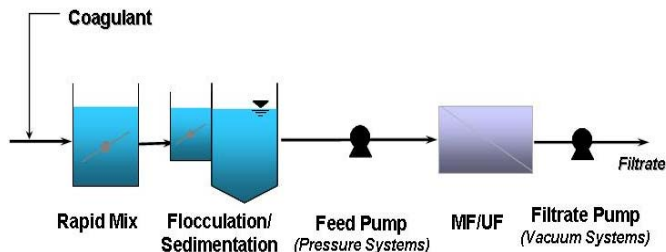


MICROFILTRATION/ULTRAFILTRATION

Microfiltration (MF) and ultrafiltration (UF) are membrane filtration processes commonly used in water treatment. MF and UF are typically applied for the removal of particulate and microbial contaminants, and are frequently used as an alternative to rapid sand filtration in conventional treatment and



softening applications.

The primary difference between MF and UF is the pore size of the membranes. Both MF and UF membranes are primarily used for particulate and microbiological contaminant removal. Particulates removed include suspended solids, turbidity, some colloids, bacteria, protozoan cysts, and viruses (only UF has been demonstrated to remove viruses to any significant degree). Inorganic chemicals (e.g., phosphorus, hardness and metals) may be removed with suitable pre-treatment. Limited dissolved organics removal may also occur by either of these processes.

MF and UF membrane systems frequently require some type of source water pretreatment to prevent membrane fouling. The type of pretreatment required depends on the feed water quality and membrane type. Generally, surface water requires more extensive pretreatment than groundwater due to higher suspended solids and biological matter content.

Water temperature has a significant impact on water density and viscosity, which impacts MF and UF membrane performance. As the viscosity and density increase, the transmembrane pressure required to pass the water through the membrane also increases.

Both MF and UF membrane systems include routine backwashing to remove foulants from the membrane. Backwash frequency and duration depend on the membrane system and specific feed water quality conditions and treatment requirements. Chemical clean-in-place (CIP) is used periodically to control membrane fouling.

Residuals generated from MF and UF systems include the spent backwash and spent cleaning solutions. Spent backwash may be recycled to the process to increase system recovery, reduce chemical doses, and improve overall treatment performance. Otherwise, disposal of spent backwash is generally accomplished by discharge to a sanitary sewer or receiving stream, much the way spent backwash from a rapid sand filter would be handled. Spent cleaning solutions are generally acidic in nature and require neutralization prior to disposal.

Approximate capital costs for MF and UF systems are provided in Table 1. Capital costs do not include pre-treatment or post-treatment processes because they are highly dependent on the specific source water quality. O&M costs include power, replacement parts, membrane replacement, CIP chemicals, and maintenance labor.

Table 1. Approximate Costs of Membrane Filtration

Design Flow (mgd)	0.01	0.1	1.0	10	100
Average Flow (mgd)	0.005	0.03	0.35	4.4	50
Capital Cost (\$/gal) ¹	\$18.00	\$4.30	\$1.60	\$1.10	\$0.85
Annual O&M Cost (\$/kgal) ²	\$4.25	\$1.10	\$0.60	\$0.30	\$0.25

1. Capital costs are based on \$ per gallon of treatment plant capacity. For example, addition of membrane filtration at a treatment facility with a capacity of 10,000 gpd would be expected to cost approximately \$180,000 (\$18.00/gal × 10,000 gal = \$180,000).
2. Annual O&M costs are based on \$ per thousand gallons treated. For example, annual O&M costs for a system with an average daily flow of 5,000 gallons (5 kgal) would be approximately \$7,756 (\$4.25/kgal × 5 kgal/day × 365 days/year = \$7,756).