Tech Memo - Aeration Basins
Preliminary Sizing & Budget Estimates

Vision Equipment

TEXAS • NEW MEXICO • OKLAHOMA

PRESENTED TO:

To:
General Distribution

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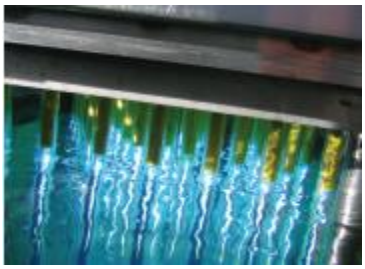

Technologies for Municipal and Industrial Wastewater Treatment

- Headworks Fine Screening
- Grit Removal
- Clarifiers
- Trickling Filters
- Surface Aeration
- Diffused Aeration
- SBR
- Extended Aeration
- Chemical Mixing
- Hypochlorite Generation
- Biosolids Thickening
- Biosolids Dewatering
- PD Blowers
- Single Stage Blowers
- UV Disinfection
- MBR
- Rotary Lobe Sludge Pumps
- In-Line Macerators
- Water Tank Mixing/Dosing
- Digester Mixers
- Sand Filters

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To: Engineering & Operations Personnel

Subject: Aeration Basin Comparison

The purpose of this Tech Memo is to provide the basis for offering a preliminary sizing and cost estimate for the aeration basin portion for several common basin sizes up to 2 MGD average flow.

Vision Equipment offers several WWTP approaches for treatment capacities up to 2.0 MGD. When evaluating WWTP approaches the biological process is the most significant variable. As the WWTP capacity passes 1.0 MGD the sludge processing approach becomes a consideration but aside from that, each approach shares headworks screening, de-gritting and effluent disinfection.

The TCEQ 217 regs stipulate that aeration technologies unable to be repaired with the basin full are required to provide redundant basins or equalization basins.

Three following five biological processes typically are considered:

- Aeration by Rotating Bio-Wheel
- Conventional Treatment with Aerated Basins
- Oxidation Ditch by Rotating Drum or Shafted Mixer
- Sequencing Batch Reactors (SBR)
- Retrievable Submersible Aeration Mixer (SAM)

The US EPA funded a study in 1986 to study the top three WWTP approaches listed above. It is the best unbiased study available. The results of the study indicate the SBR is more cost effective than conventional treatment on a 5 MGD application and the oxidation ditch at 1 MGD. The conventional WWTP was not evaluated for the 1 MGD application. No reason was given for the exclusion.

Since this report was issued several factors in Texas have changed. First, SBR suppliers have decreased thereby limiting competition. Second, owners have been left with sole sourcing of spare parts for the whole WWTP from the SBR supplier. Suppliers have lead the market towards the less efficient ICEAS version of the SBR where competition is very limited.

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Conversely, over the same period the conventional WWTP component costs have decreased. The life cycle cost reductions are a result of an increasing supply of manufacturers for each component and performance improvements. Furthermore, Oxidation Ditch users experience seasonal DO shortages during the warmest months thereby limiting their capacity to approximately 70% of the rated basin capacity during the warmest months.

At the core of each evaluation is the aeration approach. Based on several recent Life Cycle evaluations it is clear that Bio-Wheel based aeration is the most cost effective new WWTP approach up to 2.0 MGD. The Bio-Wheel aeration wins based on three factors; DO goals are reached year round, Bio-Wheel aeration meets the 217 regulations for repairs while the basin remained full and lastly they are less expensive to maintain. Conventional aeration replaces Bio-Wheel technology as the most cost effective above 4 MGD.

All four aeration approaches are shown below.

	TCEQ 217 Redundancy	Capital Costs	Installation Costs	Efficiency	Grit /Sand Deposits
Membrane	Yes	Low	High	Medium	Yes
Plate	Yes	Low	High	Medium	Yes
Submersible	No	High	Low	Higher	No
Bio-Wheel	No	High	Low	High	No

Membrane Diffuser Grid

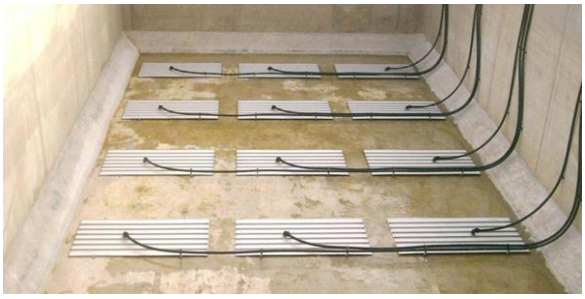

Plate Diffuser Grid

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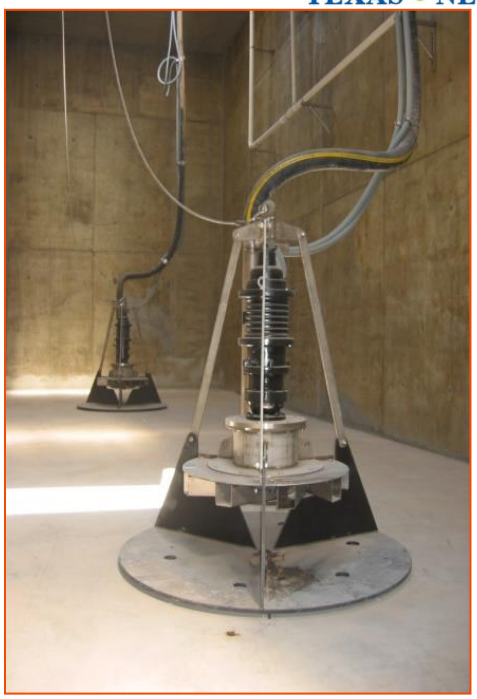

SAM in Basin

BioBio-Wheel in Basin

When does each approach make the most sense?

Bio-Wheel – The Bio-Wheel has been costed out by a major Texas based engineering firm. The Bio-Wheel was determined to be the most cost effective approach for their 2 MGD application. It was 10% cheaper to own over the life of the project than conventional aeration.

Justifications for Bio-Wheel

- Multitasking Process – The same wheel eliminates the need for the blower, provides base for IFAS and mixes the full basin depth
- Consistent DO for All Months
- Less Labor
- Lower Construction Costs
- Eliminates Periodic Basin De-gritting
- Meets TCEQ 217 Regs (no basin redundancy required)

Conventional Aeration – Aeration via fine bubble diffusion and blowers is attractive throughout all WWTP flow capacities. Fine bubble aeration is well understood and proven. Purchasing high quality membrane diffusers is critical to

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customer satisfaction. Effective headworks screening and de-gritting are important design considerations.

Justifications for Fine Bubble Aeration with Blowers

- Highly Competitive
- Proven Results
- Accepted by TCEQ
- Easy to Retrofit or Replace Existing

Oxidation Ditch – The Oxidation Ditch's greatest strength is ease of operation and low construction cost. However, as a process for Texas it the most challenged by the warm weather months. When an Oxidation Ditch is sized to maintain DO during the warmest months it losses its first cost advantage.

Justifications for Oxidation Ditch

- Low Design Costs
- Simple Process
- Low First Costs, Low O & M
- Sometimes Meets 217 Regs (no basin redundancy required)

Sequencing Batch Reactors (SBRs) – When designed properly and competitively bid the SBR can be a very cost and performance effective approach. The SBR can be cost effective from 250K GPD to 4 MGD making it a versatile process to consider. The performance of the SBR is based on multiple slow fill basins that allows for "batch" treatment. The "batching" process provides the efficiency. However, the benefits to the Texas market has been corrupted in recent years by a consolidation of suppliers and a supplier forced turn towards a "continuous" SBR process. The SBR process loses its efficiency when the treatment process is continuous while at the same time becomes much harder to optimize. The "continuous" approach reduces construction costs at the expense of efficiency. The owner never benefits from the lower first cost because competition is avoided. All SBRs depend on PLC based controls. The reliability and sole source replacement of these control components are a concern.

If the Texas consulting engineering community will reject the direction towards "continuous" feed and discharge and return to "batch" processes then the owner will benefit from and SBR approach that is hard to beat in cost and performance.

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Justifications for SBR

- High Performance with “Batch” Process
- Automated Process
- Low First Costs
- Small Footprint
- Sometimes Meets 217 Regs (no basin redundancy required)

Submersible Aeration Mixers (SAMs) – The SAM provides the best mixing and DO transfer of all mixing technologies as determined by independent testing. The generic term for the SAM is “slow speed submersible mechanical aerator with blower”. The SAM efficiency improves with basin water depth. It has been used in Texas for forty years. Two variations are installed in Texas.

The oldest approach utilizes a surface mounted drive motor with long vertical shaft to the basin floor while the more modern design employs a submersible motor that sits on the basin floor. The submerged motor design replaced the surface mounted design when Texas owners found the shaft to the basin floor could not hold its tolerances. The submersible motor approach has been in service for over twenty five years. Both approaches mix and aerate from the bottom up. The shear energy imposed by the submersible motor approach eliminates grit build up on the basin floor. The shafted approach is a much slower speed version. The reduced velocity is inherently less effective for aeration, mixing and grit suspension.

Justifications for Submersible Aeration Mixers (SAM)

- Best Performance of all Aeration Approaches
- Low Retrofit Costs
- Deeper Basins are Best
- Meets 217 Regs (no redundant basin requirement)

In summary, WWTP engineers will tend, over time, to the most performance effective approaches for their customers. Performance combines first cost and the O & M. Based on those factors the approach answer can change depending on the application and owner’s preferences.

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