

## Introduction to Sumo (Hands-on)

### MODEL1 - Exercise one

The purpose of this exercise is to familiarize users with the SUMO software through a simple example. Users will learn to use the basic functionality of SUMO: simulate oxygen uptake rates and concentrations of ordinary heterotrophs in a simple plant. Steps to follow (also please refer to Figure 1, to see the steps described below:

1. Open SUMO and click on "CONFIGURE" or "New Project" on the welcome screen.

Select process units from the PROCESS UNIT LIST and configure a model, (hover your mouse over the units to see labels). Selected process units are placed on the drawing board by clicking on the unit, dragging and dropping on the drawing board. The configuration to be built can be seen in Fig. 1. A selected process unit can be renamed by pressing F2 or choosing the 'Rename' option in the right click unit context menu.

Once a unit is dropped on the drawing board, it can be further configured: the available options can be seen in the bottom left panel once a unit in the drawing board is selected.

For this exercise pick the following configuration options:

- a. "Influent": "Concentration and COD based"
- b. "Primary" (clarifier): "Volumeless point separator" with "percent solids removal"
- c. "CSTR": "input DO" (2 reactors)
- d. (Secondary) "Clarifier": select "Volumeless point separator with fixed effluent solids"
- e. Effluent
- f. "Side flow combiner": Simple side flow combiner
- g. "Side flow divider": "Side pump"

Insert the two "Sludge outputs" and rename them 'Primary sludge' and 'Excess sludge'.

2. Model setup: For this exercise click on the "MODELS" and from the "MODEL OPTIONS" select "1-step nitrification/denitrification", "Input gas phase concentrations", and "Calculate pH", "Chemical P and precipitates not considered".

SUMO users are provided with a number of models to choose from which include "Full plant models" ("Mini\_Sumo"; "Sumo1"; and Sumo2"), while also available are the well-established models from the literature "Museum models" ("ASM1"; "ASM2D"; "ASM2D\_TUD"; "ASM3"; "ASM3\_BioP"; "Barker\_Dold", also known as an early published version of the BIOWIN model; and "SumoASM1"), as well as "Other models" (e.g. "UCTPHOplus"). These models can be selected by clicking on Advanced in the "MODEL OPTIONS". The "Oxygen requirement and sludge production", "One-step nitrification/denitrification" and "Two-step nitrification / denitrification" options select the "Mini\_Sumo"; "Sumo1"; and Sumo2" models, respectively.

The advantages for a SUMO user in choosing from options including "Input gas phase concentration" versus "Calculate gas phase concentrations", "Skip pH" versus "Calculate pH but

do not use it in rates" versus "Calculate and use pH", and "Chemical precipitation not considered" versus "Calculate chemical precipitation" will be explained in different exercises.

3. Add SRT calculation: click on "TOOLS"
  - a. Click the 'SRT' button
  - b. Drag'n'drop the two "CSTR" reactors to the numerator, "Effluent" element and "Excess sludge" ports to the denominator.
4. Customizing the model: Click the "INPUTS" tab and select "CONSTANTS". Selecting input and/or initial conditions: change the volume of the two reactors from 10,000 to 5000 m<sup>3</sup> while keeping the rest as default. The reactor volume can be changed by selecting the reactor and changing the "Volume" in the "Reactor settings" group under the "INPUT PARAMETERS" panel (bottom left panel). For illustration check Fig. 1.
5. Configuring outputs: Click the "OUTPUTS" tab and then click the "Add timechart" and "Add barchart" buttons in the top left panel.
  - a. Click and drag the "Influent" element, "CSTR" units, and "Effluent" element, onto the bar chart. Then, select any of these units, select the "Nitrogen Components" category in the bottom left panel and then drag and drop "Total ammonia" and "Nitrite and nitrate". Dragging and dropping these variables for one unit in a chart will automatically incorporate the variables for the other units added to the chart.
  - b. Repeat step 5a for adding "Total ammonia" and "Nitrite and nitrate" to the time chart for the "Effluent" element.
  - c. Feel free to add any other outputs and variables to display in the results.
6. Simulation: Click on the "SIMULATE" tab, select Dynamic and change the value from 1 (default) to 10 (days) in the "Stop time (days)" field. Keep the "Data interval (hours)" at 1 (hours). Clicking on "Start" on control panel runs the simulation – the simulation results can be studied in the output charts. *EXERCISE COMPLETE*

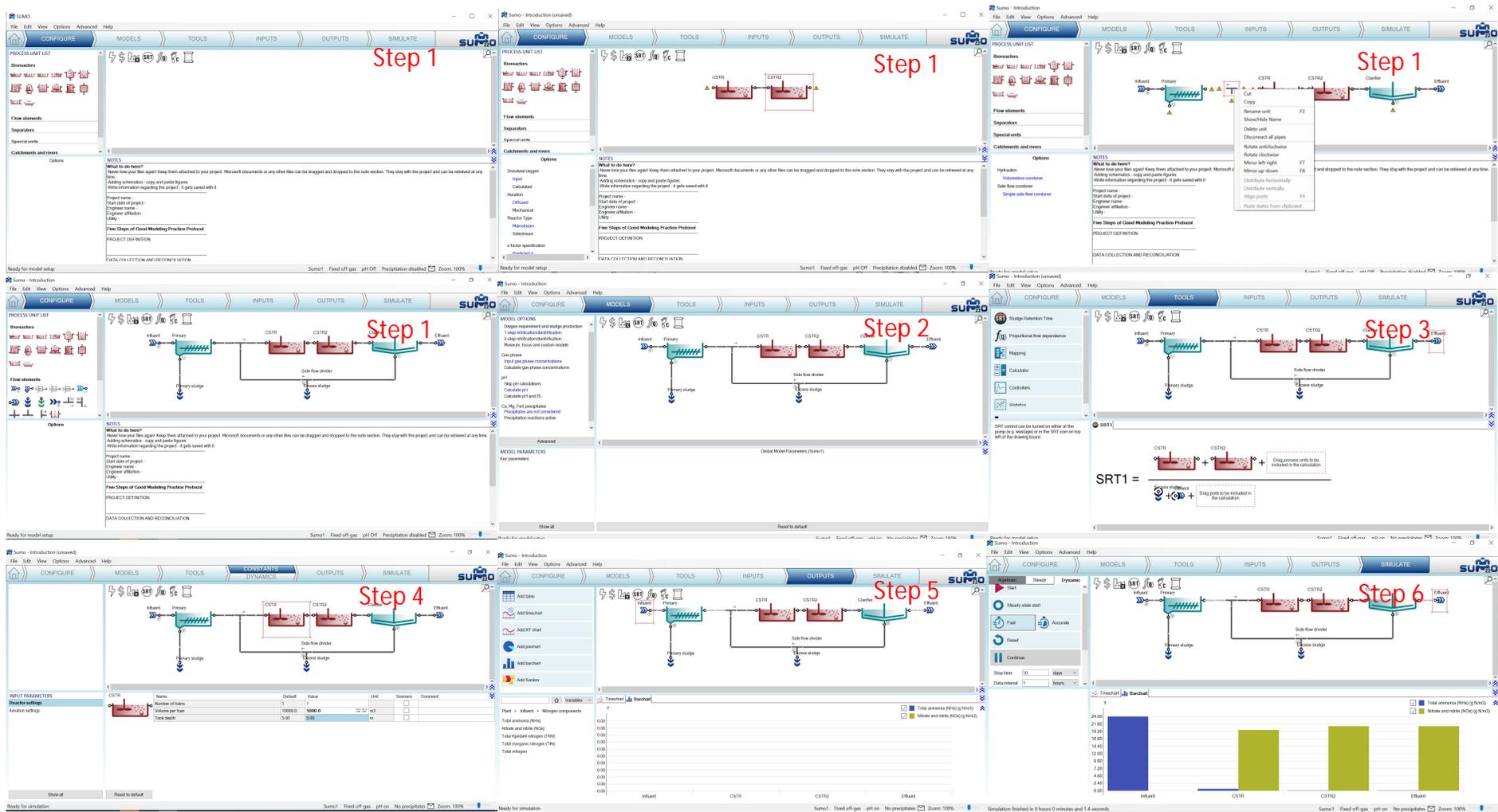


Figure 1. Steps involved in MODEL1 – Exercise

