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MEMBRANE BIOREACTOR TECHNOLOGY

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Abstract

Membrane Bioreactor (MBR) is an emerging biological treatment process which utilises reward of both activated sludge process and membrane filtration. Due to the, flexibility, reliability and robustness, MBR technology is gaining wide acceptance in field of wastewater treatment. This growth rate is much higher than any other wastewater treatment technologies; also, the market is expected to increase twice over the present increase rate in the next five years worldwide as this technology offers various reward over limitations of conventional systems. The development and application of a membrane bioreactor (MBR) for full scale municipal wastewater treatment is the most important recent technological modern in terms of biological wastewater treatment. The MBR is a hanging growth-activated sludge system that utilizes micro porous membranes for solid and liquid separation instead of secondary clarifiers. Disadvantages and advantages of MBR over CAS are concerned. This is comprehensive review of the studies dealing with recalcitrant industrial wastewater treatment by MBR, and casts light on the strategies to achieve enhanced biodegradation of hardly biodegradable industrial pollutants in MBR.

Keywords **— Biomimetic membranes, Industrial wastewater treatment, MBR, Membrane bioreactor**

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1. INTRODUCTION

Membrane bioreactor technology is an brilliant modern wastewater treatment technology, having the Several advantages over conventional activated sludge processes. Membrane bioreactor (MBR) is a biochemical engineering process involving the use of both a suspended growth bioreactor for biochemical reactions (such as fermentation, bio-oxidation, nitrification, and denitrification) and a membrane separator for subsequent solids, liquid separation Membrane bioreactor (MBR) technology, which combines biological-activated sludge process and membrane filtration has became more popular, profuse, and accepted in recent years for the treatment of many types of wastewaters, whereas the conventional activated sludge (CAS) process cannot cope with either composition of wastewater or fluctuations of wastewater flow rate It can be related with increase of water cost and need for water use again as well as with more stringent regulations on the effluent quality. The MBR process can be configured in many different ways depending on project-specific nutrient removal objectives. Anoxic zones after or before the aerobic treatment may be used for denitrification, depending on the effluent nitrate and total nitrogen requirements. Anaerobic zones may be used to complete enhanced biological phosphorus eliminate in any of its possible configurations. Membrane bioreactors could be developed for both attached growth and suspended growth processes, moreover, hybrid MBRs are also developed in recent years.

Membrane Modules

The practical instrument where the actual membrane based separation occurs is known as membrane modules. The basic aim of improvement of these modules is to provide maximum membrane area in relatively smaller volume, so that the permeate flux i.e., the productivity of the system is maximum

The plate-and-frame module is the simplest configuration, consisting of two end plates, the flat sheet membrane, and spacers The heart of plate-frame module is the support plate that is sandwiched between two flat sheet membranes. The membranes are sealed to the

plate, either gaskets with locking devices, glue or directly bonded In tubular modules, the membrane is often on the inside of a tube, and the feed solution is pumped through the tube. In such modules, the membrane is design on the inside surface of a porous tube. Tubular membranes operate in tangential, or cross-flow, design where process fluid is pumped along the membrane surface in a sweeping type action The most popular module in industry for reverse osmosis membranes or nanofiltration is the spiral wound module. This module has a flat sheet membrane wrapped around a perforated permeate gathering tube. The feed flows on one side of the membrane. Permeate is collected on the other face of the membrane and spirals in towards the center collection tube. Hollow fiber modules used for seawater desalination consist of bunch of hollow fibers in a pressure vessel. They can have a shell-side supply configuration where the feed passes along the outside of the fibers and exits the fiber ends. Hollow fiber modules can also be used in a bore-side supply configuration where the feed is circulated through the fibers.

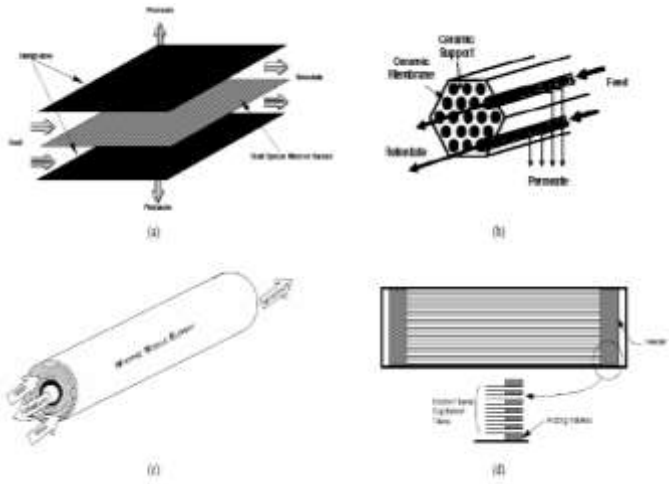

Figure 1 Membrane Modules

1.1 Membrane Bioreactor Technology

Membrane bioreactor technology simultaneously use of biological processes and membrane technology to treat wastewater and provide organic and suspended solids removal. A high standard of wastewater treatment can be achieved, without the conventional arrangement of aeration tank, settling tank and filtration to produce a tertiary standard effluent of 5: 5: 5 BOD: Suspended Solids: Ammonia. Flow passes through the membranes, while solids remain in the biological treatment system The membrane provides a long solids retention time, usually 30 - 60 days, which can greatly enhance the biological degradation of influent organics A membrane bioreactor system can be operated in either an aerobic or anaerobic mode, increasing the spectrum of chemicals suitable for biological treatment. Based on location of membrane component with respect to bioreactor basin, there are two following basic configurations of MBRs

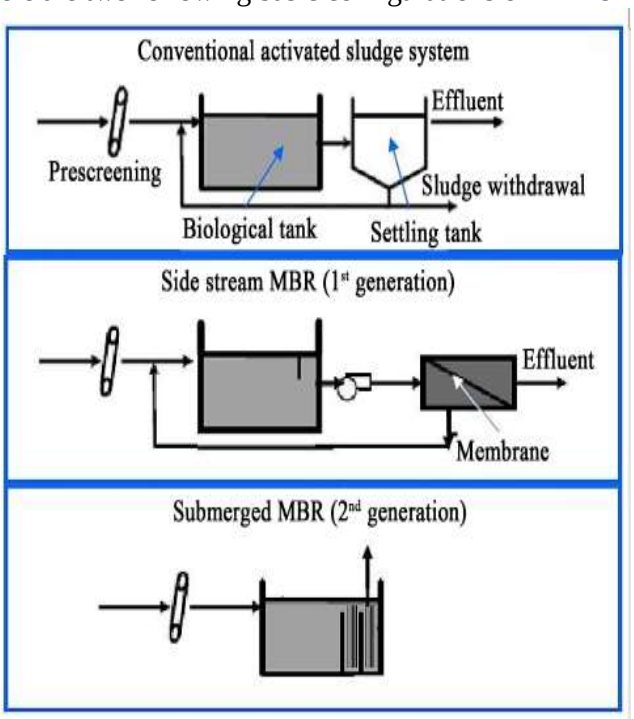

Figure 2 Membrane Bioreactor

1.2 Configuration of Membrane Modules

Today, in commercial use there are different variants to MBR system including proprietary types. MBR is creating both for suspended growth and attached growth processes. With more researches and a number of membrane manufacturers competing for the market, more variants are evolving. The two most common types are discussed below. Submerged MBR (sMBR) is by away the most common type of MBR in which the membrane modules are directly installed in the activated sludge reactor vessel. The permeate is sucked out of the membrane module with the help of a permeate pump and the suspended solids fall back into the basin. Sludge wasting is completely done directly from the reactor. sMBRs are very famous because of their compactness and low energy requirement. However, sMBRs need maximum membrane area and are more suitable for wastewater with good filterability.

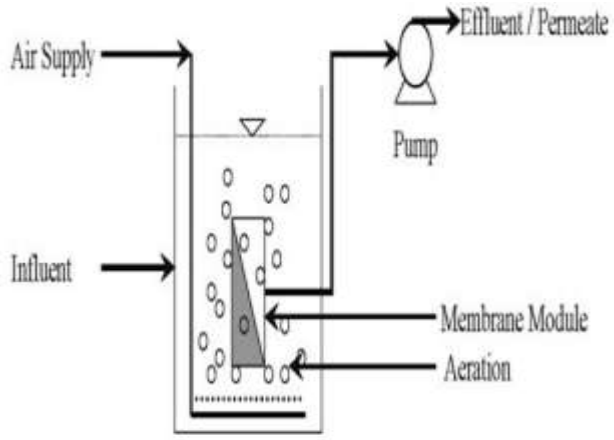

Figure 3 Submerge Membrane Modules

In External Membrane (also called Cross flow or Side stream) MBR, the membrane modules are situated outside the reactor basin, Figure 3. In this system, the mixed fluid from the reactor is pumped into the external membrane module. External MBRs are also commercially used in industries as these require minimum membrane area compared to submerged MBRs and work better for high strength wastewater with poor filterability. However, these MBRs consume more energy, need additional space and manifolds

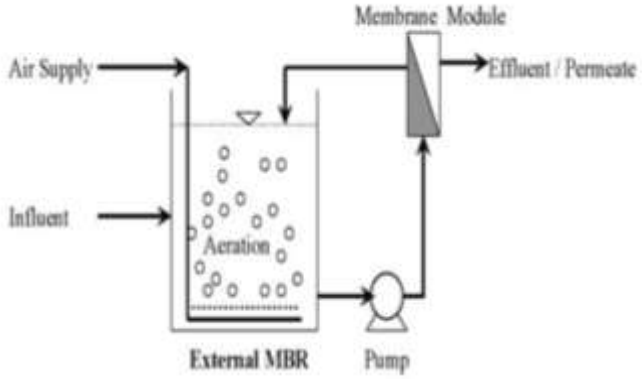

Figure 4 External Membrane Modules

Choice of a particular system configuration depends upon the use of their requirement and there is no clear-cut rule for selection. Designers should use engineering judgment to choose a particular connection after considering all the factors related to the application. Table 1 shows the key differences between the Submerged as well as External Membrane Bioreactors that should be considered in adopting a configuration.

2. Advantages of MBR over Other Treatment Process

1) The retention of all suspended matter most soluble compound within the bioreactor lead to excellent quality capable of meeting stringent discharge requirement and opening the door to direct water reuse
2) The possibility of retaining all bacteria and viruses results in a sterile influent eliminating extencsive disinfection that would be required and otherwise eliminate the corresponding hezards related to disnfection by products
3) It result in more compact systems than conventional processes significantly reducing plant footprint making it desirable for water recycling application
4) The process is more compact than a conventional activated sludge process (CAS) skiping three individual processes of the conventional scheme the feed weastwater only need to be screened (1-3mm) just prior to removal of larger solids that could damage the membrane .
5) The addition it is easier to operate and maintain
6) It has a higher nitrogen removal rate than any other treatment process
7) Finally, it has compartively low sludge yield ;thereby reducing the IOM cost of sludge handling

3. CONCLUSION

The MBR concept is same as the conventional biological wastewater treatment except for the separation of the activated sludge and treated wastewater. In the MBR system this separation is carried by membrane filtration whereas in the conventional system is done by secondary clarification. The treatment in the MBR system provides a higher degree treatment in terms of suspended solids and organic matter removal. Also the process can be run in a nitrification and denitrification mode to remove nitrogen compounds, and can be combined with the use of a coagulant for phosphorus removal.

The MBR technology has great potential in too many ranging applications including municipal, industrial wastewater treatment and solid waste digestion. Full scale systems are operational in various parts of the world and substantial growth in the number and size of installations is anticipated as a viable alternative for many wastewater difficulties like water quality issues.

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