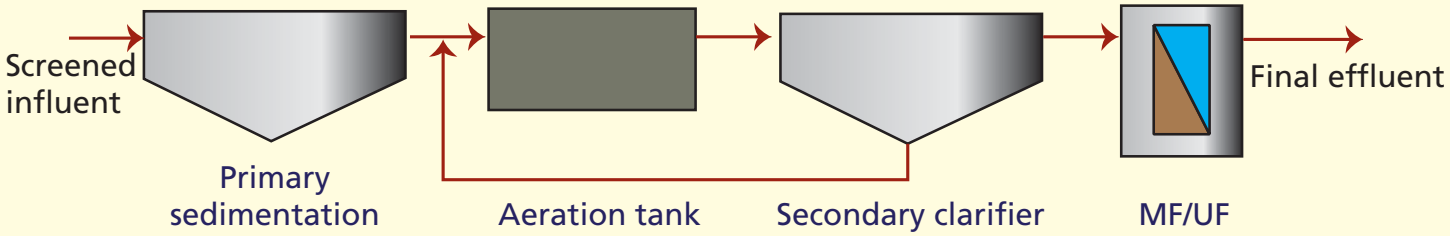
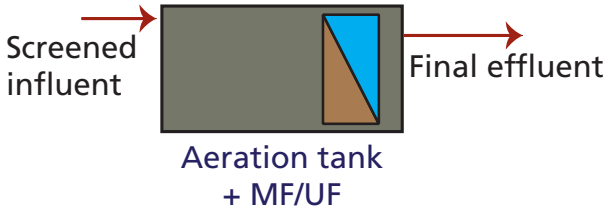
Membrane Bioreactors (MBR)

HOFFMAN LAMSON

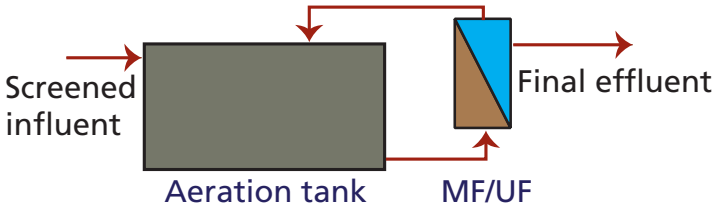
Conventional Activated Sludge Process + Tertiary Filtration



Submerged Membrane Bioreactor



Side-Stream Membrane Bioreactor



About Membrane Bioreactors

When used with municipal wastewater, MBR processes can produce effluent of high enough quality to be discharged to waterways or be used for irrigation. Advantages of MBRs over conventional wastewater treatment processes include a small footprint and the easy retrofit and upgrade of old wastewater treatment plants.

Two MBR configurations exist: internal/submerged, where the membranes are immersed in and integral to the biological reactor; and external/side-stream, where membranes are a separate unit process requiring an intermediate pumping step.

Recent technical innovation and significant membrane cost reduction have enabled MBRs to become an established process option to treat wastewater, thus increasing their popularity.

MBR history and basic operating parameters

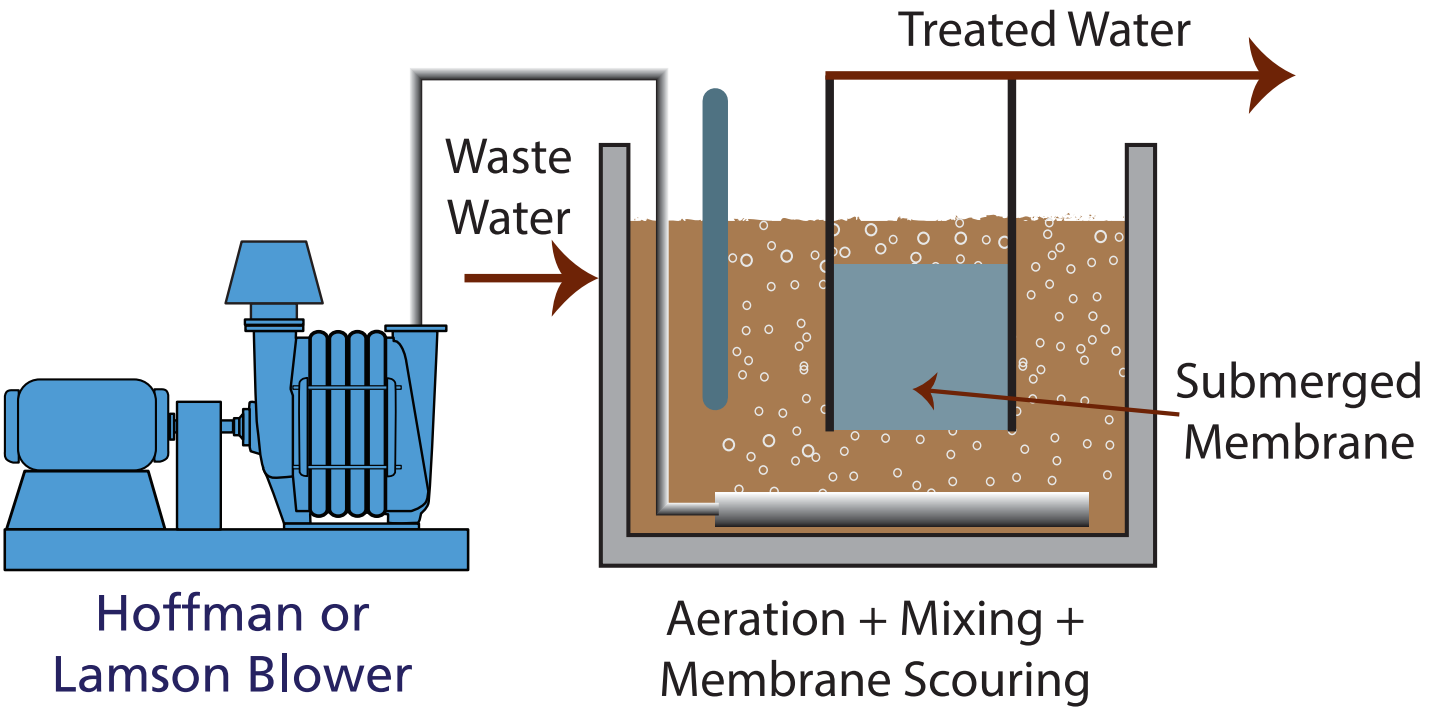
The MBR process was introduced by the late 1960s, as soon as commercial scale ultrafiltration (UF) and microfiltration (MF) membranes were available. Because of the poor economics of the first generation MBRs, they only found applications in niche areas with special needs, such as isolated trailer parks or ski resorts.

Until 1989, MBRs were designed with the separation device located external to the reactor (side-stream MBR) and relied on high transmembrane pressure (TMP) to maintain filtration. The 1989 introduction of a submerged MBR system, with the membrane directly immersed in the bioreactor, quickly led to it becoming the preferred configuration, especially for domestic wastewater treatment. The submerged MBR relies on coarse bubble aeration to produce mixing and limit fouling. The energy demand of the submerged system can be up to 2 orders of magnitude lower than that of the side-stream systems and submerged systems operate at a lower flux, demanding more membrane area. In submerged configurations, aeration is considered as one of the major parameters in process performance both hydraulic and biological. Aeration maintains solids in suspension, scours the membrane surface and provides oxygen to the biomass, leading to a better biodegradability and cell synthesis.

MBR configurations

Internal/submerged: The filtration element is installed in either the main bioreactor vessel or in a separate tank. The membranes can be flat sheet or tubular or combination of both, and can incorporate an online backwash system which reduces membrane surface fouling by pumping membrane permeate back through the membrane. Additional aeration is required to provide air scour to reduce fouling. Where the membranes are installed in the main reactor, membrane modules are removed from the vessel and transferred to an offline cleaning tank.

External/side-stream: The filtration elements are installed externally to the reactor, often in a plant room. The biomass is either pumped directly through a number of membrane modules in series and back to the bioreactor, or the biomass is pumped to a bank of modules, from which a second pump circulates the biomass through the modules in series. Cleaning and soaking of the membranes can be undertaken in place with use of an installed cleaning tank, pump and pipe work. Despite the more favorable energy usage of submerged membranes, there continues to be a market for the side-stream configuration, particularly in industrial applications. For ease of maintenance, the side-stream configuration can be installed on a lower level in a plant building and membrane replacement can be undertaken without specialized lifting equipment.



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