



AQUA-AEROBIC SYSTEMS, INC.



Aqua MSBR[®]

MODIFIED SEQUENCING BATCH REACTOR

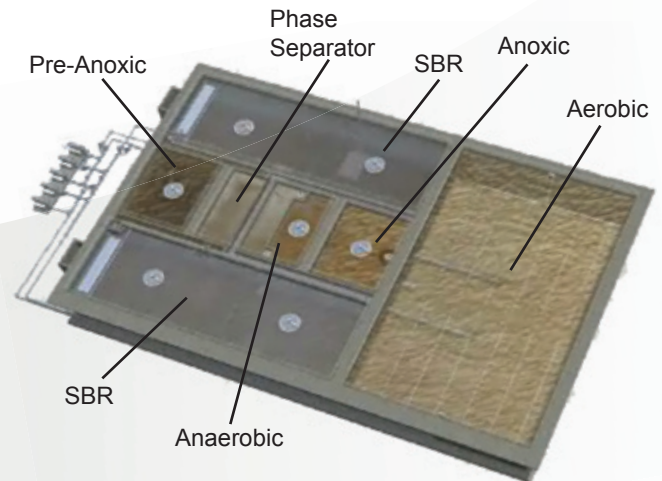
Aqua MSBR®

MODIFIED SEQUENCING BATCH REACTOR

For over three decades, Aqua-Aerobic Systems has led the industry in sequencing batch reactor technology with performance proven and cost effective treatment systems capable of effectively removing nutrients and reducing phosphorus. This expertise coupled with experience in traditional flow through activated sludge design allows us to provide a compact, continuous flow and constant water level system solution - the Aqua MSBR® Modified Sequencing Batch Reactor.

System Features and Advantages

- Proportional aeration turndown via the Aqua MixAir® system
- High equipment utilization
- Internal, low pressure sludge recycle reduces energy consumption
- True quiescent, isolated (batch) settling
- Phase separator optimizes BNR
- Fully automated control system
- No external secondary clarifiers required; small footprint
- Expandability
- Low life-cycle cost



Overview of a 7-Stage Aqua MSBR® System.

Aqua MixAir® System

The Aqua MSBR system utilizes the Aqua MixAir system by providing separate mixing with AquaDDM® direct-drive mixers and an aeration source of Aqua-Aerobic diffused aeration. This system has the capability to cyclically operate the aeration and mixing to promote anoxic/aerobic and anaerobic environments with low energy consumption. In addition, the Aqua MixAir system can achieve and recover alkalinity through denitrification, prevent nitrogen gas disruption in the settling phase, promote biological phosphorus removal, and control certain forms of filamentous bacteria.

Phase Separator



The phase separator is designed to concentrate returned solids which enhances the environment for improved phosphorus release.



Advanced Decanter/Air Weir



The air weir provides efficient effluent flow control and prevents discharge of suspended solids and scum into the effluent.

Aqua MSBR® Stages of Operation

The Aqua MSBR system incorporates multiple reactors that operate through a series of stages to provide a variety of treatment mode alternatives. The design configuration may range from a simple 3-stage configuration that provides oxidation and efficient clarification to a 7-stage configuration that provides enhanced biological nutrient removal. An Aqua MSBR system will include two sequencing batch reactors (SBRs). The SBRs are equipped to assume multiple functions such as anoxic mixing, aerobic mixing, quiescent settling, sludge wasting and clarification. Each stage features an air weir that effectively controls effluent flow. Stage functions can be designed for optimum conditions based on wastewater characteristics to meet specific effluent objectives.

Anaerobic

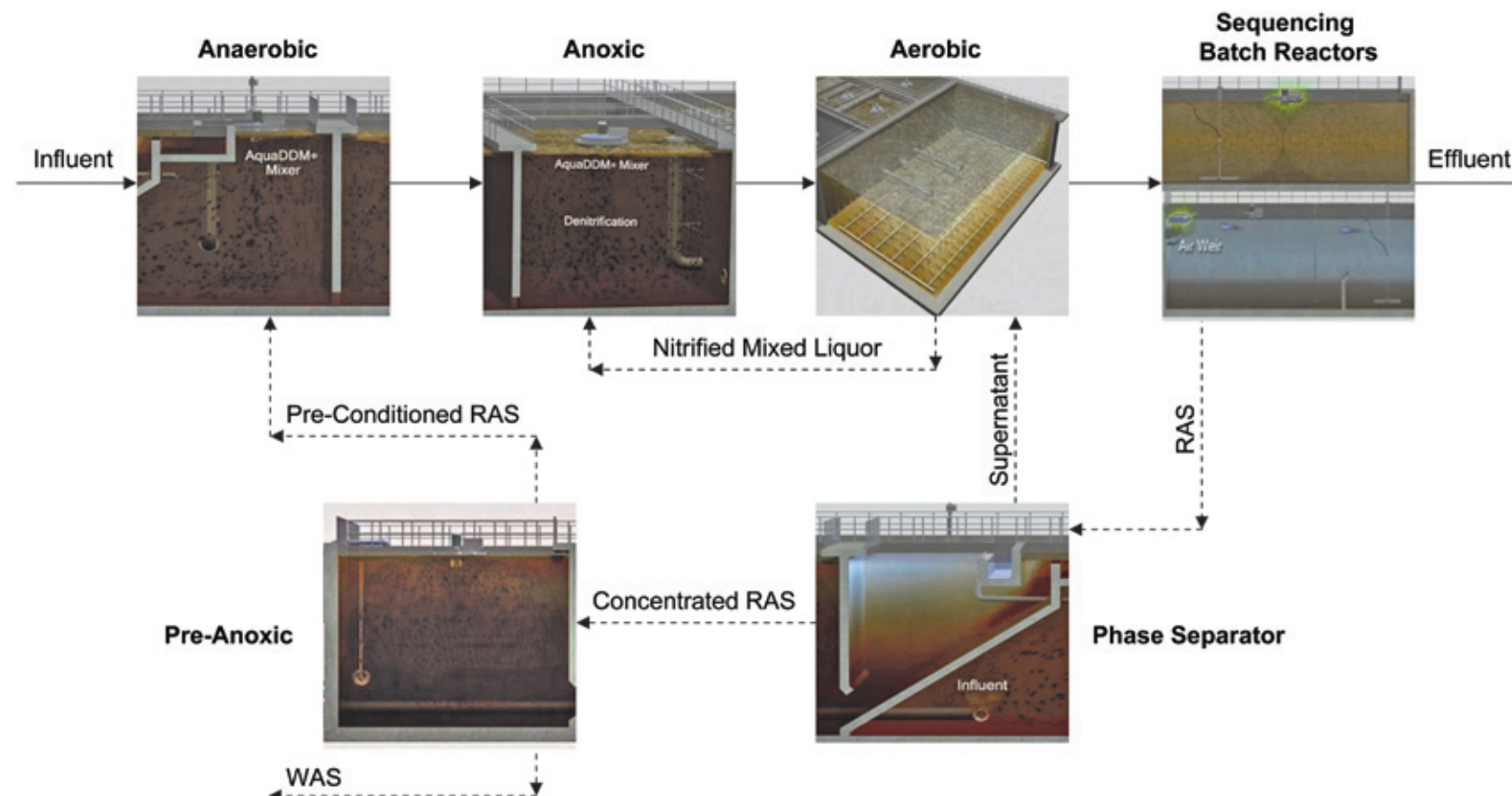
- Influent flow enters the cell by gravity
- Raw substrate is completely mixed with the thickened returned activated sludge (RAS) pumped from the Pre-Anoxic stage via the AquaDDM mixer in absence of aeration
- Anaerobic conditions are created facilitating removal of any residual nitrites/nitrates (NOx) in the RAS via denitrification
- Phosphorus accumulating organisms (PAO) release phosphorus to obtain energy to convert volatile fatty acids (VFAs) to polyhydroxybutyrate (PHB) in preparation for subsequent luxury uptake in the aeration stage
- Anaerobic conditions assist in controlling the growth of some types of filamentous organisms

Anoxic

- Mixed liquor is received from the Anaerobic stage
- Nitrified mixed liquor is pumped from the Aeration stage
- A complete mix condition is achieved via the AquaDDM mixer
- Anoxic conditions are created to reduce NOx produced in the Aerobic stage, on a rich substrate level, through a denitrification process

Aeration

- Mixed liquor is received from the Anoxic stage
- Supernatant is received from the phase separator stage
- Treated mixed liquor is directed to one of the pre-settled, clarifying SBRs by gravity during its clarification phase
- Nitrified mixed liquor is pumped to the Anoxic stage
- Continuous aeration creates aerobic conditions to reduce biological/chemical oxygen demand (BOD/COD) and ammonia nitrogen (NH₃-N)



SBRs

- A four-phase SBR operation is performed: (1) Anoxic Mixing; (2) Aeration; (3) Pre-Settling (quiescent); and (4) Clarification
- Biological/chemical oxygen demand (BOD/COD) and ammonia nitrogen (NH₃-N) are further reduced in the Anoxic and Aeration stages
- Flow does not enter the reactor, and mixing and aeration are terminated to create perfectly quiescent conditions for ideal solids/liquid separation in the Pre-Settling phase
- The air weir decanter and internal baffle allow discharge of high quality effluent at a constant water level

Phase Separator

- Returned activated sludge (RAS) is pumped from one of the SBRs
- Liquid and solids in the RAS are further segregated
- RAS is concentrated 20-50%
- Concentrated RAS flows by gravity to the Pre-Anoxic stage
- Supernatant flows to the Aeration basin

Pre-Anoxic

- Concentrated RAS is received from the Phase Separator
- Anoxic, complete-mix conditions are created by the AquaDDM mixer
- NOx levels are controlled by adjusting the pumping rates from the Pre-Anoxic stage to the Anaerobic stage to prevent secondary phosphorus release
- Pre-conditioned, thickened RAS is pumped to the Anaerobic stage

IntelliPro® Process Monitoring and Control System

The IntelliPro system is a personal computer (PC) based program that interfaces with the AquaSBR system's programmable logic controller (PLC) via a network connection to assist operators in optimizing the treatment process of the plant and further reducing operating costs.

System Advantages

- Real-time, online monitoring and control
- "Active Control Mode" which automatically receives, interprets and proactively adjusts in-basin instruments and process variables including biological nutrient removal, chemical addition and energy
- Reduces the operator's sampling time
- Real-time and historical graphical trending of process parameters
- BioAlert™ process notification provides corrective action to eliminate operational interruptions and upsets
- Assists in the optimization of enhanced nutrient removal
- Online operation and maintenance support
- Remote troubleshooting provides on-demand troubleshooting assistance



Aqua MSBR®

Typical Applications

The Aqua MSBR system is ideal for large scale projects in any municipal or industrial wastewater application with effluent requirements ranging from carbonaceous oxidation to enhanced biological nutrient removal.



Biological Nutrient Removal

- 31.7 MGD (120,000 m³/day) Avg. Daily Flow
- This Aqua MSBR system in China reduces COD, ammonia nitrogen, and total phosphorus to stringent levels for ultimate discharge into the Tai Lake.



Nitrification

- 9.5 MGD (36,000 m³/day) Avg. Daily Flow
- This plant in Thailand utilizes an Aqua MSBR system to provide BOD, TSS, and nitrogen removal.



Phosphorus Removal

- 31.7 MGD (120,000 m³/day) Avg. Daily Flow
- This plant in China utilizes (3) Aqua MSBR systems and meets phosphorus removal requirements without chemicals.



Reuse

- 6.3 MGD (24,000 m³/day) Avg. Daily Flow
- This Aqua MSBR system in Korea meets the city's nitrification, denitrification, and phosphorus effluent requirements, and is followed by (2) AquaABF® automatic backwash filters which produce reuse quality effluent.

Providing **TOTAL** Water Management Solutions

Visit our website at www.aqua-aerobic.com to learn more about the Aqua MSBR® Modified Sequencing Batch Reactor and our complete line of products and services:

Aeration & Mixing

Biological Processes

Filtration

Membrane Systems

Controls & Monitoring Systems

Aftermarket Products and Services



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The information contained herein relative to data, dimensions and recommendations as to size, power and assembly are for purpose of estimation only. These values should not be assumed to be universally applicable to specific design problems. Particular designs, installations and plants may call for specific requirements. Consult Aqua-Aerobic Systems, Inc. for exact recommendations or specific needs. Patents Apply.