BioWin 3

Created by process engineers.. for process engineers

New Developments in BioWin

The latest version of BioWin provides a host of additions and improvements to enhance your wastewater treatment plant simulations.

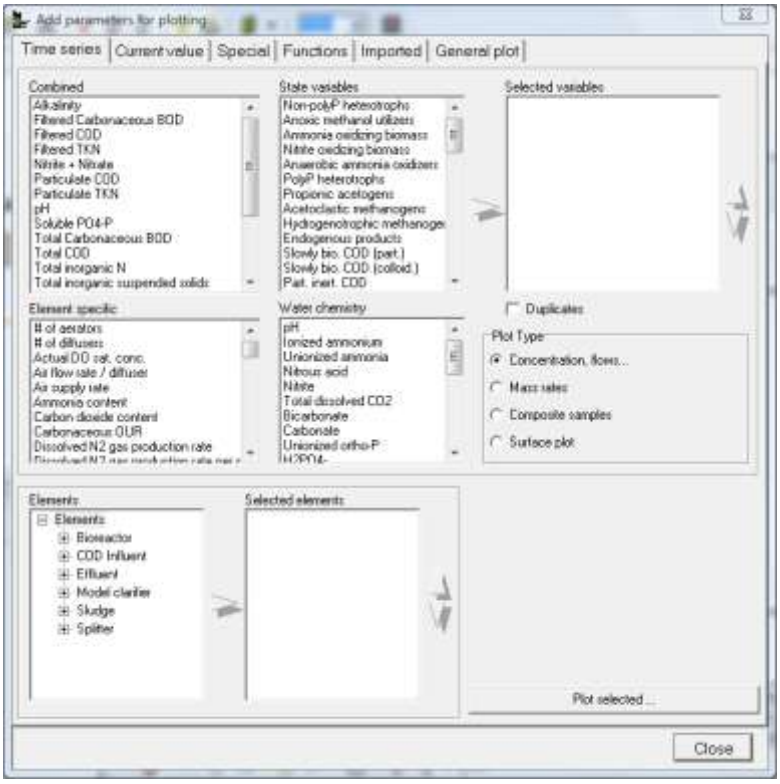
The main additions to Version 3.1 in terms of modeling capacity are:

- MBR element
- Microscreen element
- Two cyclone elements (ISS cyclone and Dewatering cyclone)
- Fast SBR model
- IWA naming as an option.

Version 3.1 includes many usability improvements in addition to the model extensions. Examples include the facility to specify flows in units of gallons per day (useful for specifying small flows for say chemical addition inputs when the selected unit basis is US units), automated file backup, simplified editing of pipe properties, the facility to duplicate pages in the Album by right-clicking on the page tab, and many more.

One significant usability improvement is the new interface for adding charts in the Album. Previously when one selected the Add Chart function the resulting dialog had 11 tabs; for example, Time Series, Multi Time Series, Mass rates, etc. The new dialog, shown below, has been simplified considerably and features have been added. The dialog now only has 6 tabs, and there is more uniformity between the Time series and Current value tabs. In each case plots of flows, concentrations or mass rates are generated from one dialog. [Previously mass rate plots could only be generated for time series, and from a separate tab].

Improvements have also been made to the interface for setting up tables. Previously there were separate options for setting up tables of flows/concentrations, mass rates, and aeration details. These have now been merged into a single Table editor, and concentrations and mass rates can be shown in the same table. A facility to totalize columns in tables also has been added.



Some of the additions, changes and upgrades in BioWin 3.1 are listed here. [A number of the features added to BioWin Version 3.0 are also listed as a reminder to users].

Linking to BioWin Controller

BW Controller is a separate Windows application which links to a BioWin configuration and allows specification of a range of process control features commonly employed in wastewater treatment systems.

Start BW Controller — To start, click on the Start BW Controller button at the right on the toolbar in BioWin to link the control application to the BioWin configuration.

BW Controller includes its own Help and Tutorials.

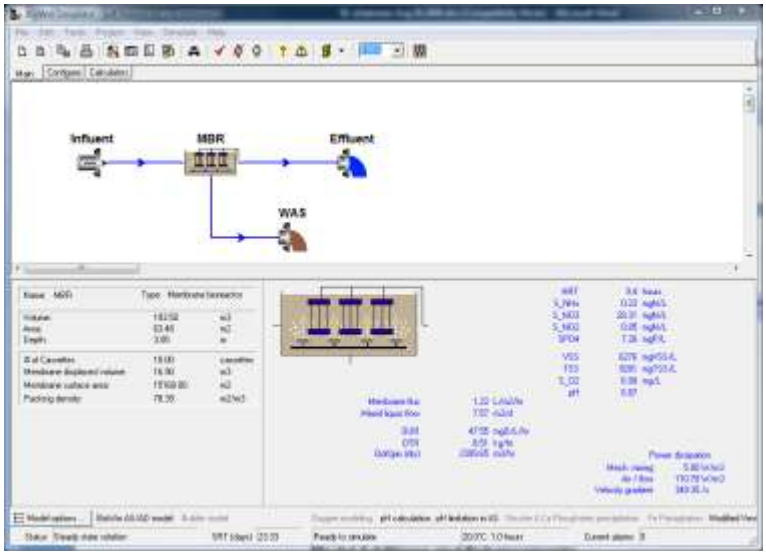
Model Additions and Enhancements

The additions to the Full Plant Edition of BioWin are significant advances in modeling of wastewater treatment plants. BioWin tracks more organic and inorganic components than any other simulator, and allows a complete mass balance for recycled sidestreams and supernatants. The integrated process model in BioWin works for any environmental condition, whether in aerated or unaerated activated sludge tanks, fermenters, sidestream reactors or digesters. This allows seamless integration of the processes in the whole plant.

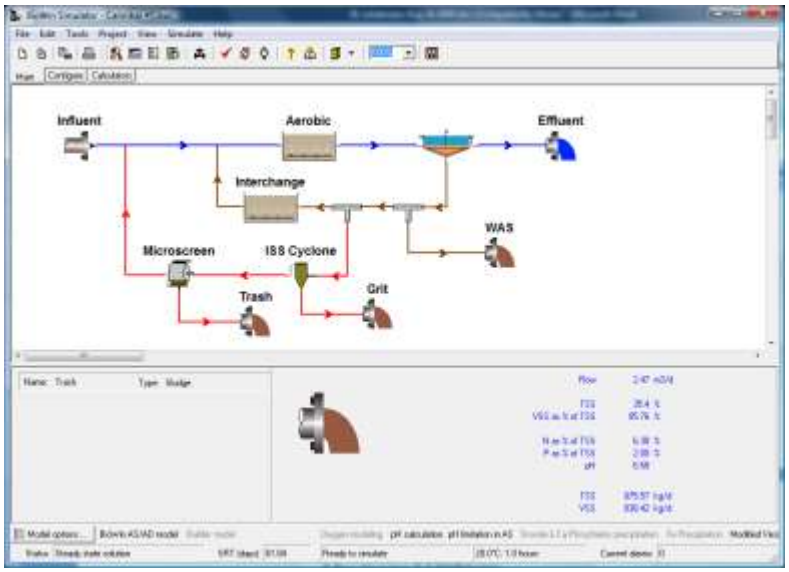
A few Version 3.1 highlights

- **MBR element**: A new process flowsheet element has been added for membrane bioreactors (MBRs). The MBR unit, shown below, has two output streams; one for permeate and one for mixed liquor from the MBR tank (wastage or recycle to upstream reactors). The user specifies

either the number of membrane modules (with editable membrane area and displaced volume per module) or the packing density (membrane area per unit tank volume). Default aeration parameters are set to values typical for coarse bubble aeration.



- **Microscreen element:** A new process flowsheet element has been added for microscreens. Units with mesh sizes of say 200 to 300 microns are used in Cannibal-type systems for screening a portion of the RAS flow (see example configuration below). Experience indicates that these units preferentially screen out unbiodegradable (inert) particulate VSS (XI) from the mixed liquor. The user specifies the flow split for the unit; by adjusting the flow split the user can modify the % solids of the so-called 'trash'. The user also specifies the percent solids capture and the additional capture of volatile particulate inerts. Adjusting the two capture rates allows the user to modify the VSS/TSS composition of the 'trash'.



- **Cyclone elements:** Two new process flowsheet elements have been added to BioWin for the simulation of cyclone separation processes; an ISS cyclone and a Dewatering (DW) cyclone. These units are used in Cannibal-type systems for preferential removal of inorganic suspended solids (ISS) which are present in the influent and that accumulate in the mixed liquor. In practice the underflow from a cyclone typically is in the range of 20 to 40 percent of the unit input flow, but the underflow is directed onto an inclined belt; the objective is to largely dewater the underflow, leaving behind mainly 'grit' (with a high ISS content). For each cyclone element the user specifies the flow split; by adjusting the flow split the user can modify the % solids of the so-called 'grit'.

    1. With the ISS cyclone the user specifies the % capture of inert suspended solids (ISS). The concentrations of other particulate components are the same in the overflow and underflow.

    2. In Cannibal-type applications the cyclone is used in conjunction with dewatering. With the Dewatering DW cyclone the user specifies the percent solids capture and the additional capture of ISS. Adjusting the two capture rates allows the user to modify the VSS/TSS composition of the 'grit'.

The two cyclone elements can be used to achieve the same results; namely a 'flow' of grit with a certain VSS/TSS composition. The ISS cyclone element is provided for users who wish to simulate cyclone operation without dewatering of the underflow.

- **Fast SBR:** Sequencing Batch Reactors (SBRs) enjoy a wide application in wastewater treatment and BioWin offers a quasi two-dimensional approach that is able to simulate situations where quiescent settling is disrupted by flow conditions. All this modeling strength comes at a cost - more complex and time-consuming simulations, particularly since the dynamic nature of SBRs means that steady-state solution techniques are not appropriate. Modeling of the settling phase is particularly intensive because the concentrations of the many particulate components may change slightly as a result of reactions, but the settling rate is a function of TSS concentration (a composite of many particulates). Version 3.1 introduces a fast approximate technique that can allow you to get reasonably close to the solution fast – and then turn on the more rigorous modeling to refine your simulations or to ensure that the approximate method reasonable accurately represent the full model. [Many of the competitors only offer only a 1 dimensional approximate technique!] In Version 3.1 the settling phase in an SBR can be modeled at three different levels of complexity:

    1. **Reactive:** BioWin considers all state variables, all biological and chemical reactions as well as pH in all cells during the settling periods.

    2. **Non-reactive:** BioWin still considers all state variables and includes pH calculations; however BioWin ignores biological and kinetic chemical reactions during the settling phase.

    3. **Fast:** BioWin consider only solids settling equations in all cells during settling modes.

- **IWA naming convention:** BioWin 3.1 now allows a third state variable naming convention – the IWA naming option displays names according to the IWA draft specification. This option is selected through the Tools | Customize menu.

Version 3 highlights

- Development of a sophisticated biofilm model. This has been implemented initially only for Media Bioreactors; that is, activated sludge suspended growth reactors that contain a free-floating carrier media for biofilm growth e.g. integrated fixed-film activated sludge (IFAS) and moving bed bioreactor (MBBR) systems. The Media Bioreactor module also can be used to configure reasonable representations for other biofilm systems such as trickling filters, biological aerated filters, and tertiary denitrification filters. For further details on the biofilm model review the "Biofilm" chapter.

- Modeling nitrification as a two-step process; that is, conversion of ammonia to nitrite (NO2) – mediated by ammonia-oxidizing bacteria (AOBs), and conversion of nitrite to nitrate (NO3) – mediated by nitrite-oxidizing bacteria (NOBs). For further details review the "Sidestream" chapter.

- Denitrification by heterotrophs [ordinary heterotrophic organisms (OHOs), phosphorus-accumulating organisms (PAOs), or methanol-utilizing heterotrophs (methylotrophs)] is modeled as a two-step process with conversion of nitrate to nitrite and then nitrogen gas.

- Modeling the growth of Anammox bacteria; autotrophic organisms that combine ammonia and nitrite to form nitrogen gas without the addition of organic substrate. For further details review the "Sidestream" chapter.

Usability Enhancements

A number of features have been added to BioWin to streamline ease of use.

Version 3.1 new features

- Upgraded, simplified and more consistent dialogs for setting up parameter plots.

- Improved table displays with options to show element specific variables for different element types, concentrations and/or mass rates as well as column totals.

- New tables replace aeration tables with the added ability to show and sum aeration details for different element types.

- Ability to duplicate Album pages including charts and series, tables and element info displays but excluding any functions.

- Flow option of gal/d for small flow elements in U.S. customary units.

- Auto-save BioWin files while you are working on them (in addition to dynamic simulation intermediate files).

- Function series that allows a BioWin series to be multiplied by a constant.

- Function periods can be specified as time intervals rather than number of points.

- Ability to monitor/plot SBR liquid depth and sludge blanket height.

- Simplified rates window display.

- Improved dynamic simulation speed.

Features added in Version 3

- In ideal separation devices (point settlers, dewatering units, and ideal clarifiers) a schedule can be defined to specify time varying percentage removals.
- Oxygen transfer calculations are based on diffuser submergence (rather than tank depth).
- When setting up charts in the Album, the list of variables that can be plotted is very extensive. These have been grouped in separate category lists (state variables, combined variables, water chemistry variables, commonly-plotted variables). This simplifies selecting variables to plot.
- Improved numerical solution techniques and more simulation method options.
- The facility to plot profiles of variable concentrations through layers in the biofilm in Media Bioreactors.
- Itineraries are now completely independent of the “constant” value.
- Additional alarms to alert the user to unusual conditions.
- Thread / process priority management for BioWin users.
- The ability to specify project start time from the project info dialog box.
- Improved grid snap methods.
- Oxygen transfer through the surface in anoxic zones.
- Improved “fly-by” panels.
- The facility to include / exclude media from media reactors.