

Application of Membrane Bioreactor Technology to Wastewater Treatment and Reuse

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Abstract:

The availability of fresh clean water during the next twenty years will become severely limited in many areas of the world. Both developed and undeveloped countries are facing the problems of water scarcity. Salinity intrusion into ground water supplies, nutrient eutrophication, heavy metals are just a few sources of contamination. One possible solution to these problems in the application of membrane bioreactors.

Keywords:

Membrane Bioreactor, Membrane Water Reuse.

Introduction:

In the near future the availability of fresh clean water will become increasingly limited in many areas of the world. Portions of Africa, Asia, India, China etc. as having a water scarcity, defined as supply less than 200 m³/person/year. One possible solutions to these problems is the application of membrane bioreactor. Although membrane technology costs have decreased by 80% over the past 15 years, making the use of MBR.

Filtration Processes:

There are six commercially used membrane separation process. Separations based on membrane pore size include MF, UF and NF. MF or UF is the most commonly used membrane size in wastewater and MBR treatment.

Flux Rate:

The ideal flux rate of an MBR system is dependent on wastewater characteristics. Standard flux rates between 50 and 200 L/m²h have been reported.

Membrane Materials:

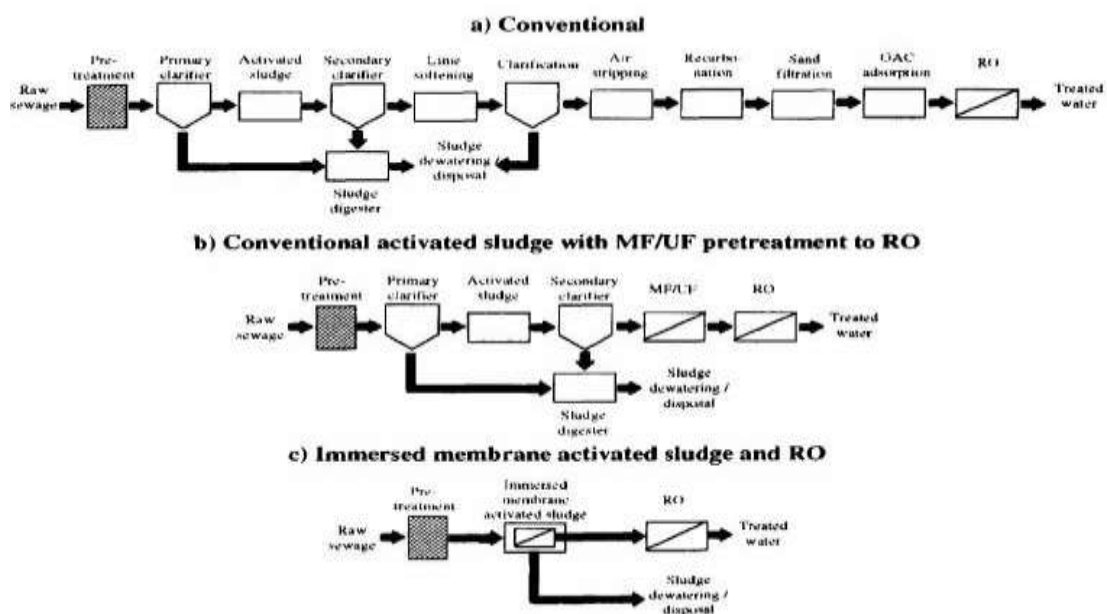
Polymer Membrane Materials and Characteristics (Layson, 2004)

Material	Abbr.	Advantages	Disadvantages
Polypropylene	PP	Low cost High pH range tolerance	No chlorine tolerance Expensive cleaning chemicals required
Polyvinylidene fluoride	PVDF	High chlorine tolerance Simple cleaning chemicals	Cannot sustain pH > 10
Polyether Sulphone & Polysulphone	PES/PS	Chlorine tolerance Reasonable cost	Brittle material requires support or flow inside to outside
Polyacrylonitrile	PAN	Low cost, typically used for UF membranes	Less chemically resistant than PVdF.
Cellulose Acetate	CA	Low cost	Narrow pH range Biologically active

Membrane Bioreactor:

Membrane Bioreactor process produced high quality recycled water but acted as a tertiary treatment process. The main advantage of using membrane is the complete physical retention of suspended solids. These are 2 main designs for MBR plants. The membrane can be submerged directly in the bioreactor or submerged in multiple side tanks.

Comparison of Conventional and Membrane Treatment Trains (Cote, et al.,1997)

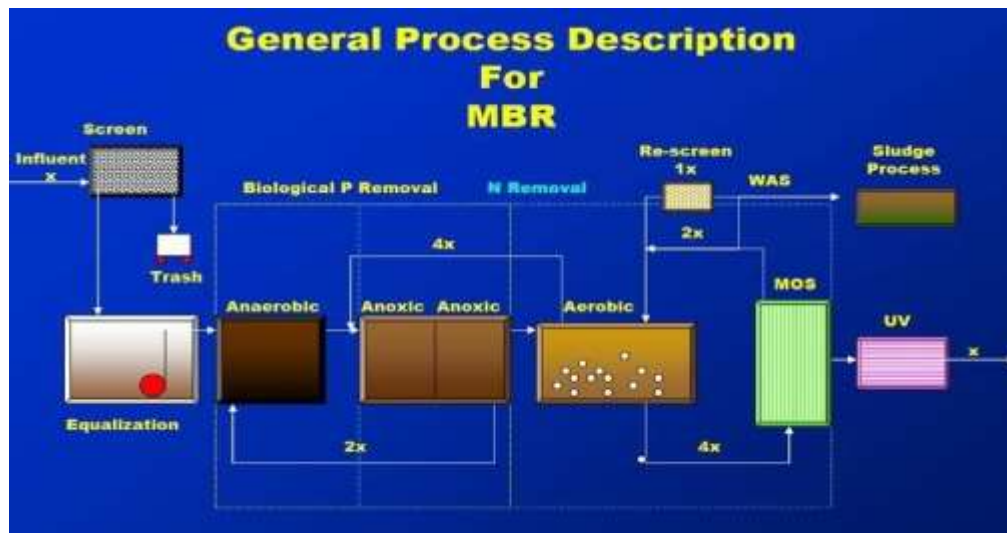


Typical MBR Effluent Quality (Tchobanoglous, et al., 2003)

Parameter	Units	Typical Concentrations
Effluent BOD	mg/L	<5
Effluent COD	mg/L	<30
Effluent NH ₃	mg/L	<1
Effluent Total N	mg/L	<10
Effluent Turbidity	NTU	<1
Effluent P*	mg/L	<0.5

Nutrient Removal:

MBR Biological Phosphorous Removal Design



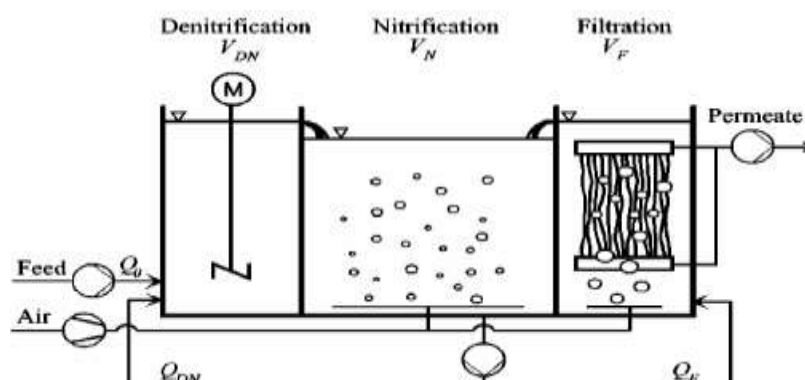
MBR Applications:

Applicable to many sectors, including municipal, industrial and water reclamation. It also reduce demand and reduce pollution.

Municipal Treatment:

The filtration of municipal activated sludge is an ideal application for MBR treatment. A zenon pilot MBR was operated for 535 days. The largest MBR system in NA is located in traverse city. The MBR is able to achieve effluent phosphorous concentration of 0.2 mg/L.

Pilot Municipal Treatment MBR Process Schematic (Rosenberger et al, 2002)



Water Reclamation:

The use of MBR technology for reclamation is a rapidly expanding application. Small MBR is used to pull wastewater directly from the sewer at the remote points of reuse.

Treatment Reuse Hierachy:

- Forest Irrigation
- Cooling
- Fishery Use
- Public Drinking Water

US Filter:

It is the largest environmental treatment company in the united states. It alsooffers an MBR package plant called the FastPac MBR that is fully self contained.

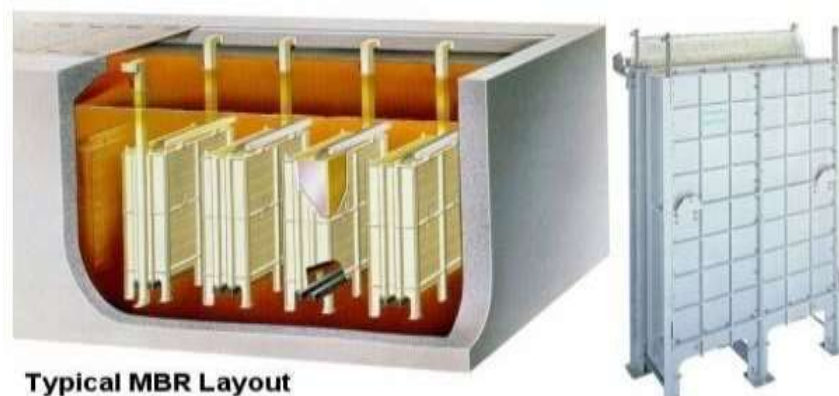
USFilter Hollow Fiber Membrane Module Rack and Memjet System



Kubota:

These membranes are distributed within the U.S by Enviroquip Inc. The system utilizes flat plate membranes loaded within multiple cassettes in a plug flow basin.

Kubota Plate and Frame MBR Configuration



Typical MBR Layout

Conclusion:

The application of MBR technology is rapidly expanding and suited for reclamation of wastewater. Wastewater can be reused for irrigation or ground water recharge. It is adapted for any municipal or industrial wastewater.

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