Mobatec
model-based technology



Mobatec Modeller

INTRODUCTION COURSE

Model User I

Advanced Equation-Based Modelling

Mobatec Modeller Intro Course – Model User I

1. Simulation of the small flow loop

1.1 Introduction

This exercise is the very first exercise of **Mobatec Modeller Introduction Course** and will teach you how to run and modify an already made model. The Introduction Course further consists of several constructive and easy-to-follow exercises that will teach you how to build your own models in Mobatec Modeller.

1.2 Objectives

By the end of this exercise, you will know:

- How to compile and run already made models in Mobatec Modeller.
- How to customize flow lines position and connection points.
- How to copy and reuse model parts.

1.2 Model description

The model we will use for this exercise consists of a **water inlet**, **two buffer tanks (A&B)**, **pump**, and a **sink**. The pump is used to push the water from **tank A** to **tank B** as there is an elevation difference. The two tanks are also connected with a bypass line. All lines (except the pump suction line) have valves which are used to control the flow.

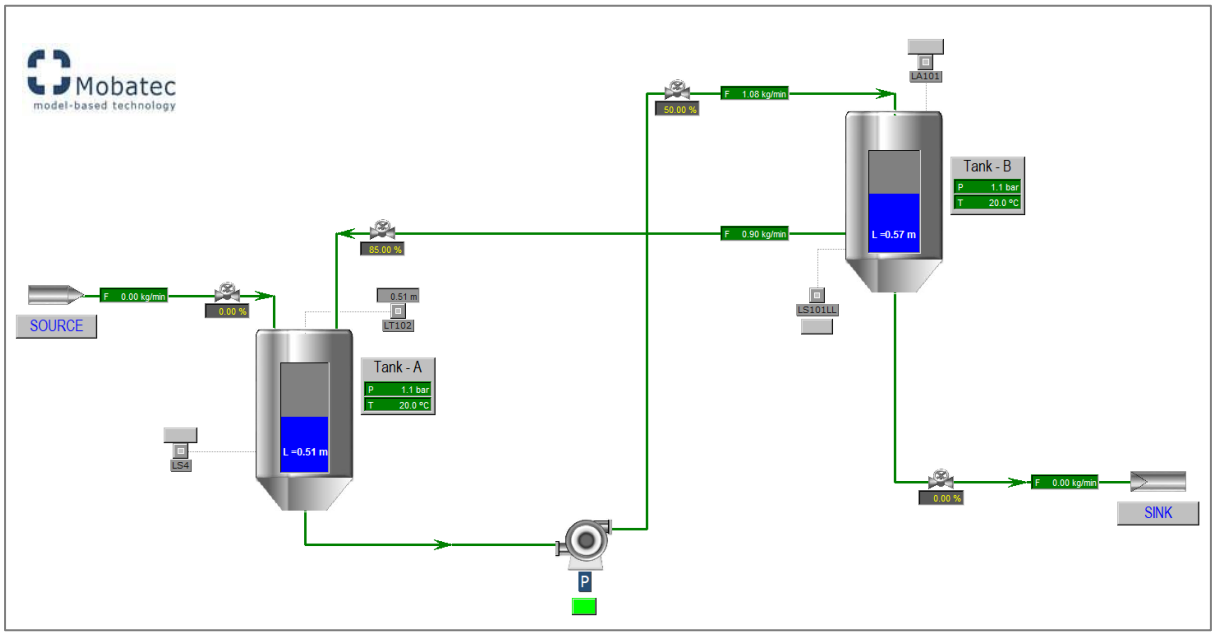


Figure 1 Mobatec Modeller Simulation Environment

1.3 Assumptions

- Tanks are well-stirred
- The vessel's diameters are constant along the heights of the units
- Liquid phase is containing single component (i.e. H_2O)
- Process in non-isothermal

2. Things to do

1. Open a template model

Open the template model, called “Small_Flow_Loop_Start_Template”. This model can be found in the Examples directory (File/Example Models...). Save your model with a name “Small_Flow_Loop” by clicking on a save as icon “”, or click File/Save Model as, choose appropriate location for your model. ***Note: Do NOT save you model in the Program Files directory (where the Examples directory is located) as Windows might not give you proper rights to save, change or run your model.***

2. Adjusting the Properties Browser appearance on the screen to your preference

The floating window consist of two detachable moving tabs. The (Properties) **Browser** tab (1), where the tree structure of all possible operations is structurally given to help you have a good overview of your model and possible functions. The **Properties** tab (2) displays the selection made in the Properties Browser tab, where you can see/edit/make the definition of the selection you have made (system graphic, equations, etc.).

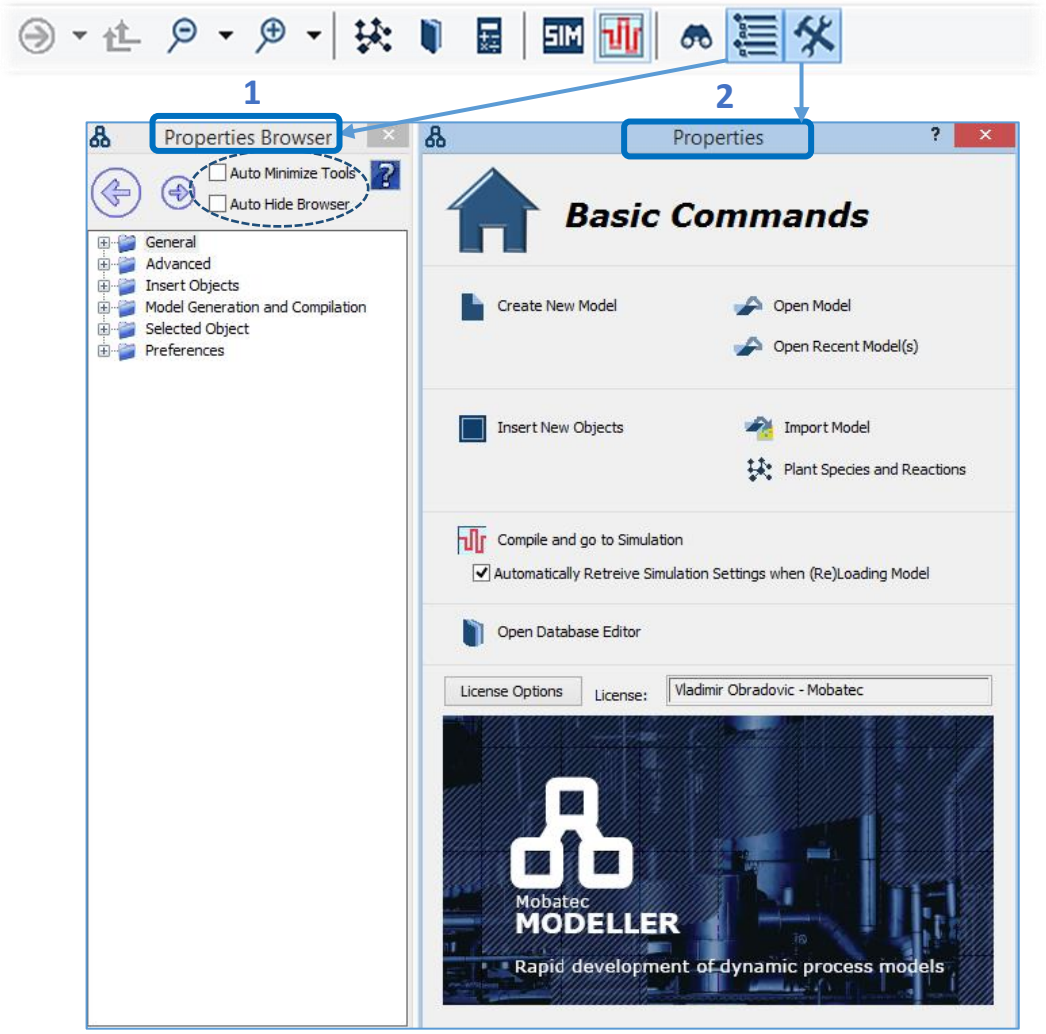
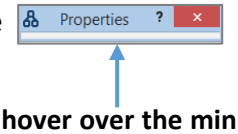


Figure 2 Properties Browser & Properties tabs

If you want to be able to see entire working surface browser has "hide" options (*marked with blue dotted line in Figure 2 on the previous page*). You can choose to hide both the browser and the properties tab by checking the Auto Minimize checkbox. In that case, after moving your mouse the tabs will minimize 

and you will be able to see your entire working surface (screen/model).

The tabs will appear again if you hover over the minimised tab, or if you click twice on any model object or select the object and do a right mouse click/Properties (F10) or in any other case the Properties are needed. You can also choose to hide only the Properties Browser. It will appear again if you hover your mouse over the Properties.

Note: The browser can be either attached to the right or left side of the properties tab, or it can be detached from the properties tab.

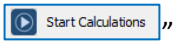
3. Compiling the model

Compilation is a process of code generation, where Mobatec Modeller generates the code automatically based on model physical topology and model defined equations. Once the model compilation is done successfully you are able to run the model.

To Compile the Model press *"Compile Model and Switch to Simulation Environment"* icon in the toolbar " " (shortcut - F12), or go to *Properties Browser/General/Basic Commands* and press *"Compile Model and Switch to Simulation Environment"* button.

When your model is compiled you will get a message that compilation was successful!
Note: Advanced model compilation options can be found in the Model Generation and Compilation tab(s).

4. Running a dynamic model simulation

To start the simulation of the process click the ***"Start Calculations"*** button " 

" (shortcut – F9) in the Properties tab or the "Start Calculations" button of the toolbar.

If there are no errors, your model should be running the simulation of the process and you are able to follow the *"Simulation time"* in seconds on the Basic Commands tab (*General/General Simulation Options*), or at the left bottom corner of the screen. Simulation will go fairly fast as you will notice (Real-Time Simulation will be addressed in the second model user exercise). To rewind simulation to its initial state and start again from there go to Basic Command tab and press "Rewind Simulation" button.

5. Changing Model parameters while running the model simulation

With the dynamic simulation running, you can now "play" with the model, by changing model parameters, while the model is running. You can open and close valves (or open just a bit, e.g. 10%) or stop and start the pump. To change a valve opening just click on the display, a small window will pop-up where you can enter the new value and press enter (click OK).

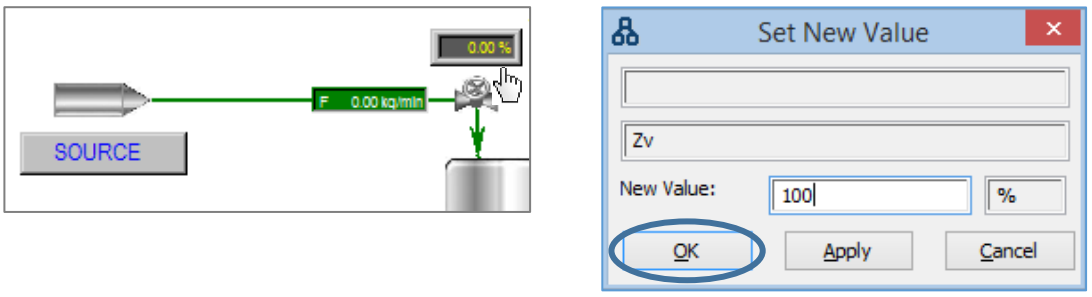


Figure 3 Changing a parameter value via defined value access display

6. Stopping the simulation, changing between MODeling & SIMulation environment

You can stop the simulation by pressing "Pause Calculations" button in *Properties Browser/General/Basic Commands* tab or by clicking on the toolbar icon " " (shortcut – F9). Go back to modelling environment by clicking on "MOD" toolbar icon. You will notice the grid appears again.



*Figure 4 **MOD**elling / **SIM**ulation environment change buttons*

To go back to simulation environment and run the simulation again, you do not have to compile the model again. Just Click on "SIM" toolbar icon and MM will automatically go to simulation environment every time (switch shortcut – F11).

If you add new physical elements or change any equation or add new equations to the model (possible only in modelling environment with visible grid by default), then you need to compile the model again so that the changes take effect in the simulation environment.

7. Connection's layout (auto-routing & custom bending points)

7.1 Auto-Routing

By default, any new connection will be auto-routed meaning that new connection layout will be automatically routed depending on the origin and target connection point. Auto-routed connection with lose target end is presented below in Figure 5. Existing layout can be changed by selecting connection active point (left mouse click) and dragging the active point to desired layout then release the click. *(Active point can be a "see-through" point as in Figure 6 n.p., or it can be coloured point or have a "valve" icon attached as in* Figure 5. *To spot easily connections active points go to Preferences/Displays and check "Draw Object Outline in Modelling Environment")*

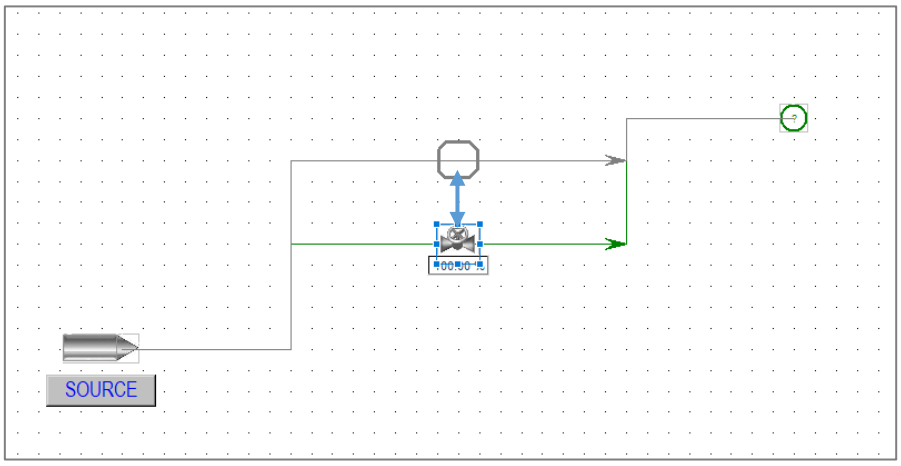


Figure 5 New connection auto-routing

To view or change the choice of connection layout select connection active point and go to: Properties Browser select "Graphics" tab. There you can make a choice between "**0**", "**1**", "**3**"

or “**5**” bend points or “**Auto-Route**” option as shown in Figure 6 (next page). To choose “Auto-Route” option directly, just select connection active point and press “**2**” on your keyboard.

7.2 Bending points

Any connection can have as many as **5 bending points**, (points you can move). You can make this choice by selecting a connection active point, then in the Properties Browser select “Graphics” and you can make a choice between “**0**”, “**1**”, “**3**” or “**5**” bend points or choose “**Auto-Route”** (Figure 6). You can also choose the number of bending points directly by selecting the active point of connection and by **pressing** “**0**”, “**1**”, “**3**” **or** “**5**” **on your keyboard!**

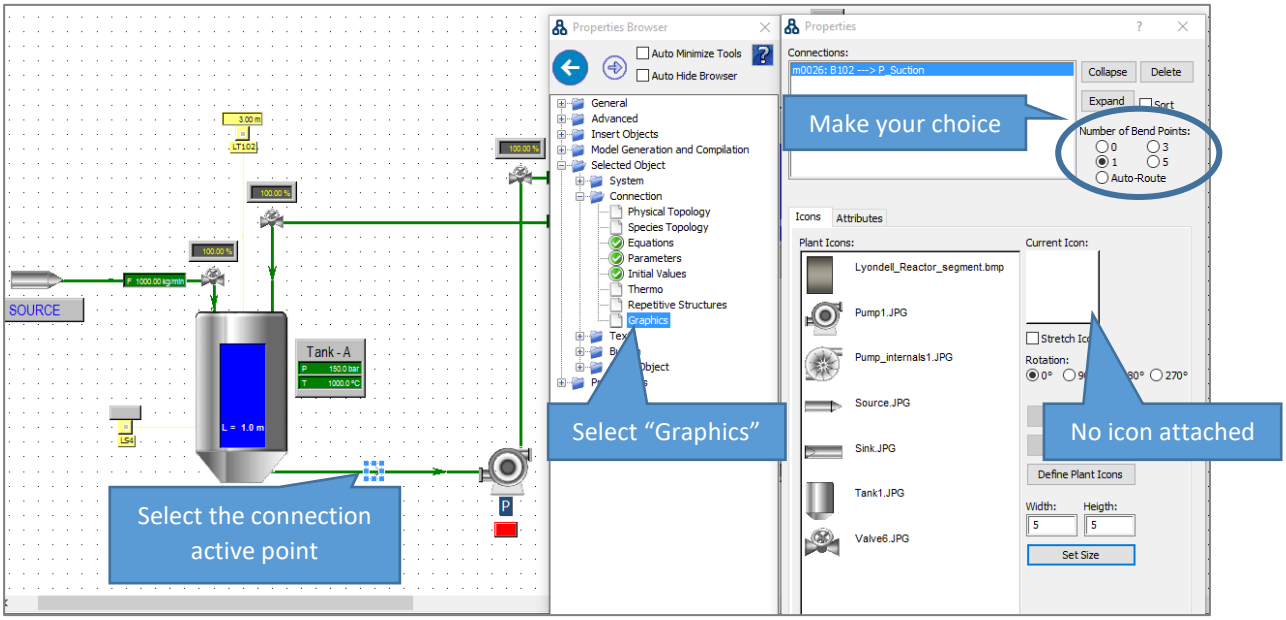


Figure 6 Choosing the number of bending points through Properties Browser

Select the active point of connection as indicated in Figure 6. Press number “3” on your keyboard, now three bending points are available for this connection line. Move the closest bending point (1) below the tank so that it looks that the line is coming from the bottom of the tank, as shown in Figure 7 below.

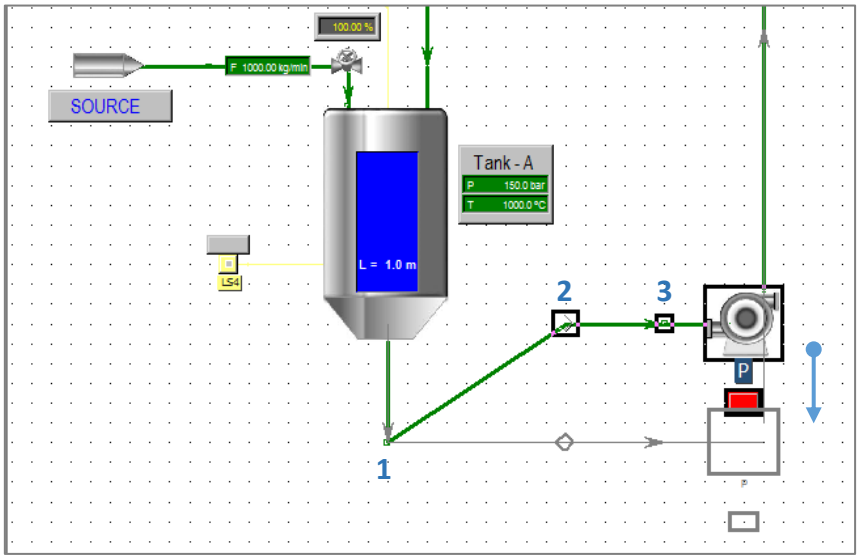


Figure 7 Multiple selection, and moving model parts

Make selection of the other two bending points and the pump with the button by clicking nearby and making a “selection rectangle” (or by selecting one by one while holding “SHIFT” or “CTRL”). When selected the selection will be active, click on any selected object and drag

the whole selection down as indicated on the picture below. When you are at the desired position let go of the mouse button.

Like this you can move a single or couple of model parts to a desired alignment position. Now, select the line (valve – active point) going from the pump to the tank – B, and press "**3**". Now this line has 3 bending points. Take the closest bending point to the pump and move the point down/right to make that the line is coming straight from the pump discharge.

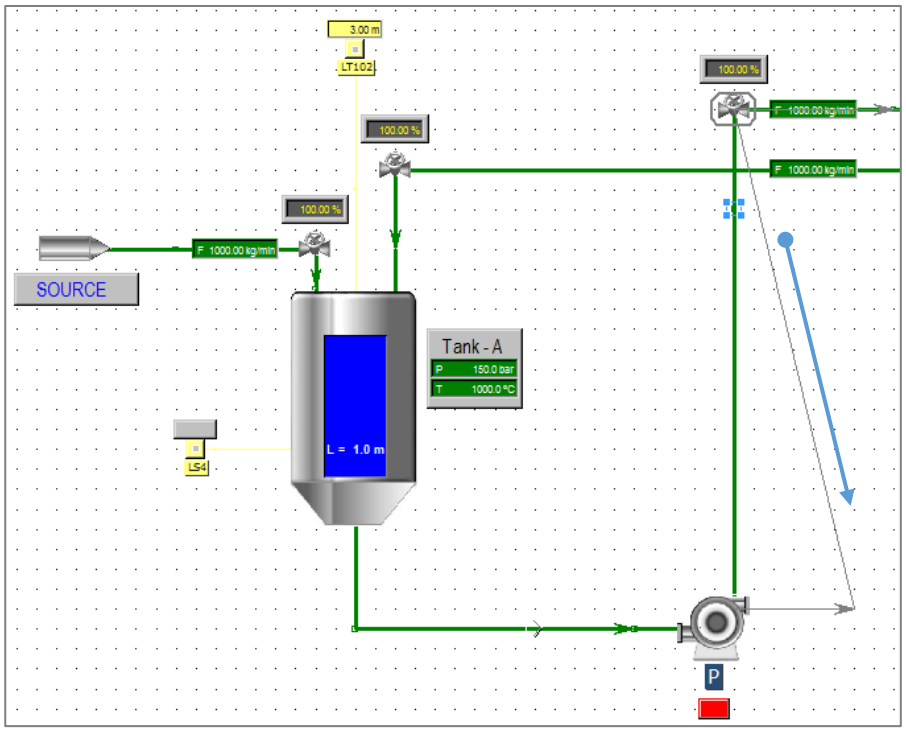


Figure 8 Aligning the pump discharge line

As you can see in the model, the line going from the pump is connected to the side of the Tank – B. We also want to change the connection point to the top of the Tank – B vessel. Do this by selecting the connection active point (the valve), do right mouse click/Set Graphical Connection Offsets or just press "g" (shortcut)!

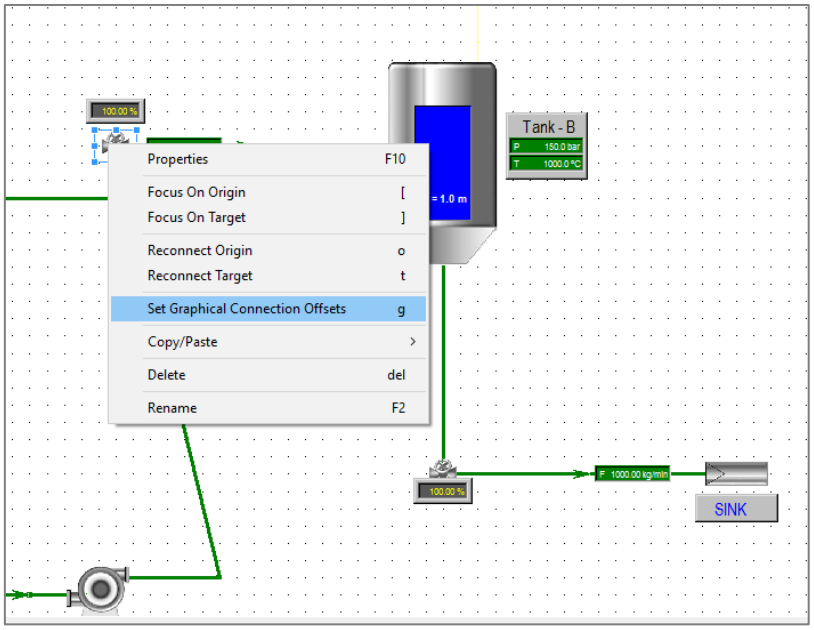


Figure 9 Set Graphical Connection Offset feature – step 1

After selecting this option, you will be able to see all the available connection points for the connection on both origin and the target object as shown in Figure 10 (next page).

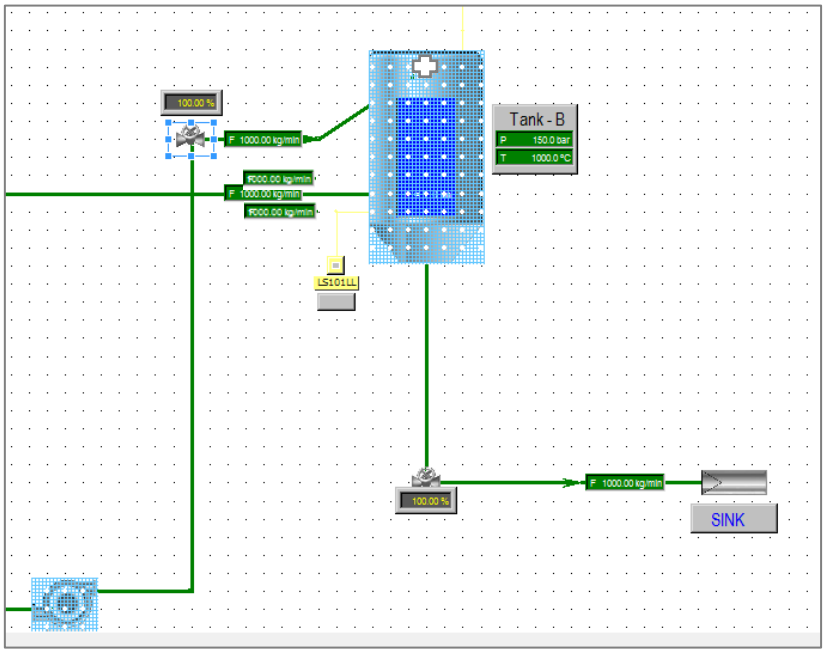


Figure 10 Set Graphical Connection Offset feature – step 2

Choose and click ( ) on the dot at the top of the Tank – B vessel. Now move the bending points and make the alignment as shown in Figure 11 below.

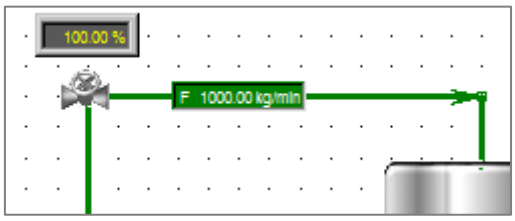
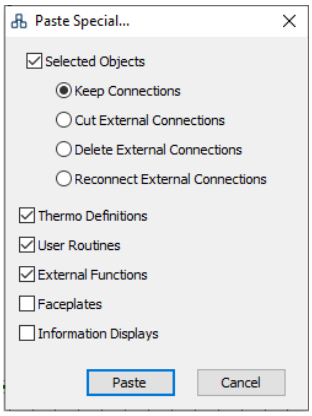


Figure 11 Changed alignment for connection coming to the Tank -B

Now, you can still change to simulation (SIM) and run the process without need to compile it again. Only if you change equations of some mode object or add new model parts compilation is required as the model will then change mathematically.

8. Re-using existing model parts

In the model there is a pump "P". Let us reuse the pump model to add a spare called "P_Spare". Select the pump (hold CTRL) and the pump switch button the discharge line flow display and the valve opening [%] display, do a right mouse click and select *copy*. Then do the right mouse click again on the empty surface and choose "*Paste Special - Keep Connections*".



This option will just duplicate the pump model with both connections as well. Now you have two identical pumps connecting the Tank – A & the Tank – B with identical connection lines.

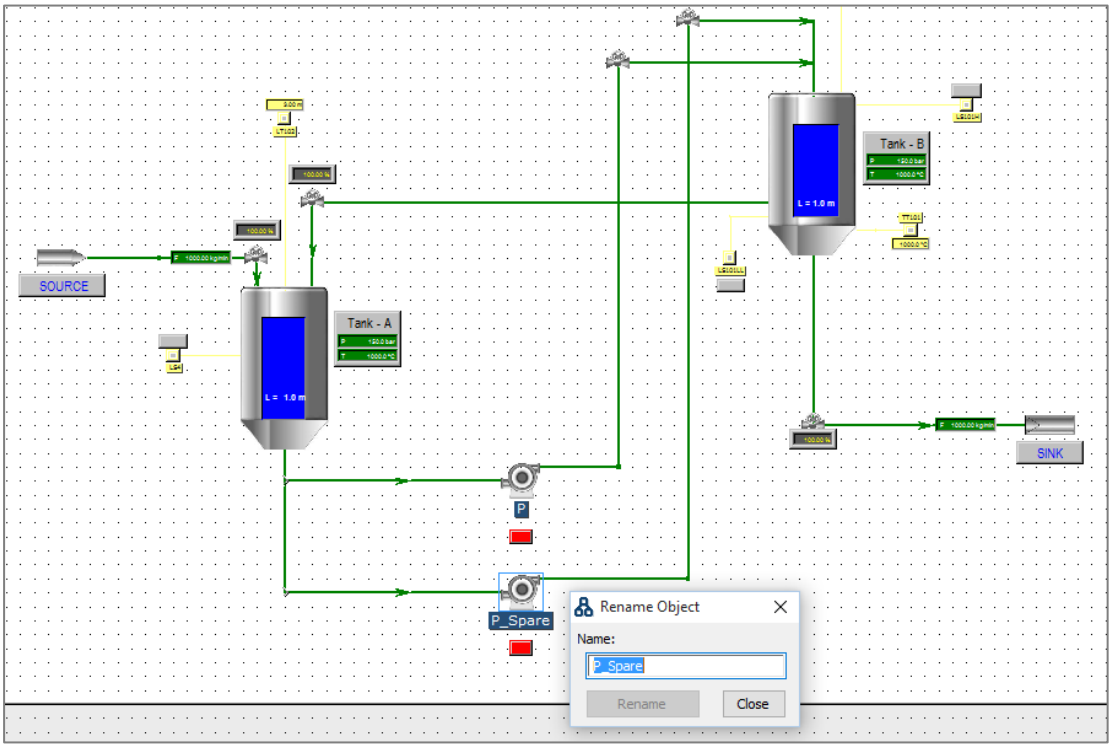


Figure 12 Adding the spare pump to the process

Align the spare pump and its lines to resemble the picture Figure 12 above. Rename the added pump to "P_Spare", by clicking the right mouse click/*Rename*. Or just by pressing F2. It is not allowed for two separate objects to have the same, because the names are used for code generation. If you decide not to give a name or delete a name of an object, then Mobatec Modeller will use an automatically generated object name to compile the model successfully.

Now, you must compile the model in order to simulate "two pump case" as the model is changed. Compile the model " " (F12) and "play" with both pumps and the line valves.

Other model object "paste special" options are:

- "*Paste Special - Cut External Connections*" – this option will paste the model object and its connections, but the connections will be only connected to the copied object and their other ends will be loose – making it possible to connect to any object.

  Let us copy a water sink line with the sink model object and re-use that part to add a water sink to the Tank – A as well. Select the water outlet from the Tank – B, together with the SINK model object and do right mouse click/*copy*.

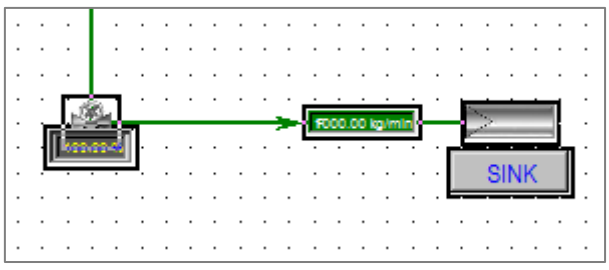


Figure 13 Multiple selection

Do the right mouse click again and select “Paste Special - Cut External Connection)” option. You will now have this selection pasted, but the outlet connection will not be connected to the Tank – B, but the connection origin will be loose.

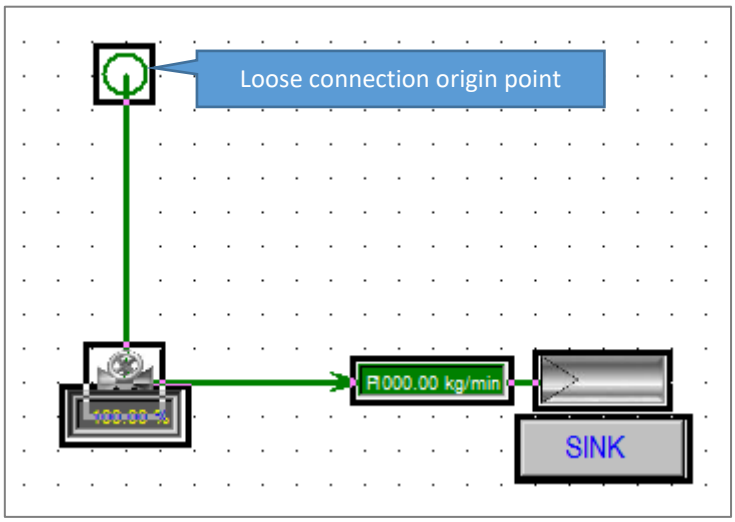


Figure 14 Paste (Cut Connection) option

Move the whole selection close to the Tank – A. Click once to disengage the active selection. Double click on the connection loose origin point and then click on the bottom of the Tank – A. Now you have connected the water sink to the Tank – A as well.

Compile the model and play with the model new features, start and stop the pumps, open and close the valves and observe the water levels indicators of the both tanks.

- “*Paste Special - Delete External Connections*” – this option will paste only the selected model system objects and will delete any “external” connections.

- *“Paste Special - Reconnect External Connections*” – this option will paste the model object and its connections. But the connections will be connected to objects with the same name they were connected to in the original. This option is handy when working with more than one model file or when very large models are made by more than one model engineer for easy reconnection of parts. In our case it’s the same as “*Paste Special- Keep Connections*” option.

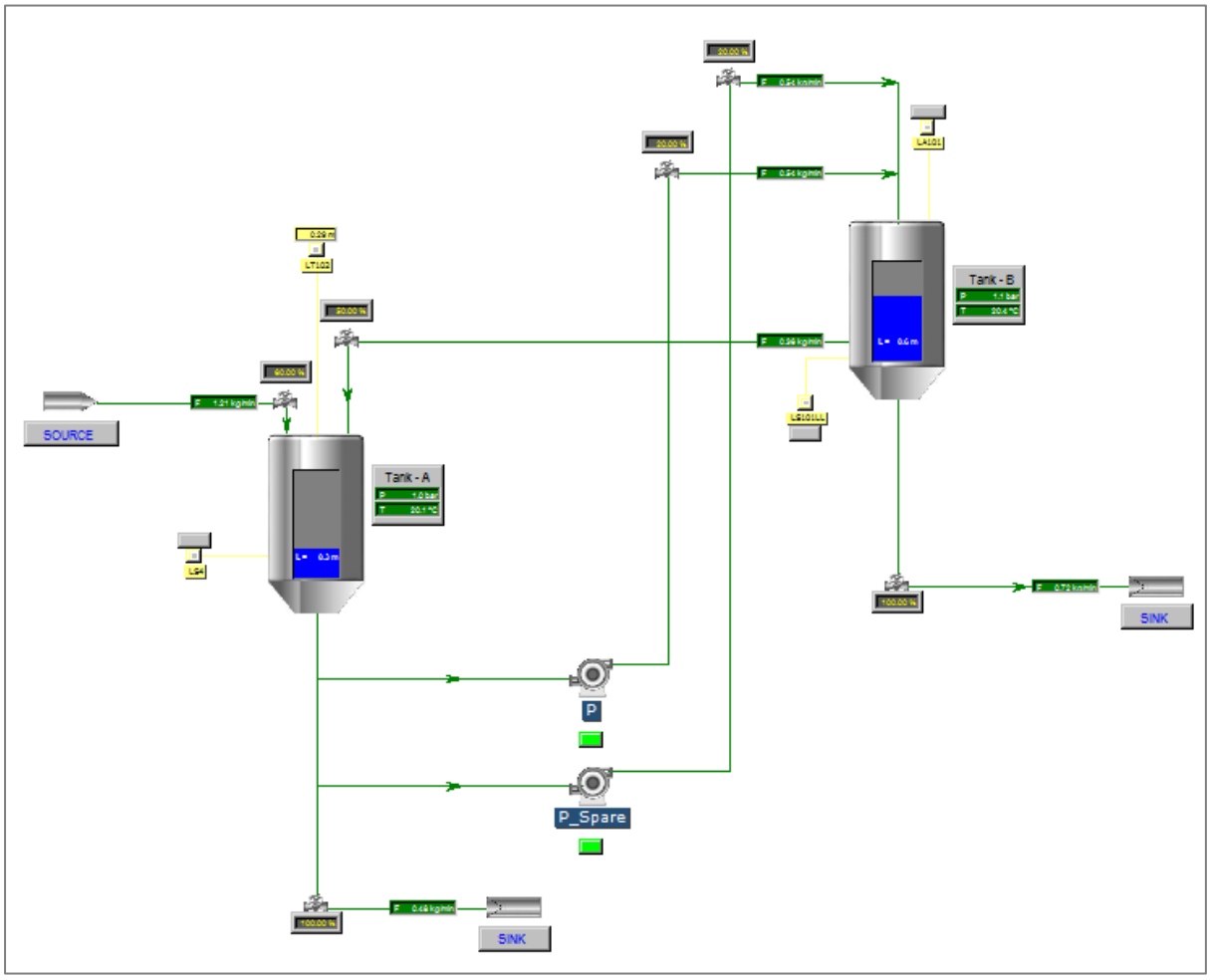


Figure 15 Small Flow Loop model with a spare pump and a sink for the Tank - A