



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 in terms of modeling capacity are:

- Biofilm model
- Two-step nitrification and denitrification
- Anammox bacteria

Incorporation of two-step nitrification and denitrification and the growth of Anammox bacteria enhance the capacity of BioWin for detailed modeling of the various sidestream (e.g. digester centrate) treatment systems that have been developed in recent years.

Note: A new Sidestream Reactor element can be included in configurations. This is mainly for convenience as it is easily distinguished from other activated sludge reactors on the drawing board. The model applied in a sidestream reactor is no different from the model used in other units. BioWin is based on a single integrated model for all biological and chemical reactions, and the same model is applied to any unit in a BioWin simulation. The only difference for a Sidestream Reactor is that the “seed” values selected by BioWin when a simulation starts differ from those for a standard activated sludge bioreactor.

Some of the additions, changes and upgrades in BioWin 3 are listed here. [A number of the features added to BioWin Version 2 are also listed as a reminder to users].

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 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.

Version 2 highlights

- BioWin includes accurate pH modeling and pH dependence of biological and chemical processes.
- Integrated biological model for BNR activated sludge, fermenters, and anaerobic digesters.
- Alum or ferric dosing model for phosphorus precipitation and chemical sludge formation integrated with the biological model. pH dependent precipitation kinetics.
- Spontaneous struvite and hydroxyapatite precipitation processes.
- Detailed tracking of inert solids content, and N and P balances in biological and chemical sludge.
- Fast pH simulation using a unique model solution based on concentrations of strong acids and bases, the dissociation state of the phosphate, carbonate, ammonium and volatile organic acid system, chemical precipitation reactions, and stripping of components such as ammonia and carbon dioxide.
- Improved modeling of denitrification with methanol addition - methanol-specific biomass, adaptation, minimum anoxic SRT, and substrate specific anoxic yields.
- Magnesium and potassium uptake with biological phosphorus uptake. Release of stored magnesium in digesters.
- Integrated digester model describes acidogenic phase (prefermenters) and methanogenic phase, predicts gas flow, composition and pH.
- Surface aerators and brushes in addition to diffused aeration.
- Improved, intuitive, customizable interface. Key variables for each process (OUR, Nitrate Production Rate, Specific Denitrification Rate, etc.) readily accessible.

- Model Builder enables users to customize models or create their own - starting from scratch or by modifying existing models.
- The International Modeling Kit includes standard models such as the ASM series and the double-exponential settler model.

Usability Enhancements

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

Version 3 new features

- 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.
- Expanded and enhanced COM interface – including read/write access to influent totals and fractions as well as project temperature. Read-only access to all liquid phase state variables and the gas phase states of anaerobic digesters.
- 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.

Features added in Version 2

- State Point Analysis plot. From BioWin 2.2 the user can plot the state point analysis flux curve for ideal and model secondary settlers as well as for SBR elements (some restrictions apply).
- Chart annotation tools.
- Multiple SRT calculation scenarios.
- Plot SRT against time during dynamic simulations.
- Automatically save dynamic simulations as they progress.

- Parameters may be “unmonitored”.
- Floating / docking toolbars.
- Improved numerical procedures for steady state solver.
- Locate a user-defined concentration within a model settling tank depth/concentration profile (e.g. use this to find where you think the sludge blanket is).
- Display full or abbreviated names for state variables and other parameters.
- The new Chart Master allows you to cascade multiple changes through selected charts in the BioWin Album.
- Further improvements to powerful Report to Word™ option.