

AquaPASS[®]

Phased Activated Sludge System



AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

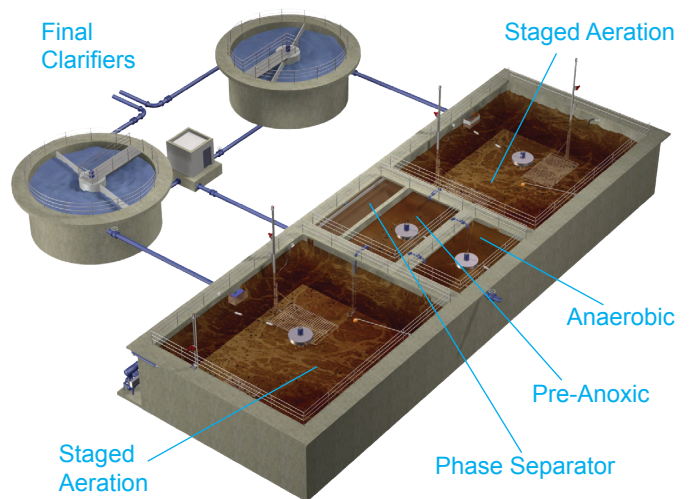
AquaPASS®

Phased Activated Sludge System

Aqua-Aerobic Systems has led the industry in time-managed, biological technology since 1984. In 2004, Aqua-Aerobic applied its expertise in time-managed technology in a unique flow-through regime to provide superior nutrient removal performance in a singular wastewater treatment system. The AquaPASS® Phased Activated Sludge System integrates the performance benefits of a batch reactor into an efficient, compact, and reliable solution for activated sludge applications.

System Features and Advantages

- Flexible tank design, tailored equipment options and final clarifiers (provided separately) make this process ideal for retrofitting existing systems
- Enhanced nutrient removal capabilities, achieving 3.0 mg/l total nitrogen and 0.5 mg/l total phosphorus:
 - Time-based anoxic intervals promote exceptional nitrate reduction
 - Phase separator and pre-anoxic basin conditions the sludge for optimum biological phosphorus removal
- Staged aeration via the Aqua MixAir® system offers power savings
- Internal, low pressure sludge recycle reduces energy consumption
- Fully automated process control system with operational flexibility
- Superior process environment is suited for cold weather climates
- Low life-cycle cost with annual energy savings up to 50% compared to similar activated sludge processes due to reduced recycle flow requirements



Overview of a 4-Stage AquaPASS® System.

Aqua MixAir® System

The AquaPASS system utilizes the Aqua MixAir® system by providing separate mixing with AquaDDM® direct-drive mixers and 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

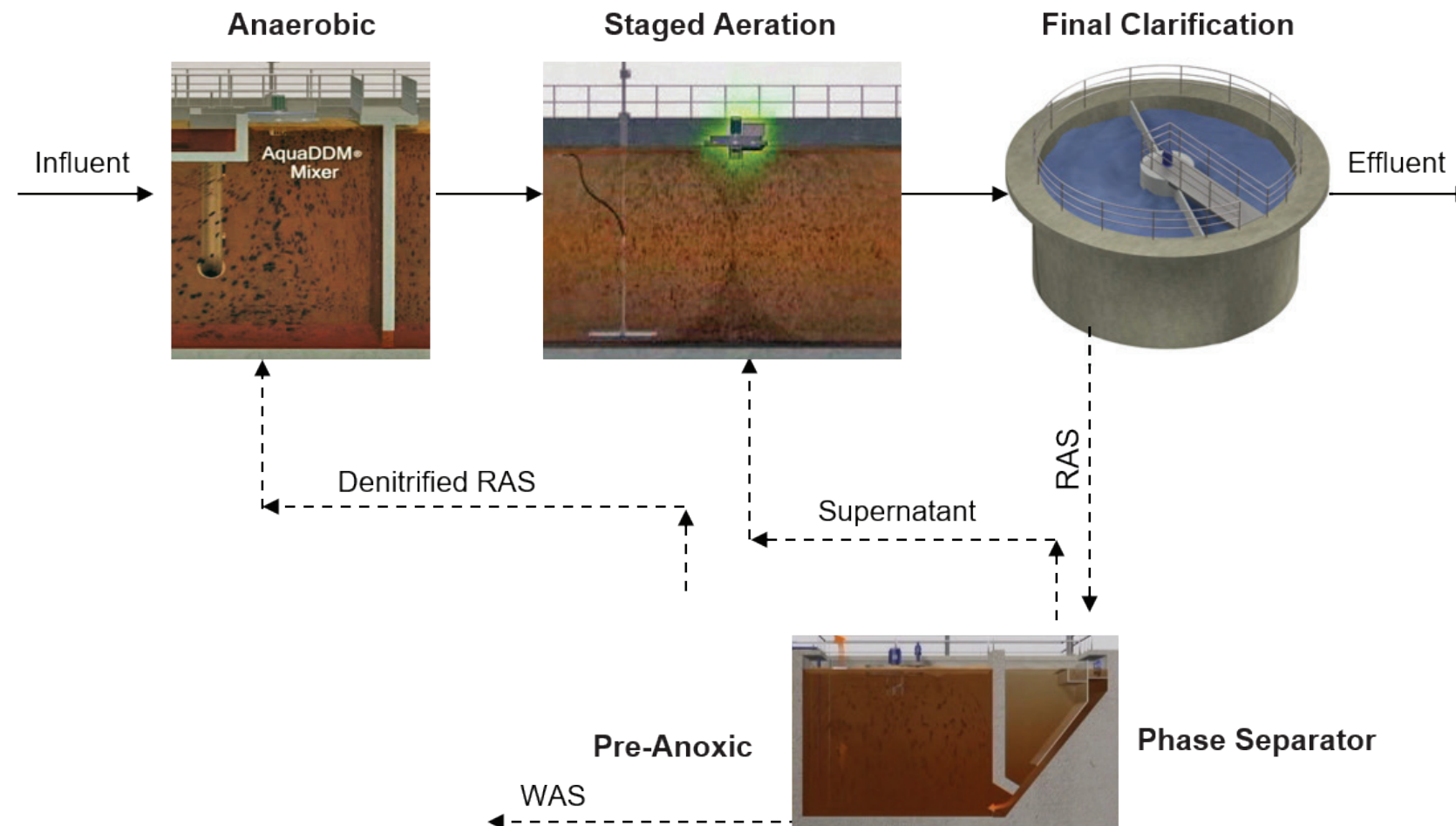
The phase separator thickens returned activated sludge (RAS) from the final clarifiers to optimize process environments, particularly phosphorus removal. Because the phase separator produces thickened sludge 20-50% more concentrated than return activated sludge, the cost associated with sludge thickening, dewatering, and transportation is decreased.



AquaPASS®

Stages of Operation

The AquaPASS® system incorporates the unique flexibility of a time-managed process configured in a flow-through activated sludge scheme. The system employs time-based aerobic and anoxic phasing via the Aqua MixAir system to meet critical nutrient removal objectives. Independent aeration and mixing allows necessary nitrification, denitrification, as well as phosphorus removal to occur within a single basin. This concept also decreases overall power consumption of the system. The AquaPASS system utilizes four (4) treatment steps: Anaerobic, Staged Aeration (multiple discrete anoxic/aerobic events), Phase Separator, and Pre-Anoxic. The stage functions can be designed for optimum conditions based on wastewater characteristics to meet specific effluent objectives.



Anaerobic

- Untreated sewage is introduced into the Anaerobic reactor
- Concentrated, denitrified biological solids are transferred from the Pre-Anoxic reactor
- Volatile Fatty Acid (VFA) production is enhanced under anaerobic conditions
- Turbulent and efficient mixing keeps particle turnover periods < 5% of the reactor's hydraulic retention time (HRT)
- Elevated VFA-enriched mixed liquor is conveyed to the Staged Aeration/Anoxic reactor

Staged Aeration

- Anaerobically conditioned bio-solids are received into the Staged Aeration reactor
- Multi-variable dissolved oxygen (D.O.) control for management of discrete aerobic and anoxic intervals can be further enhanced with the addition of the IntelliPro system
- The aerobic stage enables operator-defined D.O. levels to be controlled
- The anoxia stage produces a completely mixed biomass at near-zero D.O. levels
- Process management of aerobic/anoxic events via time or instrument feedback
- Efficient oxygen delivery via proportional aeration management

Pre-Anoxic

- Sludge from the Phase Separator is conditioned for further nitrate reduction
- Aggressive mixing in absence of D.O. prepares bio-solids prior to anaerobic treatment
- The elevated solids concentration results in reduced pumping requirements
- Variable frequency control of the pumps manages retention times in anaerobic and anoxic stages
- Denitrified sludge is conveyed to the Anaerobic stage

Phase Separator

- Receives RAS from the final clarifiers
- Enhanced solids concentration is promoted in a low-energy consumption environment
- Supernatant is returned to Staged Aeration
- Concentrated sludge is conveyed to Pre-Anoxic reactor

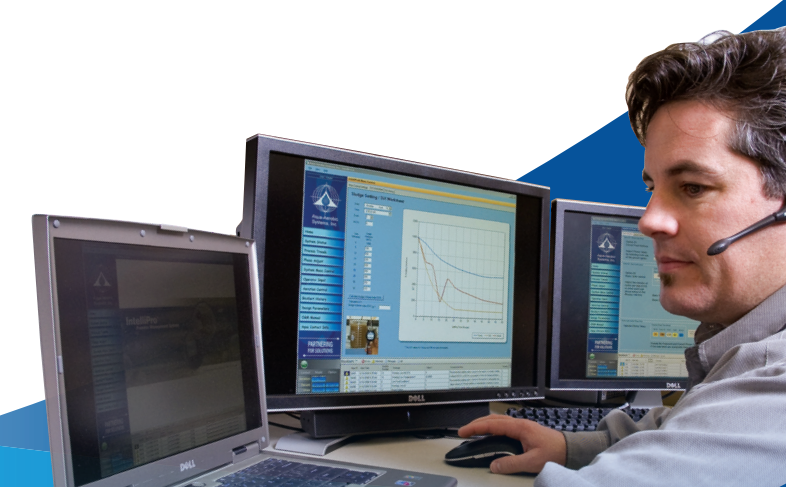
IntelliPro®

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



Typical AquaPASS® Applications

- Ideal for municipal or industrial large scale projects
- Enhanced biological nutrient removal
 - Total Nitrogen < 3 mg/l
 - Total Phosphorus < 0.5 mg/l
- Water reuse and reclamation
- New plant construction
- Retrofit existing activated sludge systems
- Convert oxidation ditches
- Easily integrated into an Aqua-Aerobic membrane system

PLANT PROFILE - Salisbury Township WWTP, PA

The Salisbury Township WWTP in Gap, PA utilized a conventional activated sludge system prior to being retrofitted with an AquaPASS Phased Activated Sludge System in May 2008. The upgrade was necessary in order to comply with the Chesapeake Bay Initiative for local impaired waterways, requiring stringent permit limits on effluent Total Nitrogen and Total Phosphorus. The plant's conventional system was not designed for nutrient removal and required only secondary limits of 20 mg/l BOD₅, 30 mg/l TSS, 6 mg/l NH₃-N, and 2 mg/l TP. Before the upgrade, Salisbury experienced constant upsets during peak wet weather flow conditions that required operator intervention to prevent solids from rising over the effluent weir. In addition, the conventional system could no longer handle the increased hydraulic loadings from the area's rapid population growth of about 11.5% in the past nine years.



After evaluating alternative technologies, Salisbury and its consulting engineer ultimately selected the AquaPASS system for its ability to combine prominent features of both batch and continuous-flow processes into a singular treatment process. This offered Salisbury an efficient, time-managed process environment within existing tank geometry at a low lifecycle cost. Salisbury was the first treatment plant to install AquaPASS technology.

Average Operating Data (2018 - 2020)

LOADING	DESIGN INFLUENT	DESIGN EFFLUENT	AVG EFFLUENT
Avg. Flow* mgd	0.58	----	0.34
Peak Flow mgd	1.16	----	0.55
BOD ₅ mg/l	250	15	4.1
TSS mg/l	215	30	< 5
TKN mg/l	40	----	< 1
NH ₃ -N mg/l	35	1	< 0.3
Total N mg/l	----	6.9	6.4
Total P mg/l	6	0.86	0.74

*Maximum Month Average Flow.

Salisbury's AquaPASS system is designed to meet the new stringent Total Nitrogen and Total Phosphorus effluent levels required by the Chesapeake Bay Initiative, 6.9 mg/l and 0.86 mg/l, respectively. The system is also designed to provide 140% more treatment capacity in the same footprint as the previous conventional activated sludge system.

Performance of Salisbury's AquaPASS system was evaluated to verify its ability to meet the future Chesapeake Bay Initiative permit. Since its startup in May 2008, the AquaPASS system has been in compliance with the future requirements of Total N and Total P effluent. In addition, effluent BOD₅, TSS, and NH₃-N have been reduced by more than 98%.

Since 1969, Aqua-Aerobic Systems, Inc. has led the industry by providing advanced solutions in water and wastewater treatment. As an applied engineering company serving both municipal and industrial customers, we work collaboratively with consulting engineers, owners, plant managers, and operators to design and manufacture the best treatment solution with the lowest lifecycle cost.

Providing **TOTAL** Water Management Solutions

Aeration & Mixing

Biological Processes

Filtration

Oxidation & Disinfection

Membranes

Controls & Monitoring Systems

Aftermarket Products and Services

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Visit our website at www.aqua-aerobic.com to learn more about the AquaPASS[®] Phased Activated Sludge System and our complete line of products and services.



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