TREATMENT EQUIPMENT COMPANY
Water and wastewater treated better

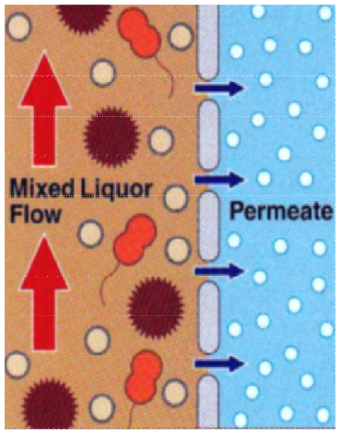
MBR 101

Background

The submerged membrane bioreactor process is an advanced wastewater treatment technology that combines a suspended growth activated sludge system with microfiltration or ultrafiltration membranes for liquid/solid separation, eliminating the need for secondary clarifiers. Precursors for this process were developed in the 1960's; however, with the worlds of water and wastewater becoming more and more intertwined, in recent years there has been a marked increase in the acceptance and proliferation of MBR installations throughout the world.

Membrane Function

When a microfiltration or ultrafiltration membrane is submerged in mixed liquor, and a positive (by gravity) or negative (by suction) pressure is applied, the pores of the membrane and the resulting biofilm formation on the surface of the membrane act as a physical barrier that allows only the permeate, or clean water, to filter through. This method of crossflow filtration eliminates the sludge settling or phase separation required by conventional activated sludge treatment, and is a distinctive difference between the MBR and other activated sludge processes. When the capabilities of the membrane are combined with a biological process, the resulting MBR system has some distinct advantages to other treatment methods.

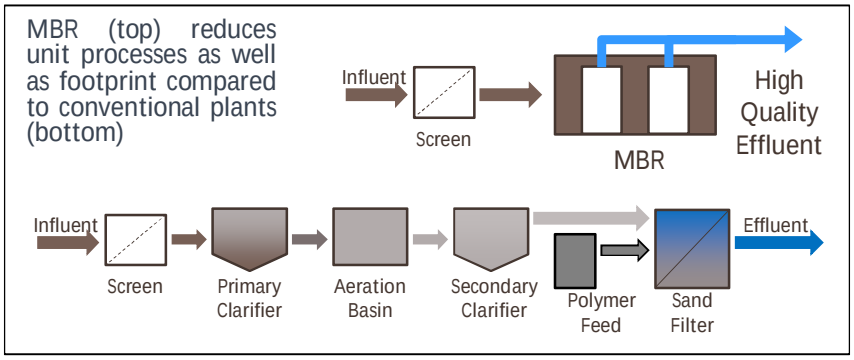


MBR Advantages

Phased Expansion

One advantage to MBR technology is in phased projects, which are commonplace in home developments, industrial parks, hotels/resorts, and in growing municipalities. While expansion with a conventional treatment plant can mean installing another large clarifier, in an MBR plant you can simply add more membranes to existing basins – expanding flow without expanding footprint. The modular design of MBR technology allows for a lot of flexibility in expanding a plant in small increments, giving the owner a shorter planning horizon, and matching the growth of the service area more accurately with just-in-time infrastructure.

Small Footprint



It is fairly well-known that MBR plants have reduced footprints compared to other activated sludge processes, and the reasons for this are twofold. First, MBR technology eliminates the need for secondary clarifiers, which equates to a huge savings in both footprint and concrete costs. Second, MBR systems can operate at higher biomass concentrations (MLSS) than conventional treatment processes. This difference in biomass concentration leads to much smaller process basins for the MBR system, and when combined with the elimination of secondary clarifiers, results in MBRs having overall plant footprints notably smaller than typical conventional treatment plant. The benefits of a small footprint – saving on land and concrete costs, greater installation flexibility, opportunities to effectively hide plants – can have a direct impact on project feasibility.

Ease of Operation

Ease of operation is often the least appreciated aspect of MBR technology. Put simply, eliminating phase separation (sludge settling) from the process greatly reduces the operator oversight required to keep the system running efficiently. Most operators of activated sludge facilities will tell you they spend the majority of their time focused on the settling characteristics of the sludge at their plant. There are many factors that impact settling characteristics and these can change from one day to the next. Not only does this require time spent in the lab analyzing sludge samples, but also subsequent adjustments to the plant to maintain good settling characteristics. If the sludge doesn't settle into a distinct layer, the plant runs the risk of compromised effluent quality. Again, this lab and plant adjustment work is greatly reduced with an MBR system since settling of sludge is not an issue.

Further, to achieve reuse quality water, a conventional treatment plant will need to be followed by a tertiary filtration system. To meet Title 22 requirements, a polymer system will also need to be added to dose the secondary effluent prior to the tertiary filters. This adds additional mechanical equipment – and the corresponding capital and O&M costs – as well as the need to supply, store, and handle polymer. Finally, the addition of polymer will be variable based on the quality (suspended solids) of the conventional plant's secondary effluent. This will require additional operator attention.

By comparison, MBR technology does not require tertiary filtration, polymer addition, or any further treatment processes to meet WA, OR, and CA standards for suspended solids and turbidity. This reduction in the number of unit processes further improves system reliability and reduces process oversight by the operator.

Effluent Quality

High quality effluent is generally the most recognized benefit to MBR technology, with many MBR manufacturers having received Title 22 approval for their systems. Due to the small effective pore size on the membrane, the filtration capabilities of MBR systems are exceptional; by comparison, conventional treatment methods, even when followed by tertiary filtration, will not be able to consistently meet the effluent quality that can be achieved with an MBR. One ancillary benefit to the effluent quality from and MBR is that it reduces the burden on final disinfection in the treatment process (typically UV or Chlorine).

Parameters	Typical Values - MBR	Achievable Values - MBR
BOD	< 2.0 mg/l	Non-Detect
TSS	< 2.0 mg/l	Non-Detect
Total Nitrogen	< 10.0 mg/l	< 3.0 mg/l
NH_3	< 1.0 mg/l	< 0.3 mg/l
Phosphorus	< 1.0 mg/l	< 0.03 mg/l
Fecal Coliform	< 2.2 CFU / 100 ml	Non-Detect

Summary

The benefits of MBR technology – high quality effluent, small footprint, phased expansion, and ease of operation – have all been key drivers in the acceptance and proliferation of MBR installations around the world. And with the water and wastewater industries becoming more intertwined, it is likely that MBR technology will be a key element in meeting the water/wastewater needs of a growing population for many years to come.