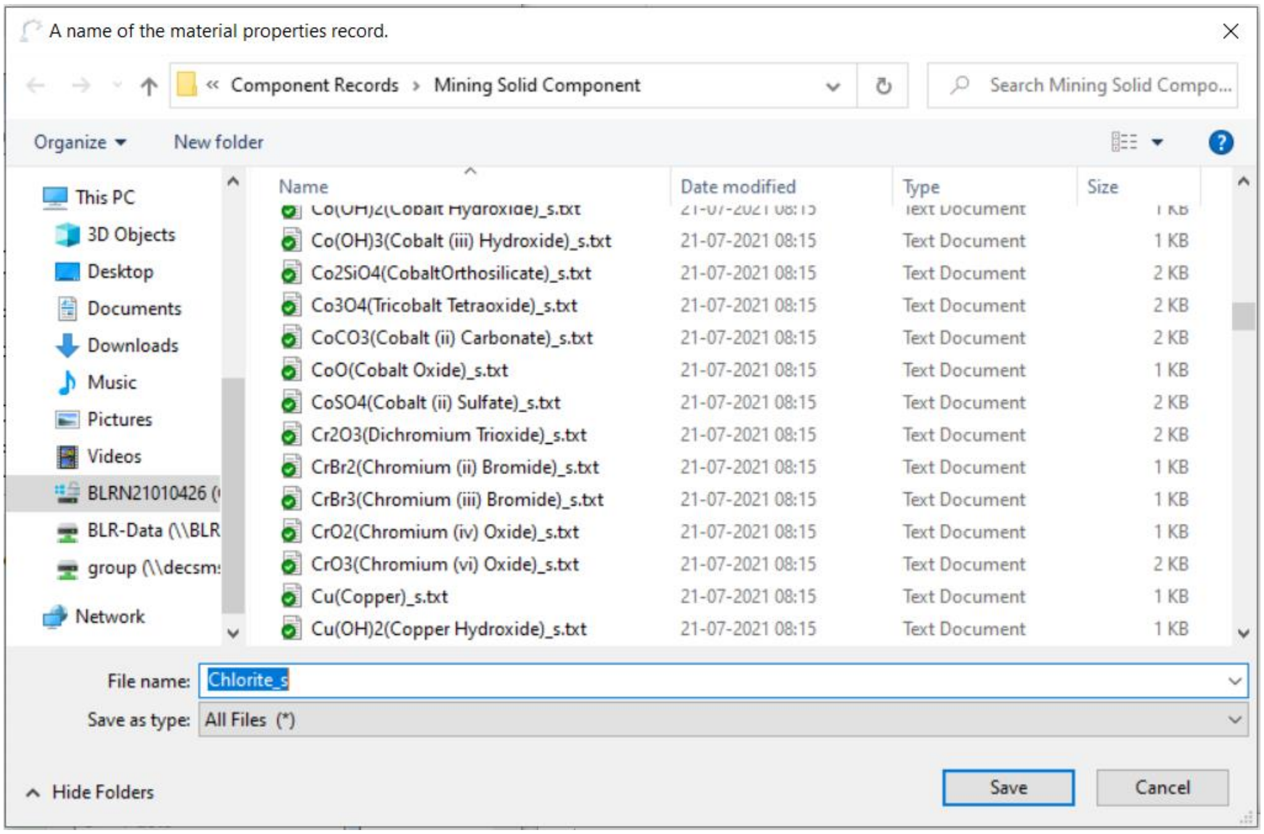


Figure 18: MP Assembler, Saving Component Record

5.3 ADDING A MATERIAL PROPERTIES COMPONENT

Open the dialog box for the **Material Properties** object. Click on **Load IDEAS Components** button. It will open IDEAS component selection window. The user can select the component from the **Select IDEAS components** window and make it available to the streams by double-clicking on the component or by pressing **Add to Selection** button. The user can search for the components by entering full or part of a name in the **Search by Name** field. We now want to add *Quartz_s* component. Enter *Q* in the *Search by Name* field (see Figure 18). This will take you to the components starting with the letter *Q*. Double-click on *Quartz_s* to add it to the selection. The user will automatically see this component in the selected components table. Similarly, add the following components.

Table 2: Table of Components

Ni(OH)2_s
MnO2_s
Mg(OH)2_s
MgO_s
MgCO3_s
Fe(OH)3_s
Fe2O3_s
Goethite_s
Al2O3_s
Chlorite_s
H2SO4_aq
Al2(SO4)3_aq
Fe2(SO4)3_aq
NiSO4_aq
MgSO4_aq
CO2_g
H2S_g
FeSO4_aq
S_s
CaCO3_s
CaSO4
NiS_s
FeS_s

Click **OK** button in the **Select IDEAS Components** window to accept the selection. The user will see all the selected components in the **Stream Component Assignments** table under the **Components** tab of the **Material Properties** object. The bottom of the final **Stream Component Assignments** table is shown in Figure 19 below.

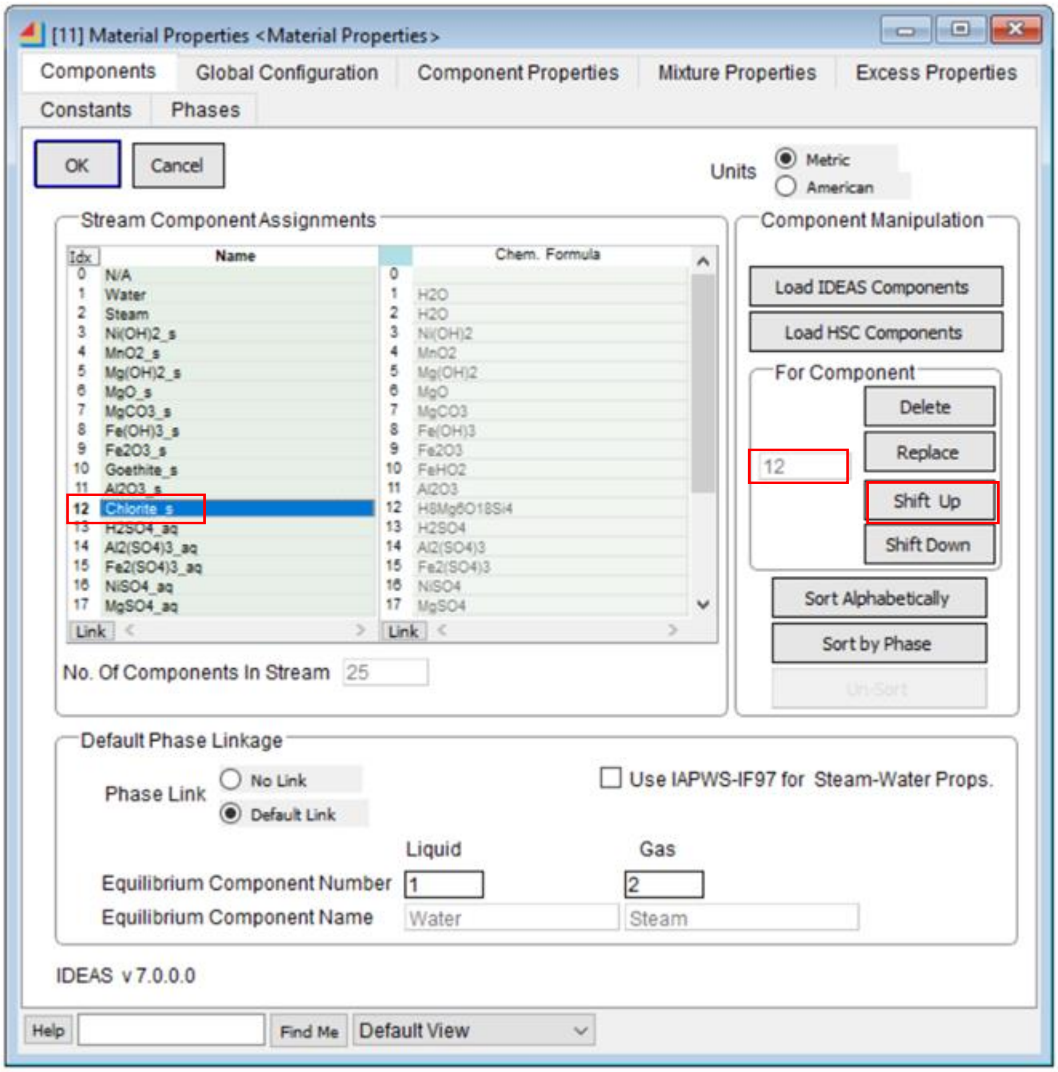


Figure 19: Material Properties (Components Tab)

You will notice that *Water* is the default liquid component and *Steam* the default gas component as these were the first liquid and first gas components that were loaded into this **Material Properties** object. If any of these components is out of order, you can select it and press the **Shift Up** or **Shift Down** button to move it up or down, one-step at a time.

5.4 DEFINING THE DEFAULT LIQUID AND GAS EQUILIBRIUM COMPONENTS

As mentioned earlier, when *Water* and *Steam* were loaded as the first liquid and first gas components, *Water* component number (1) was automatically entered into the field ***Liquid*** "**Equilibrium Component Number**" and *Steam* component number (2) into the field ***Gas*** "**Equilibrium Component Number.**" In some cases, the user may want to change the default liquid to be some other component by changing the value in the ***Liquid*** "**Equilibrium Component Number**" field below to match that of the desired default liquid component. The component number is the number to the left of the component name in the Stream Component Assignments table.

Click on the **OK** button to close the dialog box. Be sure to always click on the **OK** button to close a dialog box if you wish to accept the changes or entries that you have made within the dialog box. Pressing the **Close** button (upper right corner "X") is equivalent to pressing **OK**.

If you wish to discard the changes, press the **Cancel** button.

5.5 SETTING ANIMATION OPTIONS

Under **Run** on the menu bar, select **Show 2D Animation**. When selected, this option has a check mark (✓) next to it (see Figure 20). (Animation takes more CPU time, so if model speed is important, deselect **Show 2D Animation**. In this case, we will leave the animation option enabled.)

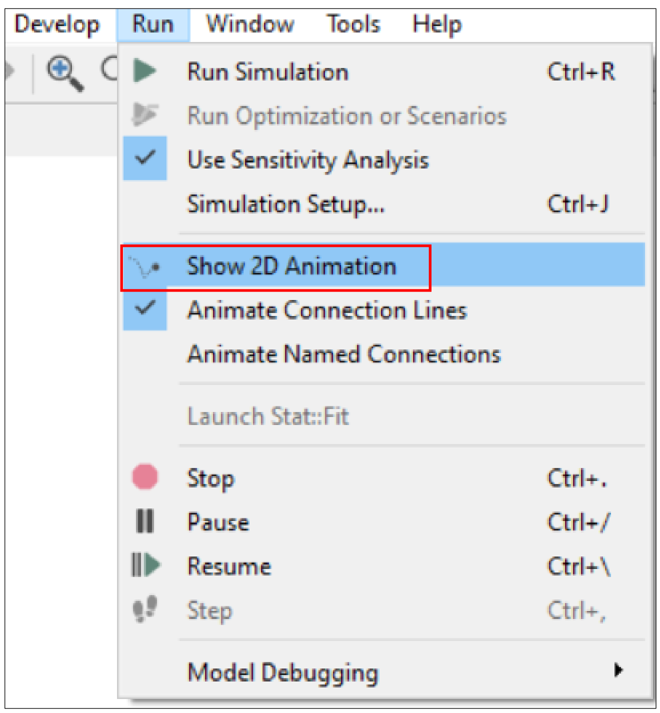


Figure 20: Selecting Animation Option

SECTION 6. BUILDING THE MODEL

Section Concepts:

- Placing Stream Source Object
- Defining Composition for Source
- Defining PSD

The next step is to build a steady-state model of a simplified acid leach facility (see Figure 1) using IDEAS steady-state or “macro” objects to represent an Autoclave, Preheaters, Flash Tanks, and Thickeners. This tutorial has been designed to explain various features of IDEAS steady state objects; it is not meant to be an exact model for any real process.

6.1 PLACING A STREAM SOURCE OBJECT ON TO THE WORKSHEET

Place a **Stream Source** object from the MATERIAL PROPERTIES library onto the worksheet. Move the object so that it is on the left side of the worksheet (see Figure 21). However, reserve the far left edge of the worksheet for administrative objects only, and DO NOT move the administrative objects from their default locations. Additional administrative objects should be placed to the left also, but no further left than the **Material Properties** object.

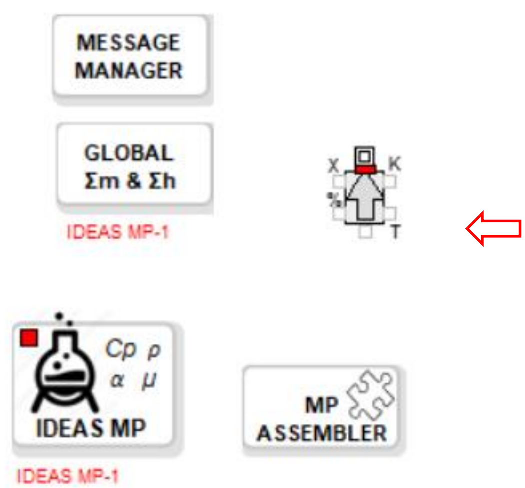


Figure 21: Placement of Source Object

The objects can be reoriented by using the dropdown menu at the bottom of the dialog box (see Figure 22).

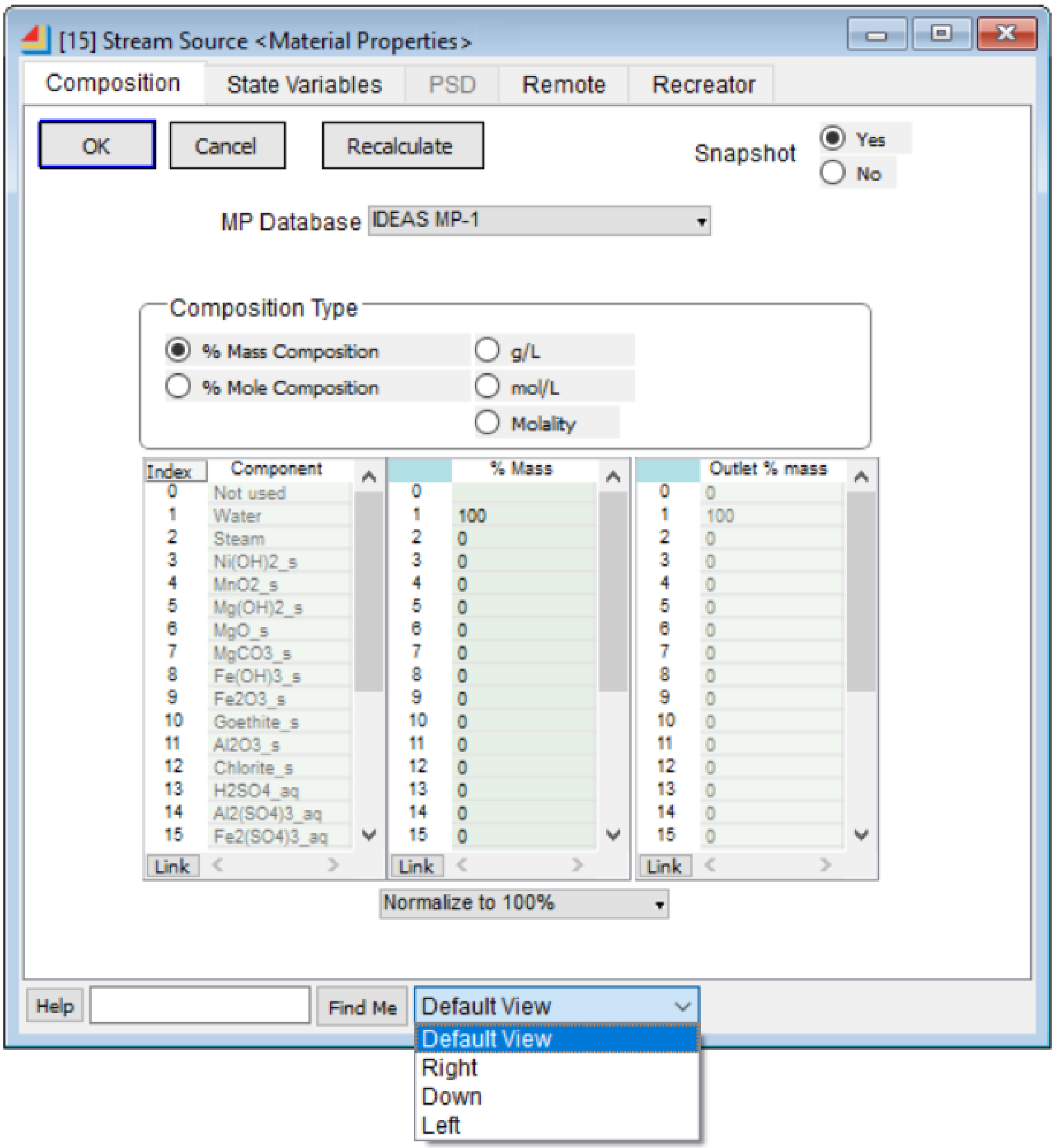


Figure 22: Object Orientation

6.2 DEFINING THE MASS % COMPOSITION OF THE STREAM

Open the **Stream Source** object's dialog box. In the Composition tab, notice that the component list is identical to the component list in the **Material Properties** object. The **Material Properties** object is the storage center of information about each component used within the model. The **% Mass Composition** radio button should be selected. In the **% Mass** table, notice that the composition is 100% water at this point. This is true because water is our default liquid for this model. We will now change the composition of this stream source. Type the following information under **%Mass** column in the fields corresponding to the components.

Table 3: Process Stream Composition

Component Name	% Mass
Water	60
Steam	0
Quartz_s	11.27
Ni(OH)2_s	0.9395
MnO2_s	0.4698
Mg(OH)2_s	1.409
MgO_s	2.349
MgCO3_s	0.4778
Fe(OH)3_s	2.349
Fe2O3_s	3.674
Goethite_s	4.698
Al2O3_s	2.349
Chlorite_s	10.01
H2SO4_aq	0
Al2(SO4)3_aq	0
Fe2(SO4)3_aq	0
NiSO4_aq	0
MgSO4_aq	0
CO2_g	0
H2S_g	0
FeSO4_aq	0
S_s	0
CaCO3_s	0
CaSO4	0
NiS_s	0
FeS_s	0

This is the composition of the Process Stream being fed to the process. Type *ProcessStream* in the **Block Label** box next to the **Help** button to give a name to this object. Click on the **OK** button to close the dialog box.

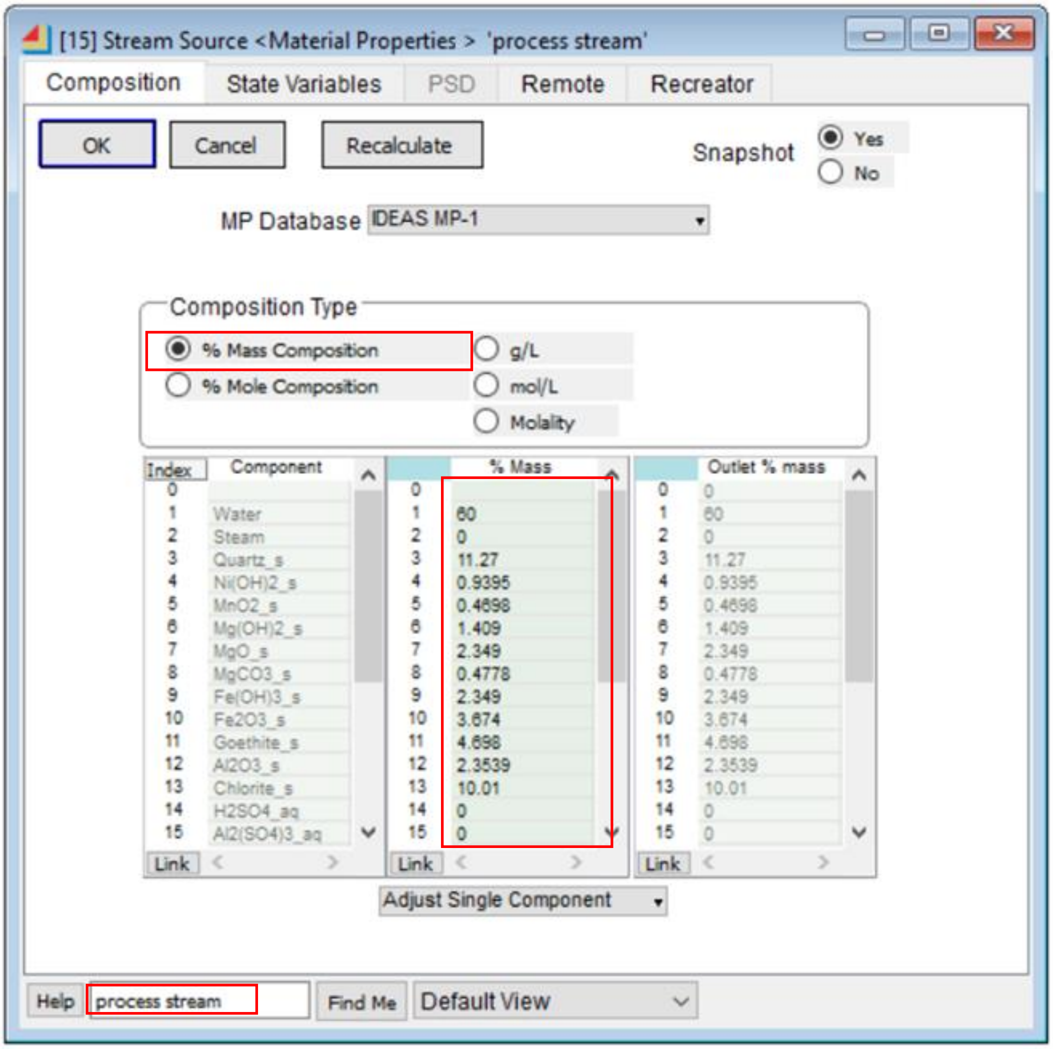


Figure 23: Stream Source Dialog Box Entries

6.3 DEFINING PSD FOR THE COMPONENTS

The components can have a defined Particle Size Distribution (PSD). To do this, place a **PSD Data** object from the MATERIAL PROPERTIES library onto the worksheet. Open its dialog box. The **Set PSD** tab is used to select the components that require the PSD information and to define the PSD for the selected components.

6.3.1 SELECTING COMPONENTS

In the **Set PSD** tab, if you click on the **Define** button in the Components w/PSD box/under Step #1, a new window, **Select Components for PSD**, appears. Select the desired components for each row. Select *Quartz_s* and press **Add** button. It will be displayed under ***Components w/PSD*** column. Similarly, select

MgCO3_s, *Fe2O3_s,* and *Chlorite_s* components. Click on **OK** button to accept the selection (see Figure 24).

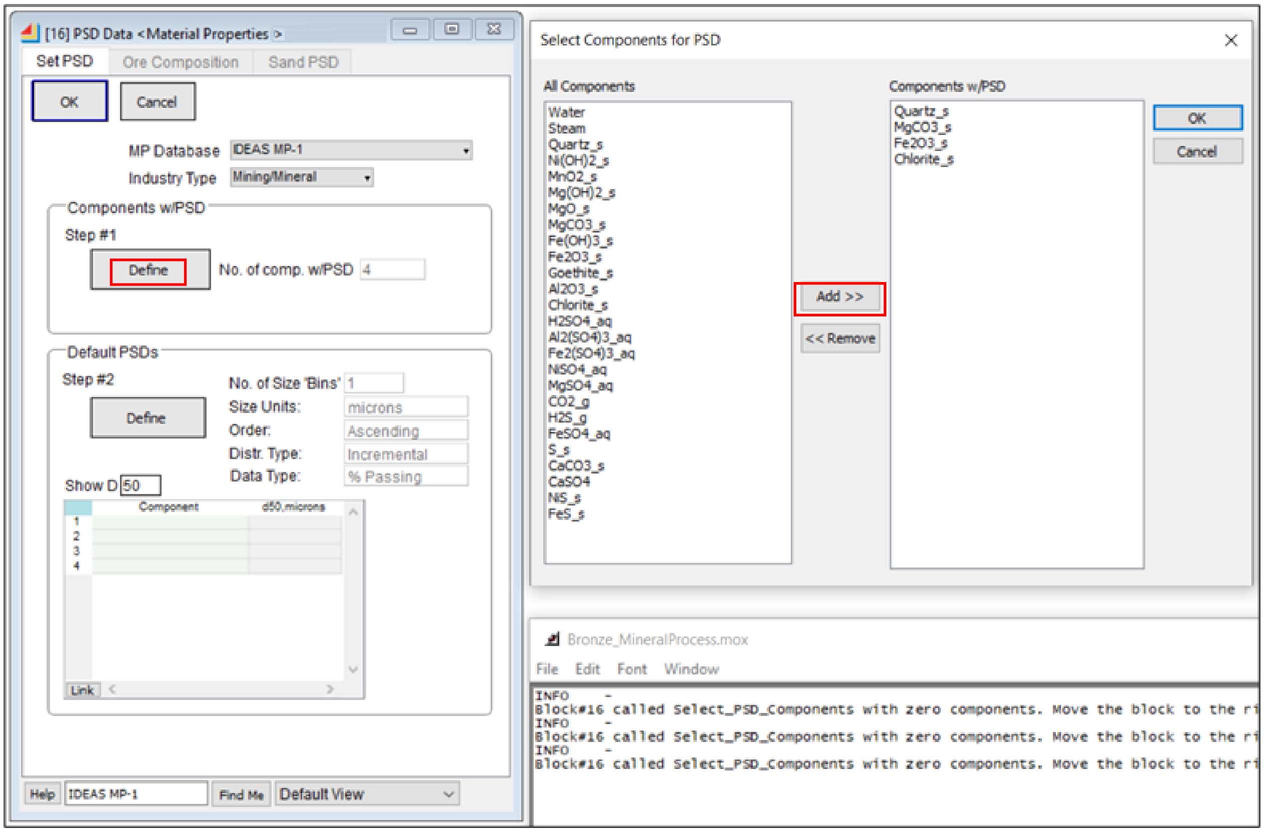


Figure 24: PSD Data, PSD Components Tab

6.4 DEFINING PSD

In the **Set PSD** tab, press the **Define** button in the Default PSDs box/under Step #2. A window called **Define Bin Information** appears. Enter **No of Bins** as 4. Enter the information given in Figure 24 under the **Diameter**, **Quartz_s**, **MgCO3_s**, **Fe2O3_s,** and **Chlorite_s** columns.

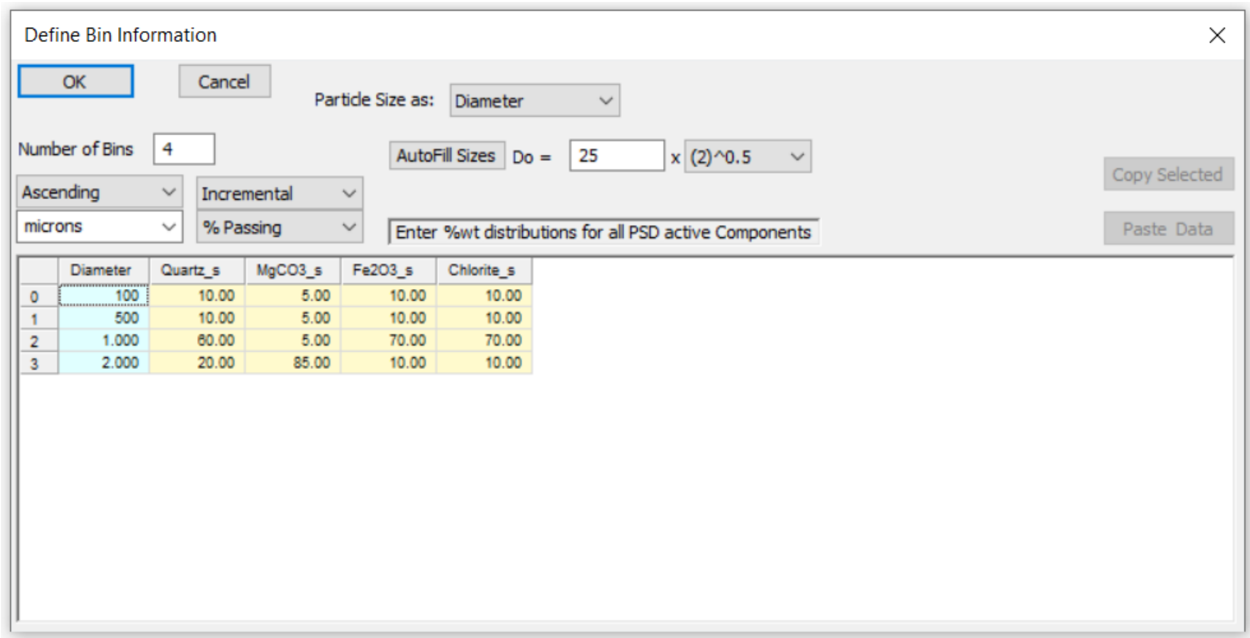


Figure 25: PSD Data, Defining PSD for Components

Press **OK** to close the **Define Bin Information** window. The **PSD Data** dialog box should now appear as in Figure 26 with the listed d_{50} values. Press **OK** to close the **PSD Data** object's dialog box.

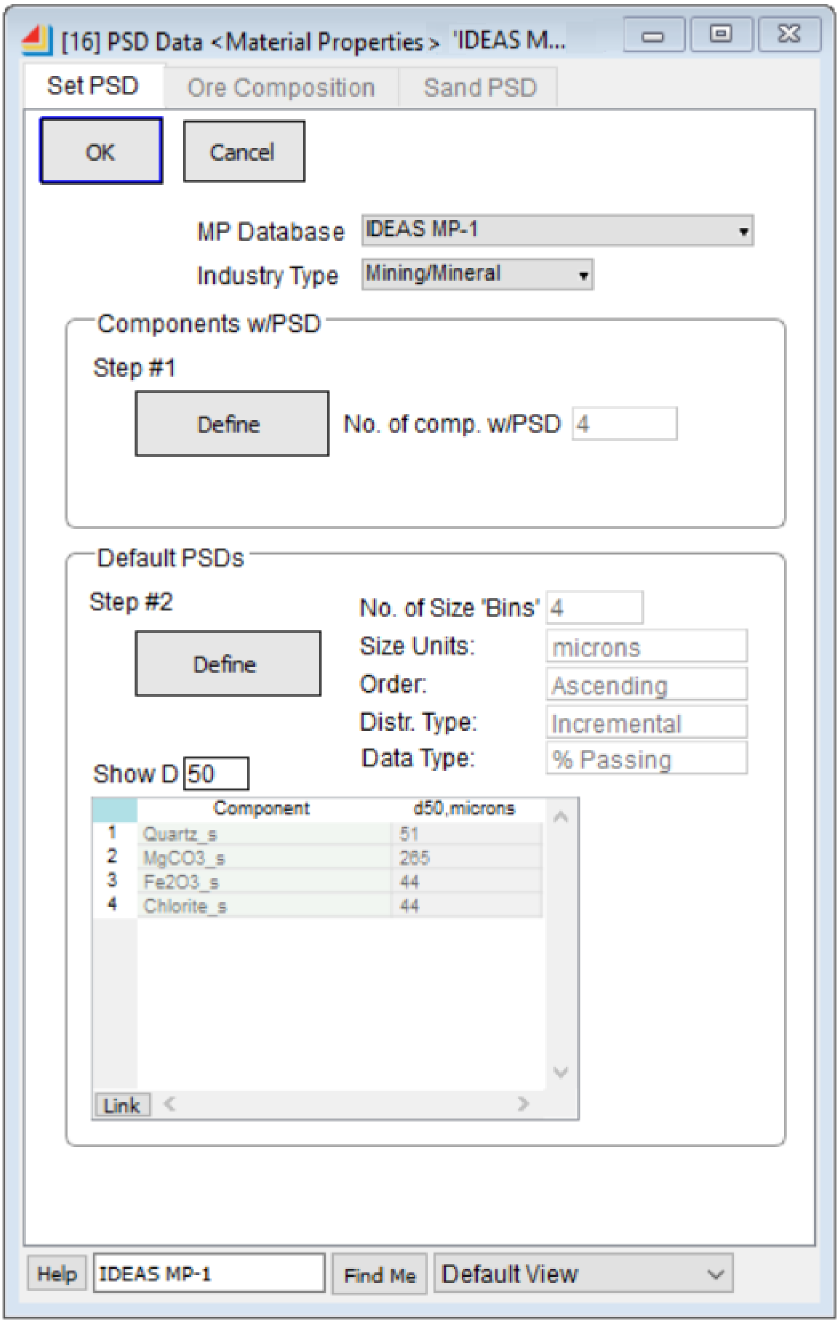


Figure 26: PSD Data, the d50s After Entering the Bin Data

SECTION 7. SELECT CONNECTION LINE CHOICES

Section Concept:

- Selecting Connection Lines

7.1 CONNECTION LINE SETTINGS

Select Connection Lines under **Model** on the menu bar. When you move the mouse button to *Connection Lines*, a submenu opens to the right of the main menu. Select and de-select items until your menu choice for connection lines is identical to the one shown in Figure 27. (Your default selections may match those already shown in the figure).

Notice that we have selected the connection lines to be perpendicular and double thickness with defaults, solid and grey. With these choices, whenever we connect objects on the worksheet, the connection lines will be formed with perpendicular sections of solid lines. The color of the lines will be grey.

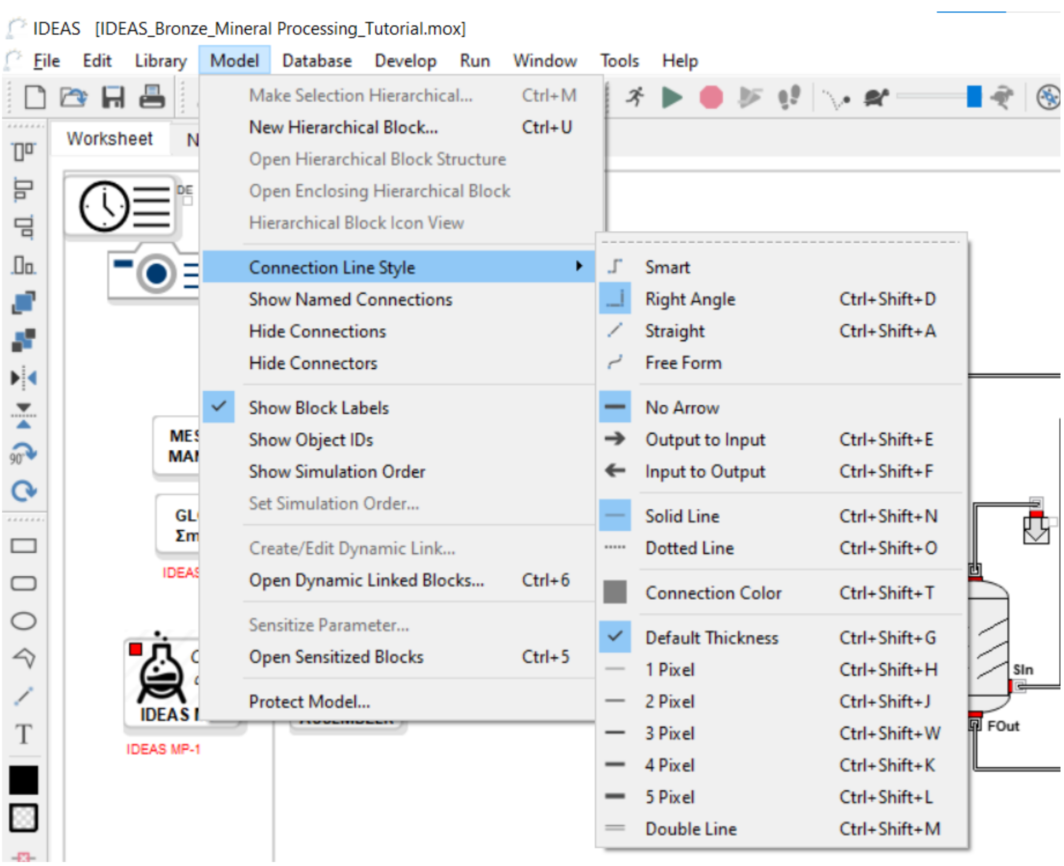


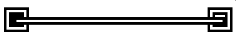
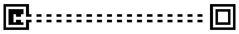
Figure 27: Choice of Connection Line Style

SECTION 8. CONNECTING OBJECTS

Section Concept:

- Connecting Objects

8.1 CONNECTORS

To make connections between two objects, place the cursor over a connector. The cursor changes from an arrow to a new double-headed or head and tail arrow . Click on the first connector to start the line. Move the mouse to the destination connector and make sure the arrow changes again before clicking to complete the line. If you miss the connector, the mouse will still be in the connection line mode. Double-click to release the connection line without connecting to a final connector - if the connection is successful, the line is solid (inlet connector  outlet connector), if not, the line is dashed (inlet connector  outlet connector).

SECTION 9. BUILDING THE SECTION 1

Section Concepts:

- Place Preheater and Flash Objects
- Place High Pressure Acid Leach Object
- Place Supervisors
- Place Various Instruments
- Connect Objects

9.1 BUILDING HIGH PRESSURE ACID LEACH PROCESSES

9.1.1 PLACING THREE PREHEATER AND THREE SINK OBJECTS

Place three **Preheater** objects from the Mineral Processing – B library on the worksheet and move them next to the Stream Source and next to each other. Place three **Sink** objects from MATERIAL PROPERTIES library and place each of them next to the *SOut* of each Preheater. Then, connect each of these sinks to the *SOut* of each Preheater (see Figure 28).

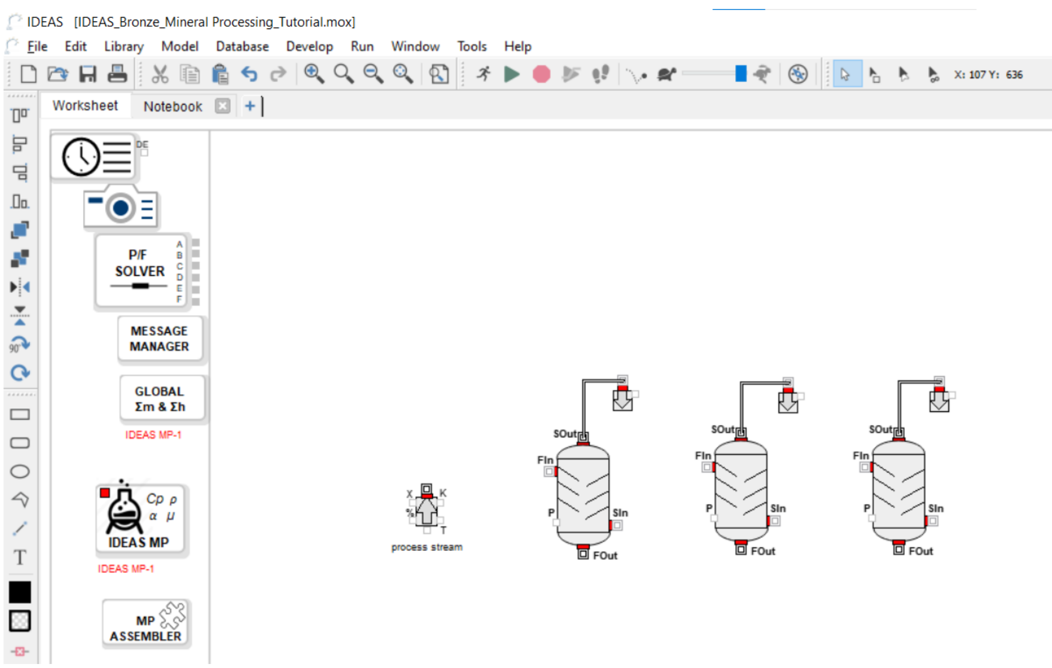


Figure 28: Placement of Preheater Objects, Sink Objects and New Connections

9.1.2 CONNECTING PREHEATER OBJECTS

Connect the outlet of the **Stream Source** object to the *Fin(FeedIn)* of the first Preheater, the *Fout*

(Slurry_DischargeOut) of the first Preheater to the *Fin* of the second Preheater, and the *Fout* of the second Preheater to the *Fin* of the third Preheater (see Figure 29).

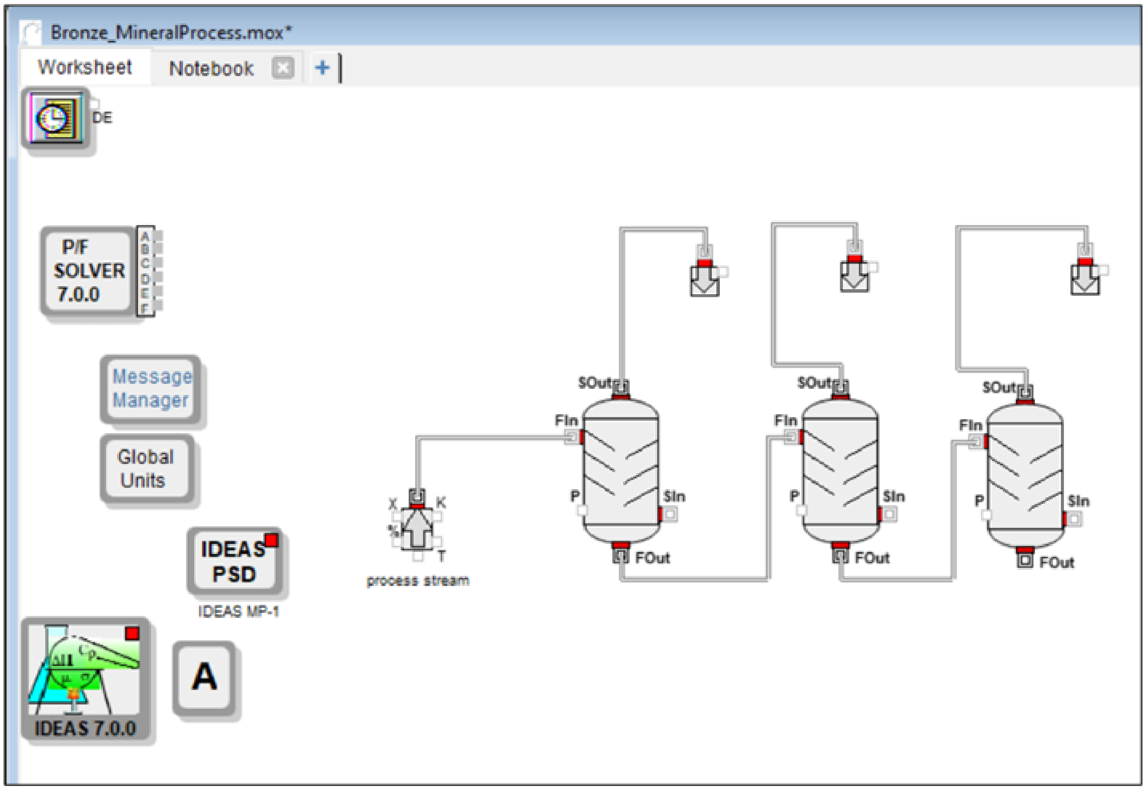


Figure 29: Connecting Preheater Objects

9.1.3 PLACING PRESSURE ACID LEACH AUTOCLAVE OBJECT

Place the **Pressure Acid Leach Autoclave** object from the Mineral Processing – B library onto the worksheet and move it next to the three **Preheater** objects.

9.1.4 PLACING ACID STREAM SOURCE AND SINK OBJECTS

Place a **Stream Source** object from the MATERIAL PROPERTIES library and move it to above the Autoclave. Open its dialog box, change the composition of Water to 0 by typing 0 in the **%Mass column** for *Water* component, and change the composition of *H2SO4_aq* from 0 to 100. Type *Acid* in the Block Label box next to the help button to give a name to this source. Connect it to the acid inlet *(AcidIn)* of the Autoclave (see Figure 30).

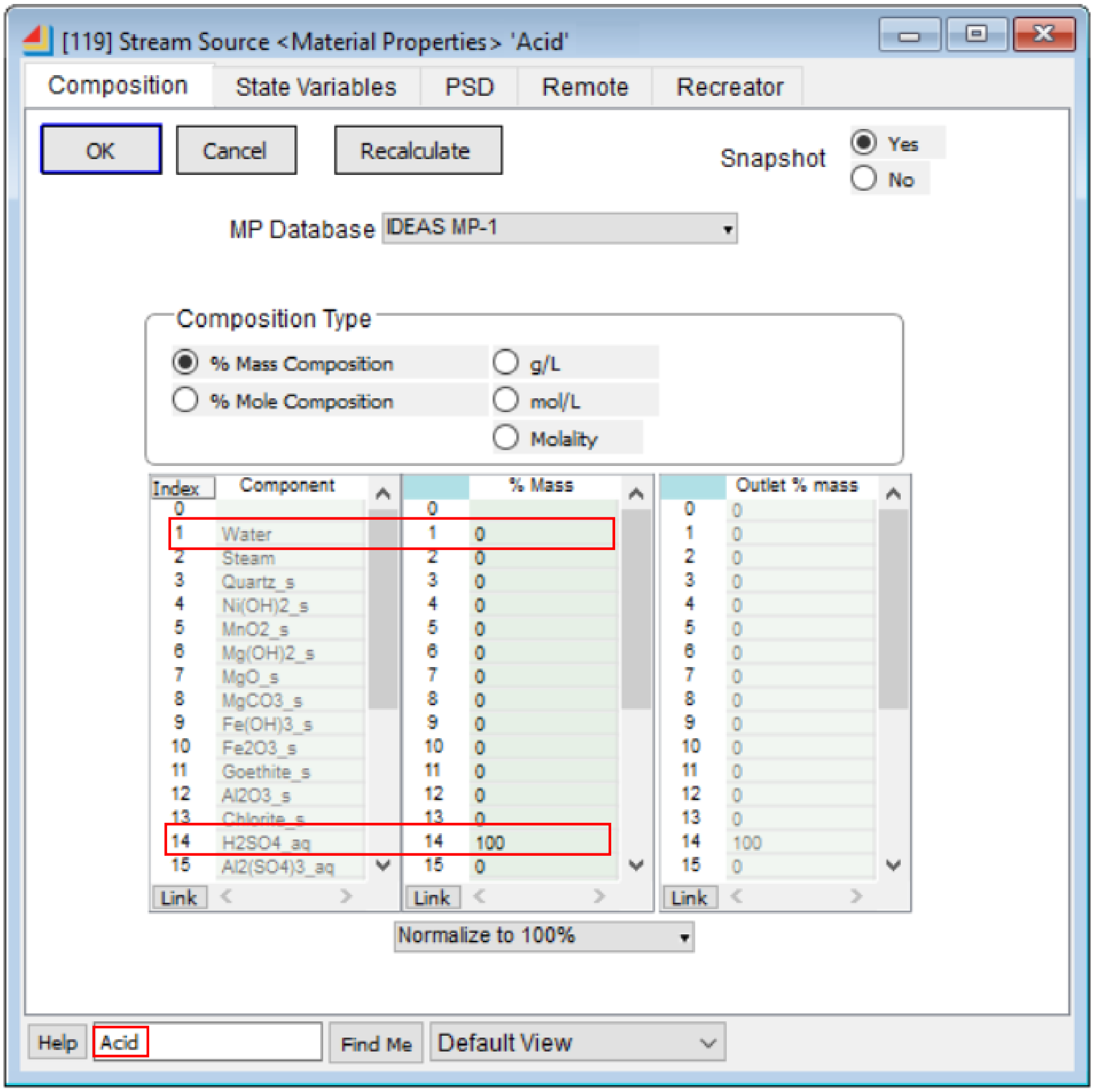


Figure 30: Acid Stream Source Composition

Place a **Sink** object (from MATERIAL PROPERTIES library) above the **Autoclave** object and connect it to the *Gasout* outlet of the Autoclave (see Figure 31).

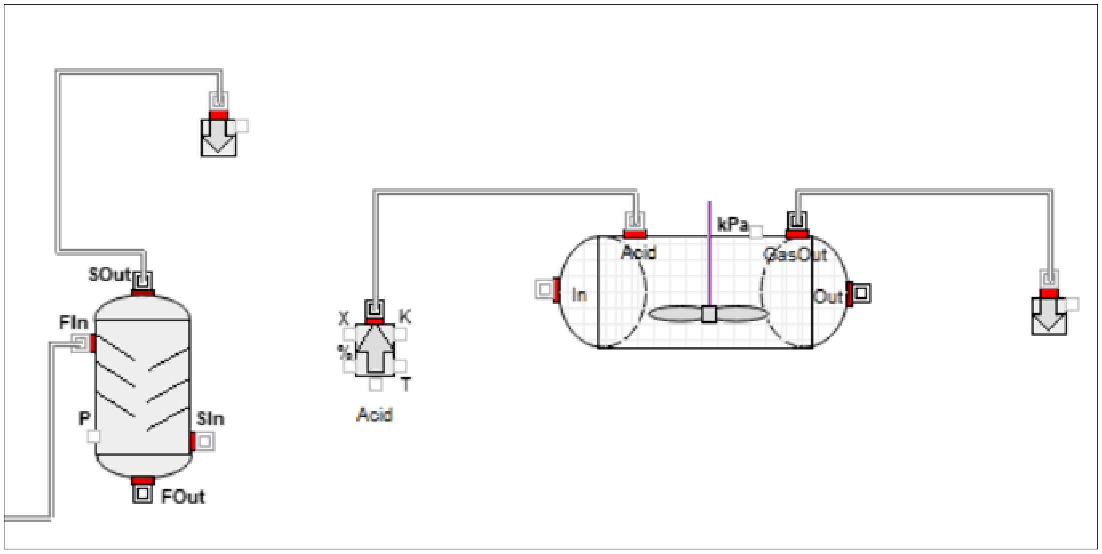


Figure 31: Placing Acid Source/Sink Objects: Connecting to Autoclave Object

9.1.5 PLACING THREE FLASH OBJECTS AND ONE SINK OBJECT

Place three **Flash** objects from the MACRO UNIT OPS library onto the worksheet and move them to the right of the **Autoclave** object next to each other. Place one **Sink** (from MATERIAL PROPETIES library) object to the right of the last **Flash** object (see Figure 32).

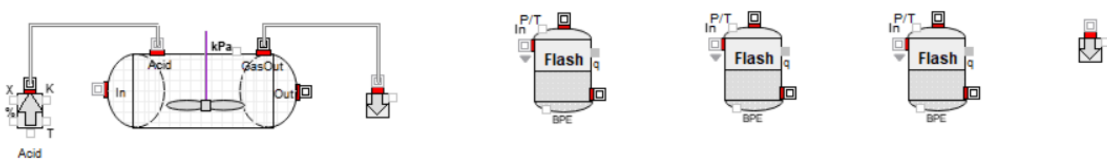


Figure 32: Placing three Flash Objects and one Sink Object

9.1.6 CONNECTING THE AUTOCLAVE, THREE FLASH OBJECTS, AND ONE SINK OBJECT

Connect the *Fout* of the third **Preheater** object to the *In(FeedIn)* connector of the **Autoclave** object and connect the *Out* connector of **Autoclave** object to the *In* connector of first **Flash** object. Connect the *LiquidOut* connector of the first **Flash** object to the *In* connector of second **Flash** object. Similarly, connect the *LiquidOut* connector of the second **Flash** object to the *In* connector of the third **Flash** object. Connect the *VaporOut* of the third **Flash** object to the inlet of **Sink** object placed near to this. See Figure 33 for details.

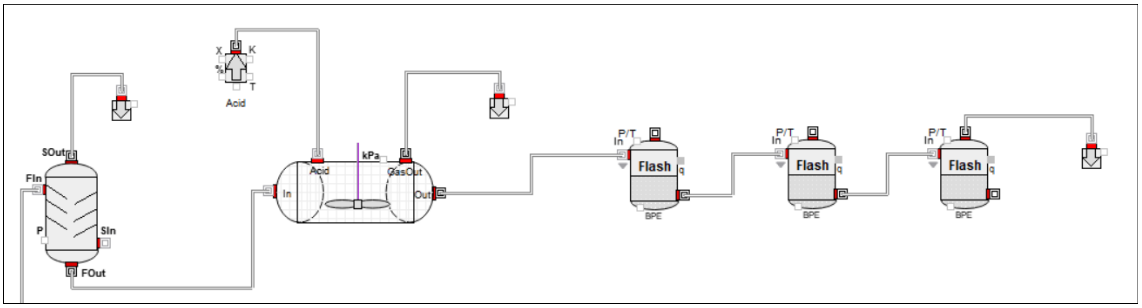


Figure 33: Connecting Autoclave, three Flash Objects, and one Sink Object

9.1.7 CONNECTING PREHEATERS AND FLASH OBJECTS

Connect the *VaporOut* of the second **Flash** object to the *SIn(SteamIn)* connector of the first **Preheater** object and the *VaporOut* of the first **Flash** object to the ***SIn*** of the second **Preheater** object (see Figure 34).

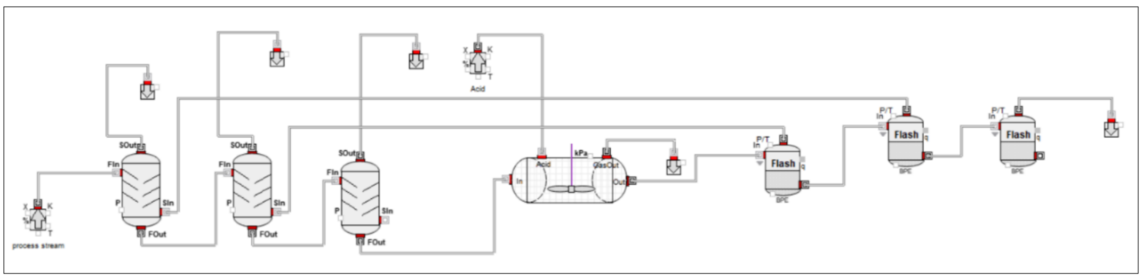


Figure 34: Connecting Flash Objects and Preheater Objects

9.1.8 CREATING STEAM STREAM SOURCE AND FLOW SET OBJECTS

Place a **Stream Source** object from the MATERIAL PROPERTIES library and move it to below the third **Preheater** object. Open its dialog box, change the composition of Water to 0 by typing 0 in the **%Mass** column for *Water* component, and change the composition of Steam from 0 to 100. Label it as *Steam* in the box next to the help button (see Figure 35). This will act as the *Steam* Stream Source.

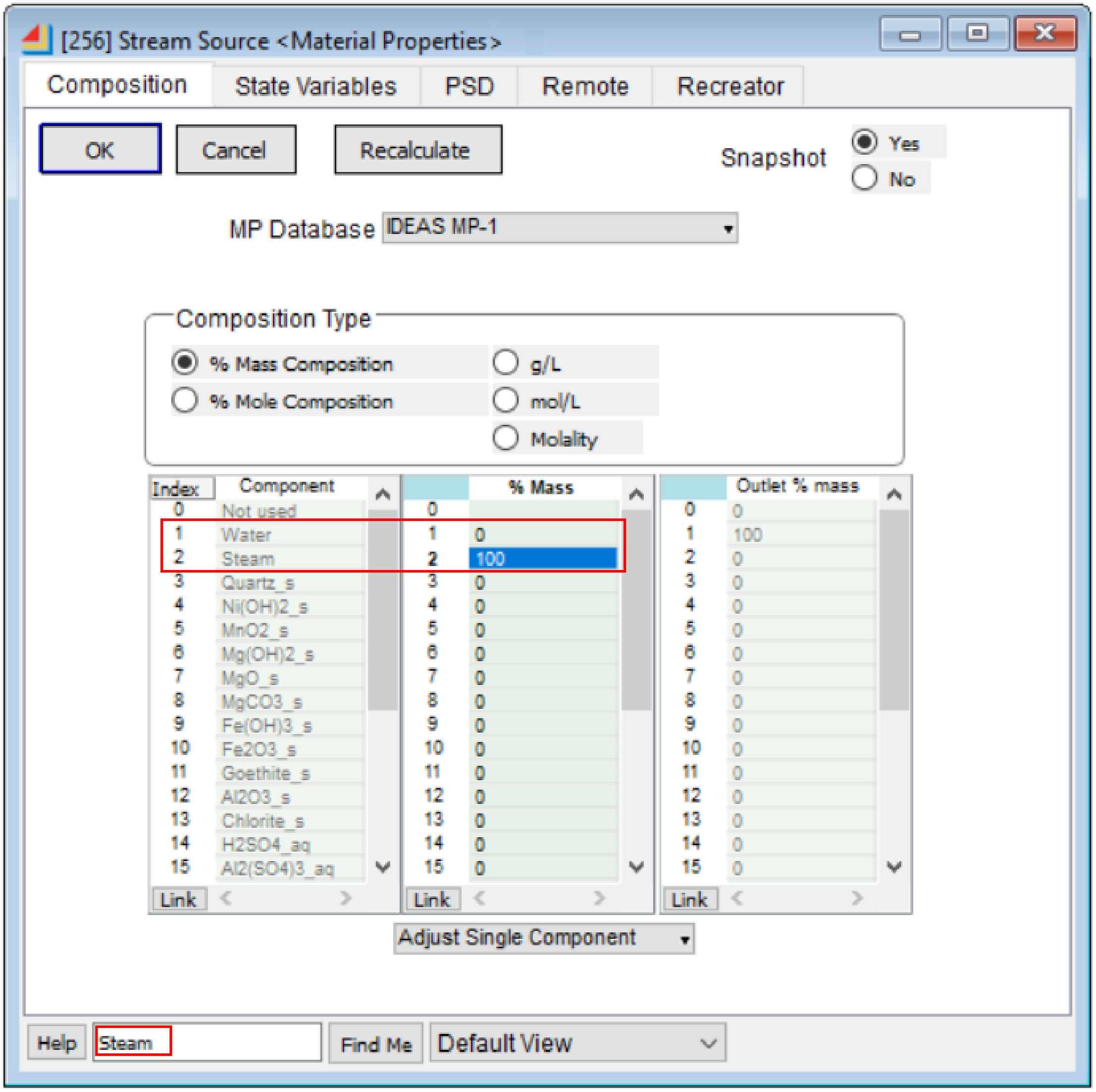


Figure 35: Steam Stream Source Composition

Place one **Flow Set** object from MACRO PRIMITIVES library on the worksheet. Move it next to the Steam **Stream Source** object. Connect the outlet of the **Stream Source** object to the inlet of **Flow Set** object and then the **Flow Set** object's outlet to the *Sin* of the third **Preheater** object. This setup supplies Steam to the third **Preheater**. See Figure 36 for details.

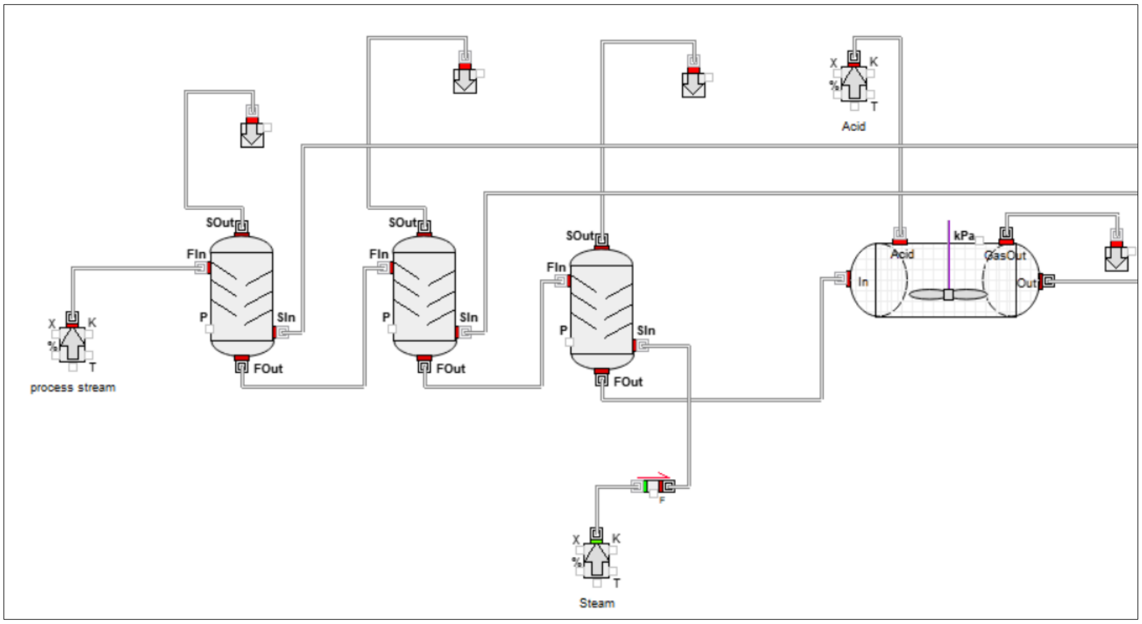


Figure 36: Steam Source, Flow Set Objects and New Connections

9.2 PLACING TRANSMITTERS

Place one **Transmitter-PSD** object, one **Transmitter-Element Flow** object, one **Transmitter-Element Content** object and one **Transmitter-Temperature** object from the TRANSMITTERS library onto the worksheet.

Move the **Transmitter-PSD** object above *ProcessStream* Stream Source and connect its inlet to the outlet of the **Stream Source** object.

Move the **Transmitter-Element Flow** object above the *ProcessStream* object and connect its inlet to the outlet of **Stream Source** object.

Move the **Transmitter-Element Content** object near to the *LiquidOut* connector of the last **Flash** object and connect its inlet to the *LiquidOut* connector (see Figure 37).

Move the **Transmitter-Temperature** object below the **Autoclave** object and near to the out connector. Connect the **Transmitter-Temperature** object's inlet to the outlet connector of the **Autoclave** object (see Figure 37).

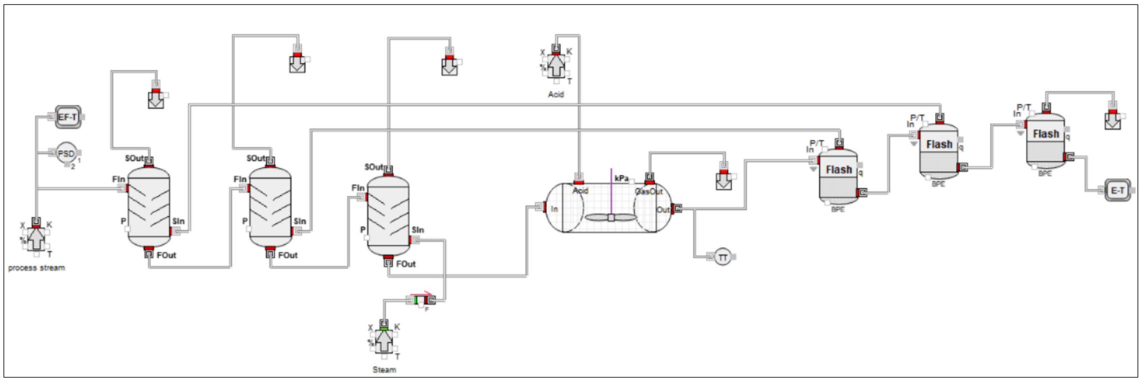


Figure 37: Placement of Different Transmitter Objects and New Connections

9.3 PLACING TWO SUPERVISOR OBJECTS

Place two **Supervisor** objects from the MACRO PRIMITIVES library onto the worksheet.

Place the first Supervisor object close to the **Transmitter-Temperature** object that is connected to the **Autoclave** object. Connect the outlet of **Transmitter-Temperature** object to the inlet of the supervisor (see Figure 38).

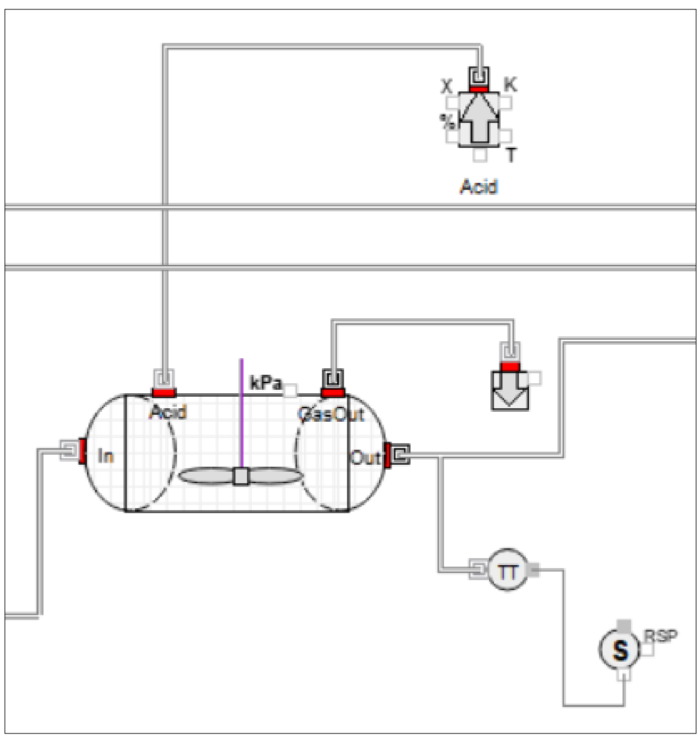


Figure 38: Placement of First Supervisor Object and New Connections

Place the second **Supervisor** object close to the **Transmitter-Element Content** object that is connected to the Third Flash object. Connect the outlet of **Transmitter-Element Content** object to the inlet of the supervisor (see Figure 39).

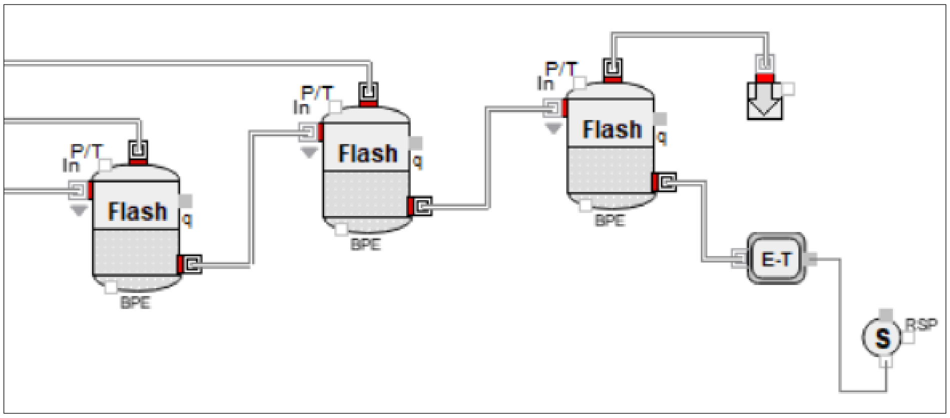


Figure 39: Placement of Second Supervisor Object and New Connections

SECTION 10. CONNECTING OBJECTS VIA NAMED CONNECTIONS

Section Concepts:

- Creating Labels
- Connecting via Labels

10.1 NAMED CONNECTIONS

Create a name text block by double-clicking the mouse on the worksheet near the first **Supervisor** object that is connected to the **Transmitter-Temperature** object's outlet. A text box will appear.

Create a text block called *Steam Flow t/hr* near the first supervisor object. Create a similar text block near the **Flow Set** object and connect them as shown in Figure 40. When doing so, the connection may be made from a connector to anywhere on the text name itself. This makes a connection that is equivalent to a direct connection (see Figure 40) (When connecting from the text to an object's connector, start the connection at the left or right end of the text—the cursor will change to a double-sided arrow when you are in an appropriate location to begin a connection.).

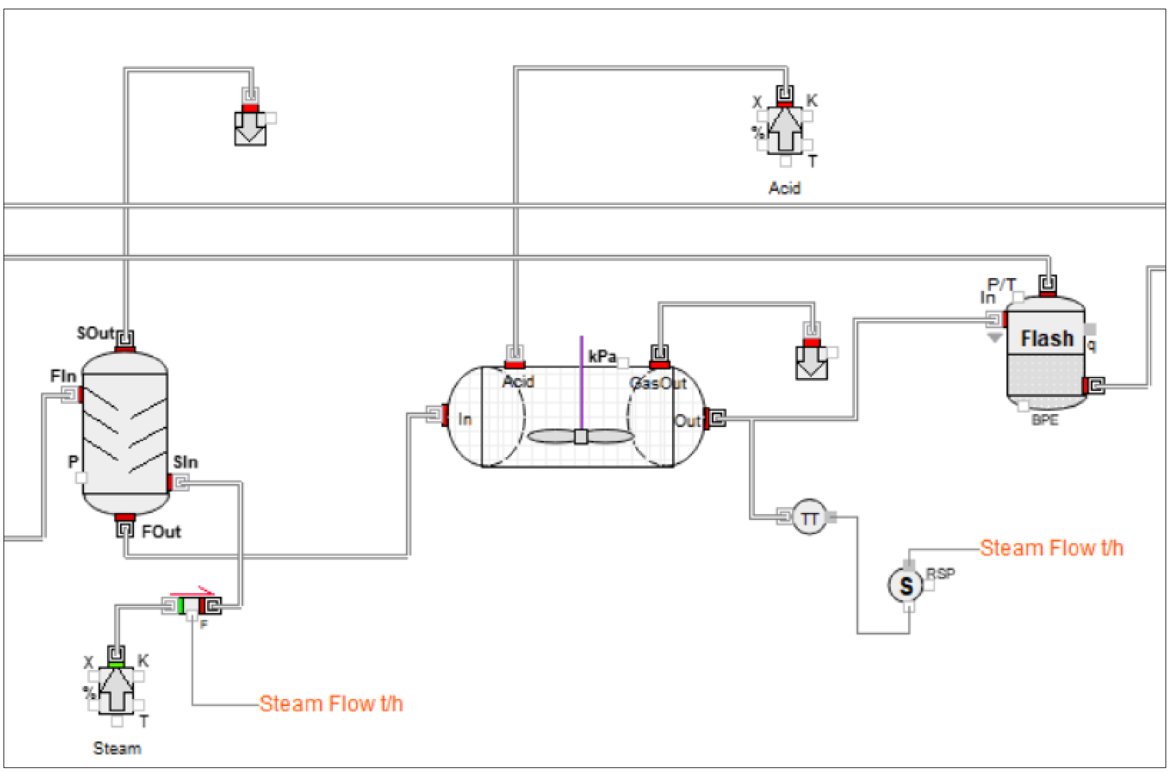


Figure 40: Connecting Objects via Text Block/Named Connections

Create another label called *Acid Flow tph* near the second supervisor object, which is connected to the **Transmitter-Element Content** object. Create the same label near the **Acid Stream Source** object, which is above the **Autoclave** object and connect them as shown in Figure 41.

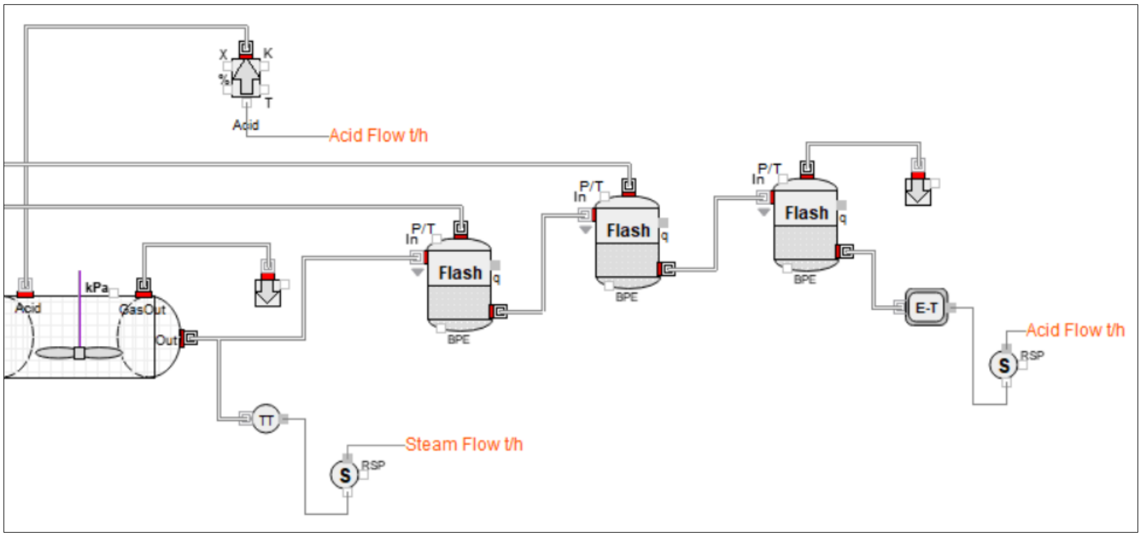


Figure 41: Connecting Objects via Labels/Named Connections

10.2 PLACING SINK OBJECT

Place a **Sink** object (from MATERIAL PROPERTIES library) near the outlet of the third **Flash** object and connect it to the *Liquid Out* connector of the **Flash** object (see Figure 42).

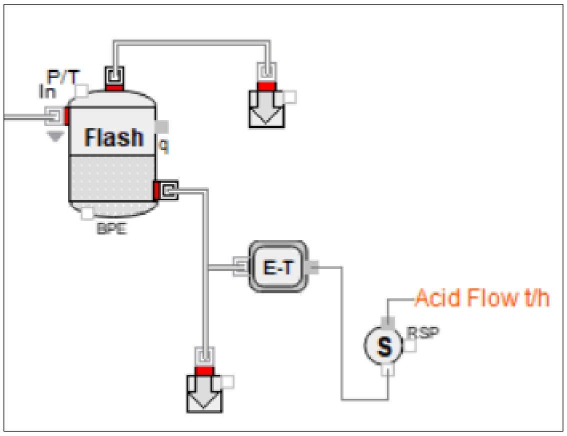


Figure 42: Connecting New Sink Object to the Third Flash Object

10.3 PLACING 4 CONSTANT_C OBJECTS

Place four **Constant**_c objects from TOOLS library onto the worksheet. Move them to locations as shown in Figure 43 and open each Constant_c dialog box. In the *Output Value* dialog box field, enter the values that appear as shown in Figure 43 (1100, 2200, 4400, 4400).

Connect each of these objects to the *P* connectors of the **Preheater** objects and the last one to the *kPa* connector of the **Autoclave** object. We will now be able to set the pressures of the objects.

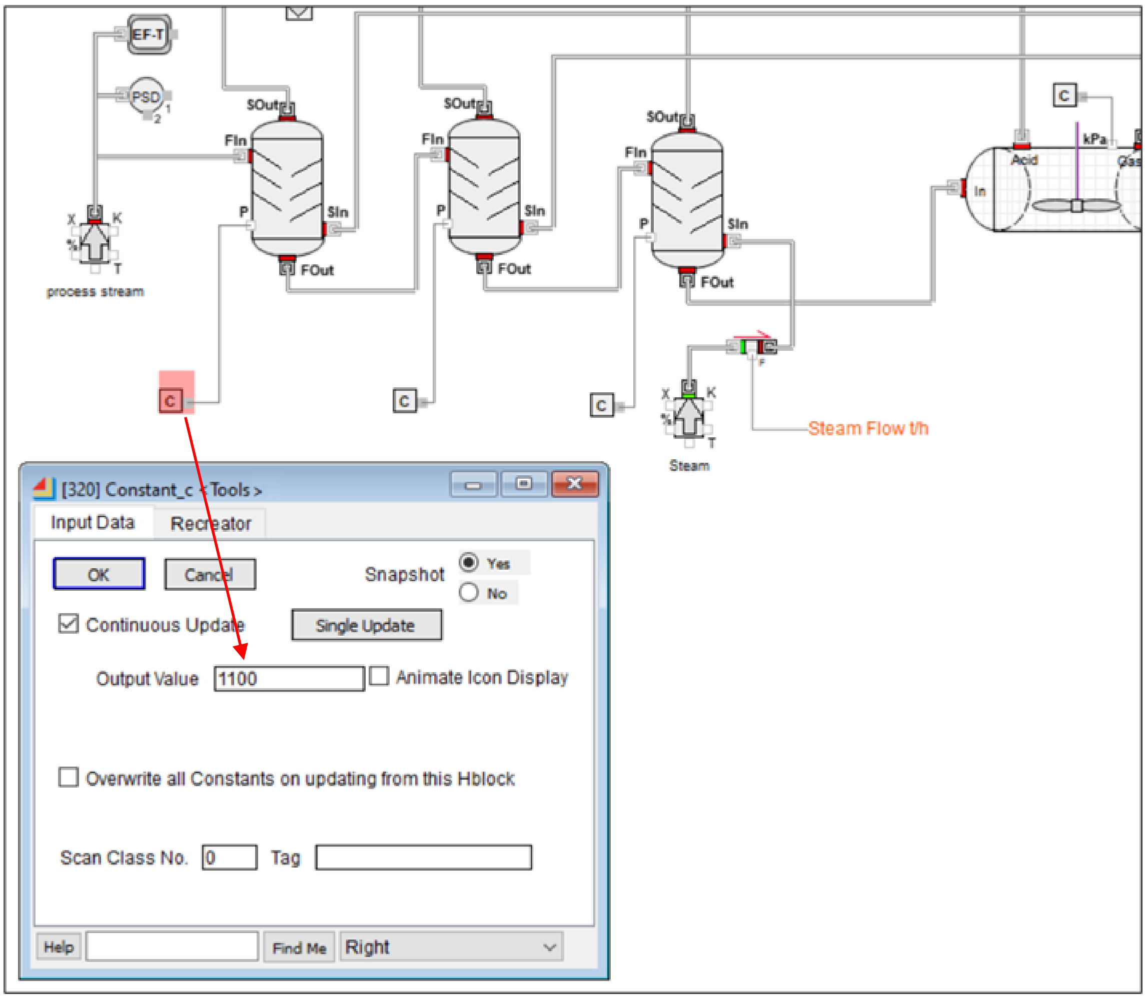


Figure 43: Placement of Constant_c Objects and New Connections

10.4 PLACING ELEMENT SELECTOR 150 OBJECT

Place an **Element Selector 150** object from MATERIAL PROPERTIES library onto the worksheet. Move it to the left bottom of the worksheet. This object will be useful to view the elemental balance and to select subcomponents to monitor in our model.

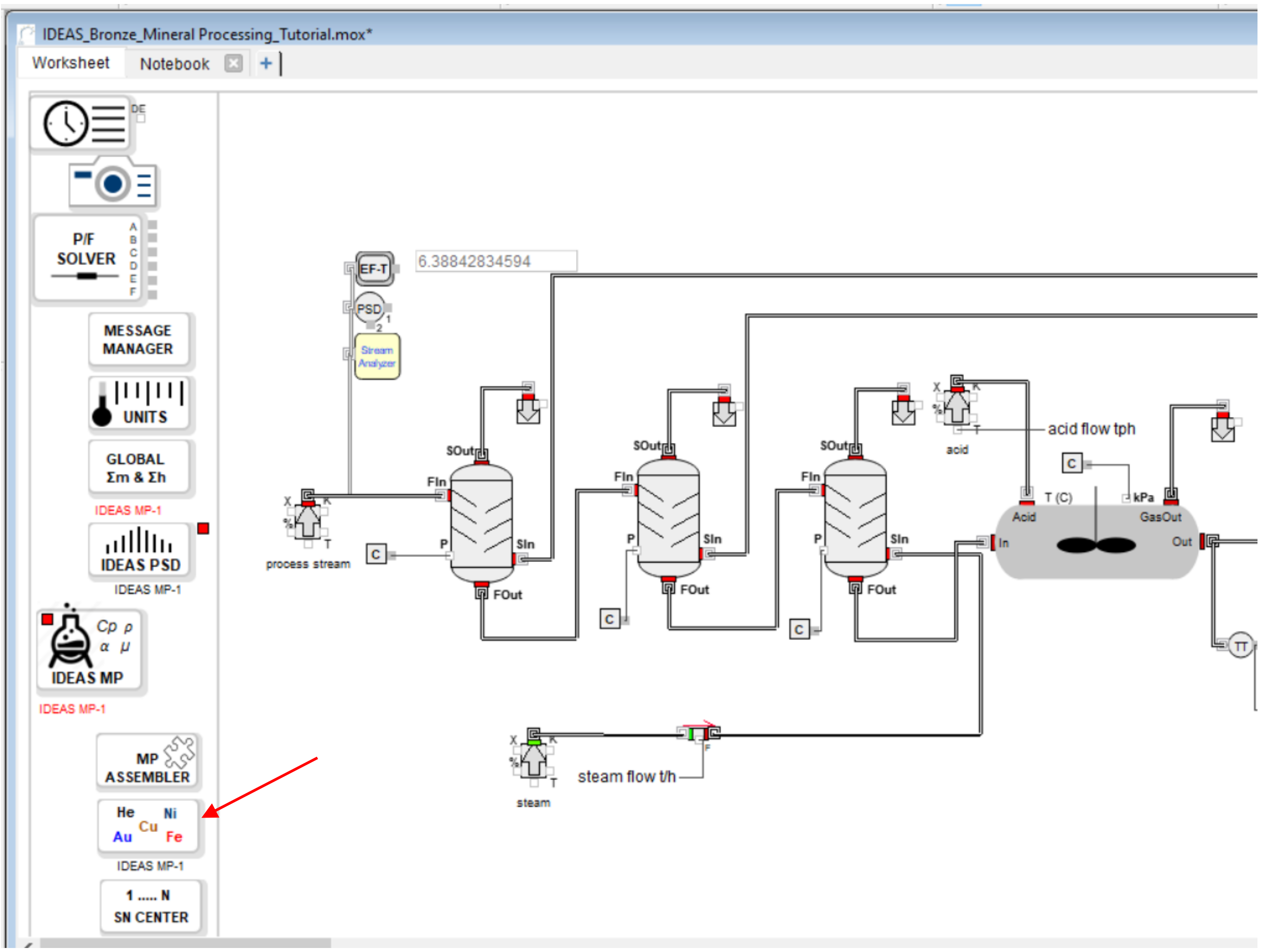


Figure 44: Placing Element Selector Object on the Worksheet

SECTION 11. SETTING OPTIONS FOR OBJECTS

<u>Section Concepts:</u>

- Set Options for Stream Source Objects
- Set Options for Flash Objects
- Define Reactions
- Set Options for Various Transmitters

11.1 SETTING OPTIONS FOR STREAM SOURCE OBJECTS

Notice that the outlet color of the *ProcessStream* **Stream Source** object is Green. Open the *ProcessStream* Stream Source dialog box and go to **State Variables** tab. Check the **Flow** radio button and enter 1074 t/h (see Figure 45). Click on the **OK** button to close the dialog box. Notice that the color of this **Stream Source** object's outlet connector has changed from *Green* to *Red*, which means that this object is setting the flow rate (see Table 4).

Table 4: Red and Green Connector Descriptions

	Red	**Green**
Inlet	Sets Pressure	Sets Flow Rate
Outlet	Sets Flow Rate	Sets Pressure

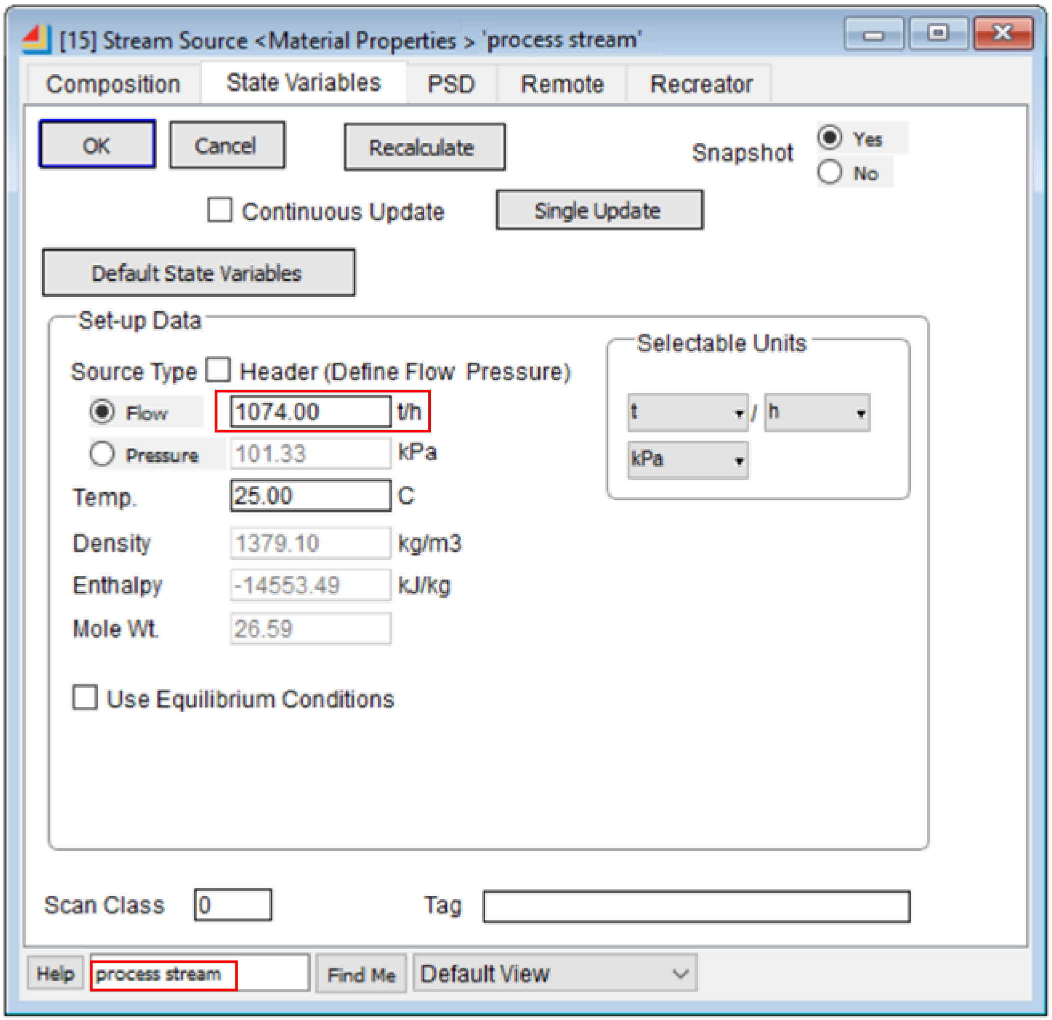


Figure 45: ProcessStream Stream Source, Input Parameters

Open the ***ProcessStream* Stream Source** dialog box and go to the **PSD** tab. Click on the **Get Default PSD data** button to import the PSD data from the database we had defined in the beginning (see Figure 46).

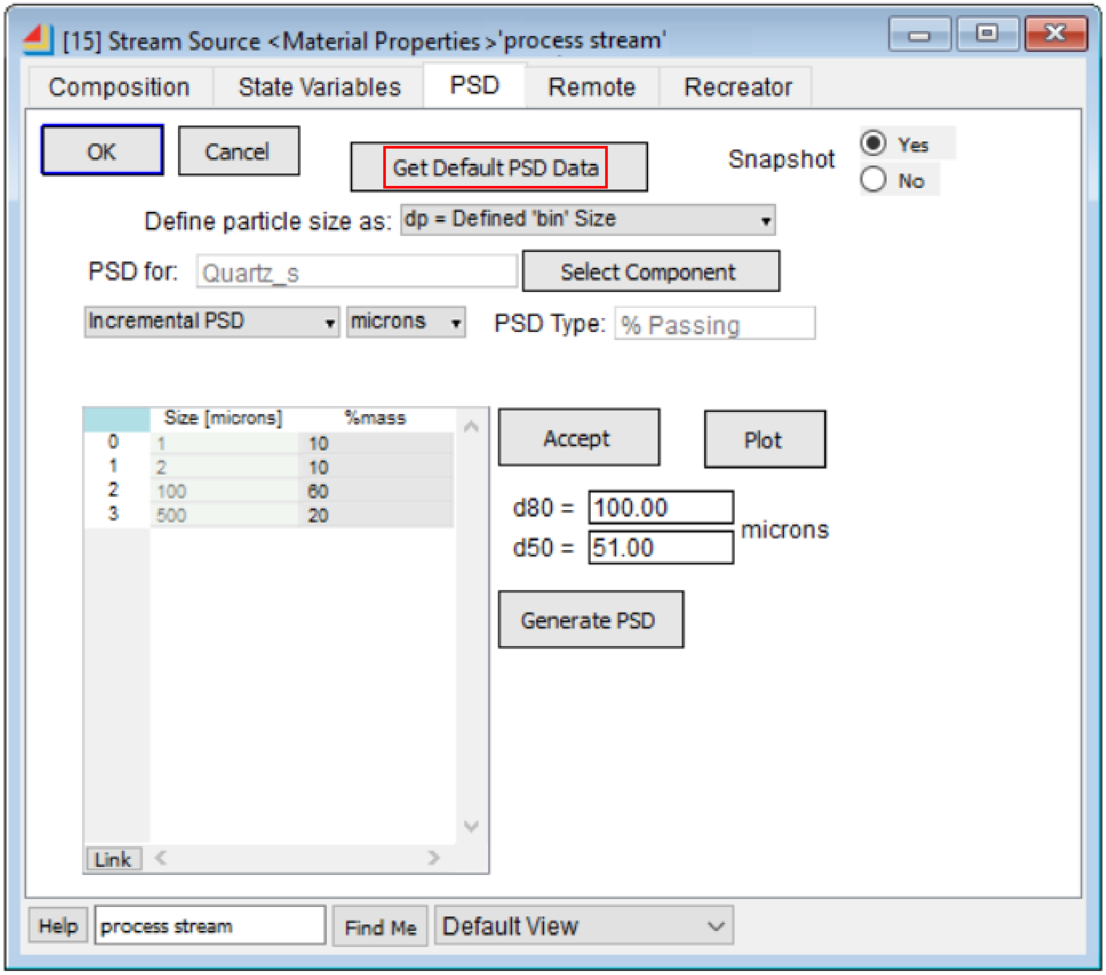


Figure 46: ProcessStream Stream Source, Importing PSD Data

Go to the *Steam* Stream Source that is connected to the third **Preheater** object, open the dialog box, and go to the **State Variables** tab. Enter 256 in the *Temperature* field. This will be used to supply steam at a temperature of 256ºC and at a flow rate demanded by the **Flow Set** object. The **Flow Set** object's demanded flow rate again depends on the first **Supervisor** object.

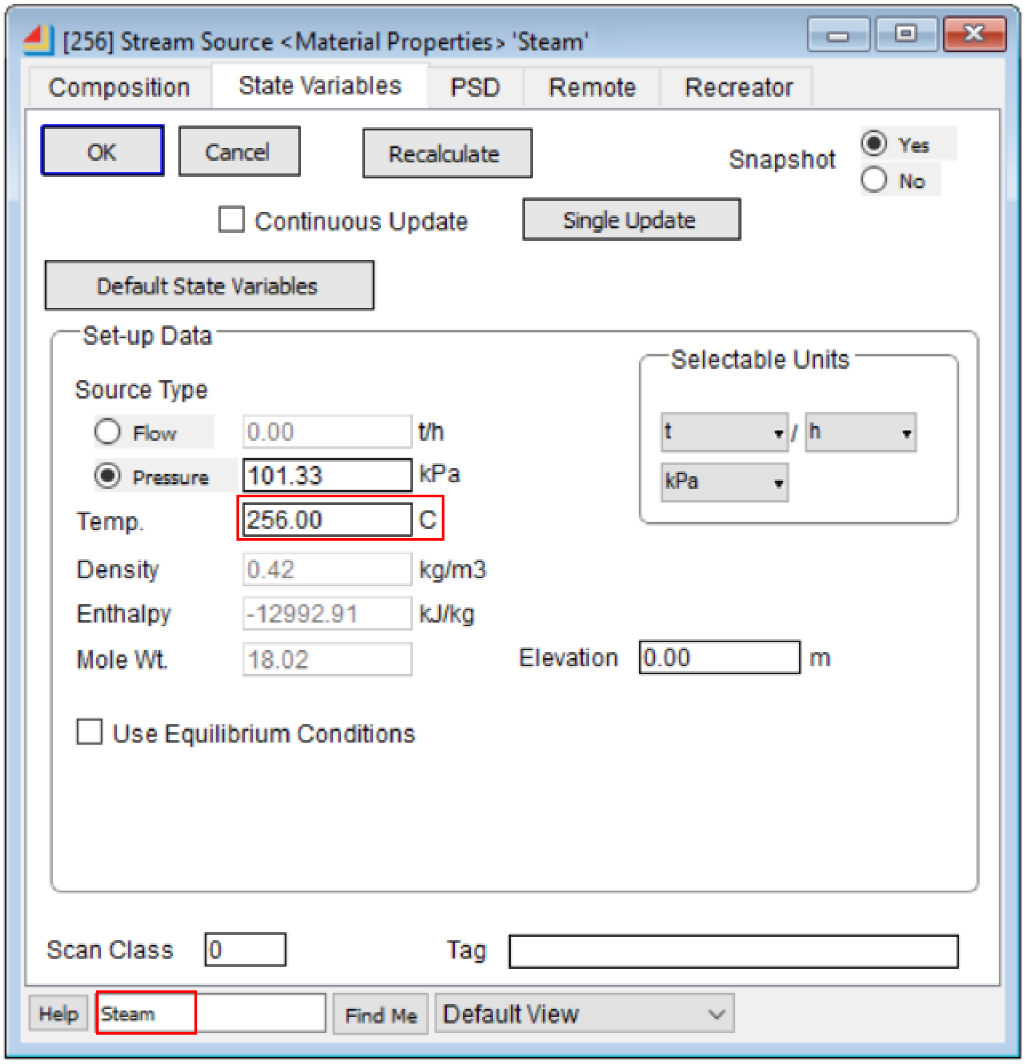


Figure 47: Steam Stream Source, State Variables Tab

11.2 SETTING OPTIONS FOR ACID (H_2SO_4) STREAM SOURCE OBJECT

Go to the *Acid* **Stream Source** object that is placed above the **Autoclave** object. This source provides the H_2SO_4 component. Notice that the outlet color of the Acid **Stream Source** object is Green. Open the dialog box and go to the **State Variables** tab. Check the **Flow** radio button. The user does not need to enter the flow rate here, as it will be calculated during the simulation run with the help of the second **Supervisor** object. Click **OK** to accept the changes and close the dialog box. Notice that the color of this **Stream Source** object's outlet connector has changed from *Green* to *Red*, which means that this object is setting the flow rate (see Figure 48).

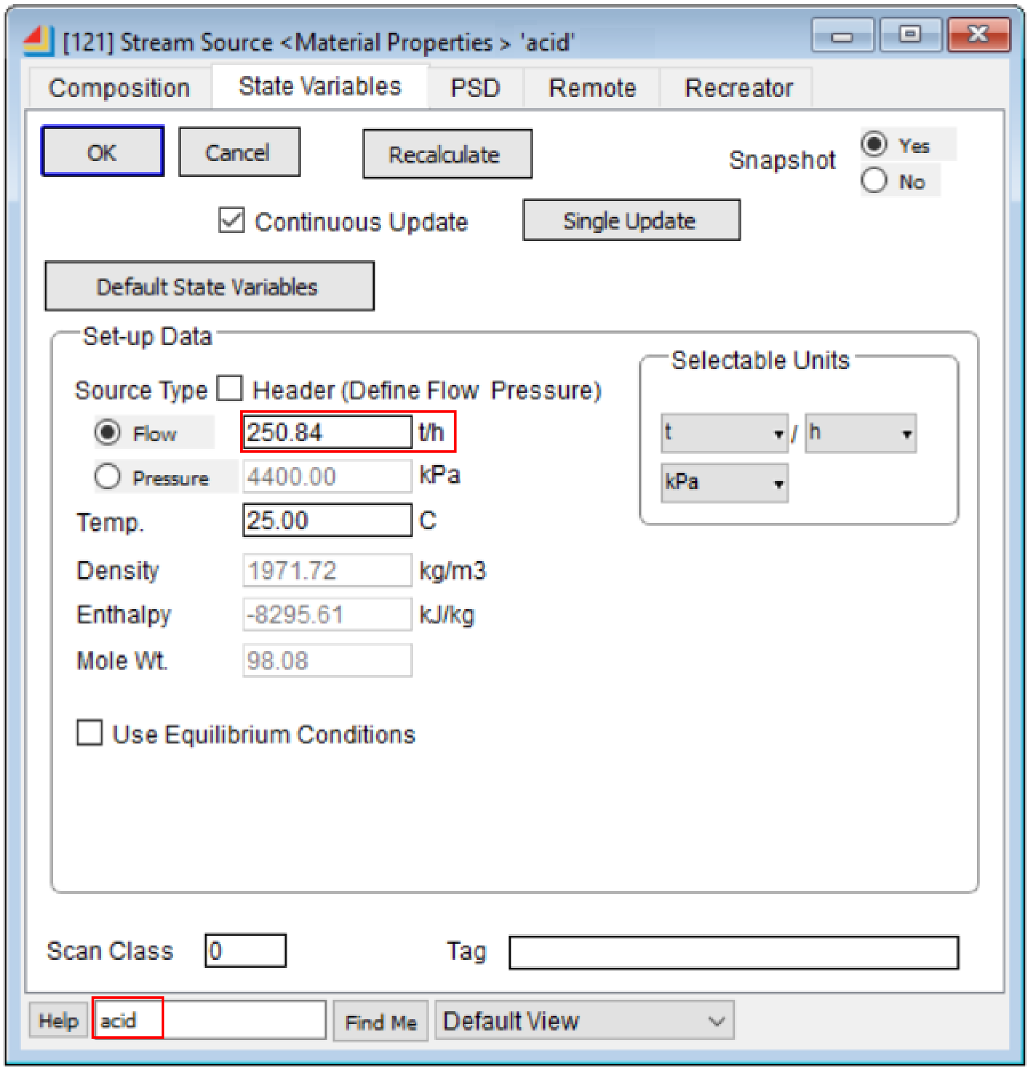


Figure 48: Acid Stream Source, State Variables Tab

Note: In this example, the Autoclave serves as a Reactor. It mixes the incoming Solids with the Acid and separates the Vapors and Products. This conversion simulates the High Pressure Acid Leaching.

11.3 SETTING OPTIONS FOR THE AUTOCLAVE OBJECT

Double-click on the **Autoclave** object. The user will see the **Display Parameter** and **Input Parameter** sections. The user can also see its configuration.

In the **Input Parameter** section, make sure the radio buttons next *to Conversion-Based, Simultaneous* is selected. Next, choose the **Enter/Edit Reactions** button and enter the reactions given below:

```
1 Al2O3_s + 3 H2SO4_aq = 3 Water + 1 Al2(SO4)3_aq
1 Fe(OH)3_s + 1.5 H2SO4_aq = 3 Water + 0.5 Fe2(SO4)3_aq
1 Ni(OH)2_s + 1 H2SO4_aq = 2 Water + 1 NiSO4_aq
1 Goethite_s = 0.5 Water + 0.5 Fe2O3_s
1 Chlorite_s + 6 H2SO4_aq = 10 Water + 4 Quartz_s + 6 MgSO4_aq
1 MgCO3_s + 1 H2SO4_aq = 1 Water + 1 MgSO4_aq + 1 CO2_g
```

Entering Reactions:

Click next to 1 with the mouse, type 1 for the stoichiometric coefficient, and select a component from the list on the right (see Figure 49).

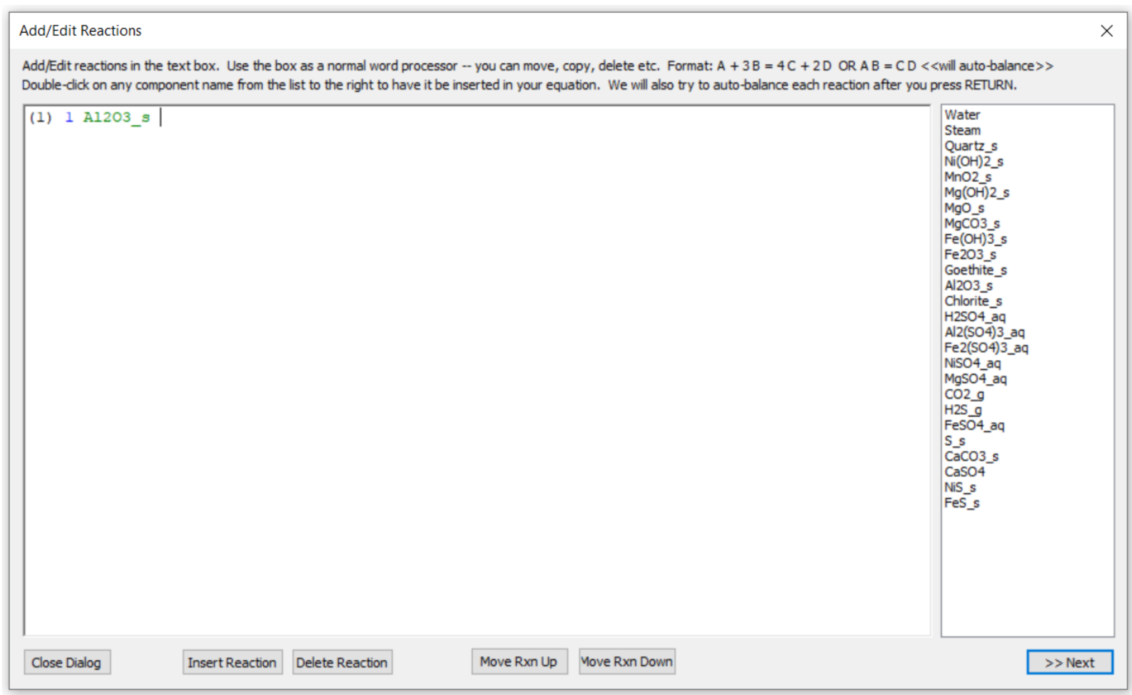


Figure 49: Entering Reactions

Use **=** and **Enter** buttons while typing the reaction. Enter all the reactions given above. The window that contains all the reactions is shown Figure 50.

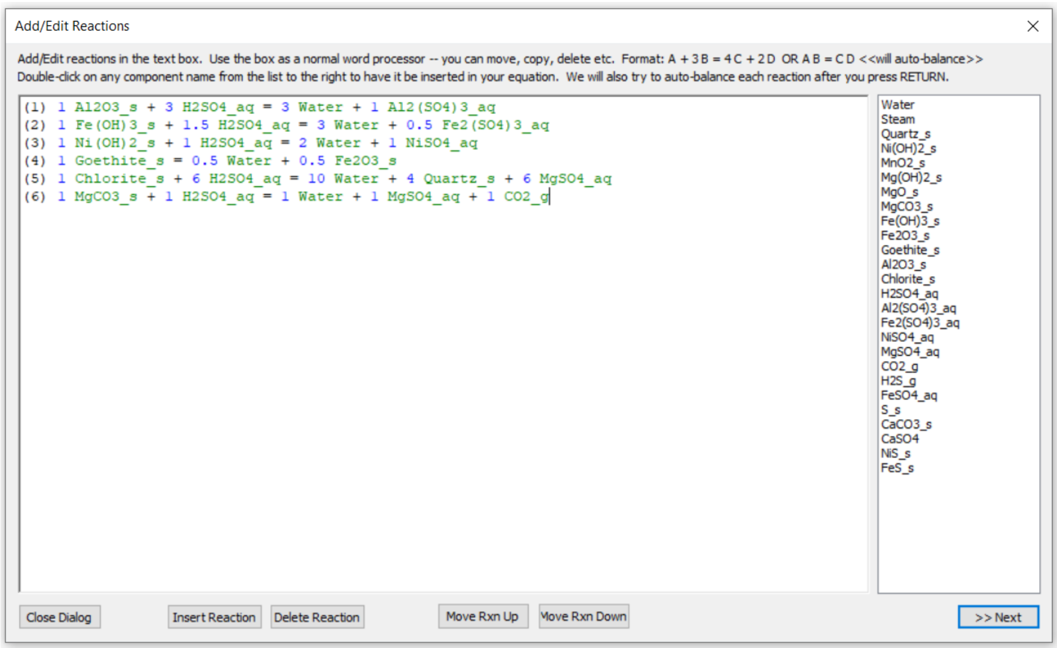


Figure 50: Entered Reactions

After all the fields are entered, press the **Next** button. The ***Specify Parameters for Reactions*** window opens. Enter the values that appear in the below figure under *RXN Target* column in the Rxn Target column of the window for each reaction. Press **OK** to accept the changes.

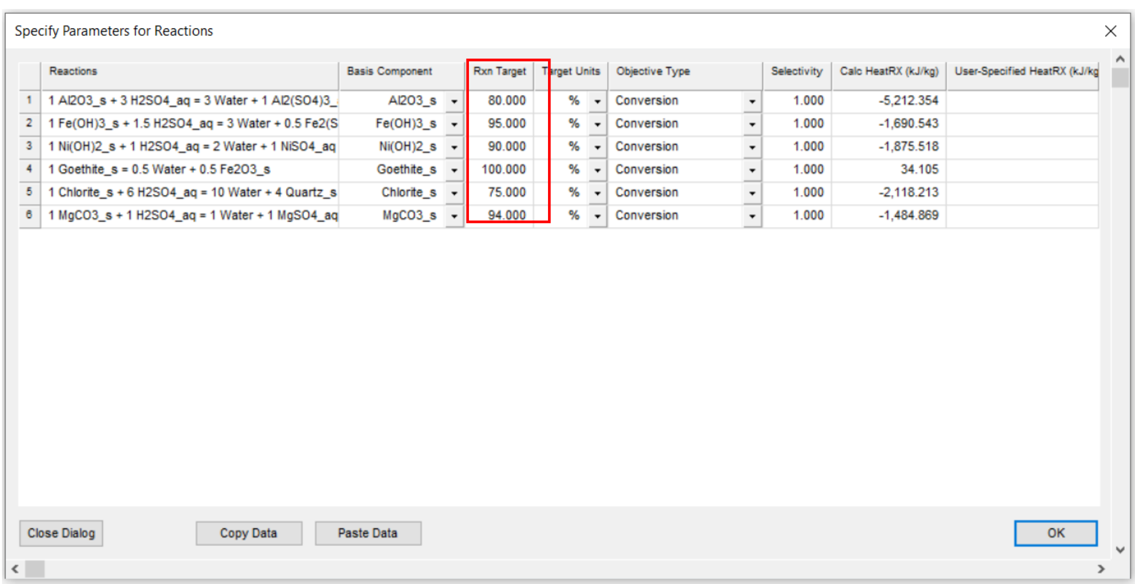


Figure 51: Specifying Parameters for Reactions

Close the window of the **Autoclave** object by pressing the close button (**X)** on the upper right-hand corner of that window.

11.4 SETTING FLASH OBJECTS OPTIONS

Open the **Flash** object dialog box. Go to the **Inputs** tab and make sure the **Define Flash Type** is set to *P-H* and select the *By downstream object* option from the dropdown menu that appears when clicked in the box next to **Define Tank Pressure**. Click **OK** to accept. Do this for all the three **Flash** objects.

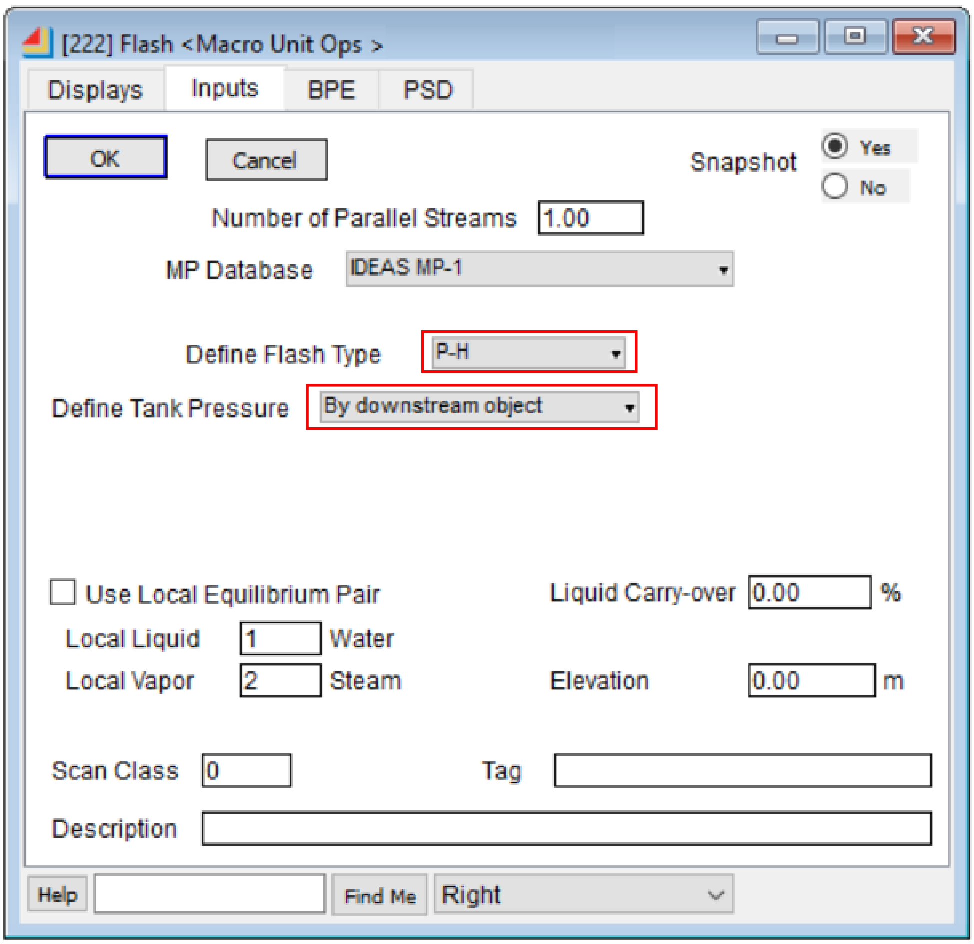


Figure 52: Flash, Inputs Tab

11.5 SETTING ELEMENT SELECTOR 150 OBJECT OPTIONS

Open the **Element Selector 150** dialog box. Go to the **Sub-Component and Ions** tab, type *H2SO4* in the field of **Sub-Component to Monitor** and press the **Accept** button.

Then it will list the component in the table below this field. Press **OK** to accept.

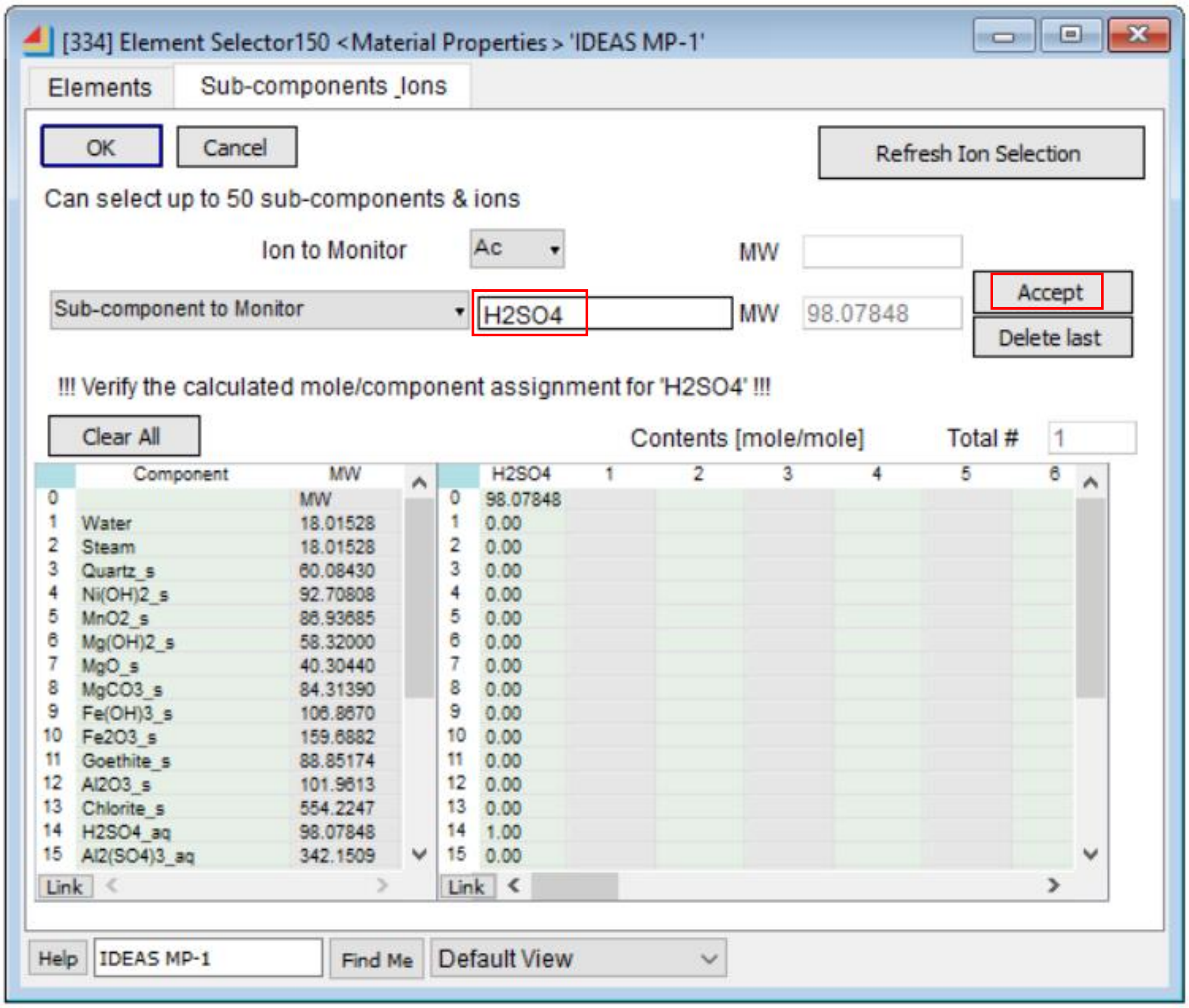


Figure 53: Element Selector 150, Sub-components and Ions Tab

11.6 SETTING TRANSMITTER-ELEMENT CONTENT OPTIONS

Open the Transmitter-Element Content dialog box. Go to **Inputs** tab and select the component *H2SO4* in the *Concentration of* pull-down menu; select the units as *g/L* from the pull-down menu available next to this and select the phase as *Aq. Phase* from the pull-down menu below the units pull-down menu. Click **OK** to accept. See Figure 54 for details. Now, this object is able to measure the **H2SO4 content** in the stream.

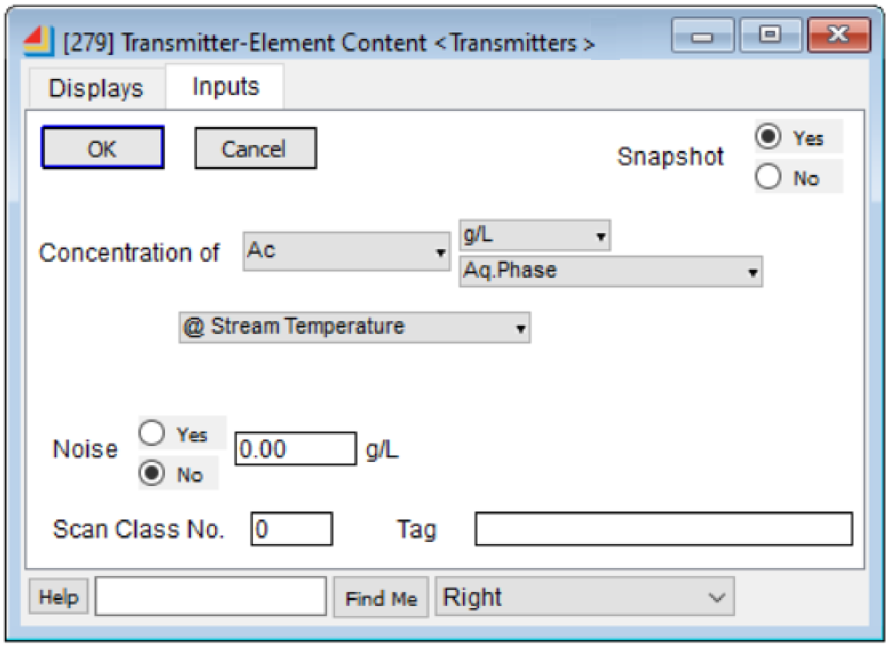


Figure 54: Transmitter-Element Content, Inputs Tab

SECTION 12. INTRODUCING PROCESS CONTROL VIA SUPERVISORS

Section Concept:

- Set Options for Supervisors

In this model, there are two supervisors. One is used to control the autoclave outlet temperature (at 261ºC) and the other one is used to control the H_2SO_4 content (at 75 g/L) in the final stream. In our model, the **Supervisor** objects are used to solve an IDEAS Bronze type model automatically.

12.1 SETTING THE SUPERVISOR OBJECT OPTIONS

Open the first **Supervisor** dialog box.

Note: This Supervisor will solve for the Steam flow rate.

The Steam flow rate is expected to vary between 0 and 400. Type 400 into the **Max** field of the **Output**. The Reactor Temperature is expected to vary between 0 and 300. Type 300 in the **Max** field of the **Input**. Check that the radio button **Decrease its Output** is selected. If there is an increase in input, the supervisor will automatically decrease its output. This is the correct setting, or controller action, for this model. Note that most of the standard inputs for the **Supervisor** object are present on both the **Basic Setup** and **Advanced Setup** tabs. The most commonly used inputs are available on the **Basic Setup** tab.

Change the set point to 255 by moving the Set point slider or by typing 255 in the field below the set point slider. When the Autoclave Temperature increases above the target (255ºC), the outgoing steam flow rate is adjusted automatically. The dialog box settings for the first **Supervisor** are shown in Figure 55. Click **OK** to close the dialog box.

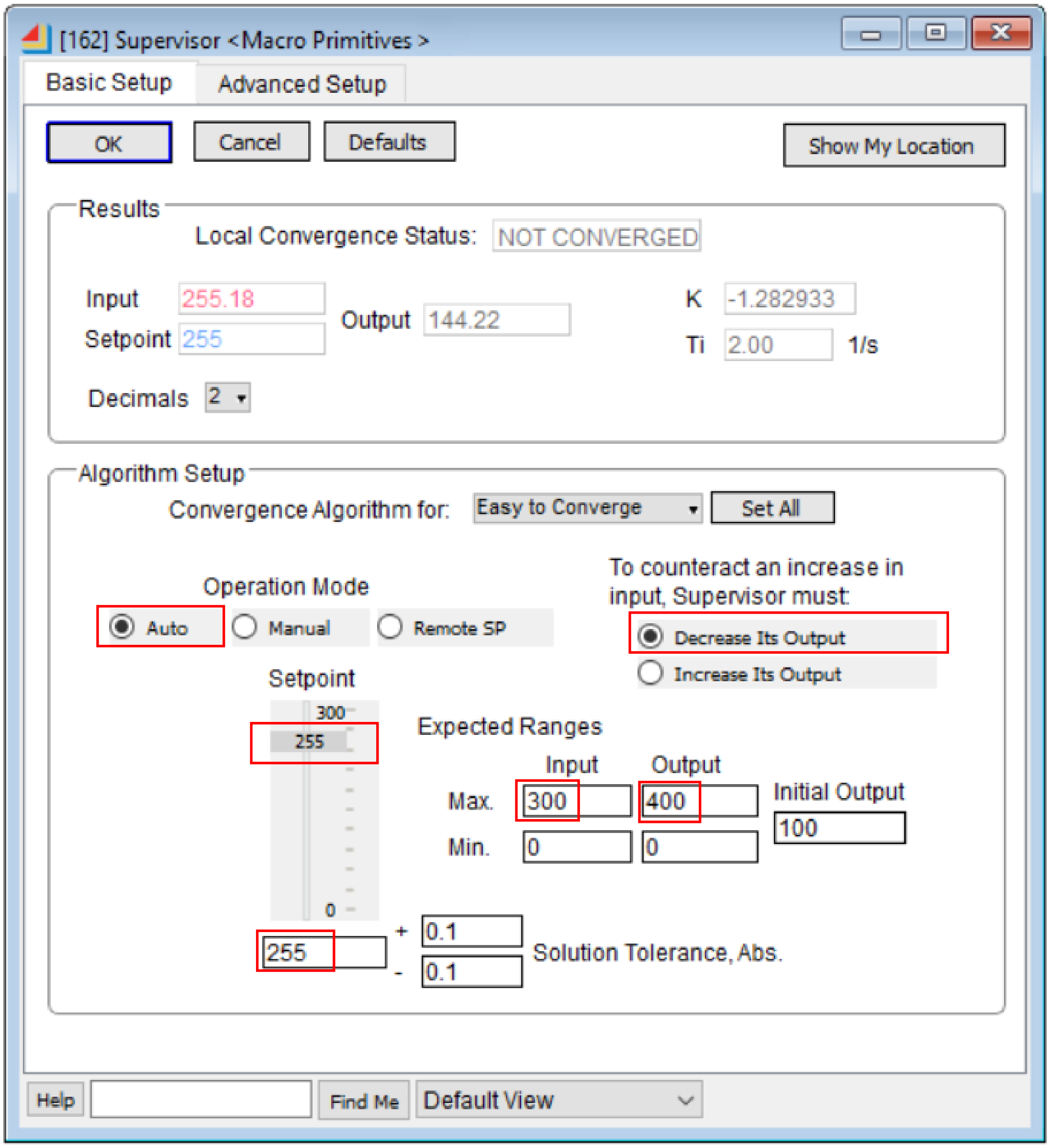


Figure 55: First Supervisor Dialog Box Settings

Notes:

1. The Supervisor does not use any units. Scalar quantities within IDEAS are very flexible and may be used to represent any possible units. It is the privilege and responsibility of the model builder to ensure that the value of a scalar and its units, as associated with its connected objects, are in agreement. An object receiving a signal from the Supervisor will use that value. For example, if the Supervisor sends the value 400 to a Stream Source, it could mean 400, or 400 liters per minute, or 400 m^3/hour, or several other possibilities, depending on the units specified in that object.

2. The ranges for the input and output variables are easy to estimate in case of consistencies or flow rates. However, in many other cases, they may be hard to predict. In these situations, use relatively wide ranges that are based on experience. Keep in mind that the closer the ranges are to the actual operating values, the faster the solution. One recommended technique for estimating these ranges is to first run a simulation with very wide ranges for 20 to 50 steps. The ranges can then be narrowed based on the operating values determined by the Supervisors, even if the worksheet has not completely converged. This operation may be repeated to further refine the ranges.

12.2 SETTING THE SECOND SUPERVISOR OBJECT OPTIONS

Open the second Supervisor dialog box.

Note: This Supervisor will solve for the Acid flow rate.

The Acid flow rate is expected to vary between 0 and 300. Type 300 into the **Max** field of the **Output**. The H_2SO_4 content is expected to vary between 0 and 100. Type 100 in the **Max** field of the **Input**. Make sure that the radio button **Decrease its Output** is selected. If there is an increase in input, the supervisor will automatically decrease its output. This is the correct setting, or controller action, for this model. Note that most of the standard inputs for the **Supervisor** object are present on both the **Basic Setup** and **Advanced Setup** tabs. The most commonly used inputs are available on the **Basic Setup** tab.

Change the setpoint to 75 by moving the setpoint slider or by typing 75 in the field below the setpoint slider. When the H_2SO_4 content increases above the target (75 g/L), the outgoing Acid flow rate is adjusted automatically. The dialog box settings for the first supervisor are shown in Figure 56. Click **OK** to close the dialog box.

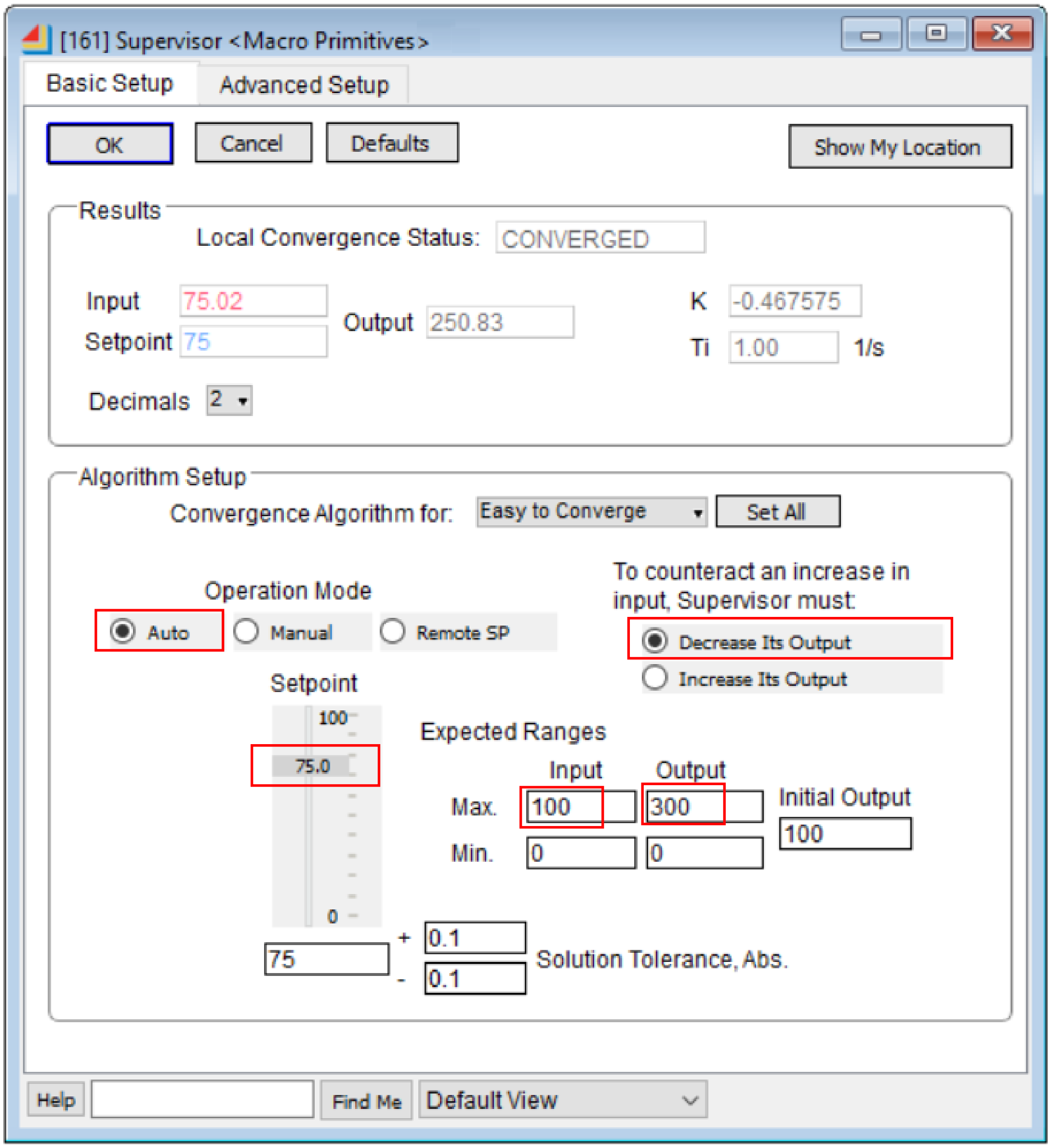


Figure 56: Second Supervisor Dialog Box Settings

SECTION 13. PHASE LINKING AND EXCESS PROPERTIES

Section Concepts:

- Phase Linking for Water and Steam Components
- Select Solvent and Solutes for Calculation of Excess Properties

13.1 SETTING MATERIAL PROPERTIES OBJECT OPTIONS

Open the **Material Properties** dialog box. Go to the **Components** tab and make sure the **Phase Link** is set to **Default Link** radio button. This should be checked for phase change calculations as there are Flash objects present on the worksheet (see Figure 57).

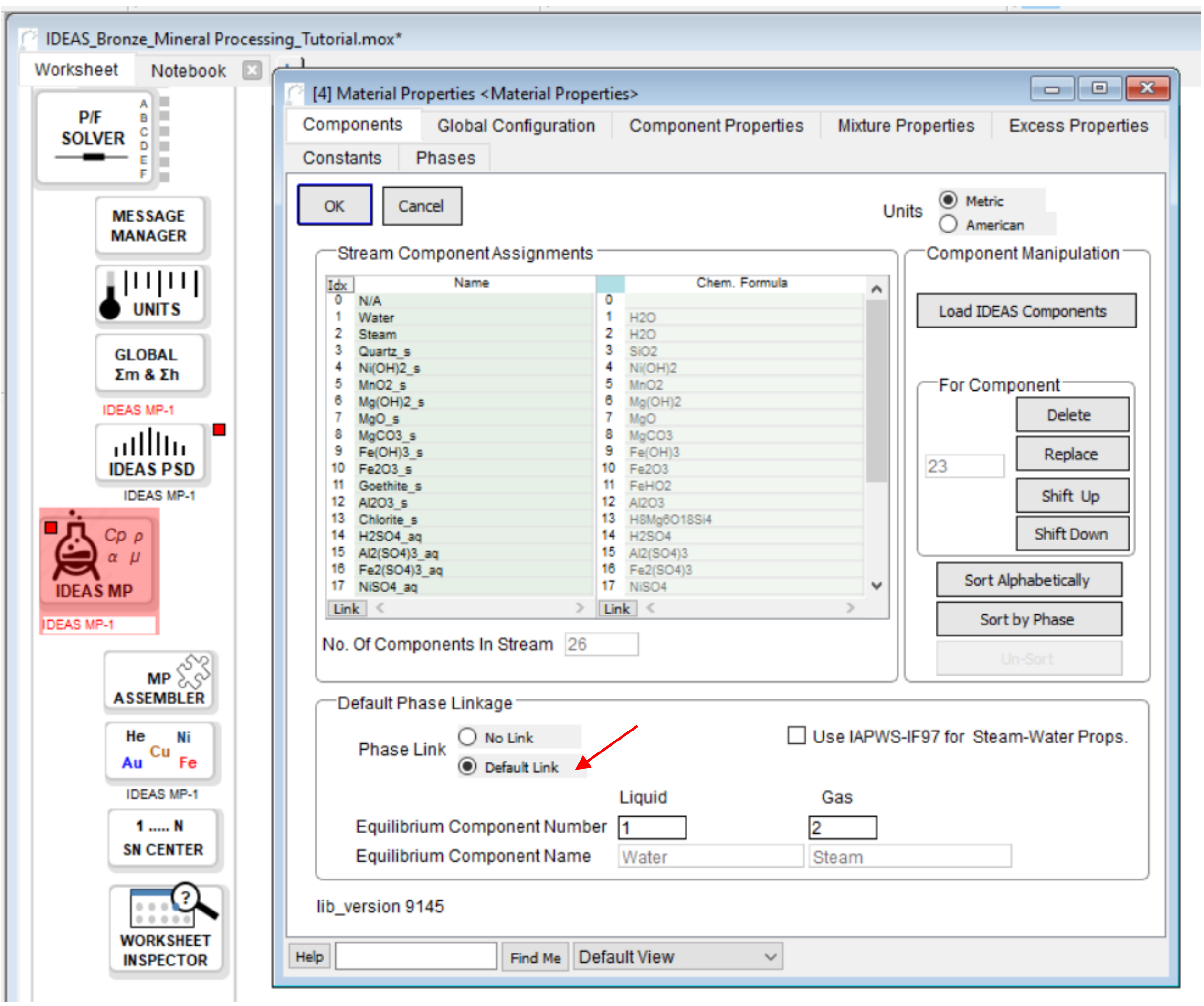


Figure 57: Material Properties, Components Tab, Phase Linking

Now, move on to the **Excess Properties** tab. Define *Water* as the solvent by typing 1 in the **Solvent Index** field. Define the solute as H_2SO_4 by checking the box in the table next to the H_2SO_4 component under *Solute* column. Press the **Accept Stream Definition** button to accept the solvent and solute selections. Next, press **Set Local Excess Properties** button. This **Material Properties** object will now automatically consider heat of mixing and volume of mixing effects. Press **OK** to close the dialog box (see Figure 58).

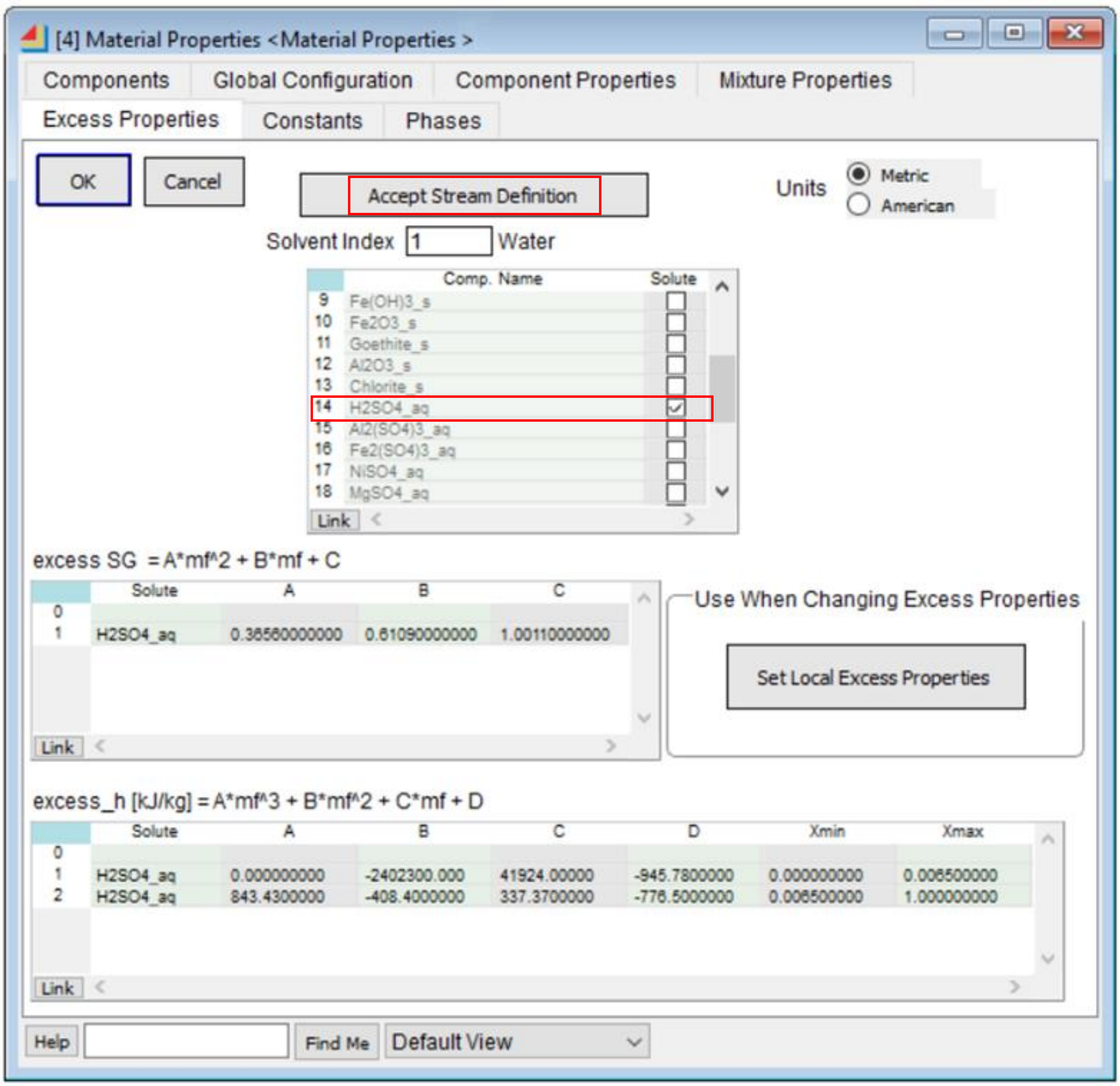


Figure 58: Material Properties, Excess Properties Tab

13.2 PLACING ONE STREAM ANALYZER OBJECT ONTO THE WORKSHEET

Place a **Stream Analyzer** object from the TRANSMITTERS library onto the worksheet. Move the first one to the *ProcessStream* **Stream Source** and connect it to the outlet of **Stream Source** (*ProcessStream*) (see Figure 59).

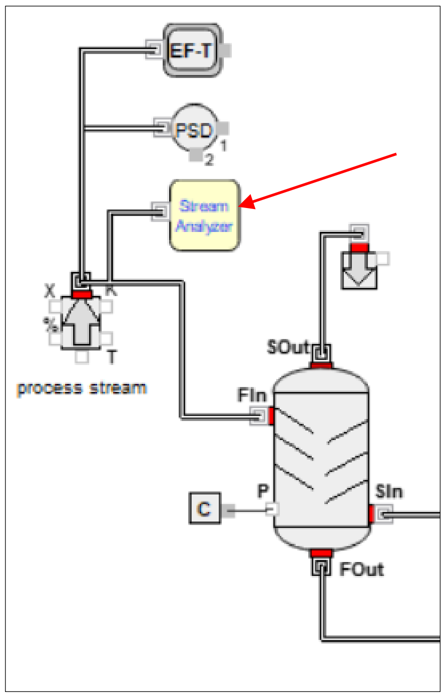


Figure 59: Placement of Stream Analyzer and New Connections

Open the dialog box of the Stream Analyzer. No changes are required in the dialog boxes of the analyzers but notice the wealth of information provided under both the **Global Displays** and **Phase Displays** tabs. Notice that there are several dropdown menus that, once changed, can display different types of information about a stream. The **Chem. Analysis** tab is used to display elemental balances and will be activated only when the **Element Selector 150** object (from the MATERIAL PROPERTIES library) is present on the worksheet. In the **Chem. Analysis** tab, check the box **Get Chemical Analysis** to get the elements balance (see Figure 60).

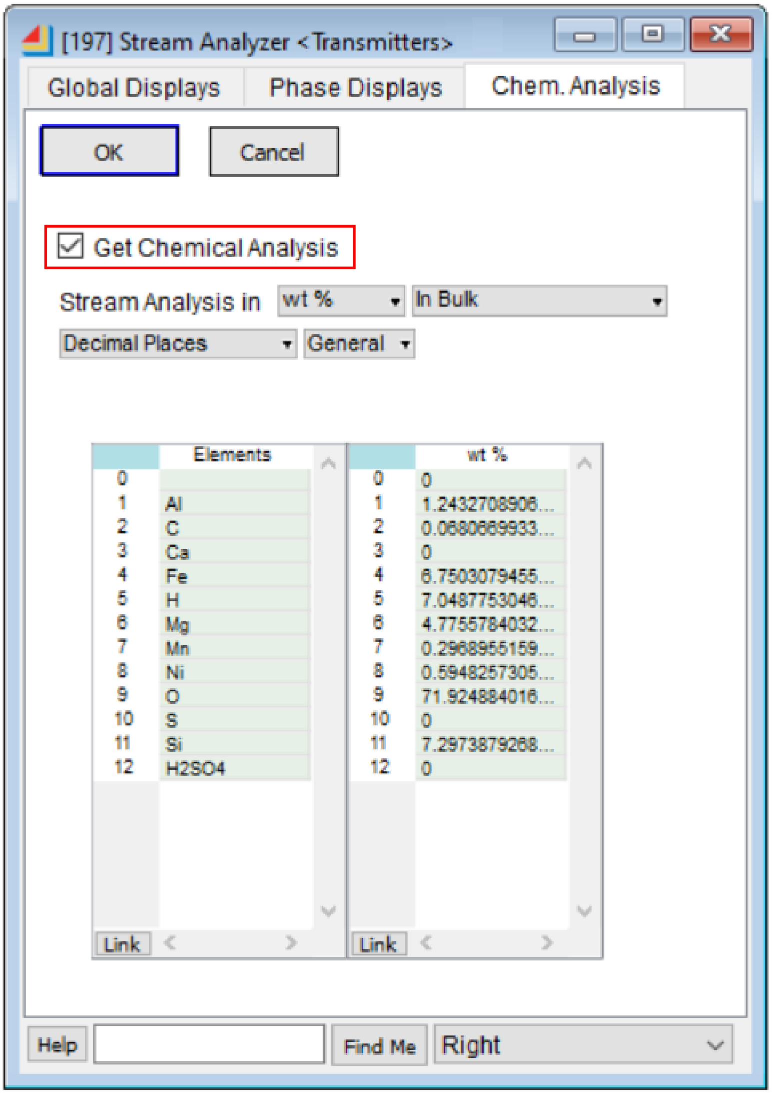


Figure 60: Stream Analyzer, Chemical Analysis Tab

SECTION 14. WORKING WITH PLOTTERS

Section Concepts:

- Place Plotter Object
- Set Plotter Options

14.1 PLACING A PLOTTER, I/O-SCAN OBJECT ONTO THE WORKSHEET

Place a **Plotter, I/O-scan** object from the PLOTTERS library onto the worksheet and move it to the right of the worksheet. Create a label with the name *H2SO4Content* near the outlet of the **Transmitter-Element Content** object and connect to it. Now, copy the label and paste it near the *inlet1* of the **Plotter** object. Copy the *Acid Flow tph* label and paste it near the *inlet2* of the **Plotter** object. Connect both of these labels to the corresponding plotter inlets. The scalar values from each of the transmitters will be sent to the **Plotter**. We are now able to track the values of both variables while the simulation is running (see Figure 61).

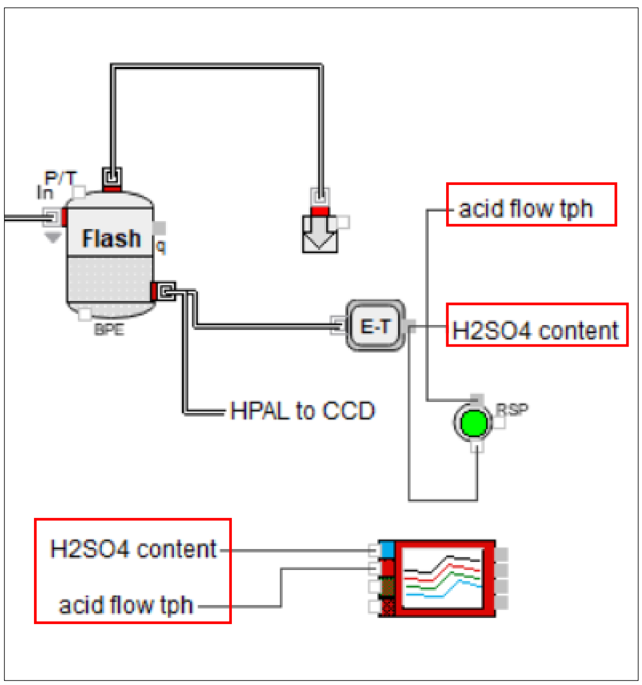


Figure 61: Plotter I/O-scan Placement and Label Connections

14.2 SETTING PLOTTER, I/O-SCAN OPTIONS

Open the **Plotter, I/O-scan** dialog box. Right-click anywhere in the window and select the first option, Trace Editor. A second sub-window opens. In the first field (to the left of the blue square), type

H2SO4Content. In the second field (to the left of the red square), type *Acid Flow*. These labels now coincide with the two labels connected to the **Plotter, I/O-scan**.

Note: If unable to achieve these tools, recheck with someone.

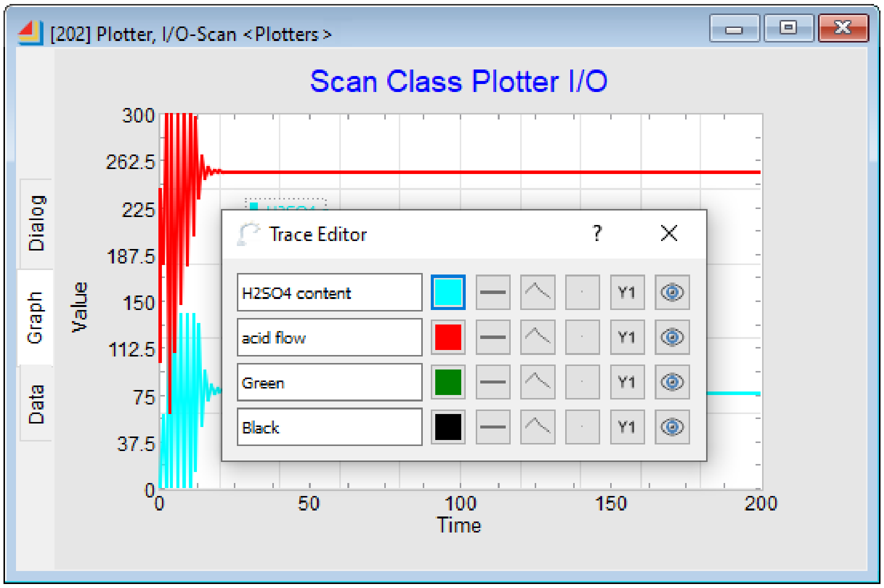


Figure 62: Plotter, I/O-scan Sub-Dialog Box with Inlet Names

SECTION 15. RUNNING THE SIMULATION

<u>Section Concepts:</u>

- Setting Simulation Setup Options
- Running the Simulation
- Understanding the Results

15.1 SETTING OPTIONS FOR THE MATERIAL PROPERTIES OBJECT

Open the **Materials Properties** object and click on the **Global Configuration** tab in the dialog box. Click on the **Continuous Update** button to the right of the text that reads *Dialog Box Displays*. This button ensures that every object is set to update continuously. In large or complex models, it might not be time-effective to have each object updating continuously because of computer processing constraints. Our model, however, is relatively small.

15.2 SETTING THE OPTIONS FOR SIMULATION SETUP

Select **Simulation Setup** from the **Run** menu. Choose the **Continuous** tab. Type 200 in the **End time** field. The **Time per step (dt)** radio button is selected and the number *1* is in the **Time per step (dt)** field. This setting makes each step of the simulation represent one (1) second of real time. The time per step can be altered but 1 second works for the vast majority of models. Make sure that the **Left to right** radio button, indicating simulation order, is selected. Click on the **Run Now** button. (The simulation can also be run by clicking on the **Run Simulation** button—the green arrow—on the toolbar, or by choosing **Run Simulation** from under the **Run** tab on the menu bar). See Figure 63 for details.

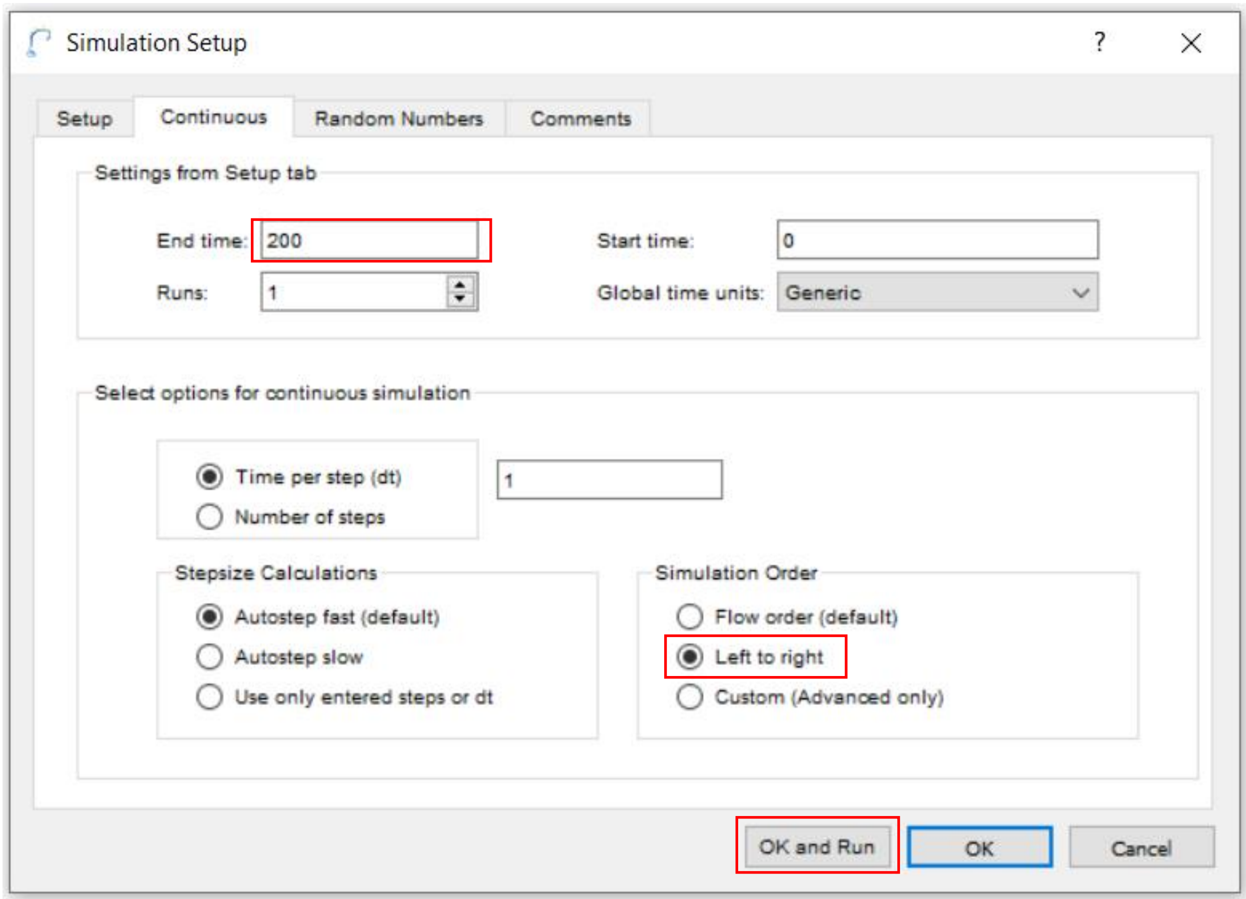
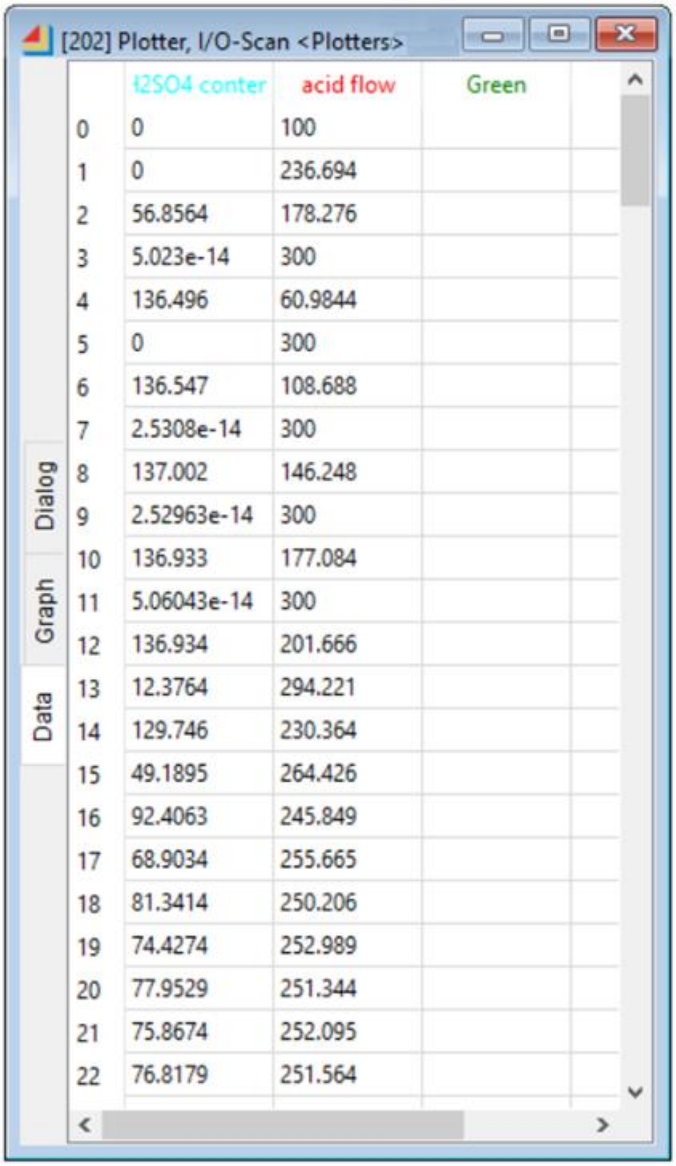


Figure 63: Simulation Setup, Continuous Tab

15.3 VIEWING THE SIMULATION VALUES

After a short initialization period, the simulation begins. Open the **Plotter, I/O-scan** window and notice the plots of the values of *H2SO4Content* and *Acid Flow*. With the **Plotter, I/O-scan** display still open, click on **Run Simulation** under the **Run** tab on the menu bar. Watch how the values of the *H2SO4Content* and *Acid Flow* are updated when the simulator runs. Scroll down through the iterations and notice how these values cease to change after approximately 40 iterations. This is an indication that the mass and energy balance for this flowsheet has been solved.

Initially, the model searches for the solution and the values change. After the model converges, the values remain constant, which are represented by the straight lines in the plot. If a tighter control is required, change the **Solution Tolerance** field in both supervisors. **Supervisors** are provided with color animation and will turn Green from Red when they are converged.



[202] Plotter, I/O-Scan <Plotters>

	!2SO4 conter	acid flow	Green
0	0	100	
1	0	236.694	
2	56.8564	178.276	
3	5.023e-14	300	
4	136.496	60.9844	
5	0	300	
6	136.547	108.688	
7	2.5308e-14	300	
8	137.002	146.248	
9	2.52963e-14	300	
10	136.933	177.084	
11	5.06043e-14	300	
12	136.934	201.666	
13	12.3764	294.221	
14	129.746	230.364	
15	49.1895	264.426	
16	92.4063	245.849	
17	68.9034	255.665	
18	81.3414	250.206	
19	74.4274	252.989	
20	77.9529	251.344	
21	75.8674	252.095	
22	76.8179	251.564	

Figure 64: Simulation Results

15.4 UNDERSTANDING THE SIMULATION RESULTS

Please note that your plot may differ from the one shown in Figure 64. The exact numbers at each step depend on the location of the objects and the simulation order. You can move the objects around and observe the slight effect of object location on the initial part of the curve. If you choose the Show Simulation Order menu item under the Model menu, you can see the order in which calculations are performed. (Regardless of the simulation order of objects, the final solved model will have the correct and accurate mass and energy balance if it has been reached, i.e., if the system has reached the solution.)

The objects will have a number imprinted on them that shows the simulation order. On large models with many recycle streams, the design of the worksheet determines the time required for convergence (which may be several minutes).

To aid the solution, a rule of thumb for models using objects from the MACRO PRIMITIVES library is to place upstream objects (that supply the flow) to the left of the downstream objects (that receive the flow). This rule cannot be followed when streams are recycled, so place the objects in the most logical fashion.

15.5 RESETTING THE SECOND SUPERVISOR AND VIEWING PLOTTER GRAPH

Select **Simulation Setup** from the **Run** menu. Change the **End time** field to *100000*. Run the simulation. After 1000 cycles, click on the **Pause** button on the toolbar (see Figure 65).

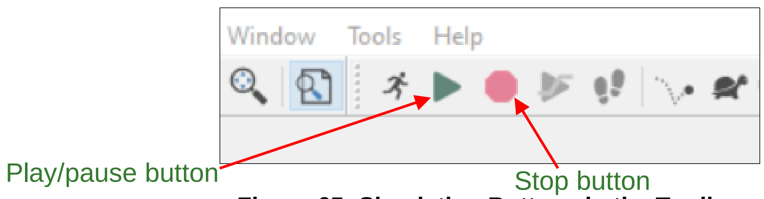


Figure 65: Simulation Buttons in the Toolbar

While the simulation is paused, open the second Supervisor (that is connected to the **Transmitter-Element Content** object) and change the set point from 75 to 33. This changes the amount of Acid flow. With the supervisor dialog box still open, click on the **Resume** button in the toolbar. After about 40 iterations, the worksheet will reach the new steady state as shown in the Input field of this supervisor. Click **OK** to close the dialog box. See Figure 66 for details. Stop the simulation by pressing **Stop Simulation** button on the toolbar.

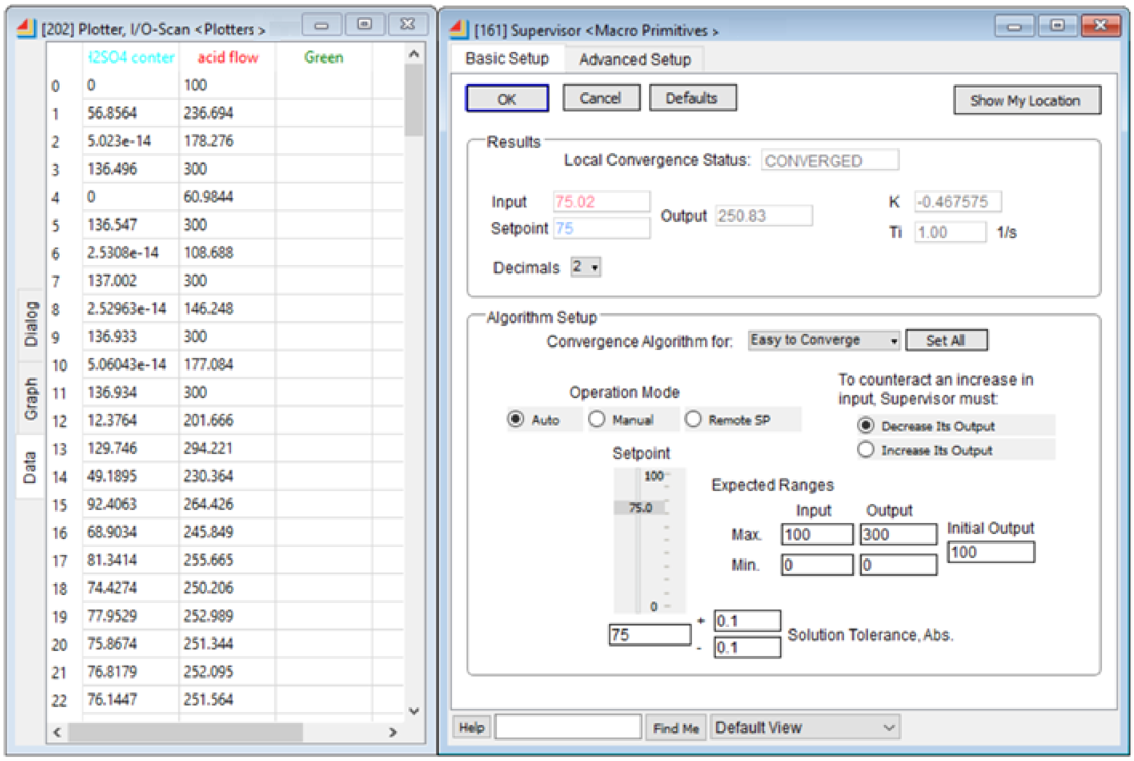


Figure 66: Second Supervisor New Parameters and Viewing Simulation Results

SECTION 16. CLONING VARIABLES

<u>Section Concept:</u>

- Cloning the Variables

16.1 CLONING A DIALOG BOX ITEM

Displaying the Flow of Ni Element measured by the Transmitter-Element Flow object would also be useful. First open the dialog box of the object, go to the Inputs tab, and select Ni element from the dropdown menu available next to Flow of description. The flow rate of nickel is displayed in Displays tab. One way to display this on the worksheet is to use the Clone tool. Cloning of ANY dialog box item can be accomplished by following these steps:

1. Select the clone layer tool ( ) from the toolbar. (See Figure 67 below).
2. Open the dialog box and select the dialog box item to be cloned. You can choose multiple items at once by clicking on an empty space in the dialog box, hold down the mouse button and drag to highlight all the selected entries.
3. Stop holding down the mouse button and the cloned entries will follow your mouse. Click on worksheet window to drop the clones to that location.
4. Once finished, click on the Main Cursor tool (arrow) on the toolbar.

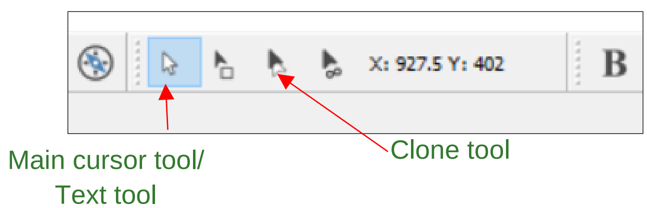


Figure 67: Clone Tool and Main Cursor Tools Location in IDEAS Toolbar

Results are shown in Figure 68.

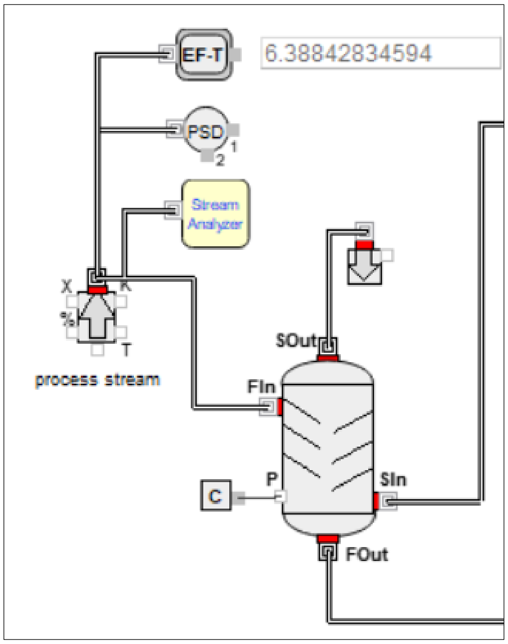


Figure 68: Clone of Transmitter-Element Flow (of Ni Element)

There are a few important qualities one should know about the Clone tool and cloned displays:

- Cloned objects on the worksheet can only be selected when the Clone Layer Tool or the Select All Layers Tool (the button to the right of the clone tool) is selected from the toolbar.
- A cloned item acts exactly as the item does in the dialog box. If the cloned item is from an input field, changing its value in the clone will also change its value in the dialog box. Be cautious when altering information in a cloned item.
- In order for the display in the clone to be continuously updated, the Continuous Update checkbox inside the dialog box must be checked.

SECTION 17. USING THE S-CLICK FEATURE

Section Concept:

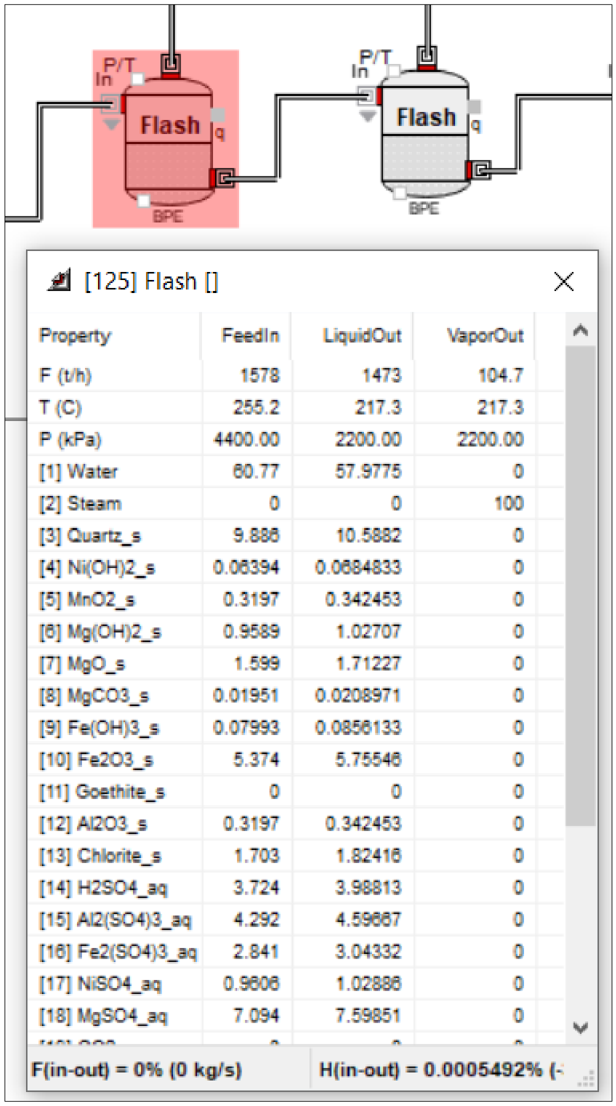
- Using S-Click Features

17.1 S-CLICK FEATURES

Another way to monitor objects is by using the S-Click feature. While the simulation is running, or after it has finished running, hold down the S key on the keyboard and click on an object with the mouse. A table will appear that shows information such as flow into and out of an object and various other data (see Figure 69 which is an S-click on the **Thickener** object). Run the simulation again and try using the S-Click command.

Note: The S-click feature only works while the simulation is running or after it has finished running.

You can also right click in the S-Click table to change the display from Flow Parameters to % Mass/Mole Composition, and to view the flow rates in primary, secondary, or other flow units.



Property	FeedIn	LiquidOut	VaporOut
F (t/h)	1578	1473	104.7
T (C)	255.2	217.3	217.3
P (kPa)	4400.00	2200.00	2200.00
[1] Water	60.77	57.9775	0
[2] Steam	0	0	100
[3] Quartz_s	9.886	10.5882	0
[4] Ni(OH)2_s	0.06394	0.0684833	0
[5] MnO2_s	0.3197	0.342453	0
[6] Mg(OH)2_s	0.9589	1.02707	0
[7] MgO_s	1.599	1.71227	0
[8] MgCO3_s	0.01951	0.0208971	0
[9] Fe(OH)3_s	0.07993	0.0856133	0
[10] Fe2O3_s	5.374	5.75546	0
[11] Goethite_s	0	0	0
[12] Al2O3_s	0.3197	0.342453	0
[13] Chlorite_s	1.703	1.82416	0
[14] H2SO4_aq	3.724	3.98813	0
[15] Al2(SO4)3_aq	4.292	4.59667	0
[16] Fe2(SO4)3_aq	2.841	3.04332	0
[17] NiSO4_aq	0.9606	1.02886	0
[18] MgSO4_aq	7.094	7.59851	0

F(in-out) = 0% (0 kg/s) H(in-out) = 0.0005492% (-

Figure 69: Using the S-Click Feature

SECTION 18. MASS/ENERGY BALANCE: MODEL CONVERGENCE ISSUES

Section Concepts:

- Checking Overall Mass and Energy Balance
- Understanding Convergence Issues
- Checking Elemental Balance

So far, we depended on the plotters to figure out the number of iterations required for model convergence. When the plots of *H2SO4Content* and *Acid Flow* became horizontal lines, we interpreted that observation to mean that all mass and energy balance equations were solved. However, with multiple streams to track on a large model, this approach of plotting all important variables becomes cumbersome. Instead, you can use the **Global Mass Balance** object from the TOOLS library to check for the convergence of the model.

18.1 PLACING A GLOBAL MASS BALANCE OBJECT ONTO THE WORKSHEET

Add a **Global Mass Balance** object from the TOOLS library to your model and place it on the left side of the worksheet under the **Material Properties** object. Run the simulation again and open the dialog box for the **Global Mass Balance** object. Press the **Check Mass Balance** button. This object will report any discrepancies in the global mass balance. See Figure 70 for results.

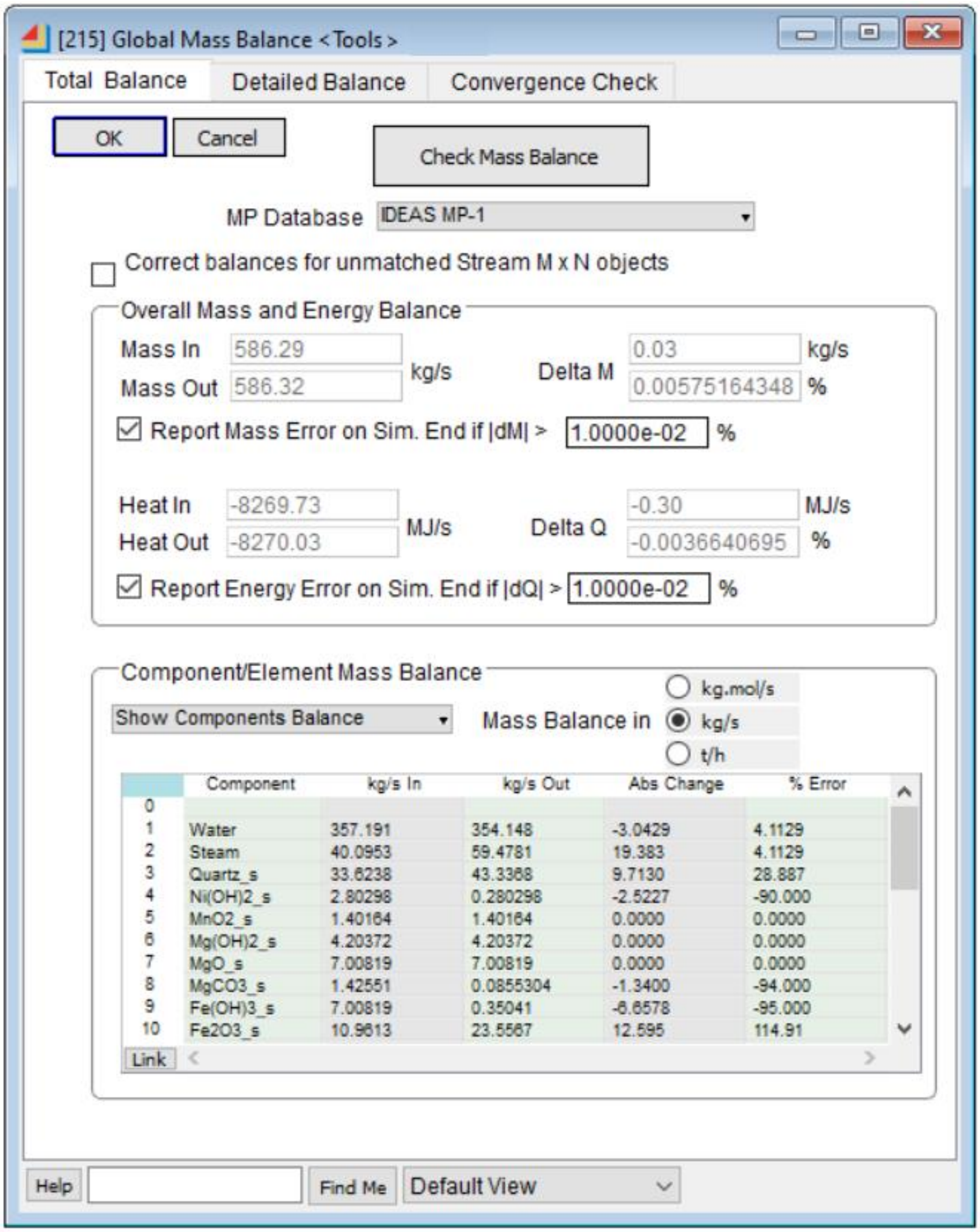


Figure 70: Global Mass and Energy Balance

Remember that a global mass balance is expected to be achieved only after a worksheet converges. If you had tanks on a worksheet that were filling up, you would not expect the **Delta M** % term for the global mass balance to reach zero because the same amount of mass would not be entering and exiting the system (i.e., accumulation—mass would be accumulating in the tank if the tank level is changing). When dealing with dynamic models, you should expect a global mass balance to converge only after steady state operation is achieved. Steady state operation will require the use of controllers and an appropriate control strategy.

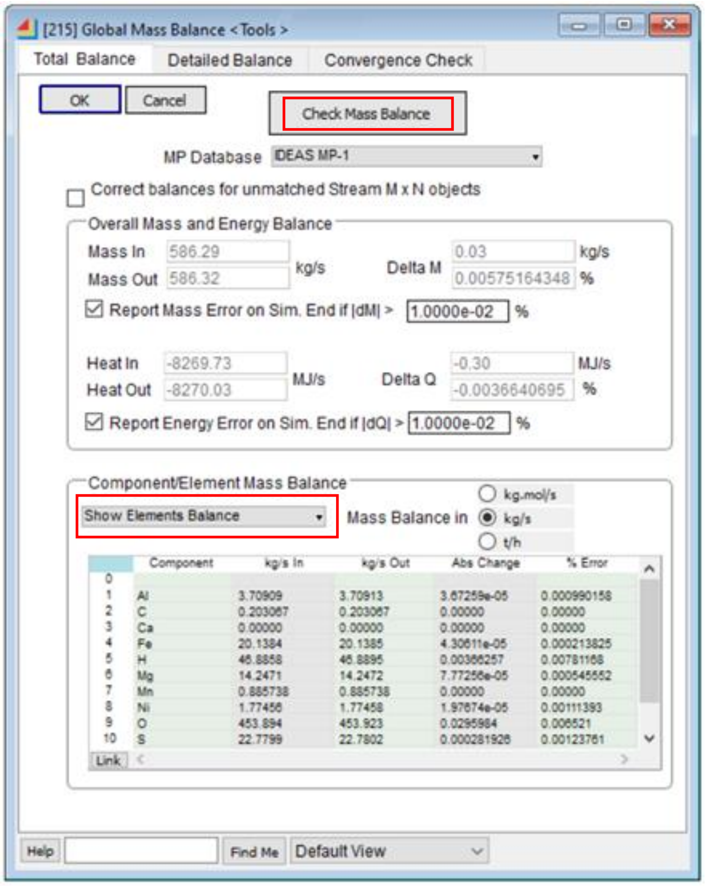
Enthalpy (or energy) balance is achieved only when the system has reached steady state. Notice the fields for **Heat In**, **Heat Out**, and **Delta Q** %.

18.2 CHECKING CONVERGENCE

Finally, click on the **Convergence Check** tab and press the **Check Convergence** button when the simulation is running. This button checks all macro objects on the worksheet and reports any convergence problems with the macro objects. Notice the messages that appear in the IDEAS Message Window. Please see the help documentation of the **Global Mass Balance** object for more details.

18.3 ELEMENTAL BALANCE

An **Element Selector 150** object from the MATERIAL PROPERTIES library should be present on the worksheet to view the elemental balance. Run the simulation again and open the dialog box for the **Global Mass Balance** object. Press the **Check Mass Balance** button. This object will report any discrepancies in the global mass balance. Select *Show Elements Balance* from the pull-down menu available above the table. See Figure 71 for results. Every component must have a chemical formula to get the overall Elemental Balance; otherwise, the user gets warning messages to the Output window. This feature is very useful for mining applications. This is described here to give you an idea about this feature. Please see the help documentation of the **Global Mass Balance** object and **Element Selector 150** object for more details.



	Component	kg/s In	kg/s Out	Abs Change	% Error
0					
1	Al	3.70909	3.70913	3.67259e-05	0.000990158
2	C	0.203067	0.203067	0.00000	0.00000
3	Ca	0.00000	0.00000	0.00000	0.00000
4	Fe	20.1384	20.1385	4.30611e-05	0.000213825
5	H	46.8858	46.8895	0.00366257	0.00781168
6	Mg	14.2471	14.2472	7.77256e-05	0.000545552
7	Mn	0.885738	0.885738	0.00000	0.00000
8	Ni	1.77456	1.77458	1.97674e-05	0.00111393
9	O	453.894	453.923	0.0295984	0.006521
10	S	22.7799	22.7802	0.000281926	0.00123761

Figure 71: Elements Balance

SECTION 19. USING SNAPSHOT

Section Concept:

- Using Snapshot Object

The **Snapshot** object is a useful tool for saving various conditions in the model. Select **Simulation Setup** from **Run** on the menu bar. Type 200 in the **End time** field. Click **OK** to close the dialog box.

19.1 PLACING THE SNAPSHOT OBJECT ONTO THE WORKSHEET

Place the **Snapshot** object from the EXECUTIVES library onto the worksheet. A window opens asking to specify snapshot file name. By default, the file name is same as the model name. Press the **Save** button. See Figure 72 for details.

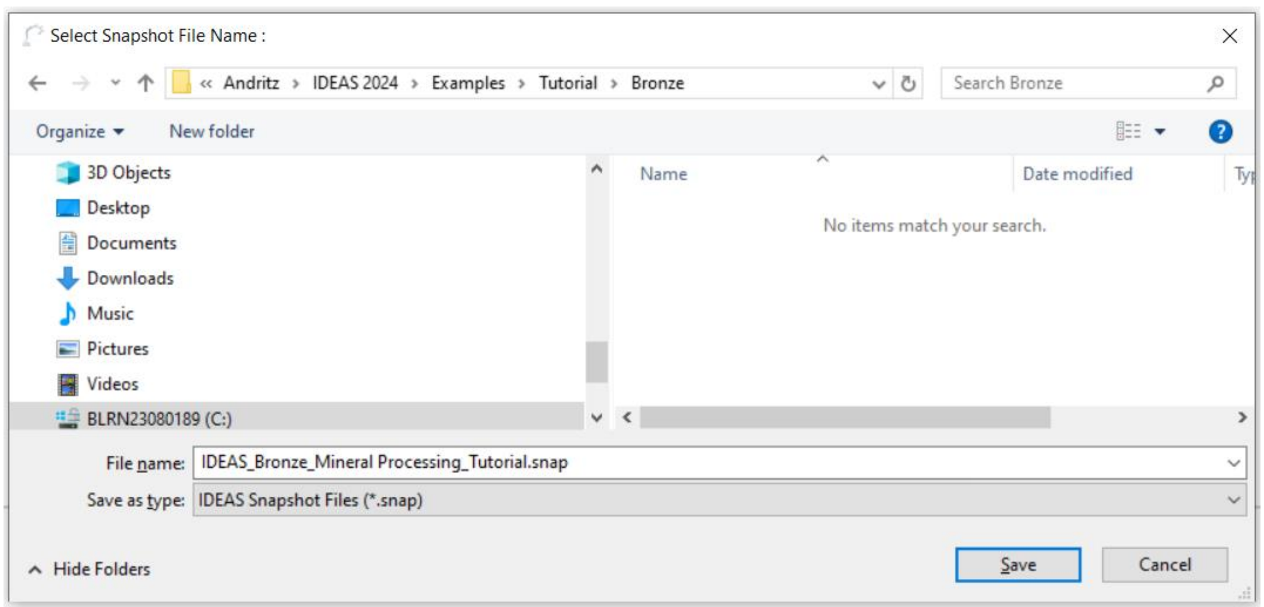


Figure 72: Snapshot File Name Selection

Open the Snapshot dialog box and click the **Turn all 'Yes'** button. A message should appear that reads "Snapshot buttons in all objects have been set to 'Yes'." Click on the **OK** button to close the dialog box. Open the **Plotter, I/O-scan** window and notice the plots of the values of the *H2SO4Content* and *Acid Flow*. With the Plotter, I/O-scan display still open, click **Run Simulation** under the Run tab on the menu bar. As the model runs, watch how the values of the *H2SO4Content* and *Acid Flow* change. Scroll down through the iterations and notice that after about fifty (50) iterations these values become constant. As we previously learned, this is an indication that the mass and energy balance for this flow sheet has been solved. Initially, the model searches for the solution, and the values change. After the model converges, the values remain constant because a solution has been reached.

19.2 SETTING SNAPSHOT OPTIONS

Open the **Snapshot** dialog box again and click the **Start from CONTINUE** radio button. Click **OK** to close the dialog box. With the **Plotter, I/O-scan** display still open, click on the **Run Simulation** button under the **Run** tab on the menu bar. Notice the values of the *H2SO4Content* and *Acid Flow* even at the very beginning of the run. There was no oscillation at the beginning of the simulation because the **Snapshot** object saved the previous run's solution and used those end values from the previous run as the initial conditions for the current run. Therefore, the simulation had already been solved.

Because it can allow an operator to bypass the initial time it takes the simulator to converge, the **Snapshot** object is particularly useful when running large, steady state models that take a long time to converge. If needed, different snapshots of the same model can be saved and recalled for later use.

19.3 SETTING SNAPSHOT DEFAULTS

Open the **Snapshot** dialog box and click the *Start from DEFAULTS* radio button and the Turn all '**No**' button. Click **OK** to close the dialog box.

SECTION 20. BUILDING THE SECTION 2

Section Concepts:

- Placing Thickener Objects
- Copying and Pasting Objects
- Stream Numbering
- Connecting Objects
- Building Counter-Current Wash Process

20.1 PLACING STREAM SOURCE OBJECT FOR WATER

Place a **Stream Source** object from the MATERIAL PROPERTIES library and set it as a flow source by checking the **Flow** radio button in its **State Variables** tab and label it as *Water* by typing in the text box available next to the help button, which is located at the bottom left of the dialog box. Move it to the far right of all the objects.

20.2 PLACING SIX THICKENER OBJECTS AND SETTING THEIR OPTIONS

Place a **Thickener** object from the MINERAL PROCESSING-B library and open its dialog box. Go to **Inputs** tab, enter *35* in *Solids in Underflow* field, and *99* in the *Mixing Efficiency* field (see Figure 73). Click **OK** to accept these changes.

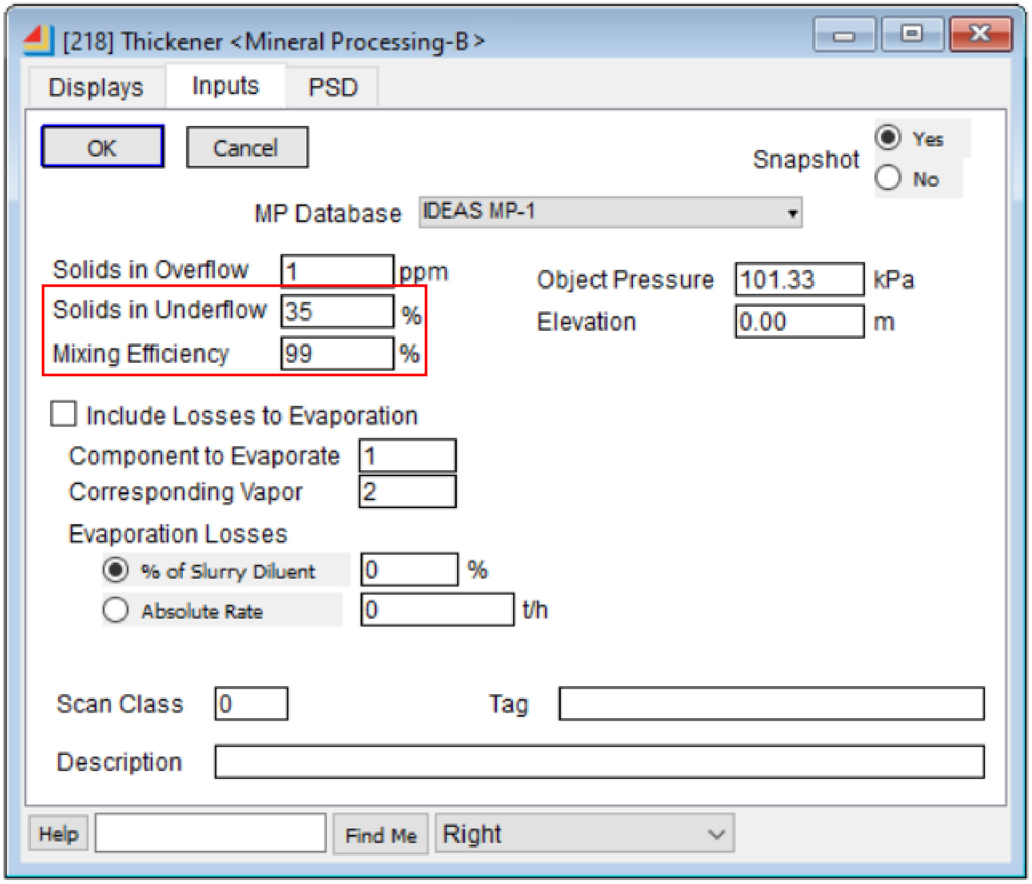


Figure 73: Thickener (Inputs Tab)

Now copy (CTRL+C) the **Thickener** object and Paste (CTRL+V) it 5 times to create five (5) more thickener objects. Arrange them as shown in Figure 74 to the right of the worksheet.

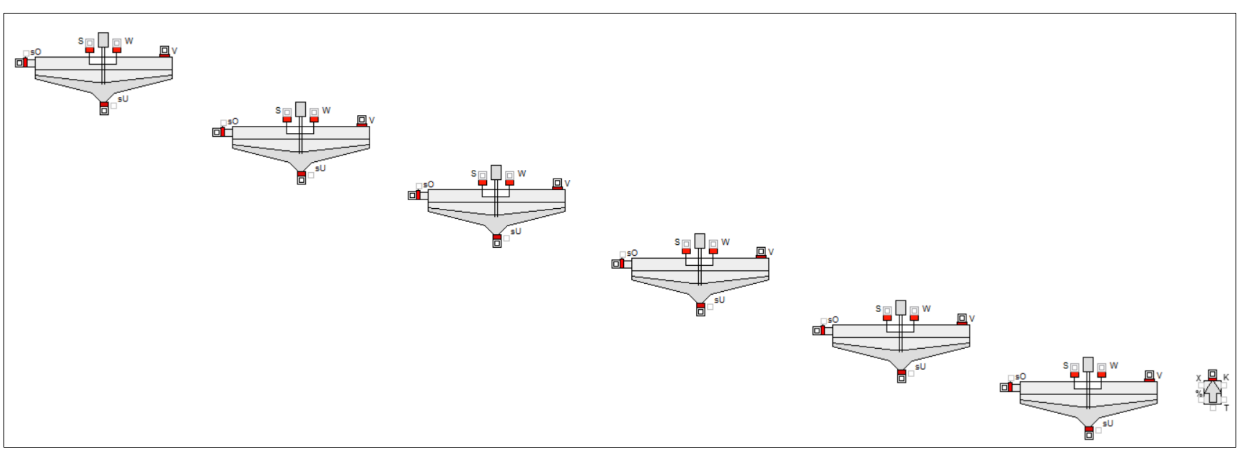


Figure 74: Placement of Thickener Objects

20.3 PLACING SEVEN SINK OBJECTS AND CONNECTING THEM TO THE THICKENERS

Place seven **Sink** objects from the MATERIAL PROPERTIES library onto the worksheet near to the *V (VaporOut*) connector of the **Thickener** objects. Connect 6 **Sink** objects to the 6 *V* connectors of the **Thickener** objects. Now connect the seventh **Sink** object to the bottom of sixth thickener. See Figure 75 for details.

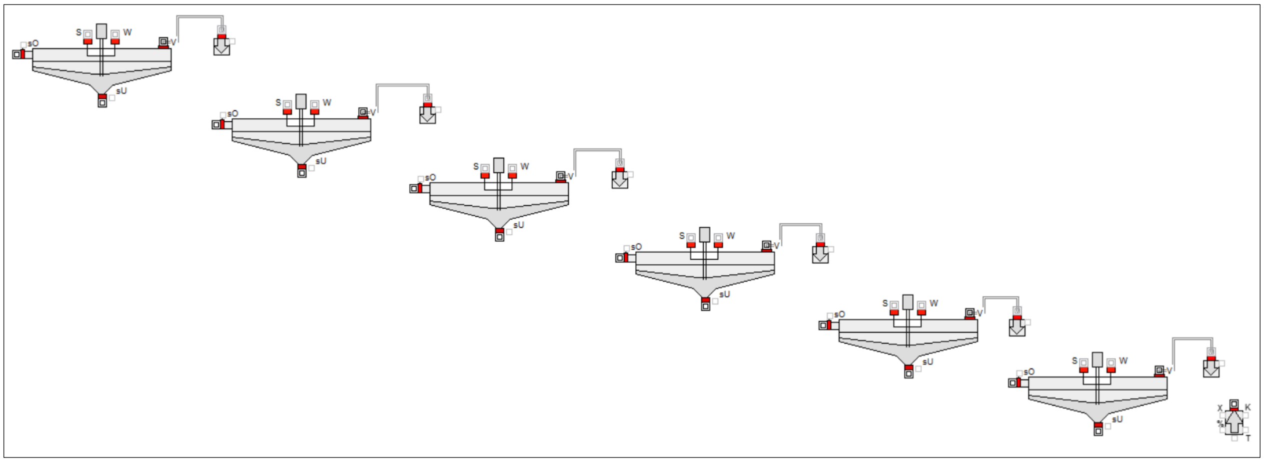


Figure 75: Placement of Sink Objects and New Connections

20.4 AUTOMATIC STREAM NUMBERING WITH STREAM NUMBER CENTER OBJECT

Place a Stream Number Center object from the EXECUTIVES library onto the worksheet and place it below the left-hand side of the worksheet. Open its dialog box. In the Inputs tab select SN Tag type as From BN-BN and type S: in the SN Tag prefix field (see Figure 76). Now the new connections will automatically be numbered. The syntax of stream numbers follow with S :< BN1>-<BN2>.

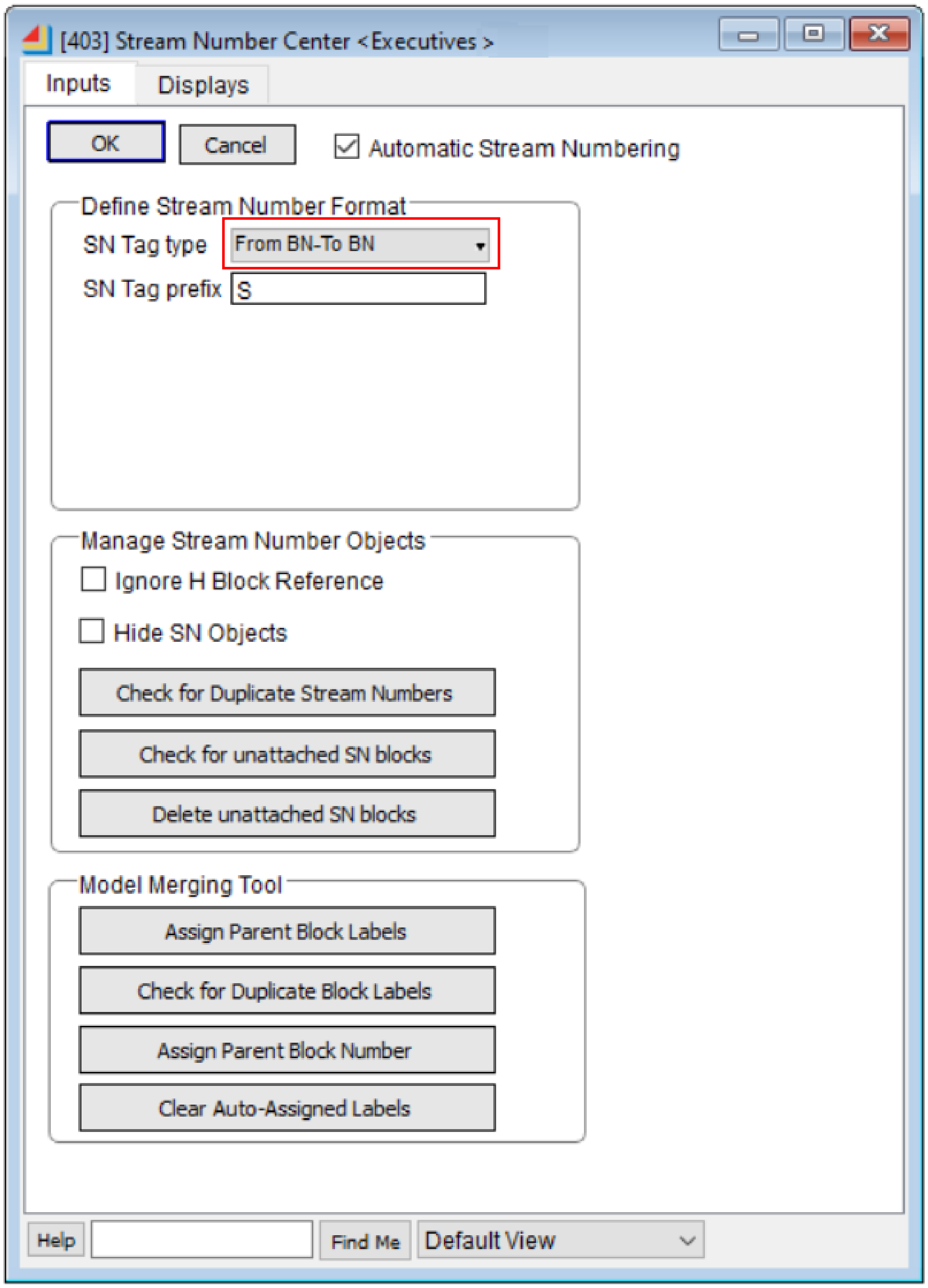


Figure 76: Stream Number Center Object (Inputs Tab Parameters)

20.5 CONNECTING THICKENER OBJECTS

Go to the area of the worksheet where you are working now. Connect the *Con2Out* of each thickener to the *S(SlurryIn)* connector of the thickener below it. Stream lines can be numbered with an N-Click on the stream (Hold the N key and click on the stream line). See Figure 77 for details.

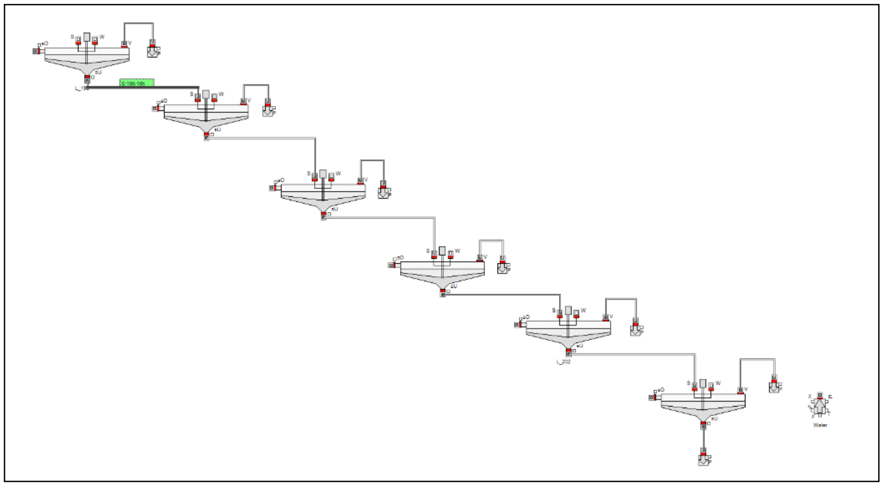


Figure 77: Connecting Thickener Objects

Now, come back to the working area and go to the last thickener. Connect the Water stream source to the *W (WashIn)* connector of the last thickener. Connect the *Con1Out* of each thickener to the *W* connector of the thickener above it. Do this except for the topmost thickener. For the topmost thickener, place a **Sink** object (from MATERIAL PROPERTIES library) and connect the *Con1Out* to the Sink inlet. See Figure 78 for details.

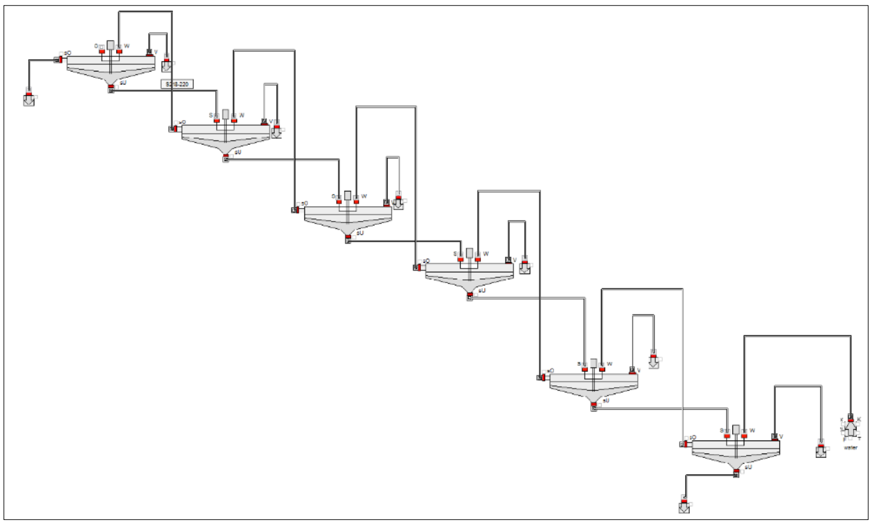


Figure 78: Connecting Thickener Objects

SECTION 21. LINKING THE TWO SECTIONS

Section Concept:

- Linking via Labels

21.1 LINKING THE TWO MODELS

Click on a blank area of the worksheet and press Ctrl+0 (Zoom to Fit) to see the entire model in one window. Press Ctrl+1 to zoom back to Normal (100%) view and scroll to the junction of the two models.

Remove the sink that is connected to the last **Flash** object of the first model and type a label called *HPAL to CCD* near the outlet of the last **Flash** object and connect it. Copy the same label and paste it near the *S* connector of the top **Thickener** object and connect it. See Figure 79 for details.

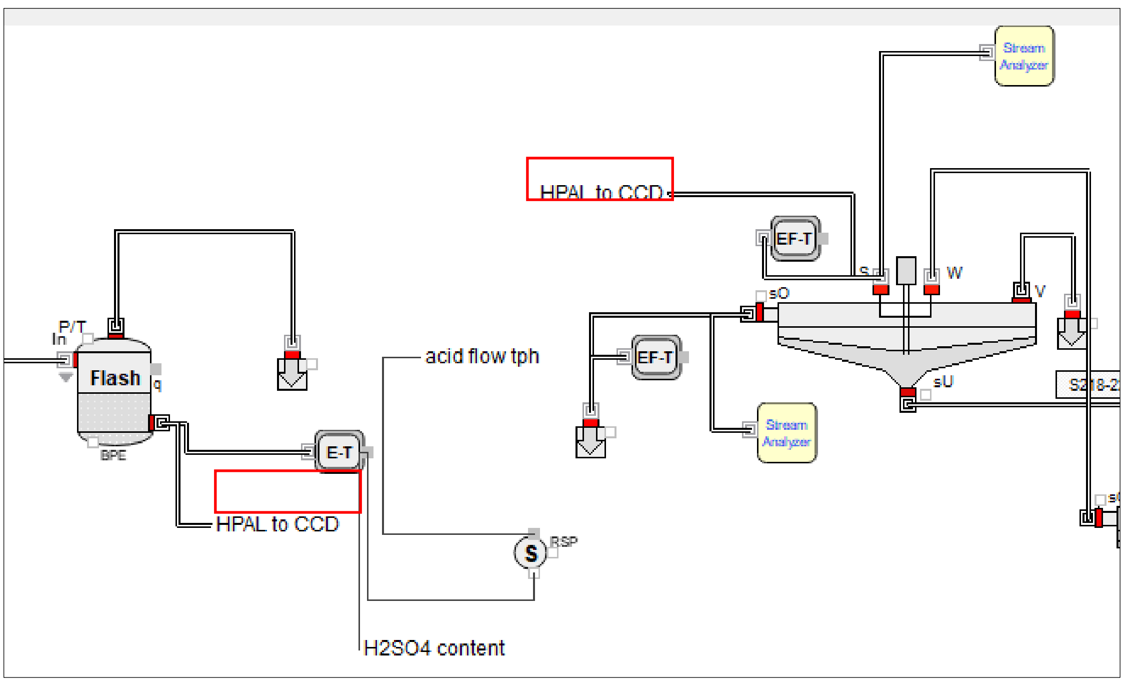


Figure 79: Linking Two Sections via Named Connection

21.2 PLACING MORE OBJECTS

Place three **Stream Analyzer** objects from TRANSMITTERS library. Connect the first one to the *S* connector of the top thickener and connect the second one to the *Con1Out* of the same thickener. Now connect the third one to the **Sink** that is connected to the *Con2Out* connector of the bottom thickener (see Figure 80).

Place the three **Transmitter-Element Flow** objects from the TRANSMITTERS library onto the worksheet and connect them to the same connectors in the way Stream Analyzers are connected. Open the dialog boxes, go to the **Inputs** tab, and select the *Ni* element in **Flow of** dropdown menu (see Figure 80).

Now, place the **Transmitter-Phase Flow** object from the TRANSMITTERS library near the **Sink** that is connected to the bottom thickener and connect it to the **Sink** object. This setup will be used to measure the Solids flow rate.

Place a **slider** object and a **Multiply_c** object from TOOLS library near the **Transmitter-Phase Flow** object. Connect the outlet of the **Transmitter-Phase Flow** object and the middle outlet of the **Slider** object to the two inlets of the **Multiply_c** object. Open the **Slider** object's dialog box and set the slider to 2. Connect the outlet of the **Multiply_c** object to the F connector of Water **Stream Source** object (see Figure 80).

Note: To change the slider output, the user can drag the slider bar, or click anywhere in the gray box for the slider and use the keyboard. The up/down keys move the slider output by 1% of the range, and the Page Up/Page Down keys move the output by 10% of the range. The range limits at the top and bottom of the slider are dialog entries if the user clicks on them.

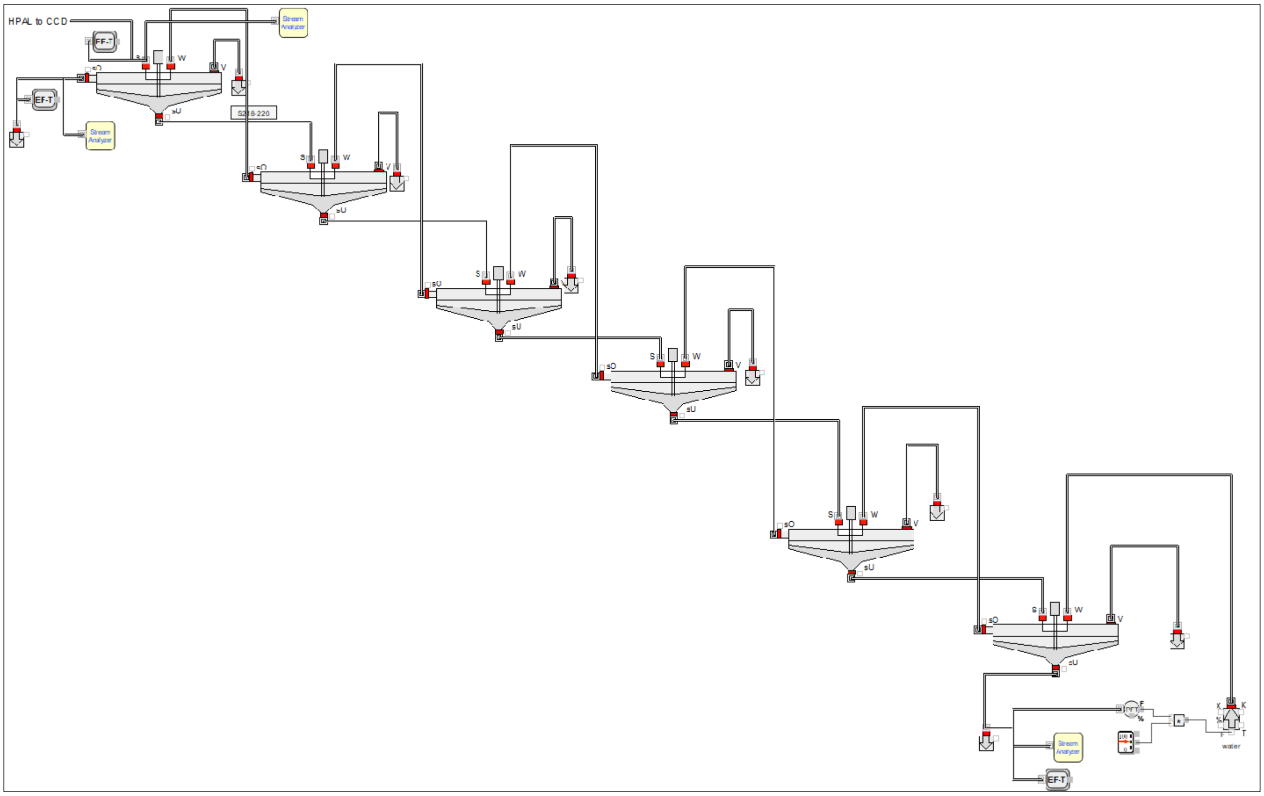


Figure 80: Placing Various Transmitter Objects and New Connections

Run the simulation and observe the results. In particular, the Supervisors should be green as shown in Figure 81.

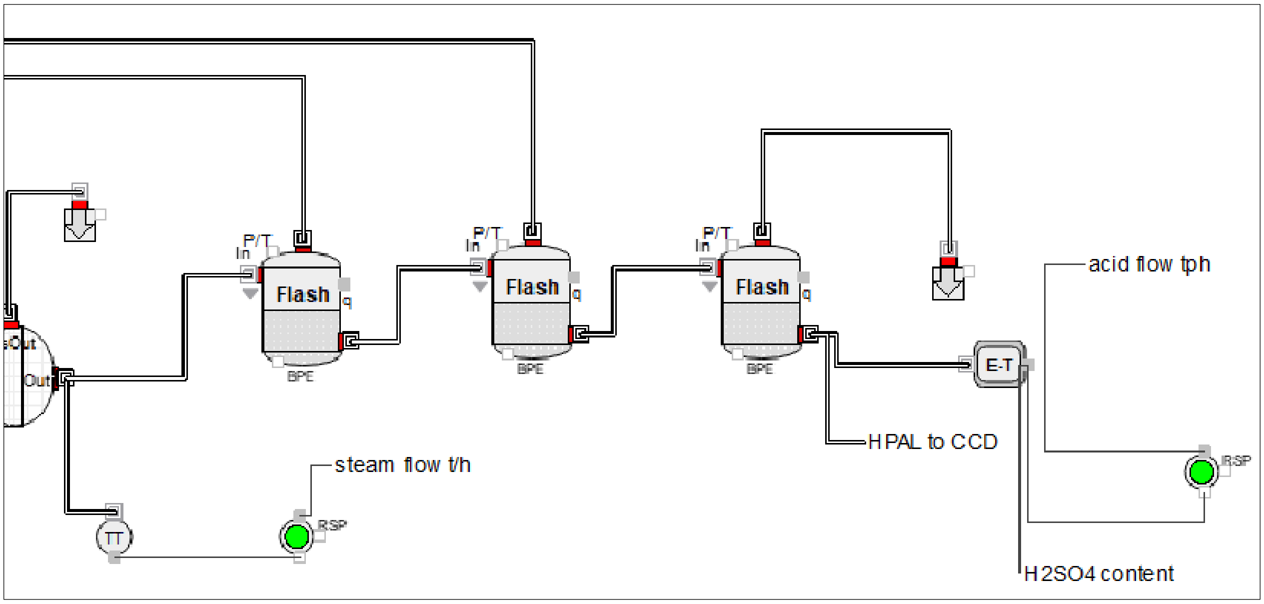


Figure 81: Supervisors (Converged)

SECTION 22. SPECIAL TOPICS

Section Concepts:

- Monitor Object
- Worksheet Inspector Object
- Terminator
- Recreator
- Data Tracker ++

There are some special tools in IDEAS that are particularly useful while running big steady-state models. We will discuss a few of them.

22.1 USING MONITOR OBJECT

This is a very useful tool to display how supervisors approach their convergence during simulation. It can be used when a worksheet contains a large number of supervisors, and we want to monitor all of them remotely.

22.2 PLACING MONITOR OBJECT ON WORKSHEET

Place a **Monitor** object from the MACRO PRIMITIVES library onto the worksheet. Open **Monitor** dialog box and you will find two tabs. One is **Supervisors** and other is **Reactors**. The **Supervisors** tab will show all the Active and Manual supervisors. Check the *Continuous Update* box. The **Reactors** tab will show all the reactors.

Now, set the simulation time equal to 200 and run the simulation. As the simulation runs, watch how the values inside the table (Under Monitor object/Supervisors tab) are changing.

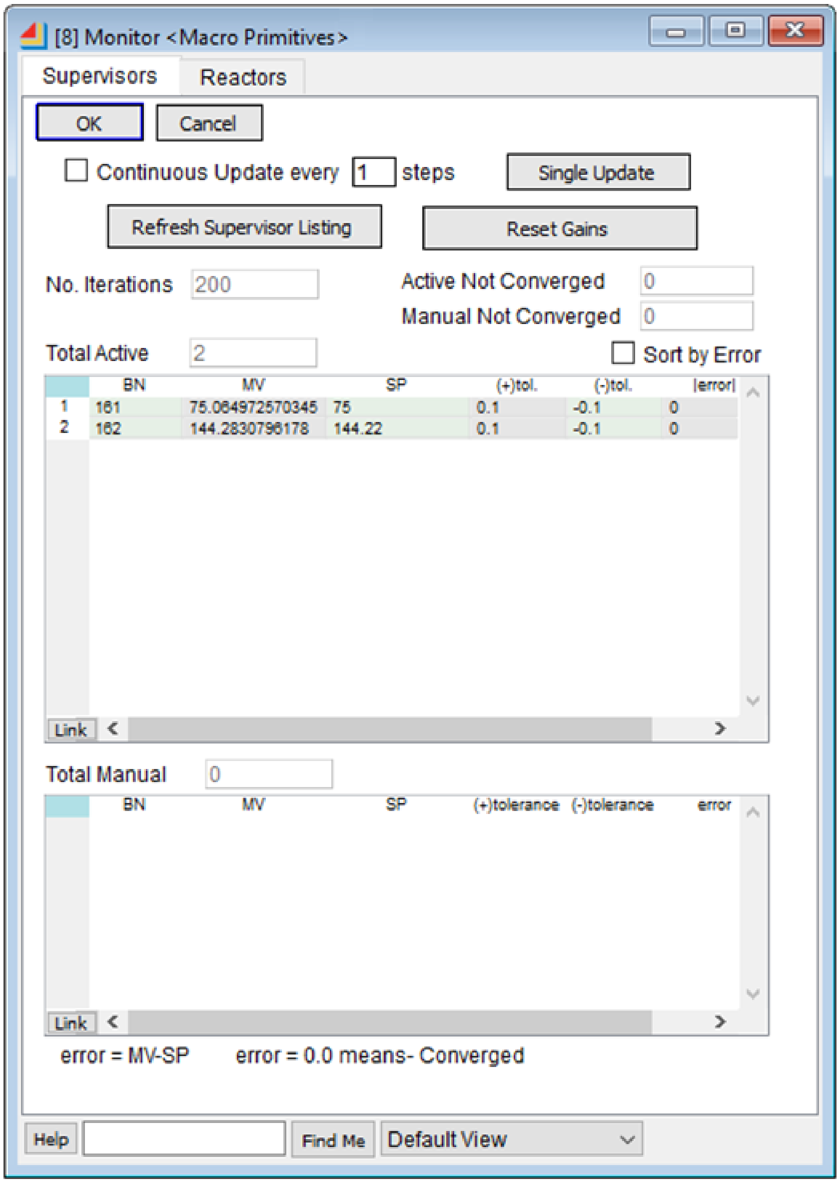


Figure 82: Monitor, Supervisors Dialog Box

If you click on the Block Number (BN) of any supervisor inside the table, it will open the dialog box of that particular supervisor.

22.3 USING WORKSHEET INSPECTOR OBJECT

As the name suggests, this object is used to find objects, display objects' calculated variables, and manipulate these variables. This object is particularly useful when running large steady-state models.

22.4 PLACING WORKSHEET INSPECTOR OBJECT ON WORKSHEET

Place a **Worksheet Inspector** Object onto the worksheet from the TOOLS_UTILITIES library.

22.5 SPECIFYING SEARCH CRITERIA FOR WORKSHEET INSPECTOR OBJECT

Open **Worksheet Inspector** object dialog box and click on **Search Setup** tab. Let us suppose we want to list all the thickeners on the worksheet. Simply enter *thickener* in **String in object name** input box and press **List all Matching Blocks** button to accept the search criteria. Now, click on **display** tab to list all the thickener objects present in worksheet. Click **Close** dialog button to close dialog box.

22.6 ACCESSING VARIABLES THROUGH WORKSHEET INSPECTOR

Before specifying variables inside the **Worksheet Inspector**, we are going to see how to view the variable names inside an object. Select **Edit** from the main Menu and select **Options** (see Figure 83).

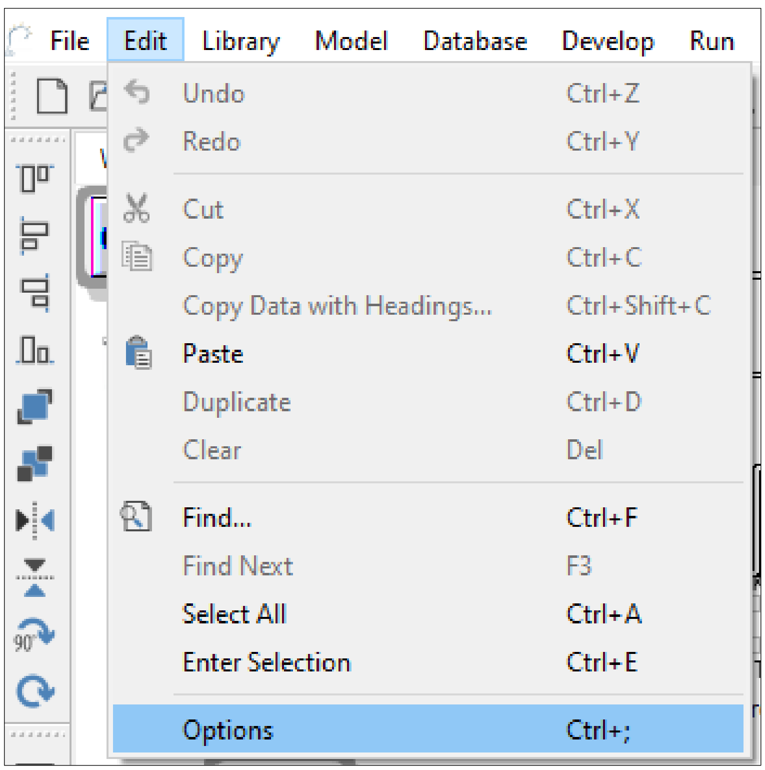


Figure 83: Opening Options Settings

In **Options**, click on **Misc** tab and select the check box for **Tool for dialog items: Show in block dialogs** (see Figure 84).

This will allow the user to view the variable names inside any dialog box.

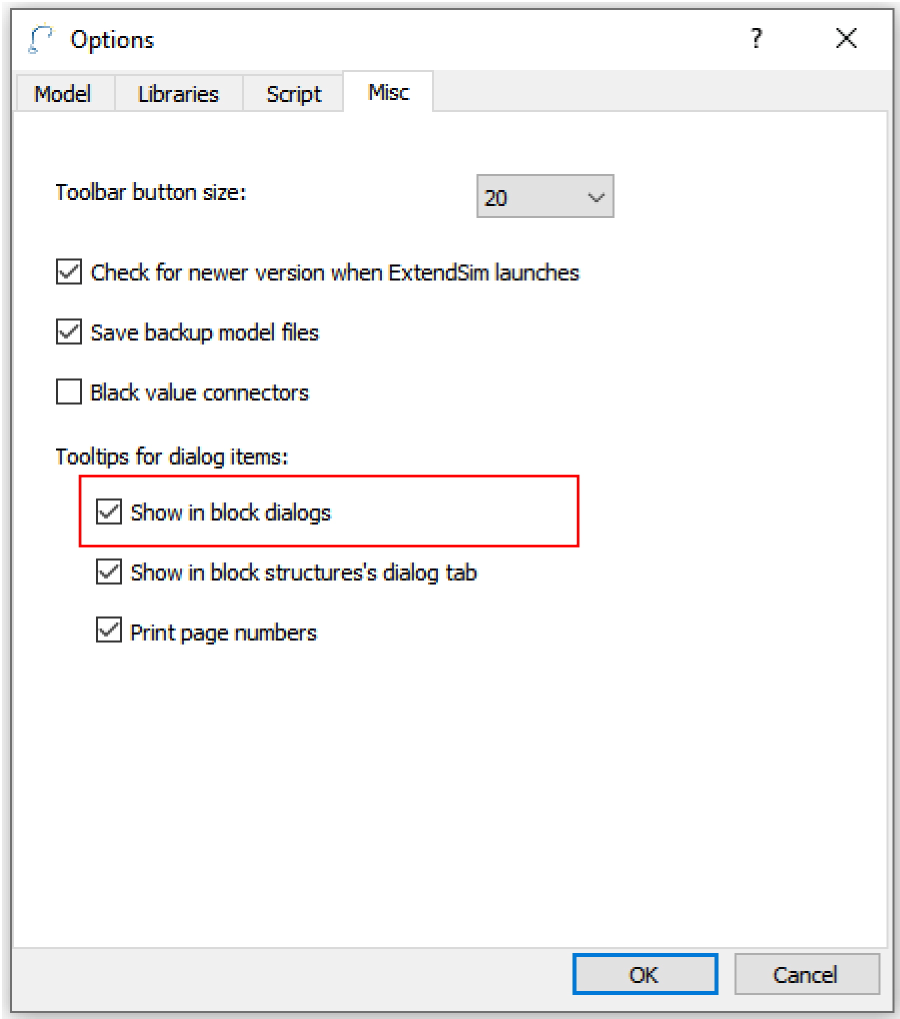


Figure 84: Options, Misc Tab, Tooltips checkbox

For example, open the dialog box for thickener, go to the **Inputs** tab and place your mouse pointer on **Mixing Efficiency** input field (as shown in Figure 85). This will show you the variable assigned for Mixing Efficiency.

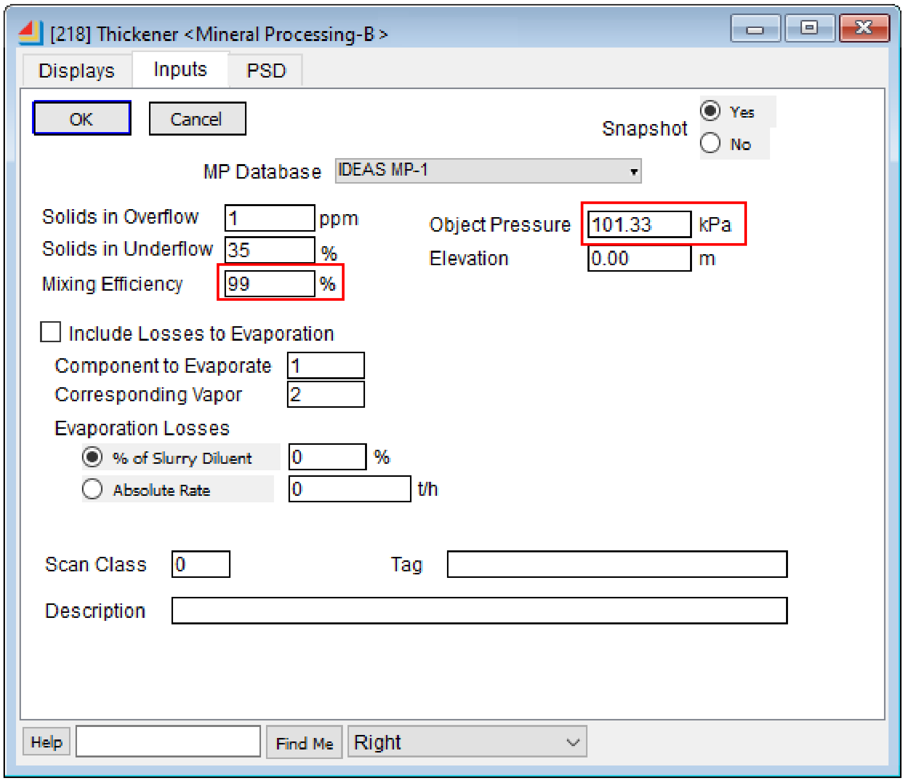


Figure 85: Displaying Variable Name in the Dialog Box

Coming back to access the variables from **Worksheet Inspector**, open the dialog box for the **Worksheet Inspector,** click **Search Setup** tab, and specify the variable name under the **Variable name** column of the table as *Mixing Efficiency* (as shown in Figure 86).

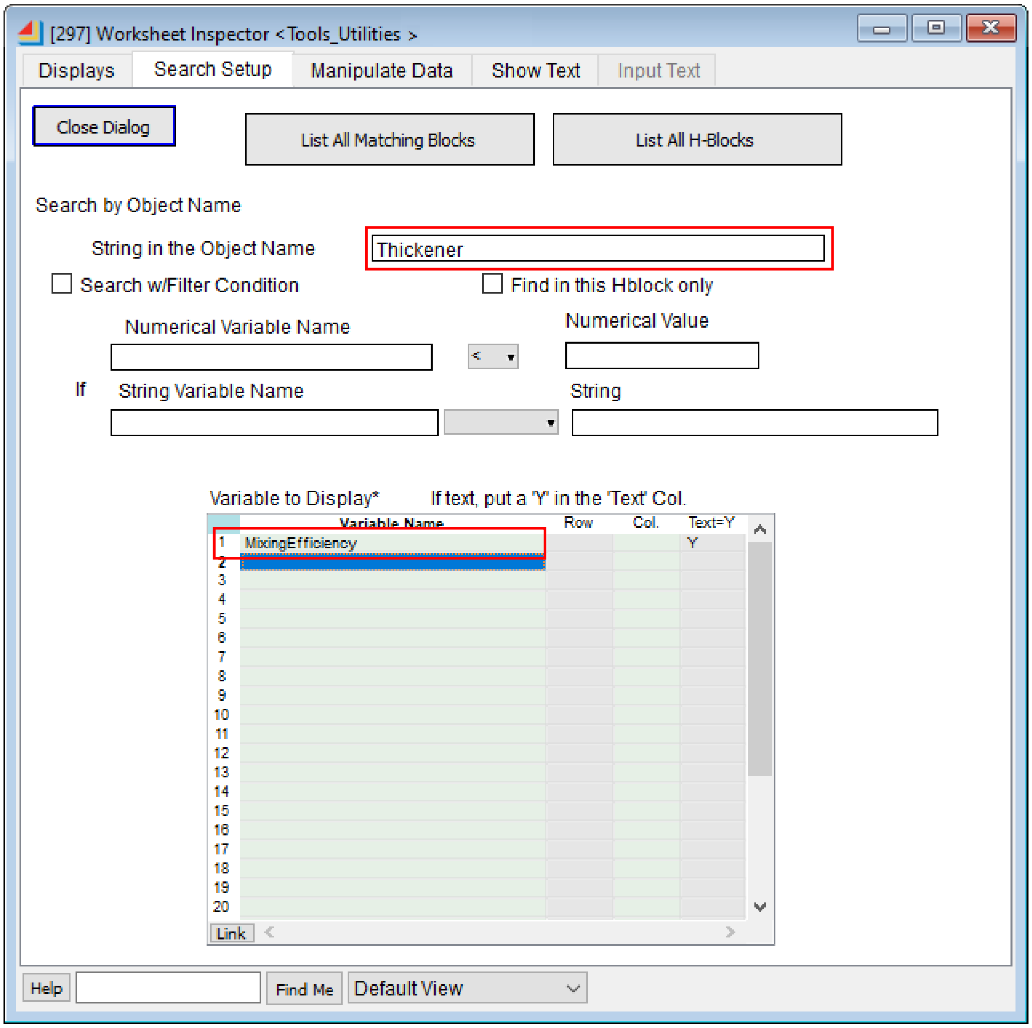


Figure 86: Worksheet Inspector Dialog Box Settings

Click on **List All Matching Blocks** and select the **displays** tab, and you can see that all the thickener objects with *Mixing Efficiency* variable are listed in a table (see Figure 87). In the same way, we can list out any of the variables. Please refer to the Help document for further information on Worksheet Inspector.

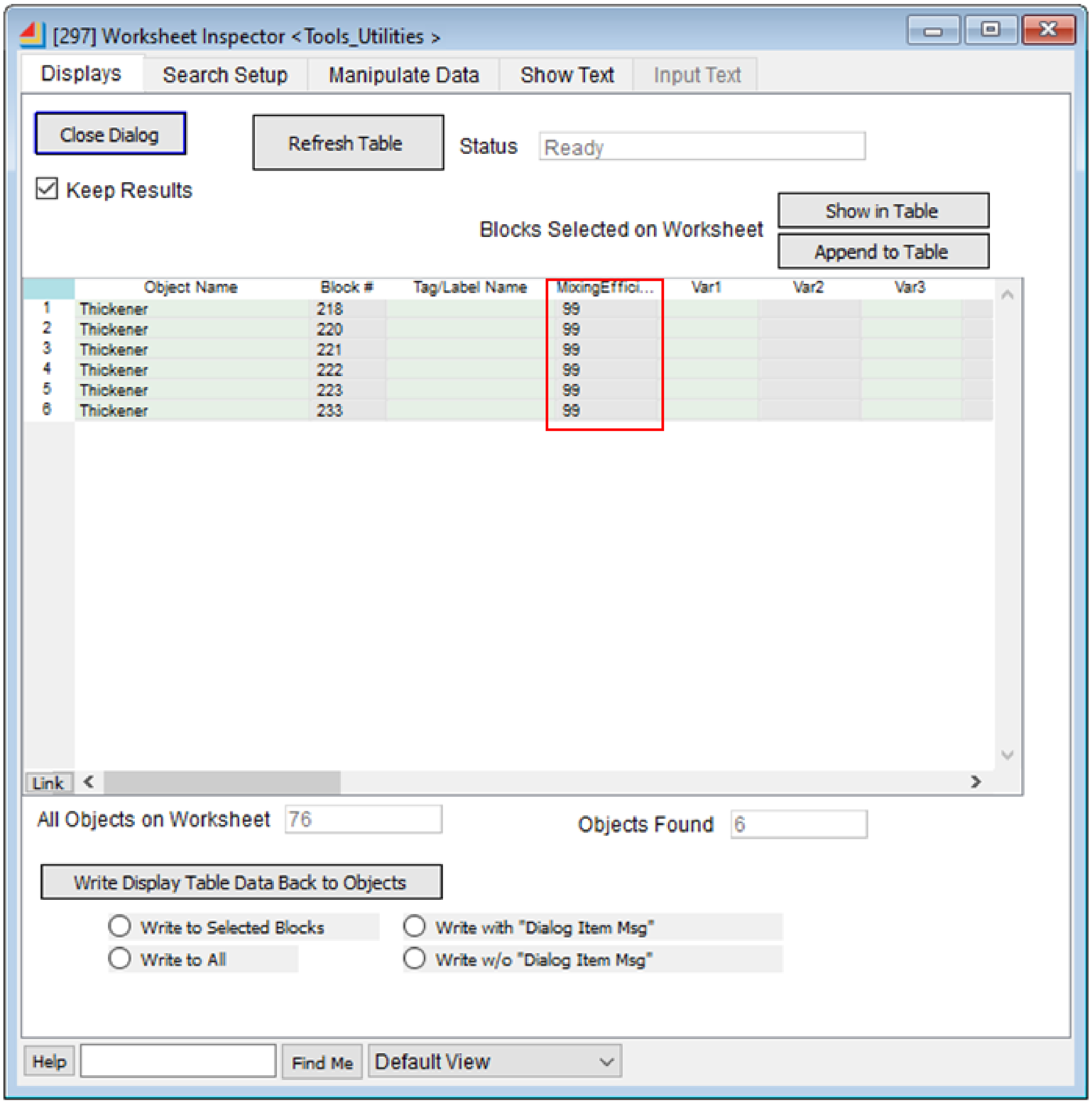


Figure 87: Worksheet Inspector Display Dialog

22.7 USING SCALAR TERMINATOR AND RECREATOR OBJECTS

These two objects are used to pass values to different locations without physical connection. The **Scalar Terminator** object is able write a value to a label and the **Scalar Recreator** object is able to read a value from a label. The **Scalar Terminator** object can be created from the **Scalar Reader** object from TOOLS library and the **Scalar Recreator** object can be created from the **Constant_c** object from the same library. For more details about the usage of **Constant** and **Scalar Reader** objects, refer to the help documentation.

22.8 WORKING WITH SCALAR TERMINATOR AND RECREATOR OBJECTS

Now, let us suppose we are interested to change the pressure of the **Autoclave** from 4400 to 4500. To do this, first place a **Constant_c** object from TOOLS library below the **Autoclave** object. Open its dialog box and enter a value of *4500* in the **Output Value** field under the **Input Data** tab.

Place a **Scalar Reader** object from the same library and place it near the new **Constant_c** object and connect it. Open the dialog box and go to the **Terminator** tab. Enter a label named *PofAutoclave* in **My Label** field and check the box *Use As Scalar Terminator*. The user can observe the object showing T upon it. Now, we are able to write a value into the label named *PofAutoclave*. See Figure 88 for details.

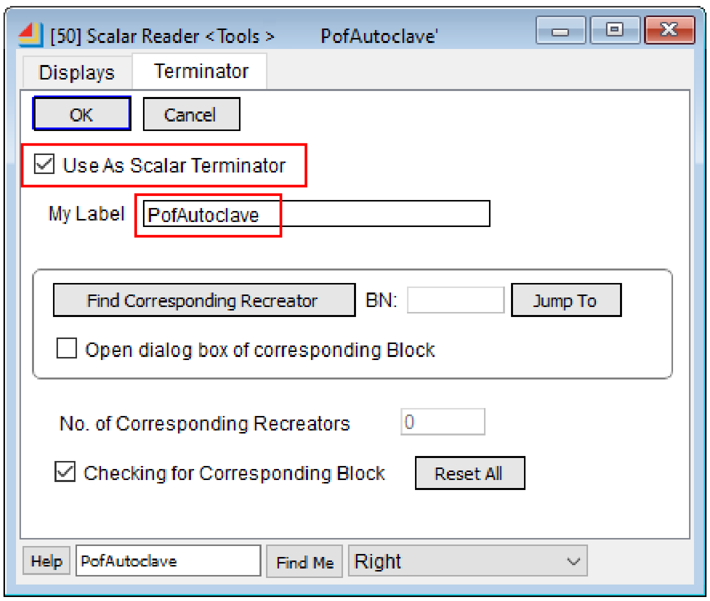


Figure 88: Scalar Reader, Terminator Tab

Now, create the **Scalar Recreator** object to read the value from the *PofAutoclave.* Open the other Constant_c dialog box connected to the Autoclave object, go to the **Recreator** tab, and type the same name (*PofAutoclave*) as defined earlier in the Scalar Reader's **Terminator** tab. Check the box called *Use As Scalar Recreator*. Observe the object showing R on it. Now, if you click on the button *Find Terminator, BN,* you will see the BN of the **Scalar Reader** object on successful linking. Be careful about the label name. If you mistype the label name, it will not find the BN. See Figure 89 for details.

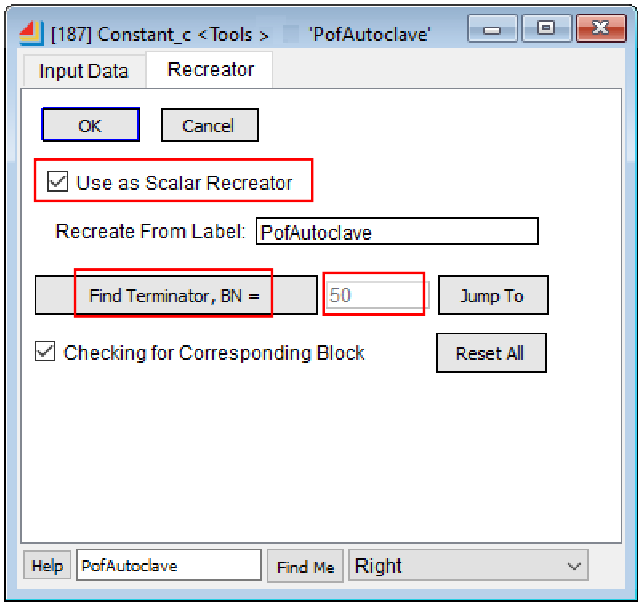


Figure 89: Constant_c, Recreator Tab

Run the simulation now and observe that the value is being reflected on the **Recreator** object, which is above the **Autoclave** object. The details of the worksheet are shown in Figure 90.

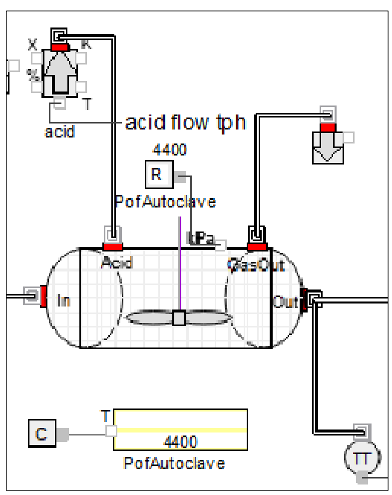


Figure 90: Scalar Terminator and Recreator Objects Usage

22.9 USING DATA TRACKER++ OBJECT

This object allows the user to select block variables to track. The user puts in the block label of the block containing the variable to track. A dropdown menu is generated with a list of variables from which to choose. This is a very useful tool to track the variables from the objects with the help of a plotter.

22.10 PLACING DATA TRACKER++ OBJECT ON WORKSHEET

Place Data Tracker++ object from TOOLS_UTILITIES library onto the worksheet below the **Autoclave** object.

22.11 WORKING WITH DATA TRACKER++ OBJECT

Let us explore the **Data Tracker++** object. First, we will label the two **Stream Source** objects for our *ProcessStream* and *Acid*, if they are not already labeled.

Now, open the dialog box of **Data Tracker++** object and go to **Displays** tab. Check the **Continuous Update** box. Go to **Read From** tab and enter the label names under the **From Block Label** column. A dropdown menu is generated with a list of variables under the **Variable Name** column. Select *Flow_dialog* for both of the labels. Make sure that the option *Inputs Directly From Objects* is set in the dialog box pull-down menu. Now, we are able to get the values from the objects to **Data Tracker++.** Go to **Displays** tab. It will list you the variable details. See Figure 91 for details.

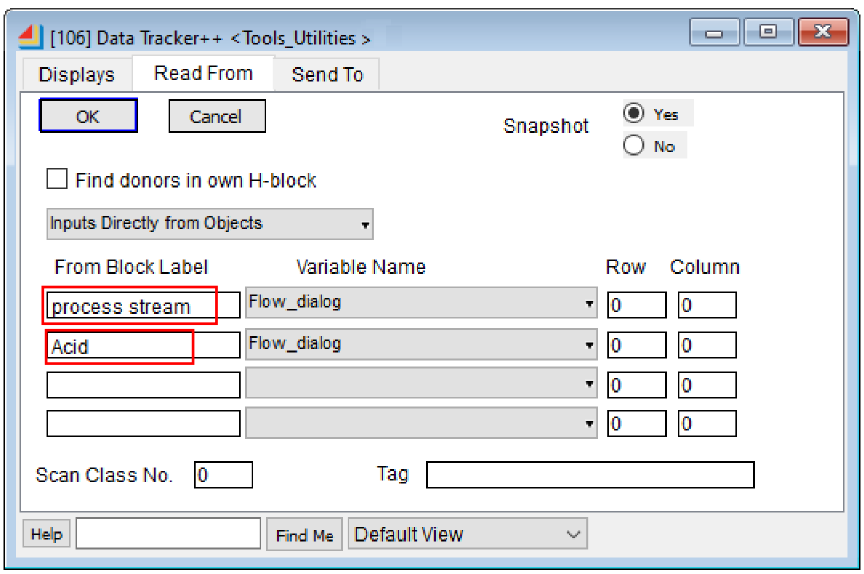


Figure 91: Data Tracker ++ Object Read from Tab

Now, add a **Plotter I/O Scan** object from the PLOTTERS library onto the worksheet near the **Data Tracker++** object. Connect the first *two outputs* of the **Data Tracker++** object to first *two inputs* of **Plotter I/O Scan** object. Run the simulation. Open the Plotter graph and observe (see Figure 92).

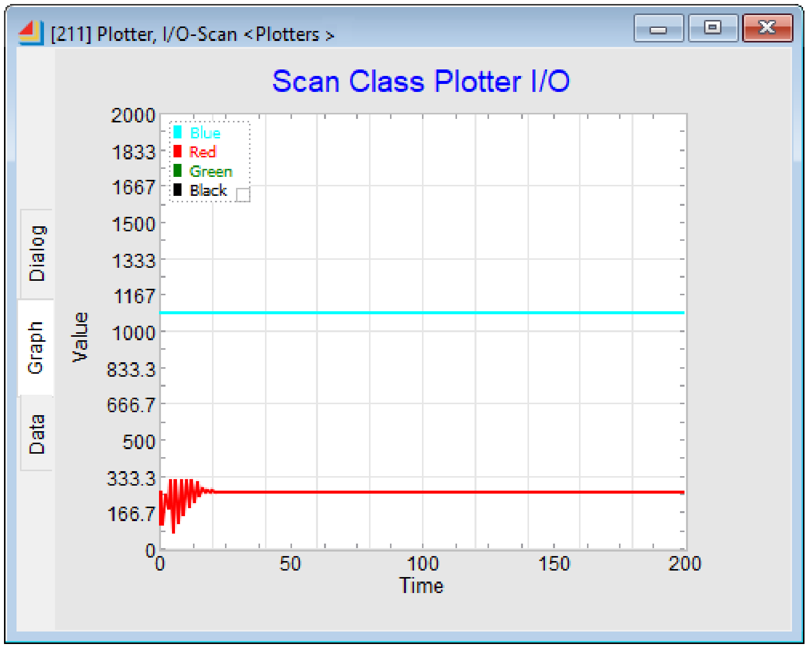


Figure 92: Data Tracker ++ Object Usage

This can also be used to send values directly to objects with or without connectors. For more information on this object, refer to the help document.

SECTION 23. ADVANCED TOPICS

Section Concepts:

There are some advanced tools in IDEAS that are particularly useful while running big steady state models. We are going to discuss a few of them.

- Stream Exporter
- Scenario Importer

23.1 USING STREAM EXPORTER OBJECT

This object is used to export stream information from IDEAS model to an Excel worksheet. The user can also format the information that needs to be exported.

23.2 PLACING STREAM EXPORTER OBJECT ON WORKSHEET

Place a **Stream Exporter** object from the DYNAMIC DATA EXCHANGE library onto to the worksheet. Open the dialog box. Go to the **Stream Selection** tab and press the **Read available streams** button. It will list all the output streams into the table. Enter 1 in the field next to **Set sheet # to** button. Now press **Set sheet # to** button. The user can see that the rows under column named **sheet#** set to 1. That means all the information is to be exported to the sheet number that is entered in the field next to the button. There are several options available. Refer to the help text documentation for details.

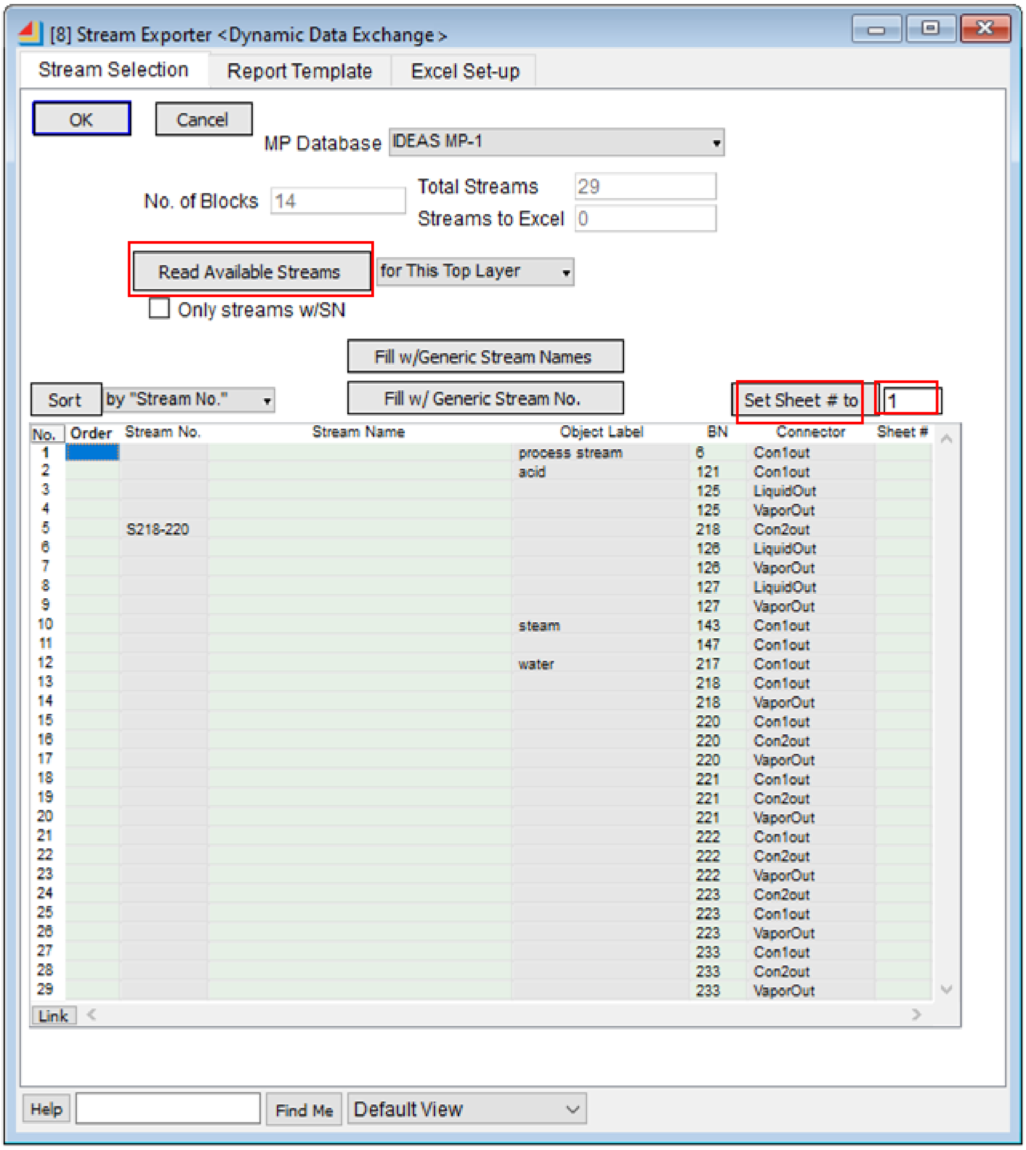


Figure 93: Stream Exporter, Stream Selection Tab

Now, go to **Report Template** tab. There are several options to format the stream information, which need to be sent to an Excel sheet. Leave it as it is. Now, move on to the **Excel Setup** tab. Click on **Select Excel File** button and select an excel file named as *HPAL_StreamExport* to which the information are to be exported.

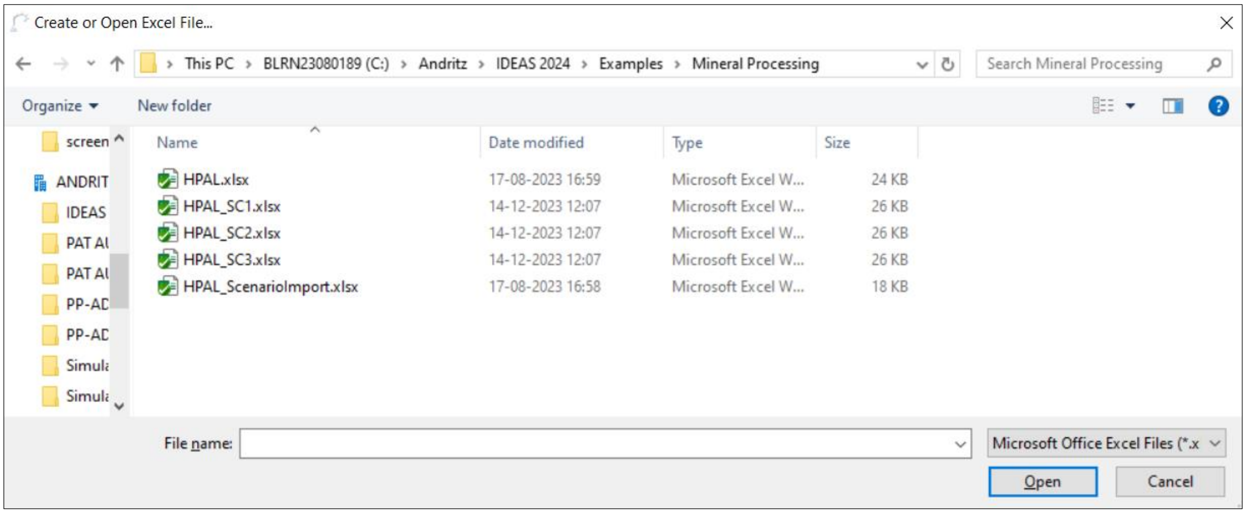


Figure 94: Creating Excel File

There is an option called ***Write Data @ Sim. End***, which when checked the Excel file will be written at the end of the simulation. Press **OK** to accept the changes.

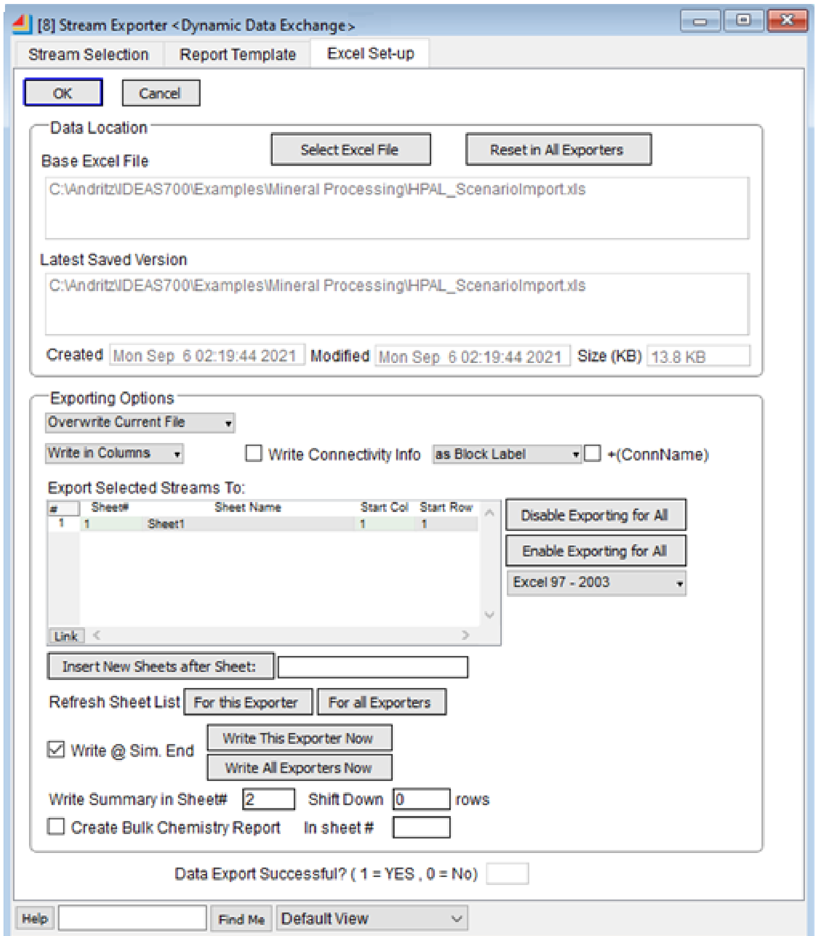


Figure 95: Stream Exporter, Excel Setup Tab

Now run the simulation. After the simulation ends, go to the location of the Excel file and open it. It looks like the one in Figure 96.

	A	B	C	D	E	F	G	H	I
1	Stream No.						S218-220		
2	Stream Name								
3	Flow	t/h	1074	250.8399226	1473.457403	104.6967138	916.3650399	1399.548775	73.90862861
4	Temperature	C	25	25	217.2877816	217.2877816	91.58847964	184.1172796	184.1172796
5	Pressure	kPa	1100	4400	2200	2200	101.325	1100	1100
6	Density	kg/m3	1379.051078	1971.718876	1189.634668	11.02560191	1494.401869	1261.725375	5.63463276
7	Enthalpy	kJ/kg	-14553.3974	-8295.61	-13339.51745	-13178.18861	-13383.89408	-13346.95378	-13197.37686
8	Water	wt %	60.00294014	0	57.97745937	0	46.66986965	55.7582953	0
9	Steam	wt %	0	0	0	100	0	0	100
10	Quartz_s	wt %	11.27055226	0	10.58819493	0	17.02513427	11.14734583	0
11	Ni(OH)2_s	wt %	0.939546038	0	0.068483313	0	0.110116749	0.072099841	0
12	MnO2_s	wt %	0.469823021	0	0.342453011	0	0.550642347	0.360537578	0
13	Mg(OH)2_s	wt %	1.409069044	0	1.027067461	0	1.651458208	1.081305762	0
14	MgO_s	wt %	2.349115107	0	1.712265057	0	2.753211733	1.802687888	0
15	MgCO3_s	wt %	0.477823413	0	0.020897069	0	0.033601138	0.02200062	0
16	Fe(OH)3_s	wt %	2.349115107	0	0.085613253	0	0.137660587	0.090134394	0
17	Fe2O3_s	wt %	3.674180035	0	5.755459104	0	9.254406884	6.059398557	0
18	Goethite_s	wt %	4.698230213	0	0	0	0	0	0
19	Al2O3_s	wt %	2.349115107	0	0.342453011	0	0.550642347	0.360537578	0
20	Chlorite_s	wt %	10.01049051	0	1.824156367	0	2.933125739	1.920488054	0
21	H2SO4_aq	wt %	0	100	3.988129861	0	3.609041842	4.198738604	0
22	Al2(SO4)3_aq	wt %	0	0	4.596670572	0	4.159738287	4.83941568	0
23	Fe2(SO4)3_aq	wt %	0	0	3.043324053	0	2.75404369	3.204038643	0
24	NiSO4_aq	wt %	0	0	1.028862125	0	0.931064584	1.0831952	0
25	MgSO4_aq	wt %	0	0	7.598511447	0	6.876241944	7.999780463	0
26	CO2_g	wt %	0	0	0	0	0	0	0
27	H2S_g	wt %	0	0	0	0	0	0	0
28	FeSO4_aq	wt %	0	0	0	0	0	0	0
29	S_s	wt %	0	0	0	0	0	0	0
30	CaCO3_s	wt %	0	0	0	0	0	0	0
31	CaSO4	wt %	0	0	0	0	0	0	0
32	NiS_s	wt %	0	0	0	0	0	0	0

	A	J	K	L	M	N	O	P	Q
1	Stream No.								
2	Stream Name								
3	Flow	1252.665041	146.8837337	144.3429063	144.3429063	641.454245	977.7560788	0	641.4560778
4	Temperature	100.0010432	100.0010432	256	256	25	91.46458407	91.46458407	79.19250571
5	Pressure	101.325	101.325	101.325	4400	101.325	101.325	101.325	101.325
6	Density	1416.564177	0.597503903	0.416535152	22.13256622	997.0261306	1162.557032	0	1125.685778
7	Enthalpy	-13351.91118	-13302.9557	-12992.91189	-12992.91189	-15877.1	-13965.37691	-13432.4	-14332.70347
8	Water	50.57064612	0	0	0	100	71.86052747	0	77.44996807
9	Steam	0	100	100	100	0	0	100	0
10	Quartz_s	12.45445007	0	0	0	0	4.86432E-05	0	4.86432E-05
11	Ni(OH)2_s	0.080554052	0	0	0	0	3.14619E-07	0	3.14619E-07
12	MnO2_s	0.402813129	0	0	0	0	1.57326E-06	0	1.57326E-06
13	Mg(OH)2_s	1.208096422	0	0	0	0	4.71845E-06	0	4.71845E-06
14	MgO_s	2.014065646	0	0	0	0	7.86632E-06	0	7.86632E-06
15	MgCO3_s	0.024580347	0	0	0	0	0	0	0
16	Fe(OH)3_s	0.100703282	0	0	0	0	3.93316E-07	0	3.93316E-07
17	Fe2O3_s	6.769905401	0	0	0	0	2.64412E-05	0	2.64412E-05
18	Goethite_s	0	0	0	0	0	0	0	0
19	Al2O3_s	0.402813129	0	0	0	0	1.57326E-06	0	1.57326E-06
20	Chlorite_s	2.145678705	0	0	0	0	8.38036E-06	0	8.38036E-06
21	H2SO4_aq	4.69107006	0	0	0	0	5.540395564	0	4.439883736
22	Al2(SO4)3_aq	5.406871002	0	0	0	0	6.385793394	0	5.117356699
23	Fe2(SO4)3_aq	3.579734574	0	0	0	0	4.227851078	0	3.388055438
24	NiSO4_aq	1.21020741	0	0	0	0	1.429317342	0	1.145406095
25	MgSO4_aq	8.937810651	0	0	0	0	10.55601515	0	8.459229967
26	CO2_g	0	0	0	0	0	0	0	0
27	H2S_g	0	0	0	0	0	0	0	0
28	FeSO4_aq	0	0	0	0	0	0	0	0
29	S_s	0	0	0	0	0	0	0	0
30	CaCO3_s	0	0	0	0	0	0	0	0
31	CaSO4	0	0	0	0	0	0	0	0
32	NiS_s	0	0	0	0	0	0	0	0

Figure 96: Excel File

23.3 USING SCENARIO IMPORTER OBJECT

This object is used to import data from the Excel sheet to the variables in the objects of the IDEAS model. The user can also define a number of scenarios in the excel sheet and run them in the IDEAS model simultaneously.

23.4 CREATING SCENARIOS IN THE EXCEL SHEET

Let us suppose we would like to run the simulation for three different ore flow rates of 1074, 1084, and 1094 t/h for the same Autoclave outlet temperature of 261ºC.

Create an Excel sheet and name it as *HPAL_ScenarioImporter*. Enter the information as shown in the Excel sheet (see Figure 97). The Column C contains labels. Column E contains IDEAS tags. The starting name should be IDEAS:tags and Ending name is IDEAS:tagsEND to mark the end of tags. In between these two are IDEAS tags. The syntax appears as IDEAS:1;<BN>;<variablename>;0;0. Column F contains Scenario 1 named as SC1. Below SC1, there are some values. These are for the variable tags mentioned in Column E. Save the Excel sheet and close it.

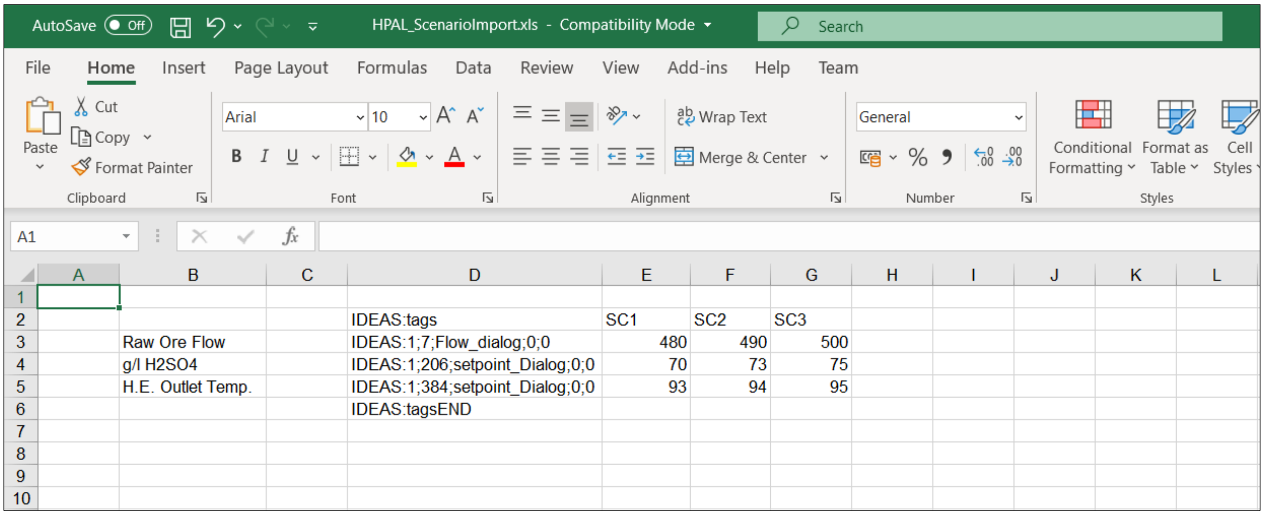


Figure 97: Excel file with Scenarios

23.5 PLACING SCENARIO IMPORTER OBJECT ON WORKSHEET

Place a **Scenario Importer** object from the DYNAMIC DATA EXCHANGE library onto the worksheet. Open the dialog box. Go to the **Setup** tab and press the **Select Excel File** button. Select the file that is created in the previous step. Check the box called *Run series of N scenarios* to run all the scenarios simultaneously and enter a value of 3 in the *Scenarios to Run* field. Now move on to the **Import Variables** tab and click on the **Import All tags** button to get the tag details from the excel file. A dialog box opens. Click **OK** to accept. It will list you the sheet number, name, and the rows and columns that the tags are present. Change simulation time to 500 and Run the simulation. Observe the values for each scenario in the Displays tab of this object. The Displays tab is as shown in Figure 98.

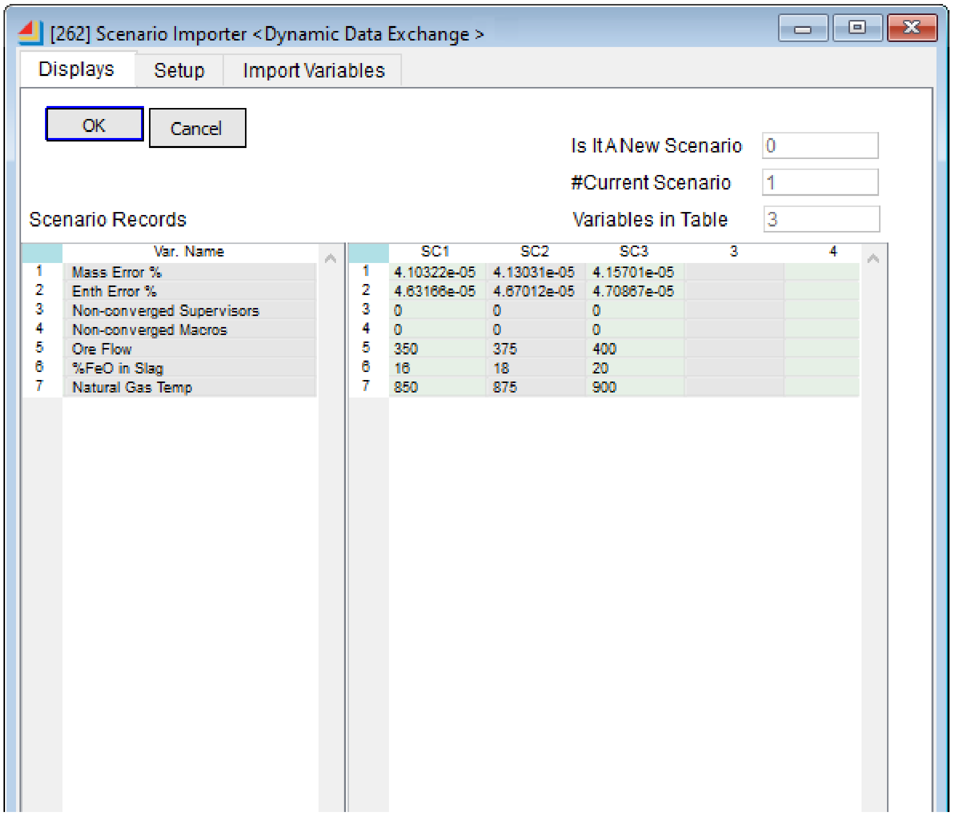


Figure 98: Scenario Importer, Displays Tab

Congratulations! You have finished your first steady state model using IDEAS. This tutorial was designed to introduce you to IDEAS, not to make you an expert in each of the objects used. Please review the help text for each object as well as the documentation for all of the libraries to understand the various options chosen in the dialog boxes for this tutorial. Remember to set up your models for maximum flexibility as designing models does not simply mean that you copy a process flow diagram. Leave some room on your worksheets for model expansion and document your choices of important dialog box entries (either directly on the model by typing in text or by preparing a separate document). Happy Modeling!

This is the end of IDEAS Bronze Tutorial. We hope you have found this material helpful in learning how to use the IDEAS Simulation Software. Another tutorial, the IDEAS Gold tutorial, is also available to assist you in your learning.

This tutorial is meant to provide a basic introduction to the IDEAS Simulation Software.

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