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**Typical 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

**AquaPASS®**

Typical Applications

**Phased Activated Sludge System**

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www.aqua-aerobic.com
solutions@aqua-aerobic.com

**Bulletin #970D  2/18**

Providing **TOTAL Water Management Solutions**

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:

- Aeration & Mixing
- Biological Processes
- Filtration
- Disinfection
- Membranes
- Controls & Monitoring Systems
- Aftermarket Products and Services

**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 by 2010. The plant’s conventional system was not designed for nutrient removal and required only secondary limits of 20 mg/l BOD, 30 mg/l TSS, 6 mg/l NH4-N, and 2 mg/l TP. 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 loading from the area’s rapid population growth of about 11.5% in the past five 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 in existing tank geometry at a low lifecycle cost. Salisbury was the first treatment plant to install AquaPASS technology.

**Average Operating Data (2010 - July 2012)**

<table>
<thead>
<tr>
<th>INFLUENT</th>
<th>DESIGN</th>
<th>AVG EFFLUENT</th>
<th>AVG EFFLUENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIN mg/l</td>
<td>3.0</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>Pein mg/l</td>
<td>1.16</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>BOD mg/l</td>
<td>208</td>
<td>15</td>
<td>0.15</td>
</tr>
<tr>
<td>TSS mg/l</td>
<td>315</td>
<td>30</td>
<td>0.3</td>
</tr>
<tr>
<td>NH4 mg/l</td>
<td>43</td>
<td>7</td>
<td>0.7</td>
</tr>
<tr>
<td>NH3-N mg/l</td>
<td>5</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total N* mg/l</td>
<td>—</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Total P mg/l</td>
<td>—</td>
<td>0.86</td>
<td>0.86</td>
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</tbody>
</table>

*Nitrite was < 0.3 mg/l and Nitrate was < 1.9 mg/l.

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 in May 2009 to verify its ability to meet the new 2010 permit requirements of the Chesapeake Bay Initiative. Since its startup in May 2008, the AquaPASS system has been in compliance with the 2010 permit levels with Total N and Total P effluent below design conditions. In addition, effluent BOD, TSS, and NH4-N have been reduced by more than 98%!
Phased Activated Sludge 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 the process ideal for retrofitting existing systems.
- Staged aeration via the Aqua® system offers power savings.
- Time-based anaerobic intervals promote exceptional nitrate reduction.
- Internal, low pressure sludge recycle reduces energy consumption.
- Phase separator optimizes biological nutrient removal.
- Total Nitrogen < 3 mg/l
- Total Phosphorus < 1.5 mg/l
- Fully automated process control system with scheduled flexibility.
- Process separator environment is suited for cold weather climates.
- Low capital costs with annual energy savings up to 10% compared to similar activated sludge processes due to reduced recycle frequency requirements.

AnitaPASS® Stages of Operation

The AquaPASS system incorporates the unique flexibility of a time-managed process configured in a flow-through aeration scheme. The system employs time-based anaerobic and anoxic phasing via the Aqua MixAir system to meet critical nutrient removal objectives. Independent aeration and mixing allows necessary nitrification, denitriication, 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 stages: Anoxic, Staged Aeration, Anaerobic (multiple discrete anaerobic/anoxic events), Phase Separator, and Pre-Anoxic. The stage functions can be designed for optimum conditions based on wastewater characteristics to meet specific effluent objectives.

Aqua MixAir® System

The AquaPASS system utilizes the Aqua MixAir system by providing separate mixing with AquaMixAir® diffuser mixers and Aqua-Aerobic diffused aeration. This system has the capability to cyclically operate the aeration and mixing to promote anaerobic and anoxic 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 phosphorous 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 phosphorous 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® System Advantages

- Significant energy savings.
- Ability to operate the system in a batch or continuous manner.
- Improved nutrient removal performance.
- Reduced chemical use and associated costs.
- Enhanced solids concentration is promoted in a low-pressure environment.
- 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).
- Standard off-the-shelf mixed liquor is conveyed to the Staged Anoxic/Anaerobic reactor.
- The elevated solids concentration results in reduced pumping requirements.
- Aggressive mixing in absence of D.O. prepares bio-solids prior to anaerobic treatment.
- Sludge from the Phase Separator is conditioned for further nitrate reduction.
- Aerobic stages enable operator-defined D.O. levels to be controlled.
- Aerobic stages can produce a completely mixed biomass with near-zero D.O. levels.
- Process management of anaerobic events via time or instrument feedback.
- Efficient oxygen delivery via proportional aeration management.

IntelliPro® System Advantages

- Remote troubleshooting provides on-demand troubleshooting assistance.
- Eliminates the need for routine operational interventions and updates.
- Assists in the optimization of enhanced nutrient removal.
- Online operation and maintenance support.
- Improved energy management.

IntelliPro® Process Monitoring and Control System

The IntelliPro system is a personal computer (PC)-based program that interfaces with the AquaPASS 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.
**AquaPASS® Phased Activated Sludge System**

AquaPASS® has led the industry in time-managed, biological technology since 1984. In 2004, Aqua-Aerobic Systems applied its time-managed, biological technology to create the AquaPASS® Phased Activated Sludge System, which 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.
- **Staged aeration via the Aqua MixAir® system** offers power savings.
- **Time-based aeration intervals:** promote exceptional nitrate reduction.
- **Internal, low-pressure sludge recycles:** reduce energy consumption.
- **Phase separator optimizes biological nutrient removal:**
  - Total Nitrogen < 3 mg/l
  - Total Phosphorus < 15 mg/l
- **Fully automated process control system:** with operational flexibility.
- **Superior process environment:** suited for cold weather climates.
- **Low life-cycle cost:** with annual energy savings up to 50%.
- **Fully automated process control system:** with operational flexibility.
- **High solids concentration:** results in reduced pumping requirements.
- **Aggressive mixing in absence of D.O.:** prepares bio-solids.
- **Effluent biological solids:** concentrated in the Phase Separator.
- **High solids concentration:** results in reduced pumping requirements.
- **Aggressive mixing in absence of D.O.:** prepares bio-solids.
- **Effluent biological solids:** concentrated in the Phase Separator.

**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 can be decreased.

**Aqua MixAir® System**

The Aqua MixAir® 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 typically operate the aeration and mixing, to promote anaerobic and aerobic environments, with low energy consumption. In addition, the Aqua-MixAir system can achieve and maintain biological phosphorus removal, and control certain forms of filamentous bacteria.

**AquaPASS® Stages of Operation**

The AquaPASS® system incorporates the unique flexibility of a time-managed process configured in a flow-through staged aeration scheme. The system employs time-based aerobic and anaerobic phases 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, Phase Separator and Pre-Anoxic. The stage functions can be designed for optimum conditions based on wastewater characteristics to meet specific effluent objectives.

**Anoxic**

- Untreated sewage is introduced into the Anaerobic reactor.
- Concentrated, destabilized biological solids are transferred from the Pre-Anoxic reactor to the Anaerobic reactor.
- Volatile Fatty Acid (VFA) production is enhanced under anaerobic conditions.
- Turbulent and efficient mixing keeps particle turnover rates > 5% of the reactor's hydraulic retention time (HRT).
- Sludge from the final clarifier is returned to the Phase Separator.

**Staged Aeration**

- Anoxic consolidated bio-solids are received into the Staged Aeration reactor.
- Multi-variable dissolved oxygen (D.O.) control for management of anaerobic and aerobic intervals that can be further enhanced with the addition of the IntelliPro system.
- Aerobic stages enable operator-defined D.O. levels to be controlled.
- Aerobic stages produce a completely mixed biomass with achieved D.O. levels.
- Process management of nutrient removal via time or instrument feedback.
- Effluent oxygen delivery via proportional sensor management.

**Pre-Anoxic**

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

**Phase Separator**

- Recovers RAS from the final clarifiers.
- Enhanced solids concentration is promoted in a low-energy configuration.
- Supernatant is returned to Staged Aeration.
- Concentrated sludge is conveyed to Pre-Anoxic reactor.
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AquaPASS

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LOADING DESIGN

<table>
<thead>
<tr>
<th>INFLUENT</th>
<th>DESIGN</th>
<th>EFFLUENT AVG</th>
<th>EFFLUENT</th>
<th>DESIGN</th>
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<td>Peak Flow (mgd)</td>
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<tr>
<td>BOD (mg/l)</td>
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<td>&lt; 3</td>
<td>TSS (mg/l)</td>
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</tr>
<tr>
<td>N (mg/l)</td>
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<td>NH3-N (mg/l)</td>
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<tr>
<td>Total N* (mg/l)</td>
<td>3.8</td>
<td>&lt; 4.5</td>
<td>Total P (mg/l)</td>
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</tr>
</tbody>
</table>

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- Biological Processes
- Filtration
- Disinfection
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Loading Design

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influent</th>
<th>Design</th>
<th>Effluent Avg</th>
<th>Effluent Std Dev</th>
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<tr>
<td>BOD mg/l</td>
<td>250</td>
<td>15</td>
<td>&lt; 3</td>
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<tr>
<td>TSS mg/l</td>
<td>215</td>
<td>30</td>
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<td>NH3-N mg/l</td>
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<td>Total N* mg/l</td>
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<td>Total P mg/l</td>
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</table>

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