Volume 17 | Issue 2

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AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Operation Update

A Newsletter for Aqua-Aerobic Plant Operators

Basin level settings, hydraulic flow rate, and storm mode

In our last issue of the Operation Update Newsletter, Vol. 17, Issue 1, we discussed how basin level settings are directly related to the hydraulic capacity of an AquaSBR® system. In this issue, we would like to expand upon that knowledge by discussing the automatic modes that an AquaSBR® system will initiate, as well as the types of adjustments an operator can make to reduce the impact that excessive influent flows can have on their plant. If you did not receive a copy of the previous issue and would like a digital copy or have any questions about this issue of the newsletter, please email *ProcessSupport@Aqua-Aerobic.com.*

SBR Level Setup

	SBR #1	SBR #2
High Level:	20.50	20.50
End React Fill:	20.00	20.00
Calculated Half Batch:	17.5	17.5
Storm 1:	16.50	16.50
Calculated Storm 1:	16.25	16.25
End Decant	15	15
Mixer Off (Low Level):	14.5	14.5

Note: The actual Storm 1 level setpoint must be greater than or equal to the calculated minimum.
*All levels are in feet.

Example of a 2-Basin SBR System's Level Settings

The majority of our AquaSBR® systems utilize automated modes of logic to process influent flows greater than the design maximum flow. These modes are known as Storm Modes 1, 2 and 3 and are automatically initiated by two level settings—the "End Mix Fill" level setting (also referred to as the "Storm 1" level setting) and the "End React Fill" level setting. For a detailed description of the Storm Modes specific to your facility, please refer to the Control Strategy in Section 3 of your AquaSBR O&M Manual. *Generally*, each of the Storm Modes will be initiated under the following conditions in most of our systems:

- Storm Mode 1 – The End Mix Fill (or Storm 1) level setting has been achieved before the system has completed the Mix Fill phase (or before the Storm 1 Time).
- Storm Mode 2 – The End React Fill level setting has been achieved before the system has completed the React Fill phase, **and** the next basin to fill has decanted for **more** than 30-minutes (or in newer systems, if the level is **less** than 50% of a full batch).
- Storm Mode 3 – The End React Fill level setting has been achieved before the system has completed the React Fill phase, **and** the next basin to fill has decanted for **less** than 30-minutes (or in newer systems, the level is **greater** than 50% of a full batch).

In some older systems, each level setting is based upon the position of physical float switches, rather than a level transducer and PLC level setpoints like most of our newer systems. Regardless of the type of level sensor utilized, we recommend confirming that all basin level settings are equal to the design values. However, in float switch based systems, it should be noted that the End Mix Fill float must be adjusted up or down manually anytime the Mix Fill or React Fill phase duration is adjusted. This will ensure Storm Mode 1 is initiated at the proper time.

Basin level settings, hydraulic flow rate, and storm mode

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To determine the height required for the End Mix Fill level setting, use the "End Mix Fill" (EMF) equation below.

$$EMF = \left(\frac{MF * (HWL - LWL)}{MF + RF}\right) + LWL$$

Where:

- EMF is the "End Mix Fill" level setting in feet from the bottom of the basin.
- MF is the "Mix Fill" phase time setting in minutes.
- RF is the "React Fill" phase time setting in minutes.
- LWL is the "End Decant" level setting or float switch position in feet from the bottom of the basin.
- HWL is the "End React Fill" level setting or float switch position in feet from the bottom of the basin.

By applying this equation to the previous issue's example plant phase times (Mix Fill = 45, React Fill = 135, React = 45, Settle = 60, and Decant = 75), and design parameters found in Table 1, the minimum End Mix Fill level setting would calculate to be 16.25 feet.

$$\left(\frac{45\ min * (20\ ft. - 15\ ft.)}{45\ min + 135\ min}\right) + 15\ ft. = 16.25\ ft.$$

Basin level settings (and/or phase times) set outside of the design values may not only change the hydraulic capacity of the plant, but may also trigger one of the Storm Modes sooner than desired which could also keep the system in Storm Mode longer than necessary. The basin level settings and phase times are adjustable in order to give the operator flexibility for various circumstances, but adjustments should be made with caution, taking into consideration the potential adverse effects of each adjustment. Hydraulic capacity, Storm Mode initiation, Storm Mode duration, mixer mooring cable tension, decanter flex joint stress, and blower discharge pressure are all affected by basin level changes, so it is not recommended to ever modify the level settings without first consulting with an Aqua-Aerobic Systems, Inc. Process Specialist. Be sure to reach out to us with any questions on the potential adverse effects a change to the cycle structure or level settings might have.

Table 1: Example Design Parameters

Avg. Design Flow = 0.508 MGD
Max Design Flow = 0.748 MGD
# of Basins = 2 Basins
Basin Dimensions = 50 Ft x 50 Ft
LWL Height = 15 Ft
HWL Height = 20 Ft
LWL Volume = 0.2805 MG
HWL Volume = 0.3740 MG
LWL MLSS = 3,000 mg/L

The intent of the Storm Mode logic is to maximize treatment to the greatest extent possible while preventing basin overflows when the influent flow rate exceeds the maximum hydraulic capacity of the system. If basin levels and phase time settings match the design values, then the flow rate that will initiate Storm Mode is a value greater than the designed maximum hydraulic flow rate sustained for a period of time that exceeds either the Mix Fill or React Fill phase durations. In essence, a basin reaching the End Mix Fill or End React Fill level settings prior to the end of the Mix Fill or React Fill phase suggests that the influent flow rate is exceeding what the basins can process when in normal operating mode, and the appropriate Storm Mode is initiated. If basin settings and phase times do not match the design values, then the actual maximum flow rate could be higher or lower than the designed maximum hydraulic flow rate depending on which values were adjusted and if they were adjusted up or down.

The initiation of Storm Mode, in conjunction with the fact that a decanter can typically evacuate a basin faster than the influent can come in, allows the SBR to process the flow without going in to an overflow situation. To accomplish this, each Storm Mode is incrementally more aggressive in its action; matching what is required to pass flow through the system. That being said, with each progressing Storm Mode effluent quality will degrade—Storm Mode 1 having the least impact on effluent quality and Storm Mode 3 having the greatest impact on effluent quality. Storm Mode works well when it comes to saving the plant from a spill during high influent flow events. However, operating in Storm Mode shortens the phase durations, specifically of React Fill, React or Settle. This means either aeration time, settle time (or both) will be shortened, which could lead to decreased effluent quality. If Storm Mode can be avoided by preparing for a known forthcoming high influent flow event, then it is recommended to do so in effort to preserve effluent quality. Depending on the severity of the high-flow event, it is possible that Storm Mode can be avoided by one simple operator adjustment—increasing the number of cycles per day a basin will complete.

Basin level settings, hydraulic flow rate, and storm mode

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As discussed in the last issue, the maximum hydraulic capacity in an AquaSBR® sytem is the product of the number of basins online, number of cycles per day per basin, and the batch size. Just increasing the number of cycles per day can drastically increase the hydraulic capacity of a plant, while maintaining relatively structured cycles and aeration times that would preserve the effluent quality to the greatest extent possible. Most high influent flow rate events are due to inclement weather related inflow and infiltration (I/I). In systems with a known I/I problem, a rain event will typically produce a dramatic *increase* in influent flow with an equally dramatic *decrease* in influent organic and nitrogen concentrations. Rain tends to dilute the influent, but the overall pounds per day of each constituent to the plant may not change. With more flow and diluted influent, more hydraulic capacity is required and the hope would be to not reduce effluent quality while operating more cycles in the SBR. To some extent the effluent quality from the SBR during a rain event will depend on how well the system was settling before the rain event.

Increasing the number of cycles per day is simply a matter of adjusting the phase times in a way that abides by the following rules:

1. The total cycle time (sum total of the 5 phase times) is decreased.
2. Adheres to the phase time rules specific to your facility. These rules are described in the Control Strategy found in Section 3 of your AquaSBR O&M Manual. For example, in a 2 or 4 basin shared blower system, the aeration time must be <= ½ of the cycle. Also, in a 2 basin SBR, the Fill time must equal the Non Fill time.
3. The Decant phase time is unchanged from the design value. The Decant phase time is directly related to the decanter's flow rating and its ability to decant a completely full basin.

In anticipation of a rain event and the need for increased hydraulic capacity, it would be beneficial for the operator to have some predetermined cycle structures prepared ahead of time and ready to be implemented.

Mix Fill:	45
React Fill:	135
React:	45
Settle:	60
Decant:	75

Aqua SBR® Phase Times (from Example Plant)

For example, recalling the phase times from our example 2-basin system in the previous issue (Mix Fill = 45, React Fill = 135, React = 45, Settle = 60, and Decant = 75), the system was operating with a total cycle time of 360 minutes, which yields 4 cycles per day, per basin at the design values. If the operator wanted to increase the plant hydraulic capacity, he could operate the plant at 5 cycles per day (288 min/cycle). In this scenario, the resulting cycle would be something like Mix Fill = 24, React Fill = 120, React = 24, Settle = 45, and Decant 75 min. As you can see, at 5 cycles per day, both the React Fill and React phase times are reduced, thereby reducing the total potential aeration time. The Settle phase time is also reduced, but only down to 45-minutes, which is greater than the 30-minute Settle time that would occur if Storm Mode logic were allowed to engage.

Using the example plant's design parameters from Table 1, we have increased the maximum hydraulic capacity from 0.748 MGD up to 0.935 MGD just by increasing the number of cycles per day a basin will complete from 4 cycles per day up to 5 cycles per day.

In summary, the operator has the ability to directly affect the plant's hydraulic capacity by modifying the quantity of cycles the SBRs will complete in a day. This may prove to be useful when a rain event is forthcoming. Running more cycles comes at the price of shortening either the aeration time, or the settle time (or both), but the settle time the operator selects can still be longer than the default Storm Mode settle time of 30 minutes. If a plant has settleability issues and they know a rain event is forthcoming that will potentially push the plant beyond its capacity, then the operator should consider temporarily increasing the number of cycles per day to accommodate foreseeable peak flows.

Cloth Media Filter Capacity

A common question among our cloth media filter customers is what is the capacity of their filtration system? The focus of this article is to define the design capacities of each of Aqua-Aerobic Systems' cloth media filtration products.

Aqua-Aerobic currently supplies five different configurations: AquaDrum®, Aqua MiniDisk®, AquaDisk®, Aqua MegaDisk®, and AquaDiamond®. Note that for each configuration, there is typically both an average daily capacity and a maximum daily capacity. Based on the wide array of configurations and sizes available, Aqua-Aerobic is able to cover a wide range of capacities, and we customize our filter size and configuration based on the particulars of each facility.

The types of cloth media filters along with their capacities and configurations are described in more detail below.

AquaDrum® Cloth Media Filter

The AquaDrum is available in four different sizes and can vary from a TF2 with 21.5 ft^2 of media, to TF10 with 86 ft^2 of media. Note that each 21.5 ft^2 of media represents 62,000 GPD of average flow capacity, and 124,000 GPD of maximum flow capacity. In order to calculate the average capacity of the AquaDrum filter at your installation, you take the media area in square feet, multiplied by 2 GPM/ft^2, multiplied by 1440 min/day. For example, a TF6 AquaDrum filter would have an average capacity of 64.5 ft^2 x 2 GPM/ft^2 x 1440 min/day = 186,000 GPM. The maximum flow capacity of the AquaDrum filter is typically twice the average flow capacity.

Aqua MiniDisk® Cloth Media Filter

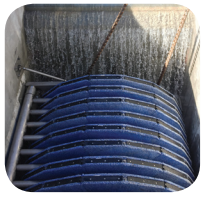
(also known as the Model 11 or Model 12)

The MiniDisk filter can be supplied in configurations anywhere from a 1-disk filter to a 60-disk filter. For this filter, each disk has an average capacity of 50,000 GPD, and a maximum capacity of 100,000 GPD. Therefore, a 6-disk Aqua MiniDisk filter would have an average capacity of 6-disks x 50,000 GPD /disk = 300,000 and a maximum capacity of 600,000 GPD.

AquaDisk® Cloth Media Filter

(also known as the Model 54)

The AquaDisk filter can be supplied in configurations anywhere from a 1-disk filter to a 16-disk filter. For the AquaDisk filter, each disk has an average capacity of 250,000 GPD and a maximum capacity of 500,000 GPD. Therefore, a 6-disk AquaDisk filter would have an average capacity of 6-disks x 250,000 GPD/disk = 1.5 MGD and a maximum flow capacity of 3.0 MGD.



Aqua MegaDisk® Cloth Media Filter

(also known as the Model 108)

The Aqua MegaDisk filter can be supplied in configurations anywhere from a 1-disk filter to a 24-disk filter. For this filter, each disk has an average capacity of 500,000 GPD and a maximum capacity of 1.0 MGD. Therefore, a 6-disk Aqua MegaDisk filter would have an average capacity of 6-disks x 500,000 GPD /disk = 3.0 MGD and a maximum flow capacity of 6.0 MGD.

AquaDiamond® Cloth Media Filter

The AquaDiamond filter is typically supplied with eight laterals in lengths varying from 40 to 80 ft in length. A 40 ft Aqua Diamond filter has an average capacity of 6 MGD average and 12 MGD maximum, while an 80 ft AquaDiamond has an average capacity of 12 MGD and a maximum capacity of 24 MGD.

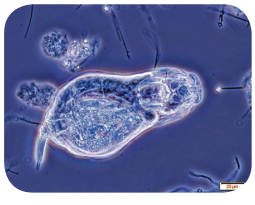
There may be slight nuances to your individual application such as 10 State Standards maximum design loadings, or Title 22 design limitations that slightly affect the general capacity estimates listed above. With that being said, if you notice that your filter's operating capacity is less than the values estimated above, Aqua-Aerobic would recommend that you review the filter's operation to confirm that there are not factors affecting your filter's ability to process its rated capacity.

Cloth Media Filter Capacity...*Continued from page 4*

When reviewing your filter's operation, it is recommended to check the vacuum on the backwash pump and the flow rate of the backwash pump. The target value for the vacuum on the backwash pump is less than 20 in Hg. If the vacuum value is greater than 20 in Hg, this is an indication that your cloth media filter may need a chemical cleaning.

The flow rate for your backwash pump on your filter can be determined via a draw down test. Procedures for performing a chemical cleaning or a draw down test are available in your O&M manual, or by contacting our Customer Service department at (800) 940-5008.

Did You Know...



Rotifers Can Improve Effluent Quality

Rotifers exist in a stable microbiological environment, typically associated with a longer sludge age, and lack of toxicity. Rotifers have a life span that ranges from one week, to about 50 days. Rotifers consume bacteria, and exude mucous that helps in floc formation. These traits actually serve to improve effluent quality.

It is Important to Check Your Chemical Dosages

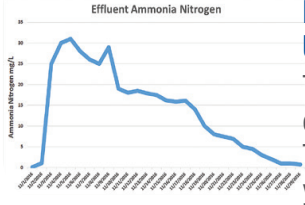
Overdosing aluminum or iron salts can actually lead to higher effluent TSS, by creating excess chemical solids. It can also lead to a nutrient deficiency in the activated sludge process. Review your chemical dosages and your orthophosphate results to ensure that you are not overfeeding metal salts.

Algae Growth Can Reduce Your Effluent Quality

Algae growth in a clarifier, channel, post aeration basin, or UV system can lead to higher effluent nutrient and TSS results. Take steps (such as cleaning a clarifier weir) to ensure that algae growth is not affecting your effluent quality.

Collection System Detention Times Can Negatively Affect Your Activated Sludge Process

Long detention times in the collection system can cause sulfide and organic acid production, which can both lead to hydrogen sulfide-based odor issues and filamentous bacteria proliferation.



Nitrifying Bacteria Can Survive Under Anaerobic Conditions

They can survive under those conditions, but only for about 4 hours. This is why it is so important to keep your aeration system functioning properly. It can be very difficult to fully regain nitrification after a complete loss of the nitrifying population, especially during colder months. Even with perfect conditions, we would expect recovery to begin after about 5-days. Under more extreme conditions it can take several weeks for a full recovery.

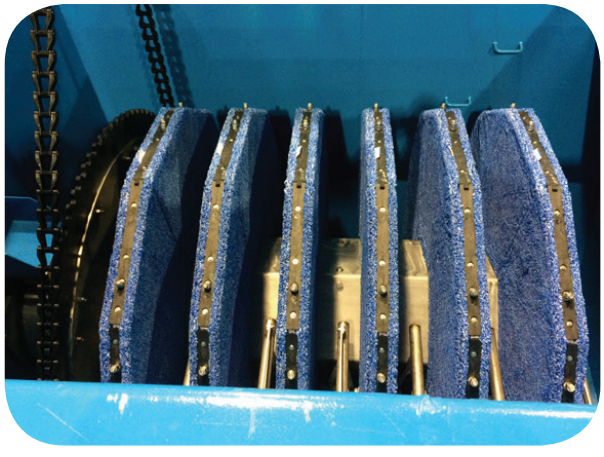
Aqua-Aerobic Systems, Inc. is the Exclusive Provider for Aerobic Granular Sludge Technology in the United States

For more information, go to www.aqua-aerobic.com and type "Nereda" in the search bar.

Cloth Media Filter Rental:
An Economical Option for Short-Term Filtration Needs

Aqua-Aerobic Systems, Inc. is now offering a fleet of AquaDisk® cloth media filters as a low cost rental option for temporary wastewater filtration. Rental filters offer significant savings over the purchase of a new filter, and are an ideal solution when plant upsets occur, when existing filters need rebuilding, or for process validation.

Units ship fully-assembled and ready for operation



Internal components are assembled from 304 SS and non-corrosive materials for durability

Filter Features and Advantages:

- Fully-assembled 6-disk (1.5 avg. - 3.0 max. MGD) or 12-disk (3.0 avg. - 6.0 max. MGD) models
- OptiFiber® chlorine-resistant pile cloth media offers maximum solids removal over a wide range of particle sizes
- Available in nominal 5 or 10 micron media
- Suitable for indoor or outdoor applications
- Filters are automatically controlled via PLC
- Rent-to-own option available
- Quick shipment with ease of installation
- Technicians available to assist with start-up
- Optional bench-scale testing prior to rental

Rental Filter Applications:

- Industrial and Municipal Applications
- Total Suspended Solids Removal
- Phosphorus Removal
- Reuse/Recycle
- Side Stream Filtration
- Tertiary Treatment
- Turbidity Removal

For more information on renting a cloth media filter, email Paul Klebs at PKlebs@aqua-aerobic.com or Denise Uchacz at DUchacz@aqua-aerobic.com, call (815) 654-2501, or visit AquaDisk4Rent.com.

Meet Your Customer Service Representative

Denise Uchacz

Aftermarket Sales Representative

Denise has been in the customer service industry for over 9 years and takes pride in finding solutions for her customers.

Fairly new to the Aqua-Aerobic team, Denise looks forward to building relationships with new and existing customers. Contact Denise directly at (815) 639-4514 or at duchacz@aqua-aerobic.com.

"Send us your data and win"
Contest Winners Announced

Since 2014, our Customer Service team has conducted an annual Treatment Plant Award Drawing as a "thank you" to those plants that send in their operating data.

The 1ST Prize Winner Receives:

Two free days of on-site assistance from an Aqua-Aerobic Field Service technician (travel to and from site included, and the plant must be in the US or Canada). The days on site can be used within a calendar year of the drawing and can be utilized for process or mechanical training, or equipment inspection.

The 2ND Prize Winner Receives:

$250 credit towards replacement /spare parts available through our Aftermarket Sales Department.

Aqua-Aerobic is grateful to all of our plants that have sent in their operating data for 2016, and in previous years. The data is very useful to our process engineers in the event your facility contacts us with process concerns. The data allows us to access how your system is loaded relative to the original design and assists us in formulating our process recommendations.

If you have not yet sent us your data, please send it to ProcessData@Aqua-Aerobic.com. To qualify for the next drawing, we request a minimum of 6 months of data in the calendar year, with a minimum of the information below:

- Influent average and maximum flows (Required)
- Effluent Data (Required)
- Influent data (If available)
- Daily operating information such as MLSS, Settleability, pH, etc (if available)

We look forward to receiving your 2016 and 2017 data and wish you luck in being one of the selected plants for these two awards.

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