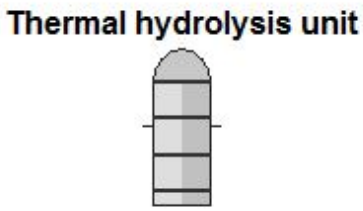
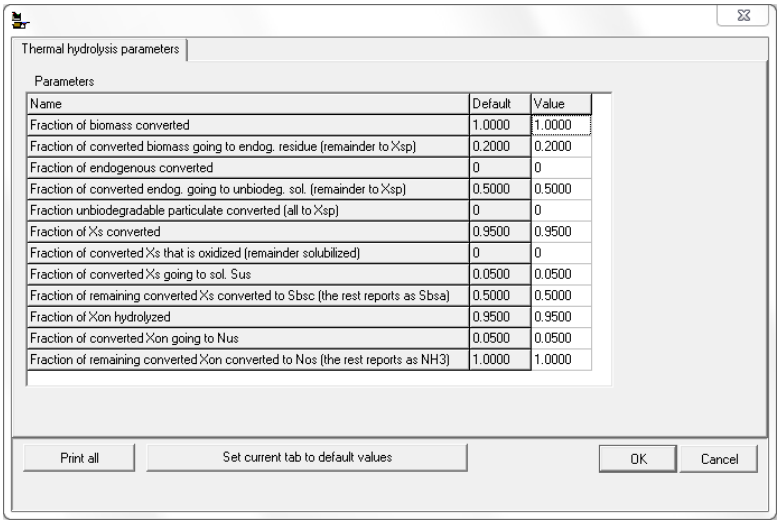
New Developments in BioWin 4.1

BioWin 4.1 adds new functionality and usability to the BioWin platform. New elements include a Thermal Hydrolysis Unit, a Submerged Aerated Filter and a Sidestream Media Bioreactor. Element enhancements and usability improvements have also been made to streamline and improve model configuration and development in BioWin.

New Element – Thermal Hydrolysis Unit

A Thermal Hydrolysis (TH) element has been added to simulate the breakdown of particulate components in a sludge stream generally into various soluble components. The TH unit is a dimensionless mass balance converter that instantaneously converts the particulate state variables into predefined sets of other state variables, and the user defines the extent of conversion and the fractional distribution between 'products' of hydrolysis. This highly flexible flowsheet element allows BioWin users to simulate a variety of sludge pretreatment technologies such as ozonation, sonication and chemical oxidation.





The TH unit parameter editor allows users to specify the degree to which major particulate components of sludge VSS (biomass [Z], endogenous residue [Z_E], unbiodegradable particulate COD [X_I], biodegradable particulate COD [X_{SP}]) will be affected by the thermal hydrolysis process. The user may also specify the fraction of biodegradable particulate organic nitrogen [X_{ON}] that is hydrolyzed by pretreatment.

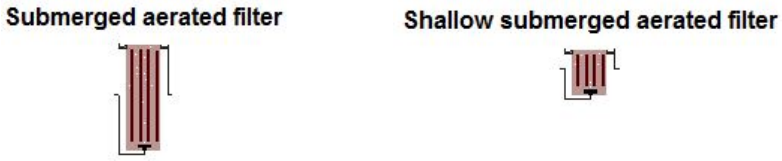
The default conversion fractions in the thermal hydrolysis unit were derived empirically to reflect the conversions typically observed when WAS is treated in a batch high-pressure thermal hydrolysis (HPTH) process at 160 to 170°C at 7 bars for approximately 30 minutes. The performance indicators associated with this pretreatment are summarized in the following table:

ATTRIBUTE	VALUE
VSS Destruction	30 to 50 %
COD Solubilization	30 to 50 %
Inert Soluble COD Generation	2 to 5 %
Organic N Solubilization	30 to 50 %
TCOD	Conserved
TN	Conserved
Biomass	Inactivated

Note: BioWin Advantage Volume 3 (Number 2) [downloadable from www.envirosim.com] illustrates application of the thermal hydrolysis unit.

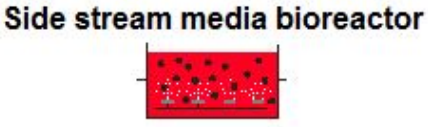
New Element – Submerged Aerated Filter

A submerged aerated filter (SAF) element has been added to simulate bioreactors with fully submerged fixed media in an upflow configuration. There are two types of SAFs available: 1) a standard SAF in which the depth is divided into three "slices" and there is a liquid volume and a biofilm mass/volume associated with each "slice"; and 2) a "shallow" SAF which has one completely mixed liquid volume and one biofilm mass/volume for the whole unit. As a result, the "shallow" SAF is less plug-flow in nature than the standard SAF.



New Element – Sidestream Media Bioreactor

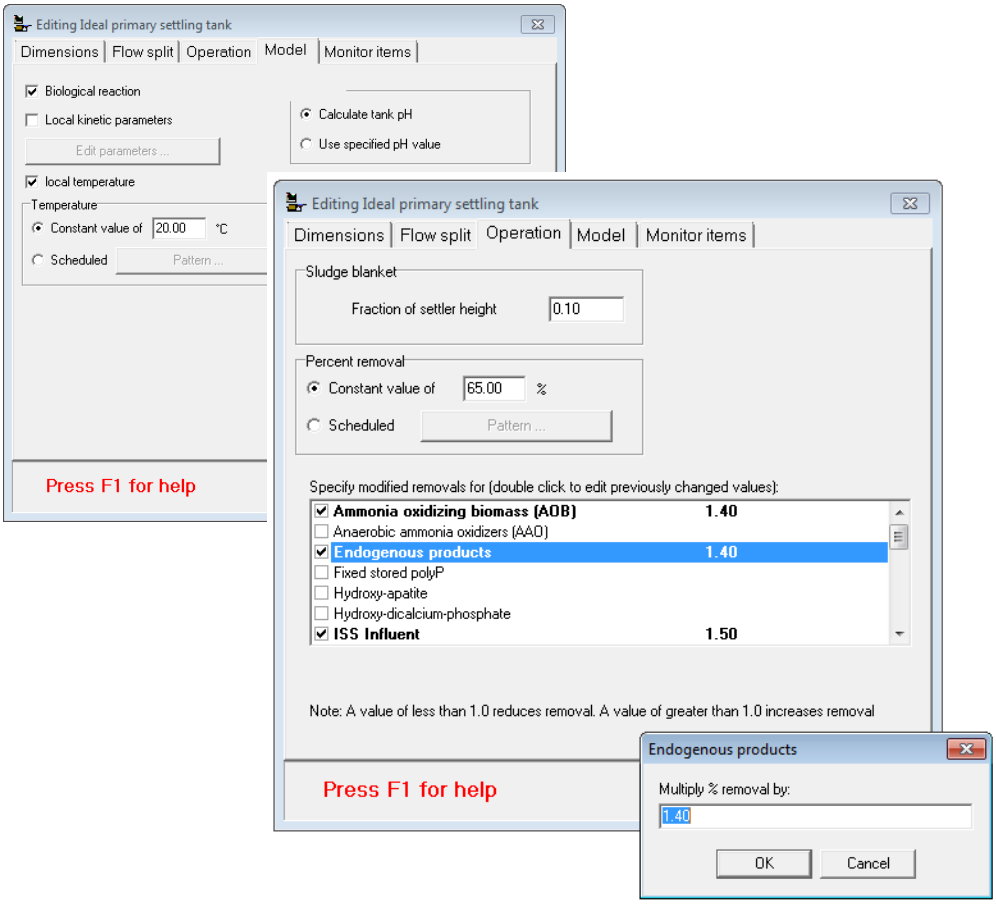
Media bioreactors using IFAS or MBBR biofilm-based systems are being applied more widely in the context of sidestream treatment; for example, for deammonification of digester centrate streams. The existing Media Bioreactor in BioWin can



be used for these systems. However, for convenience a Side Stream Media bioreactor has been added. The only difference from the existing Media Bioreactor is that this new unit is seeded with different initial concentrations more appropriate for sidestream conditions. Also, the default temperature is set to 35°C.

Element Enhancement – Ideal Primary Settling Tank

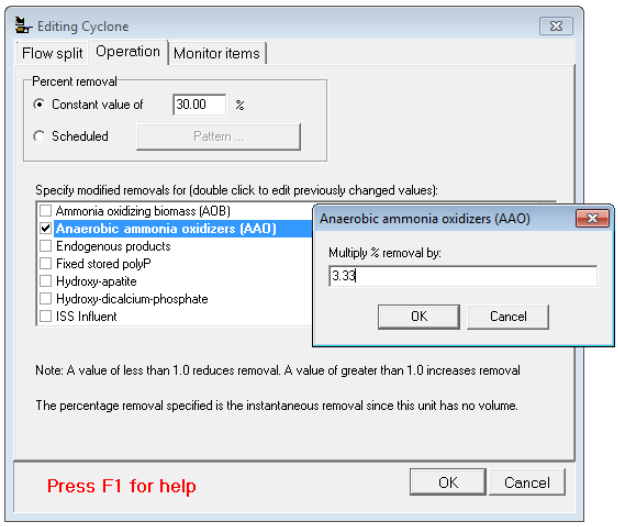
- The Ideal Primary Settling Tank element now has a Model tab which allows biological reactions to be toggled on or off. With this addition, the Activated Primary Settling tank is redundant. Existing flowsheets from earlier BioWin versions containing Activated Primary Settling Tank elements will be automatically converted to the new Ideal Primary Settling Tank elements with no change in functionality.
- It is now possible to specify individual removal percentages for particulate state variables across a primary settling tank element. For example, users can specify additional removal of inert suspended solids to simulate a changing VSS/TSS ratio across a primary settling tank.
- Percentage removals for TKN, TP, COD, BOD, and TSS are now calculated automatically and can be displayed in Album tables or charts.
- When pointing at a primary settling tank element on the flowsheet, the summary view in the main BioWin window now displays Percent TSS, COD, and BOD removal.



Element Enhancement – Cyclones

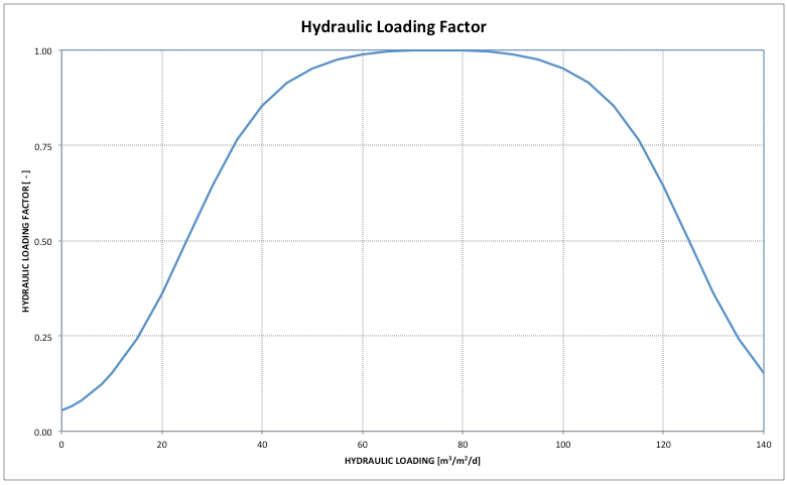
The Cyclone element now allows for individual removal percentages for particulate state variables. This is useful for simulating cyclones and other solids separation technologies proposed for certain mainstream deammonification processes. These rely on preferential retention of anaerobic ammonia oxidizing organisms.

BioWin also includes an ISS Cyclone that preferentially captures only influent inorganic suspended solids.



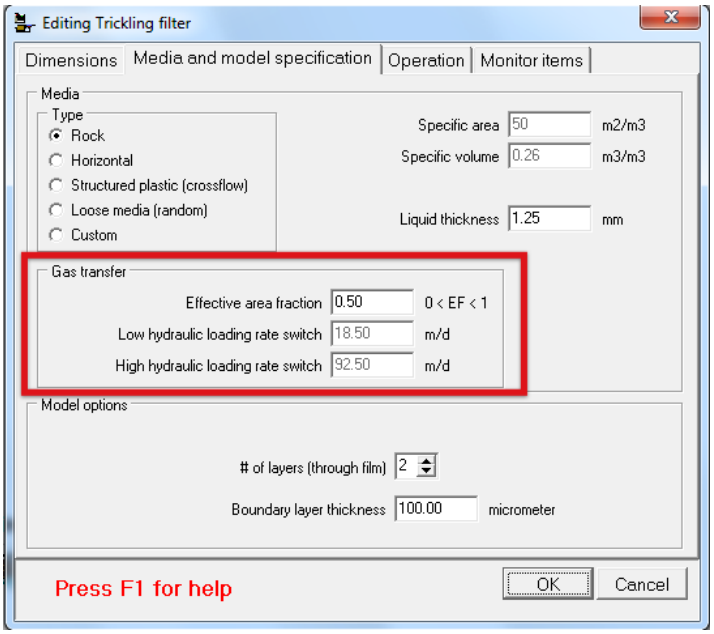
Element Enhancement – Trickling Filter

- Changes in terminology in Trickling Filter dialog boxes have been made to more closely adhere to engineering conventions. For example, model parameters now refer to “hydraulic loading rate” (as opposed to “velocity” in the previous version).
- The impact of hydraulic loading rate on trickling filter performance has been improved in BioWin 4.1. Hydraulic loading rate may impact the area available for gas transfer in BioWin. If the hydraulic loading rate is too low then not all of the media will be “wet” so the gas transfer area will be reduced. On the other hand, if the hydraulic loading rate gets too high then it is possible that the air spaces between the media will be flooded, which also will reduce the available gas transfer area. The **Hydraulic Loading Factor** attempts to account for these less-than-optimal conditions. The **Hydraulic Loading Factor** is determined by a two-sided continuous switching function; an example is shown below:



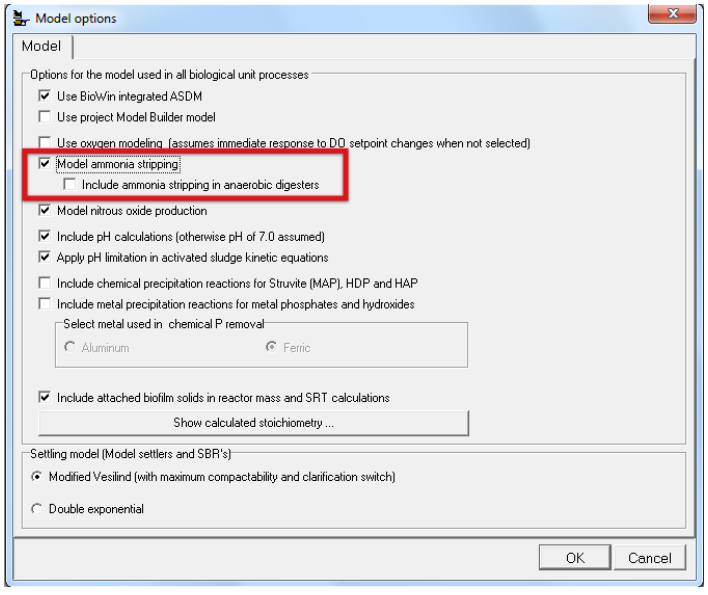
Hydraulic loading factor as a function of hydraulic loading

Over an optimal range of hydraulic loading rates the **Hydraulic Loading Factor** is equal to or close to unity (1). The value decreases towards zero for extreme low or high loading rates. The form of the continuous switching function is defined by the **Low hydraulic loading rate switch** value and the **High hydraulic loading rate switch** value. These are the low and high hydraulic loading rates where the **Hydraulic Loading Factor** has a value of 0.5 (*i.e.* the area for gas transfer is reduced to half of the effective area). Different media types have characteristic high and low loading rates. These are shown in the **Low hydraulic loading rate switch** and **High hydraulic loading rate switch** fields (highlighted in the picture below), and these change accordingly when any of the first four media types are selected. If **Custom** is selected, the user may edit the switch values.



Element Enhancement – Anaerobic Digester

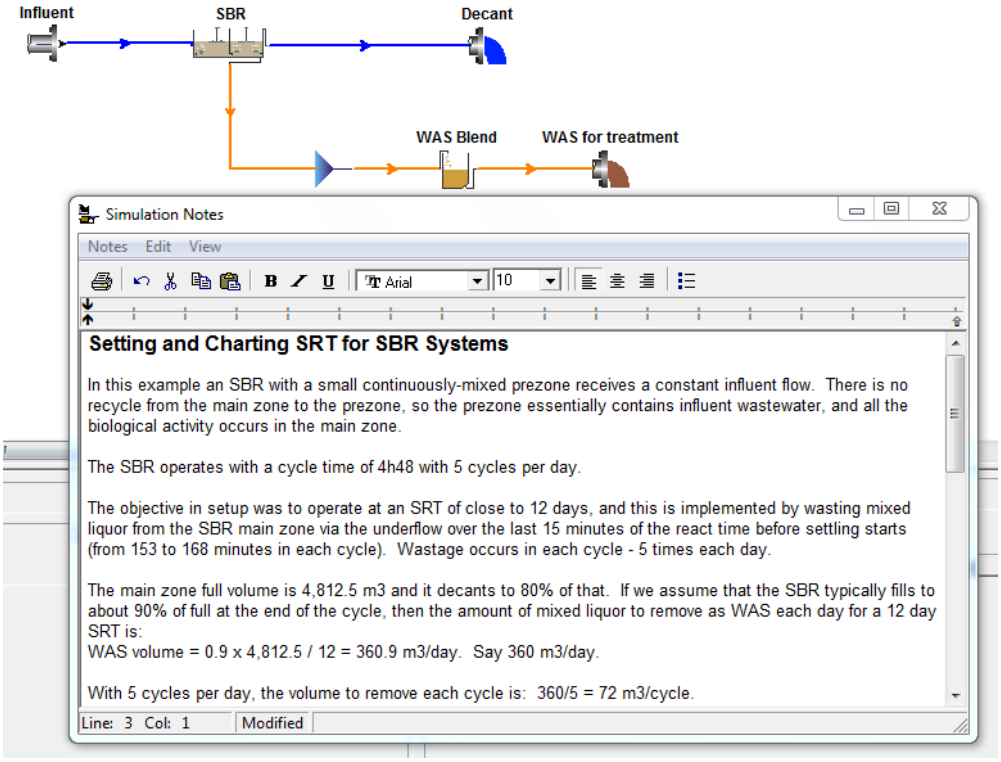
Ammonia stripping in anaerobic digesters is now a model option that can be toggled on or off. Simulation speeds can be increased if ammonia stripping is not needed in the model.



Usability Improvements

BioWin 4.1 usability improvements include:

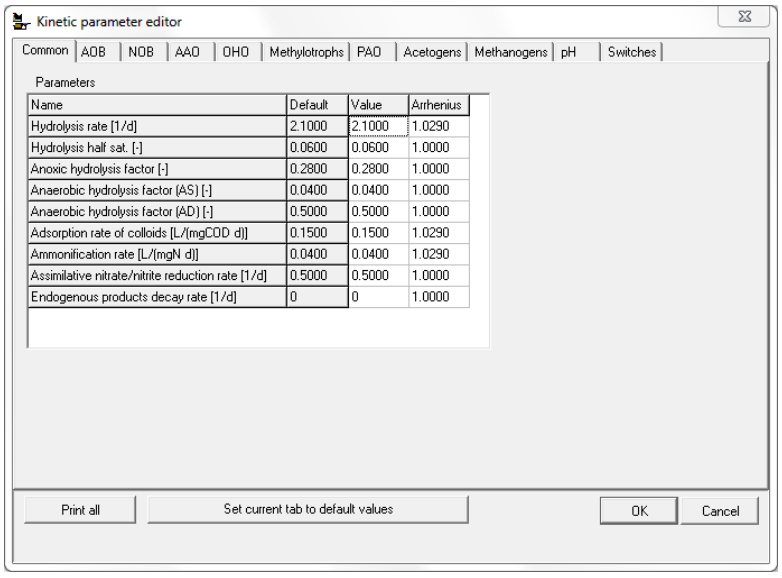
- Any notes added with BioWin's internal Notes Editor are now saved internally to the BioWin file (as opposed to a separate "*.nts" file in previous versions). If notes have been added to a file, BioWin automatically displays these when the file is opened. This greatly improves the utility of the Notes Editor and facilitates knowledge transfer.



- Table column widths are automatically resized to fit headings in the Album.
- User-defined Hydraulic Retention Time (HRT) calculators are now available. Users can select flowsheet elements to define the volume and flowrate terms for an HRT calculation. Multiple HRT calculators can be defined. Defined HRTs also can be plotted in the BioWin Album as a time series.
- The upper limit on the settling parameter V_0 has been significantly increased to facilitate simulation of ballasted activated sludge settling.
- The State Variable influent element now offers the same functionality for automatic filling of blank rows as with other influent elements.
- **Report to Word** is now directly accessible from the **File** menu.
- Several parameters related to nitrogen removal (*i.e.* deammonification rates, nitrification rates, and denitrification rates) have been made available for display in the

BioWin Album in tables and/or charts. Additionally, for media-type bioreactors, these parameters are also calculated on a unit media area basis.

- There is now a Common tab under **Project** > **Parameters** > **Kinetic**. This tab groups kinetic parameters that are not specific to one class of organism.



- Henry's Law coefficients are now shown in scientific notation format, allowing display of additional significant figures.
- BioWin alerts users if they have disabled metal reactions and attempt to run a simulation for a flowsheet containing one or more metal addition elements.
- If a user specifies an air supply rate for a bioreactor-type element, BioWin will ***automatically*** turn on the required oxygen modeling option.
- BioWin will alert the user that no model has been specified if a user does not select either BioWin's default biological model or their own user-defined Builder model.

Further details on all new elements and additions in BioWin 4.1 can be found in the Help manual.