Research of Membrane Bioreactor Wastewater Treatment Application

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Abstract: With the continuous improvement of the level of science and technology, the sewage treatment process has also been continuously improved, among which the membrane bioreactor is a high-end sewage treatment process that has emerged and adopted in recent years. Therefore, this paper discusses the membrane bioreactor in the treatment of domestic sewage, and concludes that the use of this process can convert wastewater into clean water that can be used directly. The author analyzes the operating costs of two different membrane bioreactors and believes that the integrated membrane bioreactor has the highest economic efficiency. At the same time, the influencing factors of the membrane bioreactor during operation are analyzed, and it is pointed out that the membrane bioreactor is used in the treatment of domestic sewage, and exhaust gas treatment, noise reduction, and emphasis on disinfection are required.
Keywords: Membrane Bioreactor, Wastewater Treatment, Application Research

1. INTRODUCTION

In domestic sewage treatment, membrane bioreactors have many advantages over traditional biochemical wastewater treatment. The water quality after membrane bioreactor treatment is more acceptable to residents, and the application of this treatment technology has a small footprint, environmental protection, and safety and stability. Therefore, it is an inevitable trend that membrane bioreactors are widely used in domestic sewage treatment in China. However, the application of membrane bioreactors in China's domestic sewage treatment has not yet been popularized. Therefore, relevant personnel are required to continue to conduct in-depth studies to solve some of the problems existing in membrane bioreactors in the treatment of domestic sewage, and to solve them. Domestic sewage, urban sewage, and industrial sewage have great differences. The former has large fluctuations in water quality and water volume, and is rich in organic matter and suspended solids, and has high biodegradability. Studies have shown that the quality of domestic sewage after membrane bioreactor treatment can fully meet the national standards for the recycling of municipal wastewater. Therefore, the treated water quality can be directly used in urban landscaping, road cleaning, and car washing. And since the type of membrane bioreactor wastewater can be processed much greater scope, no separation between the different sewage treatment, thus greatly reducing the cost of wastewater treatment.

2 FACTORS AFFECTING THE OPERATIONAL STABILITY OF MEMBRANE BIOREACTORS

There are two factors that affect the operational stability of membrane bioreactors. They are the biodynamic parameters that can affect the quality of the wastewater treatment, and the membrane separation parameters that can affect the wastewater treatment capacity. The data shows that in the process of domestic sewage treatment, different membrane bioreactors have the same treatment effectiveness in terms of hydraulic retention time of 1.5h and 5.8h, and the CODCr volume load is high, and different types of membrane bioreactors can be removed. More than 90% of CODCr. This shows that the volumetric load and hydraulic retention time of the water will not have a significant impact on the membrane bioreactor's operating performance, but NH3-N is greatly affected by the impact load. Increasing the membrane flux, lengthening the membrane for a long period of time, and reducing the membrane price can all greatly reduce the operating costs of membrane bioreactors. On the basis of not affecting the effect of sewage treatment, membrane flux should be increased as much as possible, thereby reducing the area of use of the membrane, thereby reducing infrastructure costs and operating costs. The size of the membrane flux is affected by the conditions of the material, operation method, and hydraulic environment. The operating pressure of the microfiltration membrane is between 0.01 and 0.3 MPa. Many practitioners point out that the membrane has a critical pressure value. If the operating pressure does not reach the critical pressure, the membrane flux is proportional to the pressure; if the operating pressure exceeds the critical pressure, the membrane surface contamination will increase, and the pressure at that time The effect on membrane flux is not significant.

3 MBR CLASSIFICATION,

Membrane bioreactors are classified into three types depending on the function of the membrane used: Separation membrane bioreactor, bubble-free membrane bioreactor and extraction membrane bioreactor. Separation membrane bioreactor (BSMBR, abbreviation) MBR) is the most common form of application at present. The advantage is that the treatment device is small in size, convenient in operation and management, and has a high biochemical reaction rate. The amount of excess sludge produced is small and the quality of the effluent is good. The membrane can retain most of the bacteria and

viruses and has a certain degree of disinfection. Ability; Sludge age and hydraulic retention time can be completely independent control, high volume load, stable operation, impact resistance load. Using membrane module Received: 20071128. Author description: Niu Taotao (1983-), master's degree, is engaged in research The direction is water treatment technology and equipment. The mixture has an efficient separation function, almost no sludge loss, so that the bioreactor can maintain the concentration of up to 10 ~ 20 g / L (aerobic type) (than traditional activated sludge method The sludge concentration is about 10 times higher. This membrane module replaces the conventional secondary sludge tank in the activated sludge process to form a separation membrane bioreactor, which effectively solves the problem of active pollution. Problems associated with high concentrations, poor effluent water quality, and excess sludge treatment costs. Domestic and international studies have shown that membrane bioreactors can maintain stable and good effluent quality at high sludge concentrations, and can be reduced due to reduced sludge load. The amount of excess sludge; Due to the long residence time of the sludge, it is conducive to the proliferation of digestive bacteria, so that the treatment device has better denitrification capacity.

MBR (Membrane Aeration Bioreactor, M ABR). The traditional aeration system uses bubbling oxygen to provide low oxygen mass transfer efficiency. When the concentration of activated sludge in the reactor is high, the microorganisms cannot meet the requirement. Oxygen demand. The membraneless bioreactor process uses a gas-permeable membrane to directly supply high-purity oxygen. Oxygen stays on the membrane module for a long time. The oxygen mass transfer efficiency can approach 100%. It is a conventional aeration of 5~7. Times [1] At the same time, the partial pressure of the gas is controlled to be less than the bubble point (no bubbles are formed on the biofilm), so that oxygen cannot be taken into the atmosphere and fully utilized. The M ABR is suitable for treating wastewater with high oxygen demand, and volatilization Biodegradation of organics, combined nitrification, denitrification or organic carbon oxidation on a single biofilm [2]. When air or oxygen enters a gas-permeable membrane with very low mass-resistance, it is driven by the concentration impetus. Diffusion of activated sludge outside the membrane. The large surface area of the membrane in the reactor creates very favorable conditions for oxygen transfer and biofilm growth. The membraneless bioreactor is particularly suitable for volatile organic compounds or foaming agents Workers Wastewater treatment does not refer to the secondary pollution caused by volatile toxic pollutants in the wastewater. Due to the high mass transfer rate of the membrane, the biodegradable organic gas may be better mixed with oxygen. The degradation effect.

The membrane module used in the Extractive Membrane Bioreactor (EMBR) process is made of silica gel or other hydrophobic polymer. One of the operating modes of the reactor is that the wastewater flow and biofilm are separated by a silicone rubber membrane. , Volatile organic pollutants can quickly pass through the silicone rubber membrane and biodegrade in the biofilm. The inorganic substances in the wastewater cannot pass through the silicone rubber membrane. Therefore, the harmful ion components in the wastewater have no effect on the degradation of microorganisms. Impact: Contaminants are degraded by microorganisms in the bioreactor after passing through the membrane, and the concentration is continuously declining. A concentration difference is formed between the wastewater and the reactor. This is the fundamental mass transfer driving force for pollutants entering the bioreactor; The mode of operation consists of a conventional bioreactor connected to a tubular membrane module with an extraction function. The shell side is a biological medium flow, the tube is a wastewater flow, and the silicone rubber membrane is arranged in a tube in a bundle, selectively poisoning the membrane. The material is transferred from the wastewater to an aerated biological medium phase where it is decomposed, and the contaminants pass from the wastewater through the membrane to the bioreactor. The nutrient medium flowing on the shell side is not affected by the wastewater in the pipe, so that the biodegradation rate is maintained at a relatively high level [3]. In addition, some specific contaminants exist in the extraction membrane bioreactor, and if it is added to the reactor for degradation, The specific bacteria of the species can increase the specificity and efficiency of degradation. Sometimes, inorganic nutrients can be added to promote efficient degradation.

4 MBR RESEARCH AND APPLICATION

At present, more and more countries use MBR for the treatment of domestic sewage and industrial waste water. In Japan, Saitama City, Saitama Prefecture adopted the MBR process to treat fecal sewage in 1985. After the fecal sewage is treated by the system, the water is not solidified. The material, COD and color can be greatly reduced, the sludge concentration of the reactor can be as high as about 15 000 ~ 18 000 mg/L, and the system operates stably. In 1994, there were more than 1,200 MBR systems in Japan for processing 4 Waste treatment of more than 10 million people[10] and landfill/compound leachate. Through the combination of MBR and RO technology, it can not only remove SS, organic matter and nitrogen, but also effectively remove salts and heavy metals. Recently, U.S. Env irogen Corporation developed a MBR for the treatment of landfill leachate, and built a device with a daily capacity of 1,500 m3/d in New Jersey [11]. In 1997, the British company Wessex was British Porlock established the world’s largest M BR municipal wastewater treatment and reuse system, with a daily capacity of 2 000 m3. In 1999, it established a 13 000 m3/d MBR plant in the Swage of Dorset[12] .1990 Since the beginning of the year, the processing target of MBR has been continuously broadened. Apart from the reuse of reclaimed water and the treatment of manure and sewage, the application of industrial wastewater treatment has also received widespread attention, such as the treatment

of food industry wastewater, aquaculture wastewater, aquaculture wastewater, cosmetics production wastewater. , Dye wastewater, and petrochemical wastewater have all achieved good results. In the early 1990s, the United States established a MBR system in Ohio for the treatment of industrial wastewater from a car manufacturing plant with a treatment capacity of 151 m3/d. The system has an organic load of 6.3 kg COD/m3d and a COD removal rate of 94%. Most of the oils and fats are degraded. In the Netherlands, a fat extraction plant uses conventional oxidation ditch wastewater treatment. The technology was used to treat its production wastewater. As a result of the expansion of production scale, sludge was expanded and the sludge was difficult to separate. Finally, Zenon's membrane module was used instead of the sedimentation tank. The operation effect was good. With nitrogen and pesticides in agriculture Widely used, drinking water is also contaminated to varying degrees. Lyo nnaisedes Eaux developed in the mid-1990s both biological denitrification and adsorbed pesticides. Removal of the turbidity function of the MBR process. In 1995 the company built a 400 m3 plant for daily drinking water in Douchy, France. The effluent nitrogen concentration was below 0. 1 mg / L and the pesticide concentration was below 0. 02 g. / L.

In 2000, China's membrane materials and membrane industries were listed as one of the 22 chemical industries supported by the country. At present, there are hundreds of research and development institutes for membrane science and technology in the country, forming a basic supporting research for thousands of people. The technical development team has hundreds of membrane industry enterprises. At present, the domestic MBR process mainly deals with: Domestic sewage, hospital sewage, fecal sewage, petrochemical wastewater, food wastewater, printing and dyeing wastewater, landfill leachate, etc. Membrane materials used The membrane module mainly includes hollow fiber organic membrane (polyethylene, polypropylene, polyvinylidene fluoride, poly maple, polyacrylonitrile, etc.), inorganic ceramic membrane, etc. Among them, the membrane module used in engineering is mainly hollow fiber.

Judging from the scale of the study, most of the work is mainly concentrated in the laboratory or pilot stage. Although there are some research results from the laboratory to the engineering application, the application scale is relatively small, and the daily processing is mostly tens of tons. The scale of processing is less than 100 tons, and in scale-type engineering applications, the problem of membrane fouling control has not yet been fully resolved, resulting in some problems that need to be improved during the operation, and also in terms of energy consumption and membrane processing capacity. There is still room for improvement. The Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, has been working on membrane bioreactors since 1993. At present, China's more active membrane bioreactor wastewater treatment institutions include the Chinese Academy of Sciences, Tsinghua University, Tongji University, and Harbin Industry. University, East China University of Science and Technology, etc. The research focuses on the development of membrane technology and the prevention and control of membrane fouling. Tianjin Tsinghua German Environmental Engineering Co., Ltd. uses the scientific and technological achievements of the wastewater treatment series of Hollow Fiber Membrane Bioreactor Research Institute of Tianjin University. , Took the lead in implementing the industrialization of membrane bioreactors in the water treatment industry in China. Very good results. In December 2000, the hollow fiber membrane bioreactor sewage treatment series device research passed the ministerial technical appraisal, and this practical technology began to be promoted nationwide. The processing capacity of this series of products is 5~ 1 000 m 3 / d. The gas-to-water ratio is between 15 1 and 25 1 , COD removal rate is 90%, NH 3 -N removal rate is 99%, and the flux changes little. The M LSS in bioreactors is mostly between 5 000 and 10 000. Mg / L. Dealing with tons of water and electricity consumption is 0. 4 ~ 0. 8 KW / h. Qinghua German Environmental Engineering Co., Ltd. invested in the Tianjin New Technology Industrial Park to establish a membrane reactor and other high-tech environmental protection technology equipment production and research base. The company has established more than 20 demonstration projects in the fields of hotels, hospitals, office buildings, etc., in the areas of water rushing, flushing, domestic sewage treatment and reuse, industrial printing and dyeing wastewater treatment and reuse, and landfill leachate treatment.

At present, there are many kinds of MBR in domestic research: (1) Combination of ceramic membrane and aeration bioreactor. (2) Combination of polyethylene hollow fiber membrane and aeration bioreactor. (3) Polyethylene hollow Fiber membrane and anaerobic bioreactor combination.

5 CONCLUSION

With the urgent need for waste water resource treatment and the continuous improvement of discharge water quality standards, MBR will have significant advantages such as its small system footprint, impact-resistant load, effluent water and stability, and easy implementation of automatic control, etc., which will surely be obtained in the field of sewage treatment. Widely used. Although there are still many problems that need to be solved in the process of researching MBR such as high-efficiency sewage treatment technology and equipment, MBR will be widely used in China soon.

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