

## BIOWIN SOFTWARE FOR PROCESS MODELING GENERAL INSTRUCTIONS

The software **BioWin** is installed on the Bechtel Computing Lab computers. Access from the Programs menu:

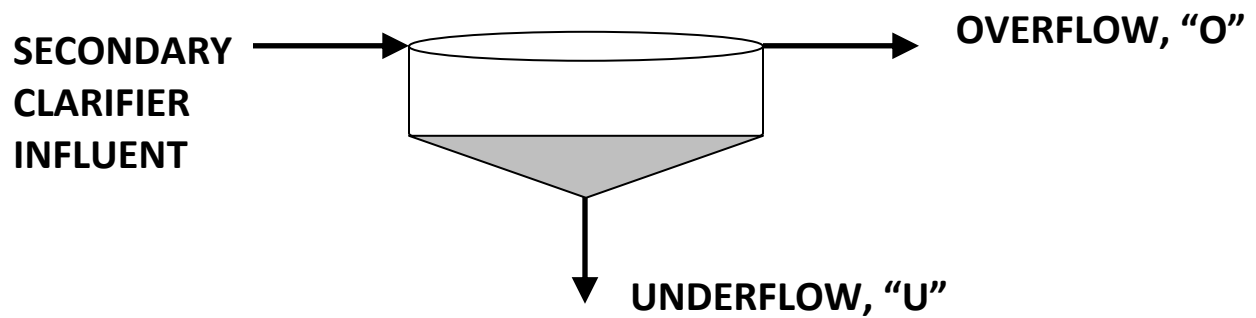
“BioWin”

“BioWin 3”

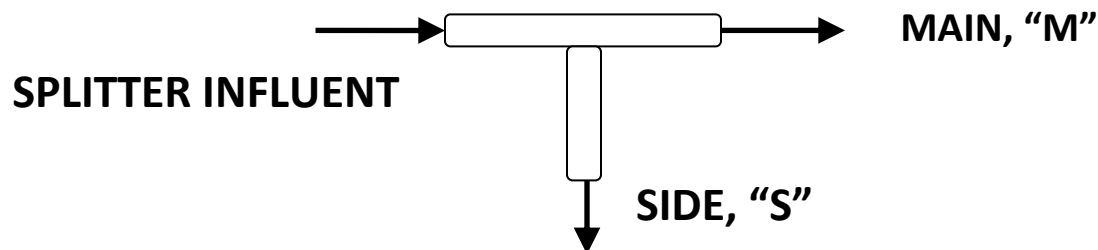
Select the “Configure” tab to draw the plant schematic and specify element characteristics. **Be sure to save your file regularly.** BioWin writes a special file “.bwp” that can only be opened with the BioWin program.

### Procedure:

1. Draw WWTP schematic (**flowsheet**) using a combination of icons for processes, influent, and effluent streams, and connectors (pipes, flow mixers, and flow splitters).
2. Specify characteristics of any element by double clicking on the element
3. Specify influent (**COD influent or BOD influent**) characteristics by double clicking the influent icon and clicking on the “Edit Data” tab in the screen that opens, including flowrate which will be constant for steady-state simulations. Keep default parameters for WW Fractions to begin with.
4. There are three effluent flows from the liquid process line: treated wastewater **effluent**, primary **sludge (if primary clarifier used)**, and waste activated **sludge (WAS)**.
5. For primary clarifier (can use **point or ideal settler** icon) with between 50 and 70% solids removal (operation tab). In the Flow split tab, set the ratio underflow (sludge) to overflow (U/O) which should be between 0.02 and 0.1. (Underflow is sludge and overflow goes to the bioreactor.)
6. Specify **bioreactor** tank volume (Dimensions tab) for  $V = (0.1 \text{ to } 0.5) \times \text{influent flowrate}$  (in  $\text{m}^3/\text{d}$ ) and depth = 4 to 5 m. **Specify oxygen concentration** (Operations tab, DO setpoint). For aerobic reactors, DO set points can vary between 0.5 and 4 mg/L, with 1.5 – 2 mg/l being typical of most activated sludge process conditions.
7. Secondary settler: use **“Clarifier – Model or Ideal”** icon in the Configure toolbar. Specify secondary settler size (Dimensions tab) with surface area = influent flowrate/surface loading rate, where surface loading rate based on average flow = 20 to  $25 \text{ m}^3/\text{m}^2/\text{d}$
8. Specify **secondary clarifier** underflow rate (U) as a ratio of underflow to overflow rate (O) = (U/O) between 0.5 and 1 (Flow split tab). You do not need to change operations or biological model screen values from the default.

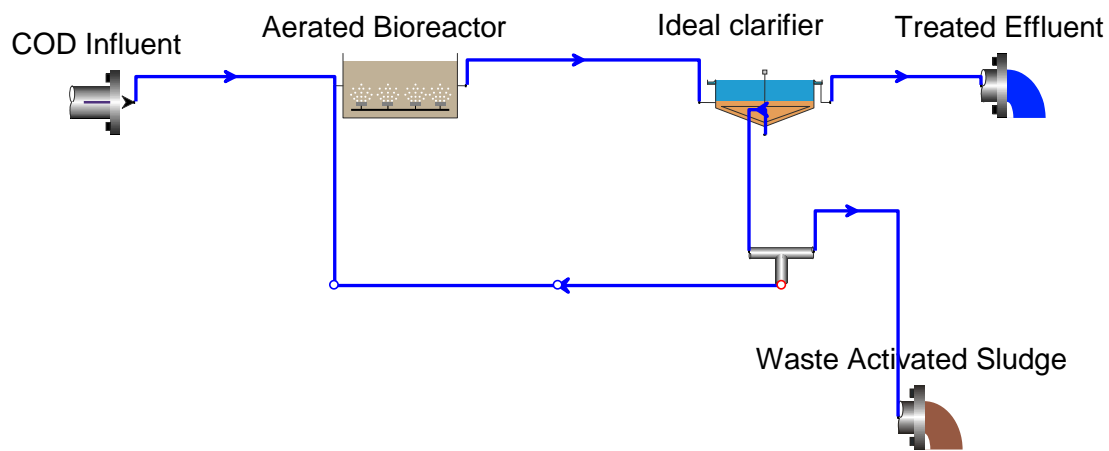


9. You then will need to split the underflow from the secondary clarifier: part goes to waste activated sludge (WAS) and part is recycled back to the bioreactor (RAS), using a **splitter** on the configure toolbar. A splitter has one influent and two effluent flows. One effluent flow is from the main pipe (M) – in line with the influent, and one is at the “T” for the side stream effluent (S). Depending on how you connect the split underflow to the bioreactor (RAS) or the sludge (WAS), use a ratio of WAS/RAS in the range of 0.01 to 0.05.



10. You will need a **sidestream mixer** (on the Configure toolbar) to combine the primary settler overflow with the recycled solids (RAS) from the secondary settler before they go into the bioreactor. You do not need to specify anything for the mixer, since the flows into it were set at the influent, primary and secondary settler. (If you try to specify, you risk overspecifying the model, and it may be difficult to converge to a solution.)
11. Use the **pipe** tool (last icon on the right of the Configure toolbar) to connect the process elements. Make sure that the pipe flows (arrows) are going in the right direction.

Try a BioWin simulation using a simple aerobic activated sludge configuration and the influent data in Table 1 (next page):



12. Once you have your process line specified, go to the “**Simulate**” tab, and do a **Flow Balance** on your plant. When the flow balance window opens, use the ► button to execute flow balance. If the flow balance is solved, then click on “**Steady-State Simulation**” line in the Simulate tab. When the Window opens, click on the ► to start the simulation. When it is done, check the effluent, MLSS and sludge characteristics to make sure that treatment and process conditions are satisfied (see below). If you hold the cursor over any component in the schematic after it is solved, you will get the characteristics at that point.
13. Advanced tools. Solids residence time (**SRT**) or  $\theta$ . BioWin will calculate SRT for any simulation from the “Project” tab. Click on “Active SRT,” and from the window that opens select “Active SRT.” From the window that opens, click on “Select elements for total mass” and upload the bioreactor(s) to the right window. After returning to the previous screen, click on “Select wastage elements,” and upload only the sludge component for the secondary settler (NOT sludge for the primary settler). You can also select the treated effluent as a sludge wastage component, although this should be a minor component. The calculated SRT (days) then appears at the bottom of the screen after solving the plant schematic.

**Process conditions should satisfy:**

1. The “**total suspended solids**” (**MLSS**) in the aeration basin should be > 1000 mg/L (and less than 2,500 mg/L)
2. **Effluent characteristics** should meet permit: soluble COD < 30 mg/L, carbonaceous BOD < 10 mg/L. Ammonia-nitrogen < 5 mg/L. Effluent TSS < 30 mg/L.
3. **Sludge total suspended solids concentration** for the primary settler should be less than 20,000 mg/L and less than 10,000 mg/L for the waste activated sludge (WAS).

**Table 1** Sample Influent for BWWTP

Name	Value
Flow (m3/d)	86400
Total COD mg/L	250
Total Kjeldahl Nitrogen mgN/L	40
Total P mgP/L	4.5000
Nitrate N mgN/L	0.0000
pH	7.3000
Alkalinity mmol/L	6.0000
Inorganic S.S. mgTSS/L	18.0000
Calcium mg/L	160.0000
Magnesium mg/L	25.0000
Dissolved oxygen mg/L	0.0000

Try this with the default kinetic and stoichiometric parameters, which you can view and change.

## OUTPUT

1. You can print the process schematic directly by going to the “File” menu and selecting “**Print Flowsheet.**”
2. You can print the process characteristics for influent, effluents, and each component by selecting “**Report**” from the File menu, and selecting “Report to Word” to write a word file which you can edit to show the information that you client needs.
3. You can get additional information for your report by opening any component, like the bioreactor, and going to the “**Monitoring**” tab. In that window, you can select process parameters you want to monitor. After you close the window, right click on the same component and a menu appears. You can name the element, and you can add to “**Album**” pages which will allow you to save and print the more detailed monitoring information you selected. Once you have added the album pages you access them from the “**View**” tab on the main toolbar by selecting “**View Album.**” You can then save and print the album pages from the window.