

# Application of Membrane Separation Technology in Water Treatment Industry

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**Keywords:** Water treatment, Membrane separation, Application

**Abstract:** Membrane separation technology plays an important role in the purification and separation of liquid substances, and it has the advantages of lower energy consumption and simple operation, so it has a wide range of applications in the water treatment industry. Especially as people's requirements for water quality continue to increase, the application range of membrane separation technology has gradually expanded. Based on this, this article starts with the basic overview of membrane separation technology, first analyzes the types of membrane separation technology used in water treatment, and then explores the specific application of membrane separation technology in the water treatment industry, hoping to use this to feed membrane separation technology in the water treatment industry Relevant research applied to provide certain reference opinions.

## 1. Introduction

Membrane separation technology uses selective permeation membranes to separate specific substances in mixed liquids. It can use potential difference, pressure difference and concentration difference as power sources to realize the separation and purification of mixed liquids. Compared with traditional liquid separation, membrane separation technology will not pollute the mixed liquid, and the energy consumption of the whole process is lower, and the operation of the whole process is very simple, so it has a very wide range of applications in the water treatment industry<sup>[1]</sup>. With the development of technology, membrane separation technology is continuously improved and optimized, and can be used in fields such as energy conversion and release control.

## 2. Overview of Membrane Separation Technology

Membrane separation technology first originated in France. Scientists at that time used the separation phenomenon of pig bladder to make copper ferrocyanide membrane, and then produced cellulose acetate membrane, which began to be used in industrial production. After that, with the continuous improvement of membrane separation technology, its application fields continued to expand, in the fields of water purification and water treatment. Membrane separation technology uses the difference in the physical properties of different substances in the mixed liquid to achieve the separation of water bodies, and usually uses the control of the membrane pores to achieve separation without the mixed liquid. In addition, membrane separation technology can retain the original properties of the mixed liquid, and at the same time have the characteristics of energy saving and high efficiency, so it has a wide range of applications in water treatment, chemical, environmental protection, metallurgy, chemical, medical and other industries<sup>[2]</sup>. Specifically, the advantages of membrane separation technology are mainly reflected in the following aspects:

(1) Less loss of active ingredients. Membrane separation technology is generally carried out at room temperature, so it can be applied to the separation of heat-sensitive substances and can reduce the loss of active ingredients. For example, membrane separation technology is often used in the separation of various proteins and enzymes.

(2) Low energy consumption. Membrane separation technology is driven by electric energy, and the energy consumption is extremely low when the mixed liquid is separated, and it can maintain the original characteristics of the mixed liquid. Generally, its energy consumption is about 30% of

freezing and evaporation concentration. Moreover, the efficiency of membrane separation technology in processing mixed liquid separation is also high, which can meet the demand for output.

(3) The original mixture is not contaminated. Membrane separation technology uses different physical properties of substances to achieve separation. No chemical substances need to be added during the whole process, which can ensure that the original mixture is not polluted.

(4) Strong adaptability. Membrane separation technology is highly adaptable, and most of the mixed liquid separation can be achieved through the choice of membrane pores. Not only the process is very simple, but also conducive to the realization of automation, so its adaptability is strong.

From the above four points, the membrane separation technology has made great progress compared with the traditional liquid separation technology. The whole process is very simple, and no additional chemical reagents are added, which can retain the original characteristics of the mixed liquid. Can have strong applicability. Especially for water treatment, membrane separation technology can reduce costs, realize the separation of various substances, and lay the foundation for subsequent recycling.

### **3. Types of Membrane Separation Technologies Used in Water Treatment**

With the changes in social needs and the improvement of membrane separation technology, the types of corresponding membrane separation technologies are gradually increasing, which can meet the needs of different fields<sup>[3]</sup>. Therefore, the membrane separation technology can be selected according to its own requirements in water treatment. Judging from the current actual situation, membrane separation technologies commonly used in water treatment mainly include the following.

#### **3.1 Microfiltration Membrane Separation**

Microfiltration membrane separation technology is mainly used for the removal of fine particles. In specific applications, the mixed liquid is first pressurized, and the pressure difference is used to promote the realization of the membrane separation process. In the pressurized state, water and macromolecular salts can pass through the microfiltration membrane, but fine particles cannot pass through, so that liquid analysis can be realized. Generally speaking, microfiltration membrane technology is used in the treatment of industrial wastewater, high-purity water and urban sewage.

#### **3.2 Ultrafiltration Membrane Separation**

Ultrafiltration membrane separation technology is an improvement of traditional membrane separation technology, which uses pressure to remove various impurities in water<sup>[4]</sup>. Ultrafiltration membrane analysis technology is very commonly used in the separation of macromolecular substances, such as the beverage industry and food industry wastewater treatment.

#### **3.3 Nanofiltration Membrane Separation**

Nanofiltration membrane separation technology is a combination of ultrafiltration membrane separation and microfiltration membrane separation technology. It is also driven by electric energy and pressure, which can not only quickly remove impurities, but also effectively improve the efficiency of mixed liquid separation<sup>[5]</sup>. Judging from the current actual situation, nanofiltration membrane separation technology is often used in fields such as biopharmaceuticals and fine chemicals.

#### **3.4 Reverse Osmosis Separation**

Reverse osmosis separation is to separate the water in the mixed liquid. The quality of the water body after this membrane separation treatment can be significantly improved. In reverse osmosis separation, the water molecules in the mixed liquid are pressurized to pass through the pores of the membrane, while other molecules and impurities are intercepted. Moreover, the water treatment efficiency of the osmotic separation technology is relatively high, and it is also very commonly used

in the preparation of ultrapure water and the desalination of brackish water.

### **3.5 Electrodialysis Separation**

The electrodialysis separation technology uses the permeability principle of the ion exchange membrane to add direct current to the mixed liquid as a driving force, and then separate the impurities in the mixed liquid. Electrodialysis technology has high separation efficiency and is very commonly used in water desalination and concentration.

### **3.6 Dynamic Membrane Separation Technology**

The dynamic membrane separation technology uses dynamic membranes to realize the separation of impurities in the mixed liquid. Usually, the dynamic membrane consists of two parts: the carrier and the structure, and then moves in the mixed liquid, so that the impurities in the mixed liquid will be attached to the dynamic membrane. Separation of impurities. The separation accuracy of dynamic membrane separation technology is relatively low, but it can be used to measure the suspended solids concentration of the mixed liquid.

## **4. Specific Application of Membrane Separation Technology in Water Treatment Industry**

Membrane separation technology has a wide range of applications in the water treatment industry. Users can choose the type of separation membrane and choose the appropriate membrane separation technology according to their own needs. The following are the specific applications of membrane separation technology in the water treatment industry.

### **4.1 Application of Membrane Separation Technology in Industrial Water Systems**

The amount of water used in industrial production is generally large, so the cost of water is relatively high. Especially for areas lacking fresh water, industrial production often requires a lot of costs in this regard. Therefore, in order to save costs, many industrial productions choose to desalinate seawater or separate sewage. Therefore, electrodialysis membrane separation technology and reverse osmosis membrane technology are used to desalinate seawater to solve the problem of water shortage. In addition, drinking water is also needed in industrial production, so reverse osmosis membrane technology and nanofiltration membrane technology can also be used to separate harmful substances in water bodies to prepare drinking water<sup>[6]</sup>. Compared with other reference water purification, the purification effect of membrane separation technology is more significant, and no other reagents are added during the purification process, and the overall energy consumption is also lower.

Membrane separation technology has been applied in industrial water systems for a long time. Relying on the reverse osmosis device can meet the boiler water consumption, which can relieve the problem of water stress to a certain extent. Judging from the current actual situation, most of the water used in industrial production in coastal areas is desalinated seawater, which can not only extend the service life of the boiler, but also help reduce the cost of production.

Judging from the current actual situation, seawater resources are very abundant, while freshwater resources are relatively scarce. Therefore, how to use seawater efficiently has become an important direction to relieve the pressure on water resources. Through membrane separation technology, impurities in seawater can be effectively filtered, and various inorganic salts can also be removed, so that the treated seawater can be used not only in industrial production, but also in the production of drinking water. In addition, the treated seawater residue can also be used for salt production. In addition, the use of membrane separation technology to treat seawater consumes less energy and does not require excessive investment in overall costs, which plays an important role in reducing the cost of industrial production. At present, many coastal industries in my country use membrane separation technology to desalinate seawater, and the actual application effect is very significant.

### **4.2 Application of Membrane Separation Technology in Industrial Wastewater Treatment**

Industrial wastewater contains a large amount of harmful substances, which will cause pollution

when discharged directly into the environment. Therefore, my country's environmental protection department has put forward clear requirements for the discharge of industrial wastewater. In the treatment of industrial wastewater, membrane separation technology is very commonly used, which can effectively remove harmful substances. For example, in the textile, chemical, and petroleum fields, industrial wastewater will adopt membrane separation technology to avoid environmental pollution or realize the recycling of water resources through advanced treatment.

In industrial wastewater treatment, membrane separation devices are usually added to the original devices, so that harmful substances in industrial wastewater can be removed. Generally, industrial production will customize the separation membrane according to the type of wastewater to remove harmful substances in a targeted manner to ensure that the treated wastewater meets the discharge standard. For example, when processing industrial wastewater with high heavy metal content, emulsion liquid membranes are often used to precipitate heavy metals to avoid environmental pollution. Of course, the treated water can also be recycled through continued treatment. In addition, the use of membrane separation technology to treat industrial wastewater can also recover useful substances in wastewater, reduce production costs, and create a circular economy.

With the continuous improvement of people's awareness of environmental protection, the current society has put forward higher requirements for industrial wastewater treatment, and in the context of the continuous deepening of sustainable development strategies, recycling industrial wastewater is in line with the concept of green development. Therefore, it is of great significance to adopt membrane separation technology in industrial wastewater treatment. From the perspective of enterprises, membrane separation technology is used to ensure that the discharged industrial wastewater meets environmental protection requirements. Second, it can effectively recycle water resources and useful substances in wastewater. The overall investment is relatively low, which reduces the production cost of the enterprise. The use of promotion has important meaning.

#### **4.3 Application of Membrane Separation Technology in Domestic Sewage Treatment**

With the continuous acceleration of China's urbanization process, the number of urban residents has increased significantly, so the amount of domestic sewage discharged has also increased year by year. This requires sewage treatment to reduce the environmental pollution of domestic sewage, and the use of membrane separation technology to achieve life recycling of sewage. In the current urban domestic sewage treatment, an embedded separation membrane will be added in the sewage treatment device to realize the recycling of water resources<sup>[7]</sup>. At present, the amount of urban domestic sewage generated in our country is relatively large every day, and it is necessary to adopt modern technology to complete the sewage treatment in a short time. Through membrane separation technology, suspended solids and impurities in domestic sewage can be effectively removed, and harmful substances in sewage can be filtered at the same time, so as to realize the recycling of domestic sewage and provide protection for people's drinking water safety.

In addition to the above three applications, membrane separation technology can also be applied to the production of high-purity water and the production of sterile non-pyrogenic water. With the continuous improvement of membrane separation technology, its application advantages will be further expanded. The optimization of the treatment process provides strong support.

### **5. Conclusion**

Membrane separation technology plays an important role in water treatment. It can not only reduce the cost of water treatment, but also has higher treatment efficiency, which can effectively realize the separation of substances in the mixed liquid. From the current practical application point of view, the membrane separation technologies commonly used in water treatment include dynamic membrane separation technology, nanofiltration membrane separation technology, ultrafiltration membrane separation technology, electrodialysis separation technology, reverse osmosis separation technology and microfiltration membrane separation basis. It can be widely used in industrial wastewater treatment, domestic sewage treatment and drinking water purification fields. This article

analyzes the main advantages of membrane separation technology, and at the same time explores the types and specific applications of membrane separation technology, hoping to provide certain reference opinions for the application and optimization of membrane separation technology in water treatment in my country.

### **Acknowledgment**

This article is part of the project “Research and Development of Chemical Laboratory Wastewater Treatment Equipment”, which was funded by the school-level scientific research project of Yinchuan Energy College in 2018, project number 2018-KY-K-02.

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