



Key Features of the Aqua-Aerobic® MBR

The main feature of the Aqua-Aerobic® MBR Membrane Bioreactor System is its **very low life cycle cost** compared with other MBR systems. There are several reasons for this:

Time-Managed Control:

Our unique Aqua MixAir® system, which separates the mixing and aeration functions, allows each complete-mix bioreactor to reach anaerobic, aerobic, and anoxic conditions based on timer control, not tank volumes. This not only gives more flexibility but allows the system to use only the air needed for treatment. Most other MBR systems have separate aeration basins that either use a constant air flow – regardless of oxygen demand – or can only be partially throttled because the air is used for mixing also.

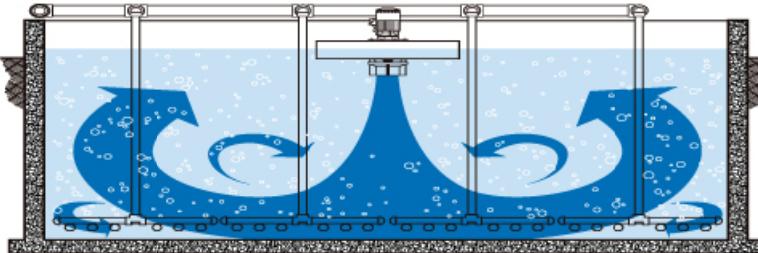


Figure 1: Aqua MixAir System with Floating Mixer and Diffused Aeration

Enhanced Flux Control:

The product (permeate) flow being pulled through the membranes (known as flux) is constant at one of two settings: optimum flux, and peak flux. The longer the membranes run at optimum flux, the longer the membrane life and the lower the air scour, backflush water, and chemical usage. On our flow-through MBR, this is done based on the influent flow. But on our batch-style MBR, the membranes stay at optimum flux even longer since each batch treated has a known volume. Enhanced flux control also allows permeate, air, and recycle flows to be stopped completely during periods of low flow, which not only saves energy and prolongs membrane life, but lowers trans-membrane pressures (TMPs) by “relaxing” the membrane.

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Free-floating Fibers:

Each of the hollow membrane fibers is sealed at the top, whereas other hollow fiber membranes have a top header into which the fibers are potted (similar to the potting at the bottom header). Our free-floating fibers allow solids, debris, and air to pass freely out the top of the fiber bundle, while these must go around the bottom header on other modules, resulting in sludging at the top of the fibers and debris collecting around the top header. While flat plate membranes don't have a top header and, therefore, don't have this problem, sludging is more likely to occur on most modules because the permeate flow can't be reversed (backflush is not possible).

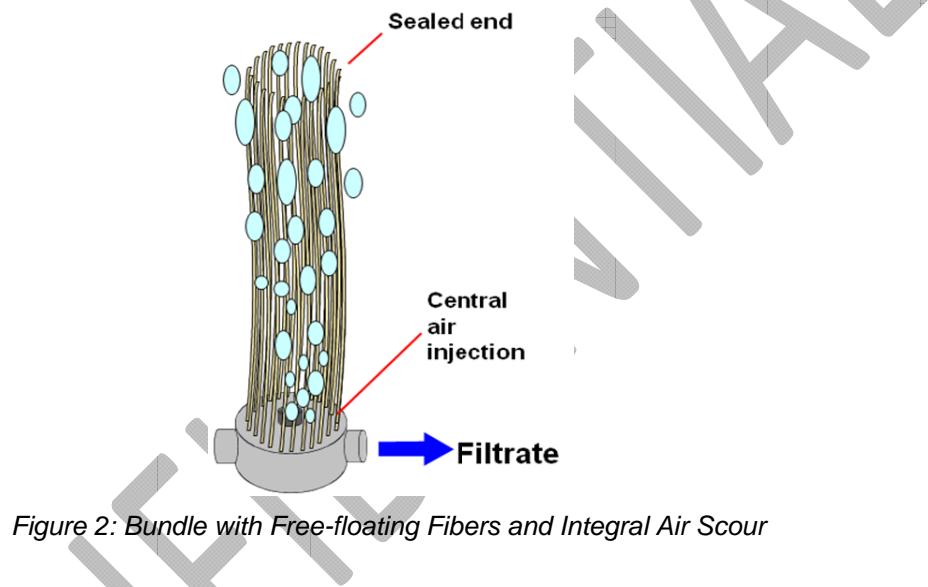


Figure 2: Bundle with Free-floating Fibers and Integral Air Scour

Integral Air Scour:

The air scour is injected into the middle of each fiber bundle, whereas other hollow fiber membranes have an air distributor located below the bundles such that air has to go around the module's bottom header, resulting in sludging at the bottom of the fibers. While flat plate membranes don't have a bottom header and, therefore, don't have this problem, sludging occurs between plates if they are not perfectly level or evenly spaced.

Fewer Pumps on Nutrient Removal Applications:

Because anaerobic, aerobic, and anoxic conditions can be achieved in a single basin, nitrate and carbon recirculation pumps are not needed for nitrogen or phosphorus removal. This also results in a smaller footprint.

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Other Advantages of the Batch System:

In addition to the above benefits, there are other advantages to our batch-style MBR.

- *Inherent Equalization* – as in any batch system, flow is equalized in the basin during the fill modes. This means the membranes don't have to be designed to handle peak flows that have short durations since these flows will be equalized before being passed through the membranes.
- *Superior Effluent Quality* – the flow of raw wastewater into the bioreactor is stopped while each batch is being treated; therefore, a higher quality effluent is attainable.

Parameter (avg. monthly)	Influent	Design Effluent	Actual Effluent
BODs (mg/l)	246	5.0	<1.5
TSS (mg/l)	205	5.0	<1.0
TN (mg/l)	42.78	3.0	2.97
Total P (mg/l)	4.8	0.3	.07

Figure 3: November 2013 Data from Shepherdstown, WV MBR at 0.2235 MGD

- *Greater Flexibility at Low Loadings* – At low flows or organic loadings, the level in the bioreactor can be lowered in lieu of lowering the mixed liquor concentration, allowing the system to treat much lower flows than flow-through (constant-level) MBRs.