## **Membrane Bioreactors**

Membrane Bioreactors combine conventional biological treatment (e.g. activated sludge) processes with membrane filtration to provide an advanced level of organic and suspended solids removal. When designed accordingly, these systems can also provide an advanced level of nutrient removal. In an MBR system, the membranes are submerged in an aerated biological reactor. The membranes have porosities ranging from 0.035 microns to 0.4 microns (depending on the manufacturer), which is considered between micro and ultrafiltration. This level of filtration allows for high quality effluent to be drawn through the membranes and eliminates the sedimentation and filtration processes typically used for wastewater treatment. Because the need for sedimentation is eliminated, the biological process can operate at a much higher mixed liquor concentration. This dramatically reduces the process tankage required and allows many existing plants to be upgraded without adding new tanks. To provide optimal aeration and scour around the membranes, the mixed liquor is typically kept in the 1.0-1.2% solids range, which is 4 times that of a conventional plant.

During MBR wastewater treatment, solid–liquid separation is achieved by <u>Microfiltration</u> (MF) or <u>Ultrafiltration</u> (UF) membranes. A membrane is simply a two-dimensional material used to separate components of fluids usually on the basis of their relative size or electrical charge. The capability of a membrane to allow transport of only specific compounds is called semi-permeability This is a physical process, where separated components remain chemically unchanged. Components that pass through membrane pores are called permeate, while rejected ones form concentrate or retentate.







## **5-Constructed Wetland**

Constructed wetlands are engineered systems that use natural functions vegetation, soil, and organisms to treat wastewater. Depending on the type of wastewater the design of the constructed wetland has to be adjusted accordingly. Constructed wetlands have been used to treat both centralized and on-site wastewater. Primary treatment is recommended when there is a large amount of suspended solids or soluble organic matter (measured as BOD and COD).

Similarly to natural wetlands, constructed wetlands also act as a biofilter and/or of pollutants (such remove organic can a range as matter, nutrients, pathogens, heavy metals) from the water. Constructed wetlands a sanitation technology that have not been designed specifically are for pathogen removal, but instead, have been designed to remove other water quality constituents such as suspended solids, organic matter and nutrients (nitrogen and phosphorus).<sup>[1]</sup> All types of pathogens (i.e., bacteria, viruses, protozoan and helminths) are expected to be removed to some extent in a constructed wetland. Subsurface wetland provide greater pathogen removal than surface wetlands





## **CONSTRUCTED WETLANDS**





