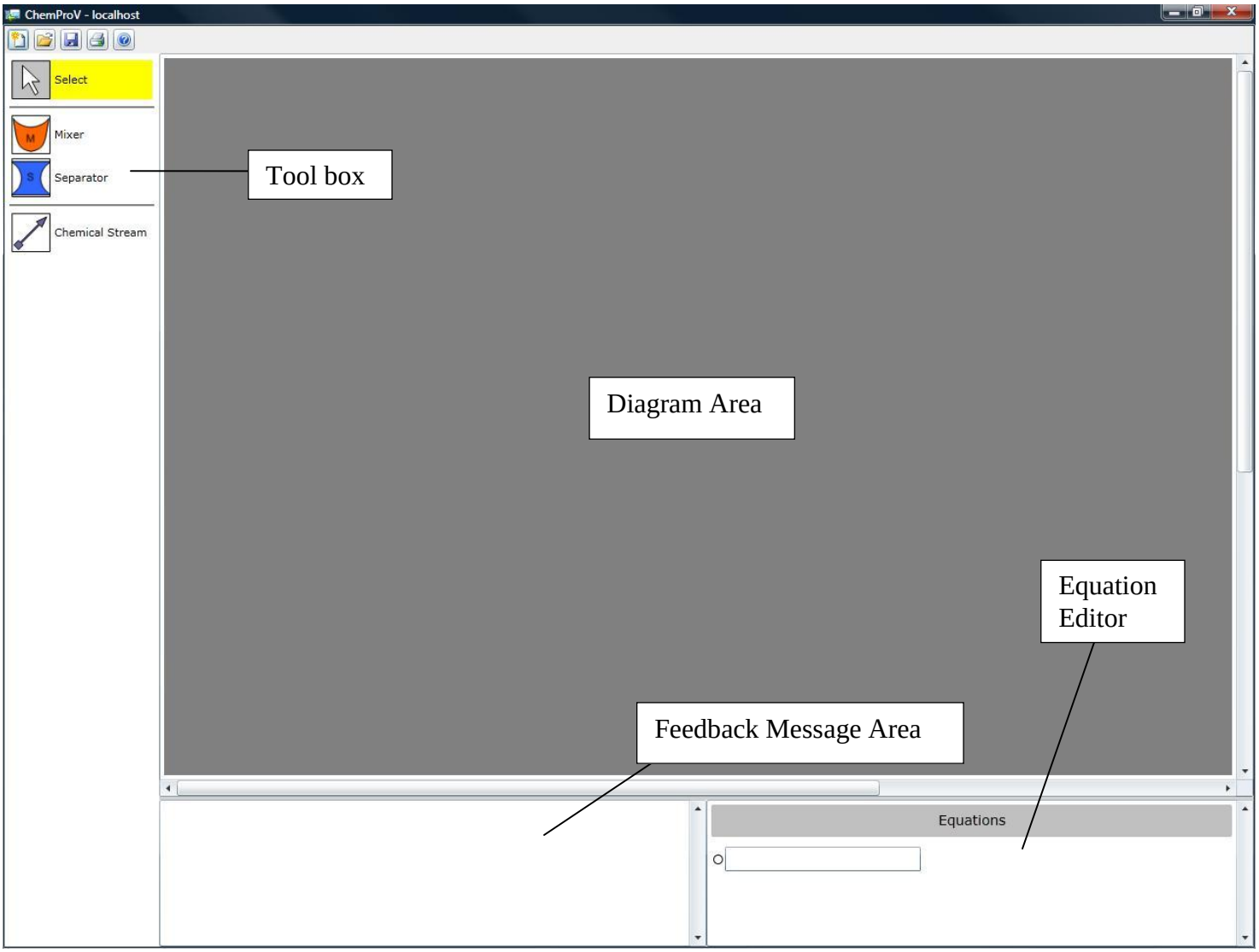
TUTORIAL

(Please read all instructions aloud as you work through this tutorial.)

In this study, you will be solving problems using Chemical Process Visualizer (ChemProV), a software environment designed to help you solve material balance problems.

To begin this tutorial, launch ChemProV by double-clicking the ChemProV shortcut on the desktop:

The ChemProV application will appear. It will look something like this:



Step 2(a): Create a Mixer Process Unit

1. Click on the "Mixer" icon 

in the toolbox.
2. Position the mouse in on the left side of the Diagram Area, about halfway down.
3. Click in the Diagram Area.
4. A Mixer should appear in the Diagram Area where you clicked.

Step 2(b): Delete the Mixer Process Unit

5. Click on the "Mixer" icon 

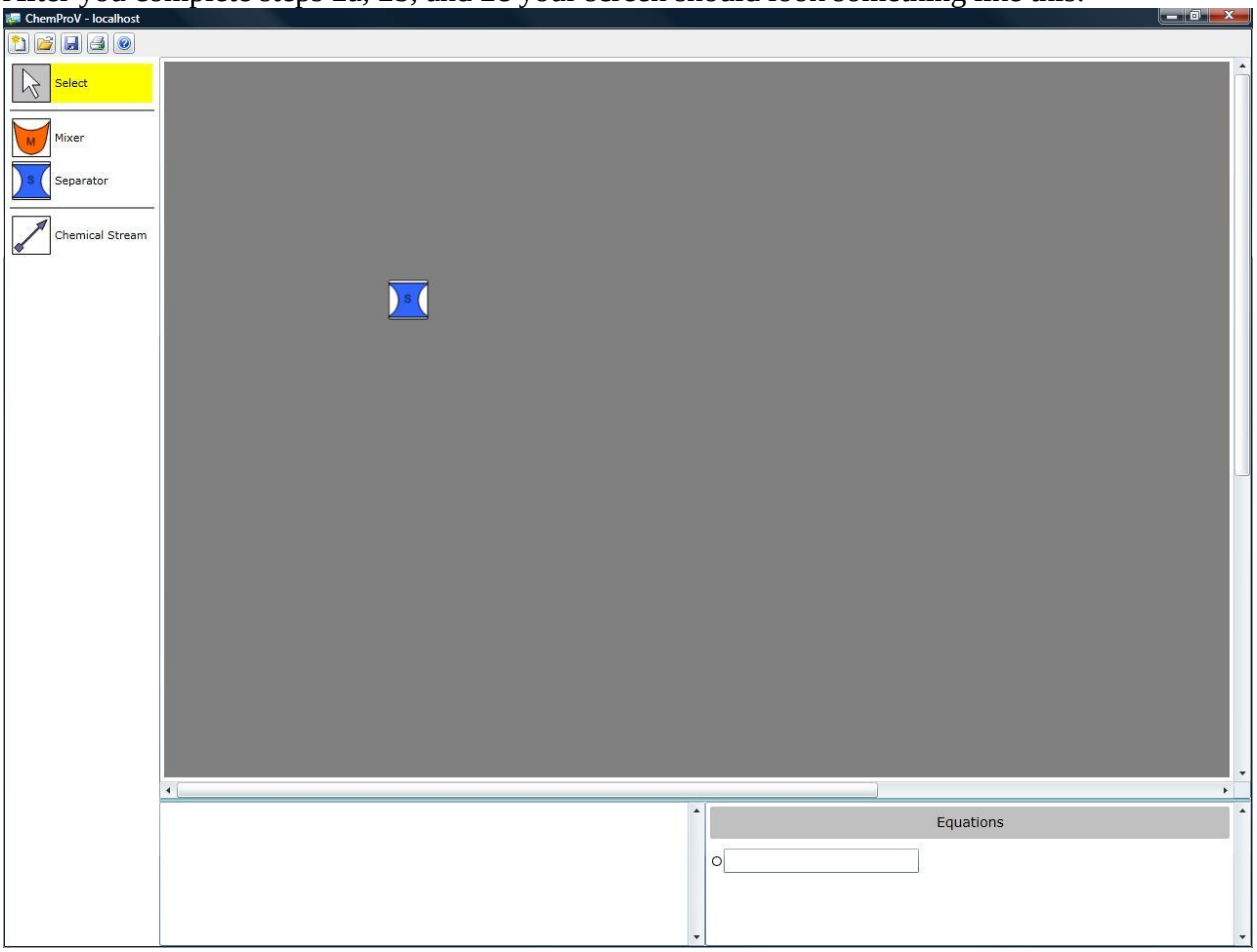
in the Diagram area.
6. Right click on the icon and select Delete from the dropdown menu. Alternatively, you can select the mixer icon and hit delete key on the keyboard.
7. Note that the "Mixer" icon has disappeared, indicating that it has been deleted.

Step 2(c): Create a Separator Process Unit

8. Click on the "Separator" icon 

in the toolbox.
9. Position the mouse in the middle of the Diagram area.
10. Click in the Diagram Area.
11. A Separator should appear in the Diagram Area where you clicked.

After you complete steps 2a, 2b, and 2c your screen should look something like this:



Step 3: Create a Chemical Stream to the Separator

1. Click on the "Chemical Stream" icon  in the toolbox.
2. Position the mouse cursor inside the Diagram Area.
3. Press the left mouse button to the left hand side of the separator and drag the mouse into the Separator.
4. Release the mouse button inside the Separator (you will see a green border on the Separator when the stream is properly connected.
5. A chemical stream flowing into the Separator should appear in the Diagram Area, along with a table like the following that indicates the contents of the stream:

Label	Quantity	Units	Compound
M2	?	grams	Overall
m21	?	%	Select

Chemical Stream Table

This table has four columns that specify the following information about the components of a stream:

- **Label**: Each stream component has a unique identifying label. By convention, use ALL CAPS letters to denote the overall stream label (e.g., "M1") and identical lower-case letters to denote subcomponent labels (e.g., "m11").
- **Quantity**: The quantity of stream component, which might be unknown, in which case it should be represented with a **'?'.**
- **Units:** The units in which the quantity is specified, e.g., grams, kilograms, %.
- **Compound**: the names of the chemical compounds contained in the stream, e.g., acetic acid. In the case of the "Overall" stream (first row of the table), use the label "Overall" to indicate that it is the overall stream and potentially composed of several different compounds (which should then be listed in separate rows below).

Step 4: Specify the Properties of the Chemical Stream to the Separator

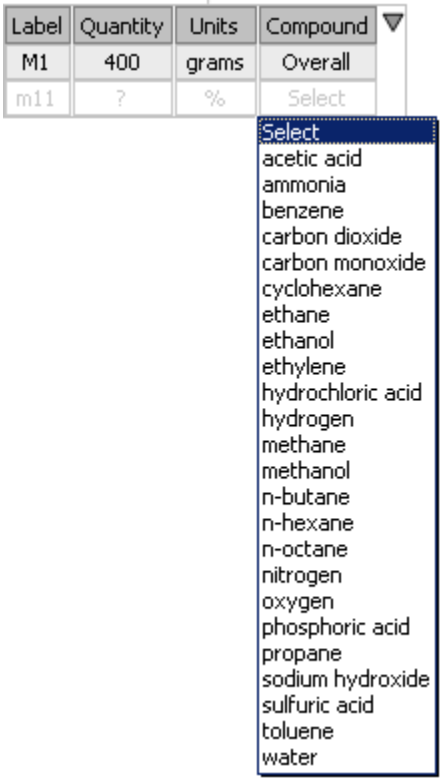
Label	Quantity	Units	Compound
M1	?	grams	Overall
m11	?	%	Select

Chemical Stream Table

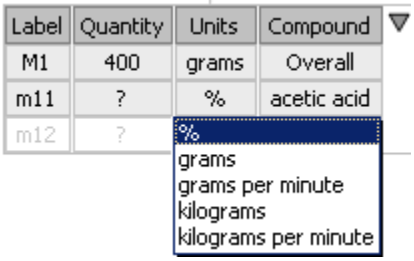
1. In the stream tag table associated with the incoming stream, double click the *Quantity* column of the first ('Overall') row of the table.
2. The '?' will be highlighted.
3. Type in the numerical value **400**.

Label	Quantity	Units	Compound
M1	400	grams	Overall
m11	?	%	Select

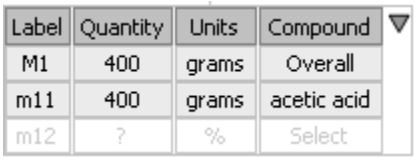
4. Positioning the mouse cursor in the next row, double click in the cell under the *Compound* column. A drop down menu will appear that contains the names of all possible materials.
5. Choose “acetic acid” from the dropdown menu as the compound.



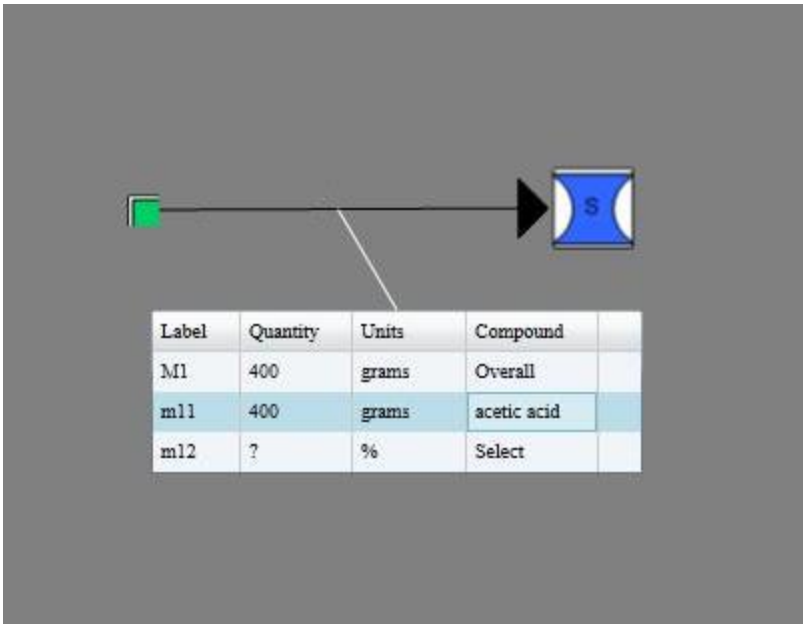
6. Positioning the mouse cursor in the row labeled ‘m11’, double-click in the cell in the *Units* column. A drop down menu will appear.
7. Choose ‘grams’ from the dropdown menu as the unit.



8. Double click under the *Quantity* column of the second row labeled ‘m11’.
9. Specify **400**, a numerical value equal to the overall quantity.



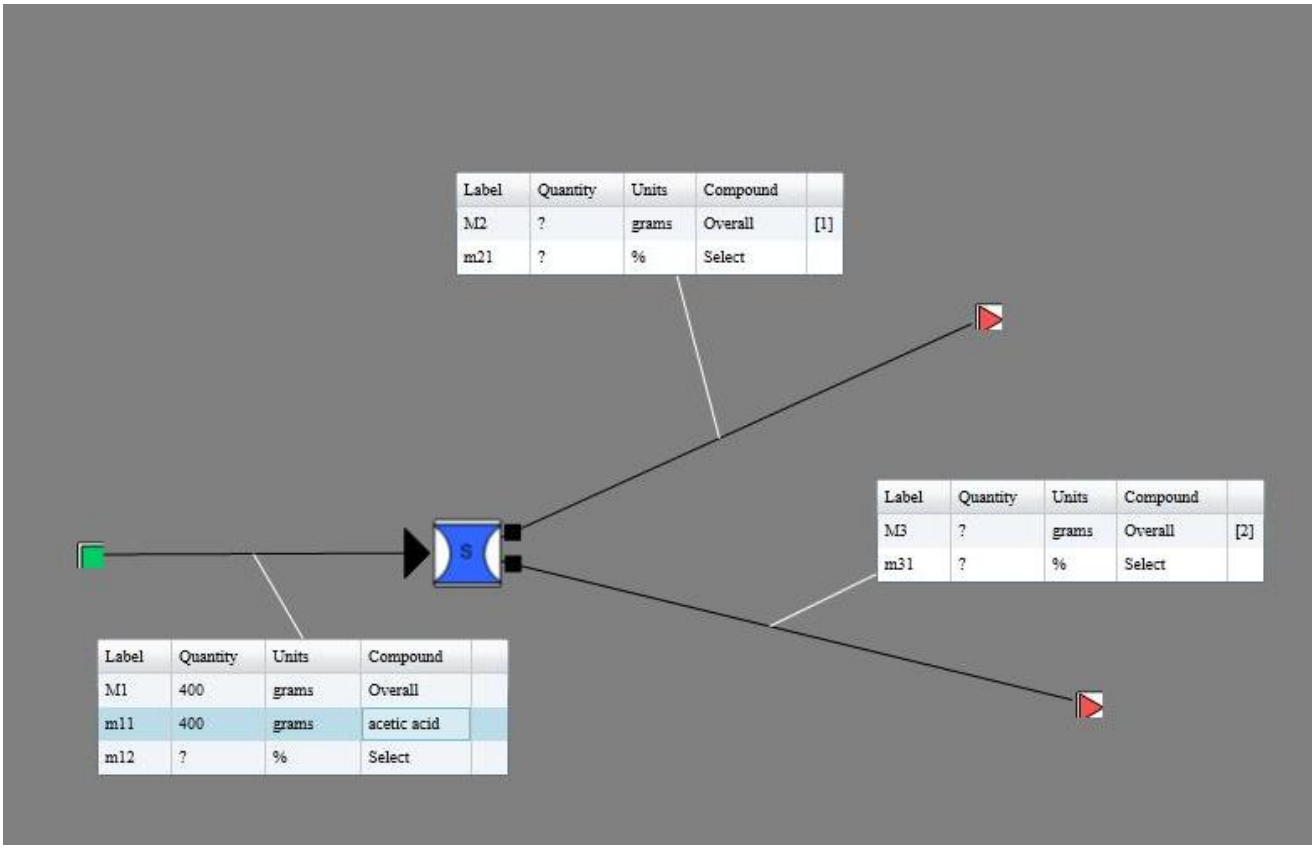
After you complete steps 3 and 4, your screen should look something like this:



Step 5a: Create Two Outgoing Chemical Streams from the Separator

1. Click on the "Chemical Stream" icon  in the toolbox.
2. Position the mouse cursor inside the Separator.
3. Click the left mouse button and drag the mouse to the right of and above the Separator.
4. Release the mouse to create a stream angled to the top-right of the Diagram area.
5. Follow the same procedure in steps 1-4 to create a second stream angled to the bottom-right of the Diagram area.

Once you have created the two streams, they should look something like this:



Step 5b: Specify the top Chemical Stream coming out of the Separator

1. In the table associated with the top-most stream you created in Step 5a, double click under the Quantity column of the 'Overall' component in the first row.
2. Specify **200** as the Quantity. By default, the units will be set to grams, which is what you want.
3. Double-click in the Quantity column of the second row the table (labeled 'm21'). Enter **100** as the quantity.
4. Double-click in Units column of the second row the table (labeled 'm21'). Enter '%' as the unit.
5. Double click in the Compound column of the second row of the table (labeled 'm21'). From the drop-down menu, choose "acetic acid" as the material.

When you have completed this step, the table associated with the top-most stream should look like this:

Label	Quantity	Units	Compound
M2	200	grams	Overall
m21	100	%	acetic acid
m22	?	%	Select

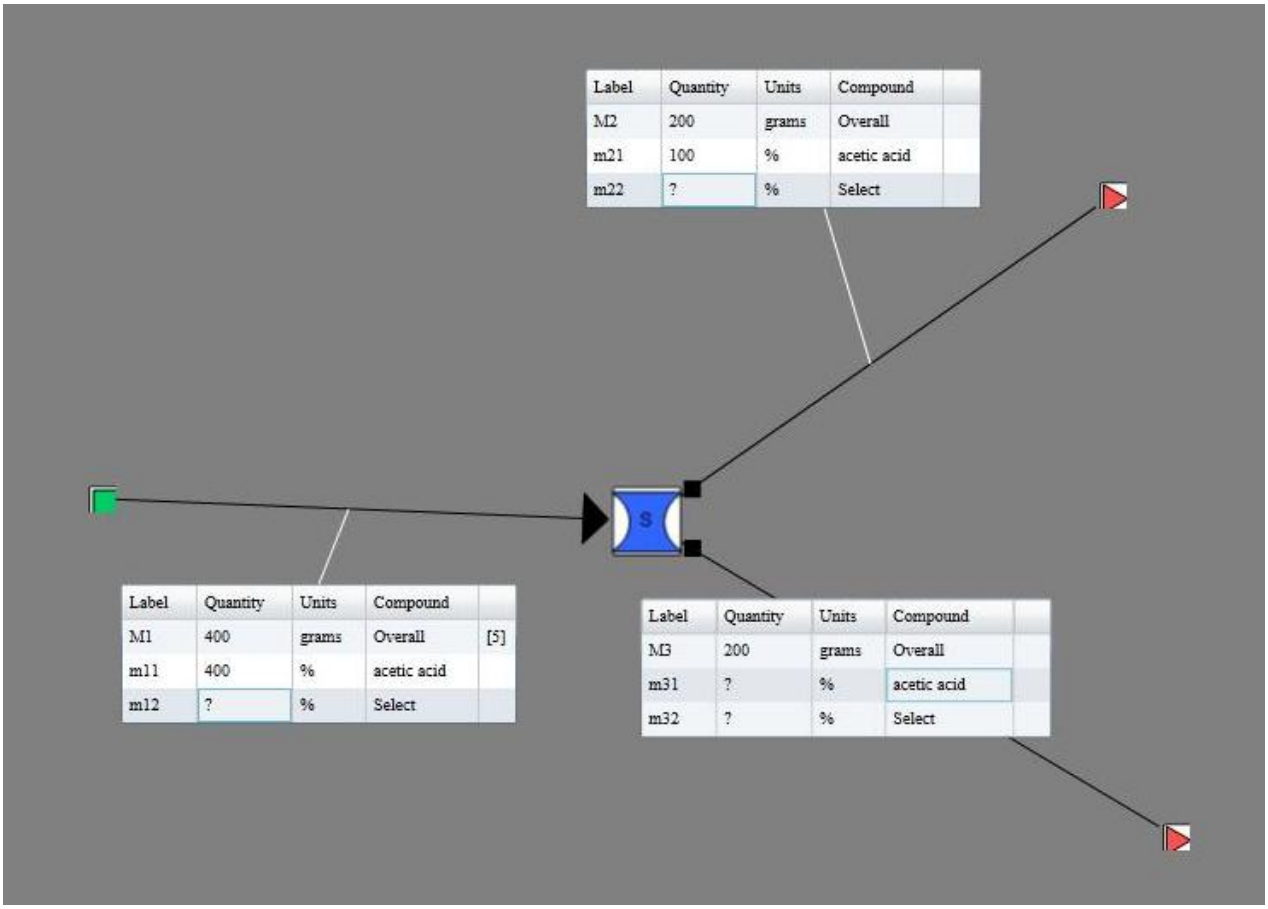
Step 5c: Specify the bottom Chemical Stream coming out of the Separator

1. In the table associated with the bottom-most stream you created in Step 5a, double click under the Quantity column of the 'Overall' component in the first row.
2. Specify **200** as the Quantity. By default, the units will be set to grams, which is what you want.
3. Double click in the Compound column of the second row of the table (labeled 'm31'). From the drop-down menu, choose "acetic acid" as the material.
4. Leave the quantity of the row labeled 'm31' as it is: '?' (which means 'unknown').

When you have completed this step, the table associated with the bottom-most stream should look like this:

Label	Quantity	Units	Compound
M3	200	grams	Overall
m31	?	%	acetic acid
m32	?	%	Select

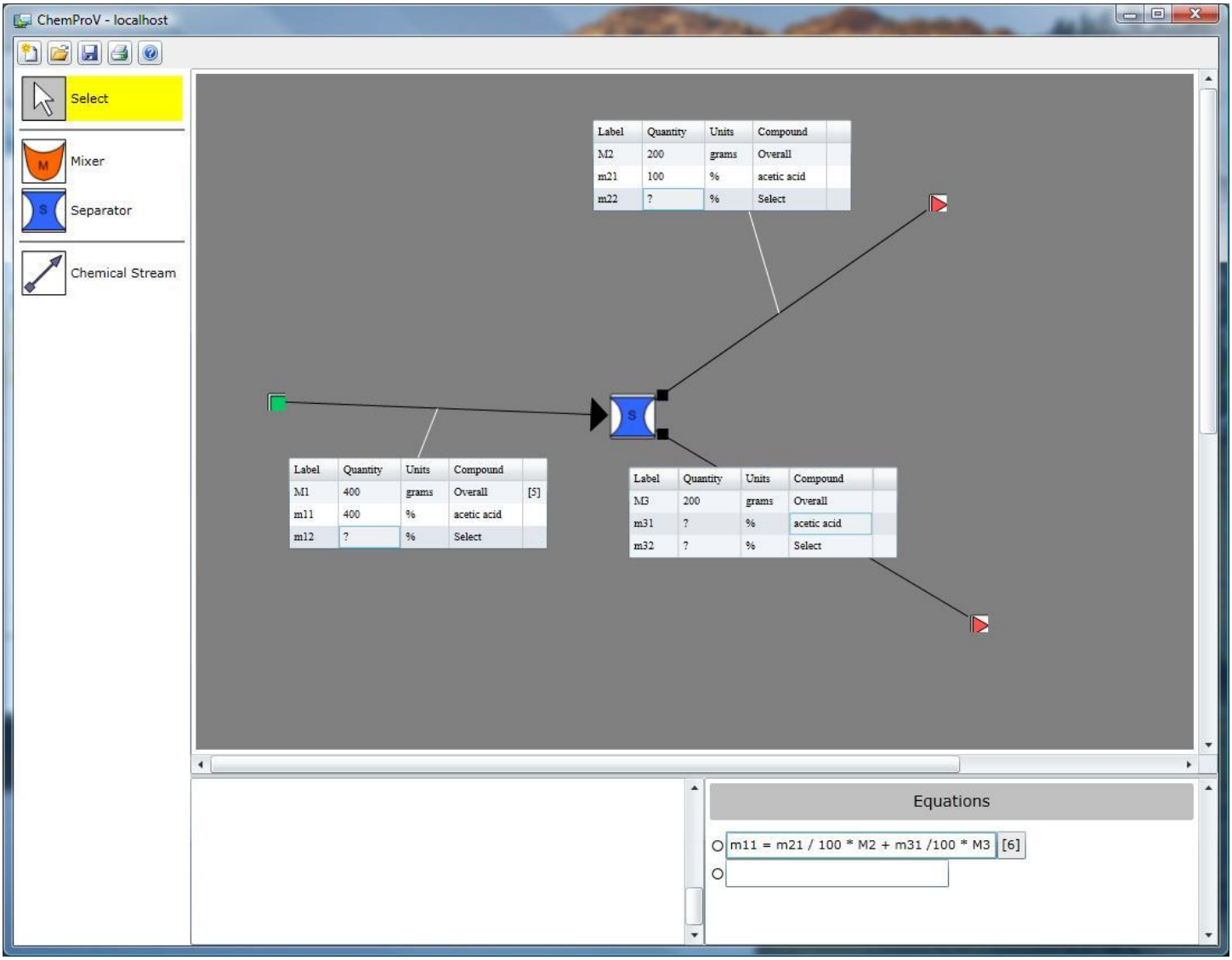
After you complete steps 5a, 5b and 5c your screen should look something like this:



Step 6: Create Equation(s)

At this point there is one unknown quantity in your process flow diagram: *m31*. To determine what the value of this quantity is you can derive equations that represent the fact that material must be conserved, i.e., the amount of any compound (or the total amount of material) entering any processing unit (mixer or separator) must be the same as the amount of that compound (or total amount) leaving the unit. To account for this unknown, enter the

following equation into the first Equations text box: “m11 = m21 / 100 * M2 + m31 /100 * M3”. Your final screen should look something like this:



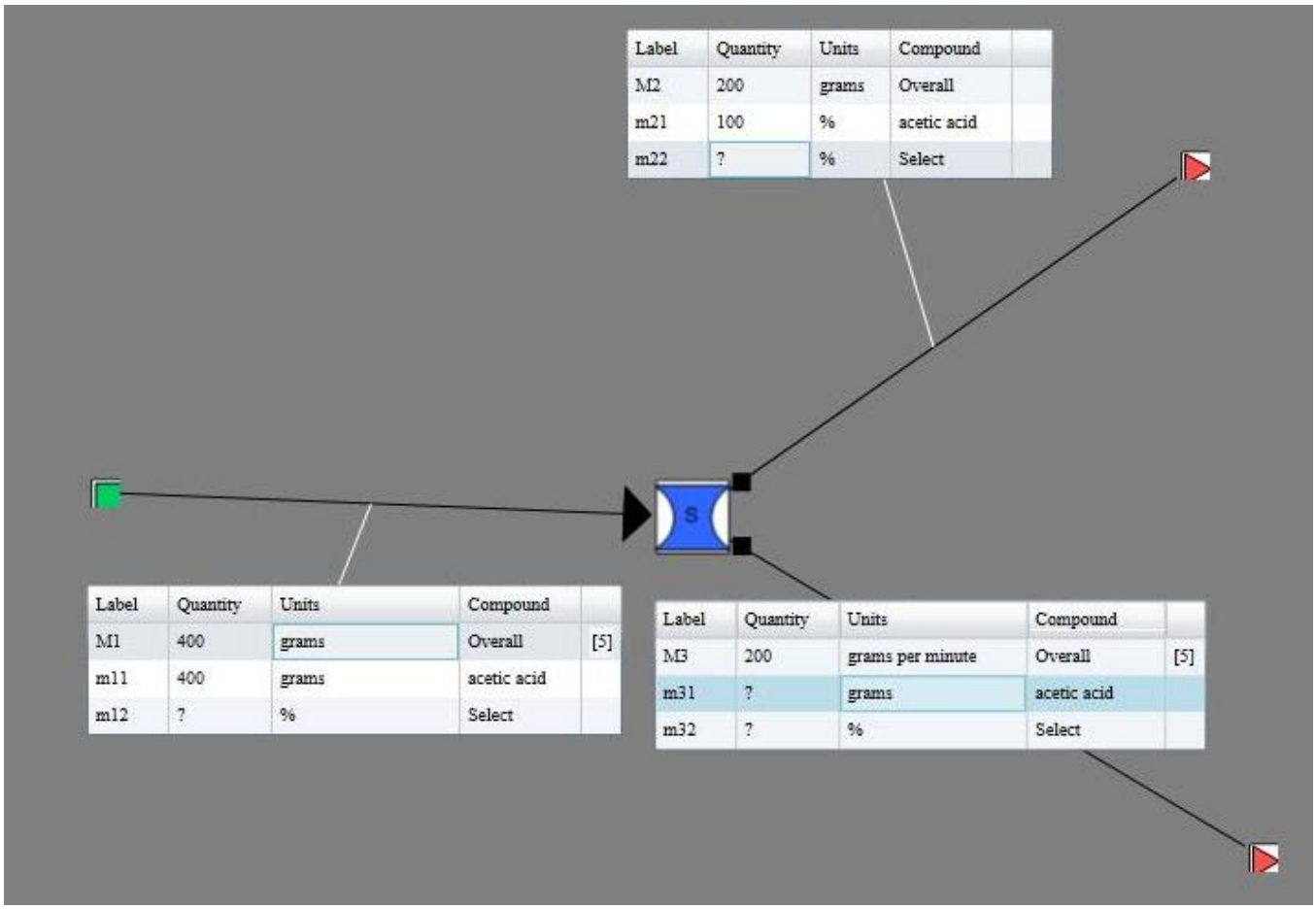
With one equation and one unknown you could solve the equation to calculate the value of the one unknown. In this study, you do **not** have to solve the equations for actual values.

Step 7a: Create an Error to Fix

1. Click on the units for the overall stream in the stream table for the lower stream in the diagram. Change the units to grams per minute for M3. Note that a number enclosed by brackets has appeared to the right of this line.

Label	Quantity	Units	Compound	
M3	200	grams per minute	Overall	[5]
m31	?	grams	acetic acid	
m32	?	%	Select	

2. Note also that, in the feedback messages area at the bottom of the screen, a corresponding message has appeared. This is an indication that you have attempted to do something that is not allowed or incorrect.
3. Click on the appropriate message in the feedback message area. Notice that the window highlights the corresponding error in the diagram area.



Step 7b: Addressing Feedback Messages To Fix Errors

As you work through a problem with this version of ChemProV, your goal is to eliminate all feedback messages. To eliminate the messages in the present example, do the following:

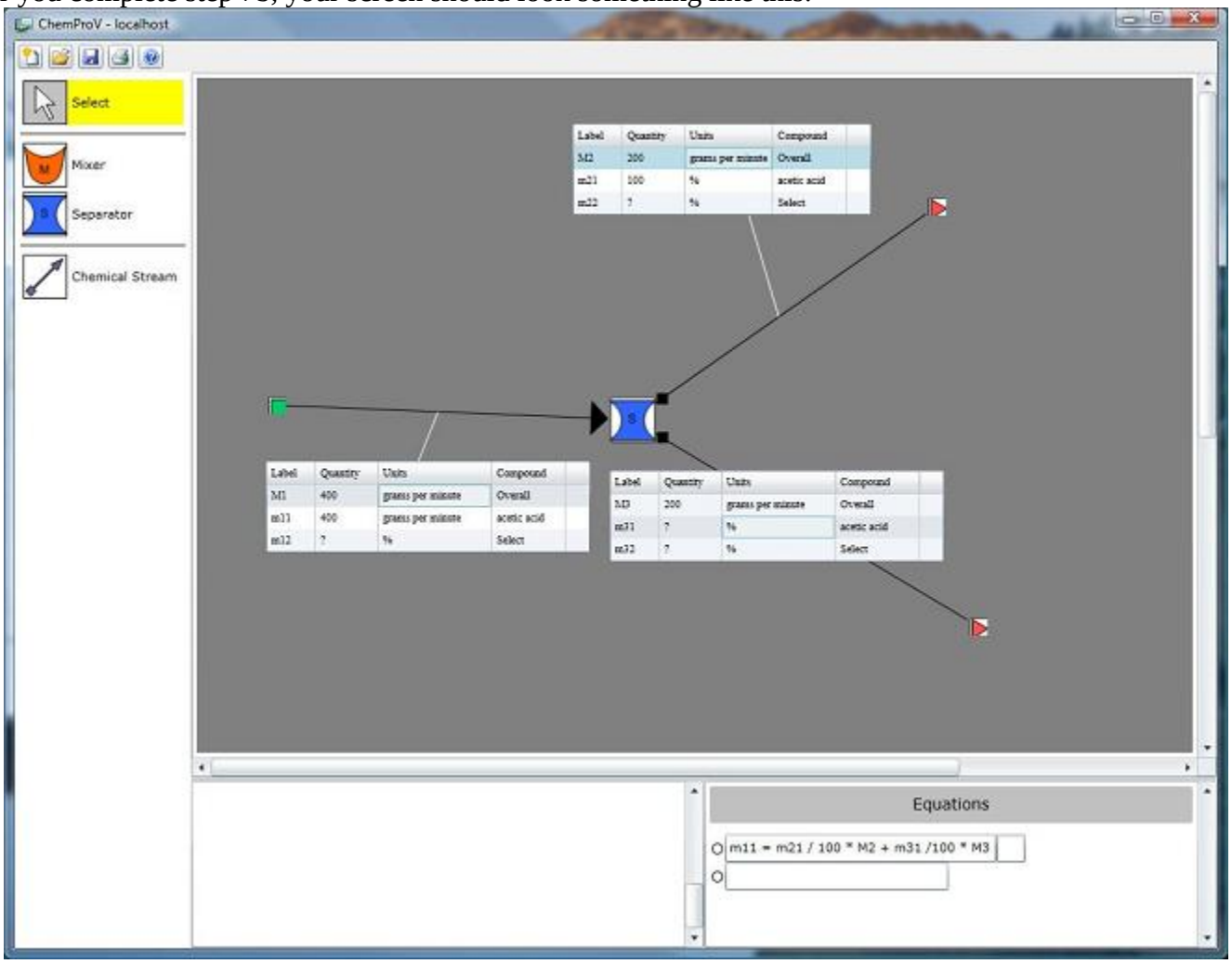
4. Go to the stream table for the upper stream and change the units on M2 to grams per minute.

Label	Quantity	Units	Compound
M2	200	grams per minute	Overall
m21	100	%	acetic acid
m22	?	%	Select

5. Go to the stream table for the feed and change the units on M1 and sub component "m11" to grams per minute.

Label	Quantity	Units	Compound
M1	400	grams per minute	Overall
m11	400	grams per minute	acetic acid
m12	?	%	Select

After you complete step 7b, your screen should look something like this:



Notice that the number to the right of M3 has disappeared, as has the message at the bottom of the screen. This is an indication that you have properly specified the amount of every compound involved in the problem (units and quantity).

Remember: As you work through the problem, your goal is to eliminate all of the feedback messages generated by ChemProV.

Finally, while the example process flow diagram constructed in this tutorial includes only a single process unit (a separator), it is possible to create process flow diagrams consisting of *multiple* process units.

Congratulations! You are done with this tutorial. Please exit ChemProV by choosing "Exit" on the "File" Menu. There is no need to save your work.