

(Membrane Bioreactor)

main content

- 1 MBR原理
- 2 MBR Operation
- 3 MBR process design
- 4 MBR answer use
- 5 Advantages and characteristics
occupy
- 6 MBR and other aerobic processes

一、MBR principle

MBR special point :

1. Good water quality



- ◆ Soluble macromolecules are trapped increasing residence time.
- ◆ A longer SRT accumulates a large number of nitrifying bacteria and improves digestibility.
- ◆ The effluent can retain suspended solids, and bacteria and viruses are largely removed.

一、MBR principle

MBR special point :

2, Process parameters are easy to control



Instead of secondary settling tank, realize short HRT and long SRT at the same time .



The interception of sludge eliminates sludge bulking.

3. Shock load resistance



High microbial concentration and high volume load.



High microbial concentration, strong impact resistance.

二、MBR Operating factors

1, Biokinetic parameters that affect the stable operation of MBR

Organic load:

In aerobic MBR In the process, the sludge concentration increased rapidly with the increase of the volume load, and there was

The removal rate of organic matter is accelerated, and the sludge load remains basically unchanged, thereby inhibiting the output of

The deterioration of water quality; in anaerobic MBR , the sludge concentration rises slowly, and the sewage

There is almost a positive correlation between mud load and volume load, so anaerobic

MBR Effluent water quality is susceptible to volume loads.

二、MBR Operating factors

1, film Ring MBR Biokinetic parameters for stable operation

Sludge Concentration:

Sludge concentration is MBR Important parameters of the system, not only affecting the removal of organic matter capacity and also has an effect on membrane flux. Research results show that under certain conditions

The higher the sludge concentration, the lower the membrane flux. But the domestic scholars in the integrated MBR place

However, the research on the treatment of domestic sewage found that when the aeration intensity is large enough (air-water ratio approximately 100:1), MLSS by 10 g/L. When changing to 35 g/L, MLSS

There is no obvious correlation with the membrane flux; but if the aeration intensity is reduced,

MLSS here may have some effect on membrane flux.

二、MBR Operating factors

2, Membrane Separation Parameters

Membrane selection:

Membrane materials are divided into organic membranes and inorganic membranes.

Due to higher investment costs Limits the wide application of inorganic membranes in China , domestic MBR is generally used Organic membranes, commonly used membrane materials are polyethylene, polypropylene, etc. Split MBR Ultrafiltration membrane modules are usually used, and the molecular weight cut-off is generally 20,000 to 300,000. hold back The larger the molecular weight, the larger the initial membrane flux, but the long-term operation of the membrane flux may not be better.

big. For one-piece MBR, Both ultrafiltration and microfiltration membranes can be used.

二 MBR Operating factors

2, Membrane Separation Parameters

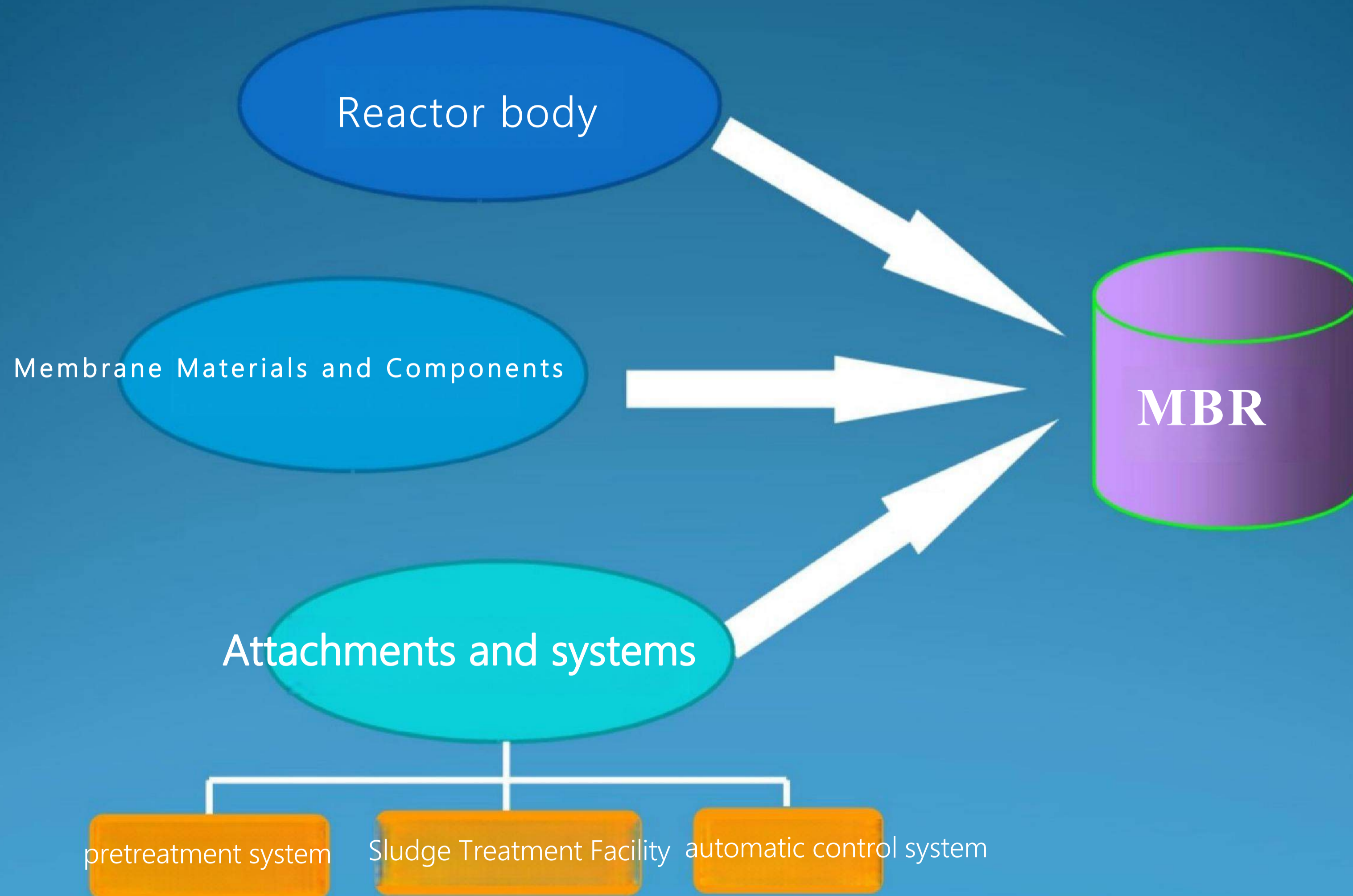
Optimization of operation mode:

For split MBR, In order to slow down membrane fouling, backwashing is to maintain the MBR stable Important operations for scheduled operation. For one-piece MBR, Shorten the suction time or prolong the Long suction stop time and increased aeration volume are beneficial to slow down membrane fouling, and the suction time It has the greatest impact on the rise of membrane resistance, followed by aeration.

Improved hydraulic properties:

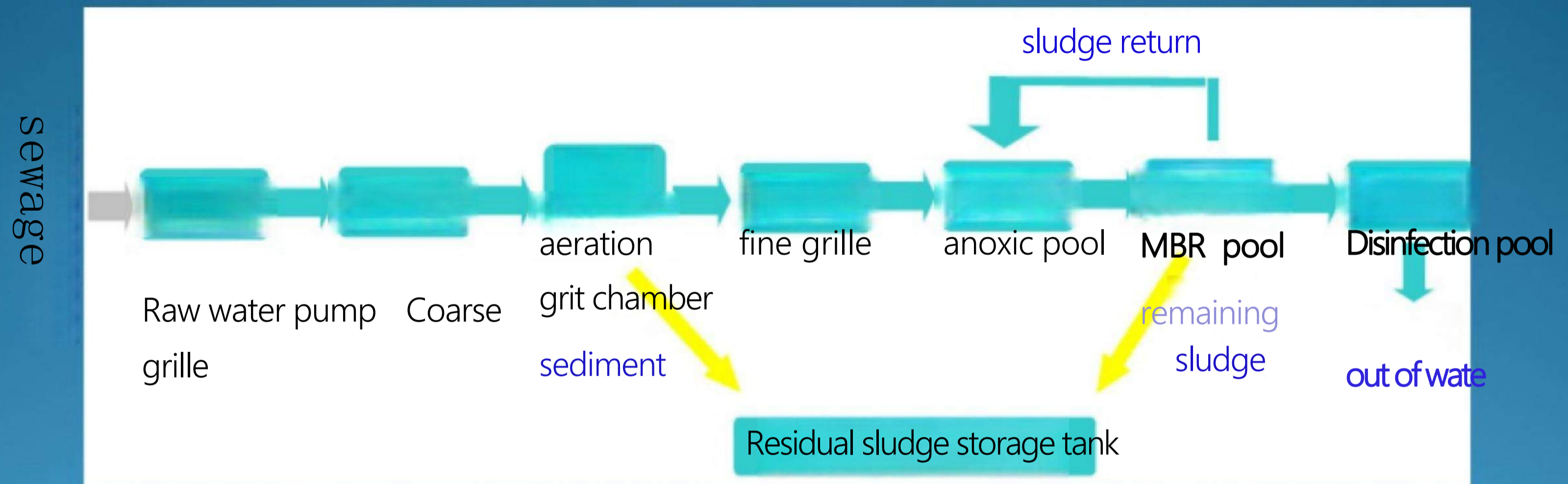
For split MBR, It can increase the water inlet flow rate of the fluid, reduce the concentration polarization, The trapped solute is taken away in time. For one-piece MBR, well designed The flow channel structure improves the aeration intensity, so that the larger aeration volume can flush the membrane The cross-flow filtration effect of the surface is particularly important.

≡ 、MBR technological design



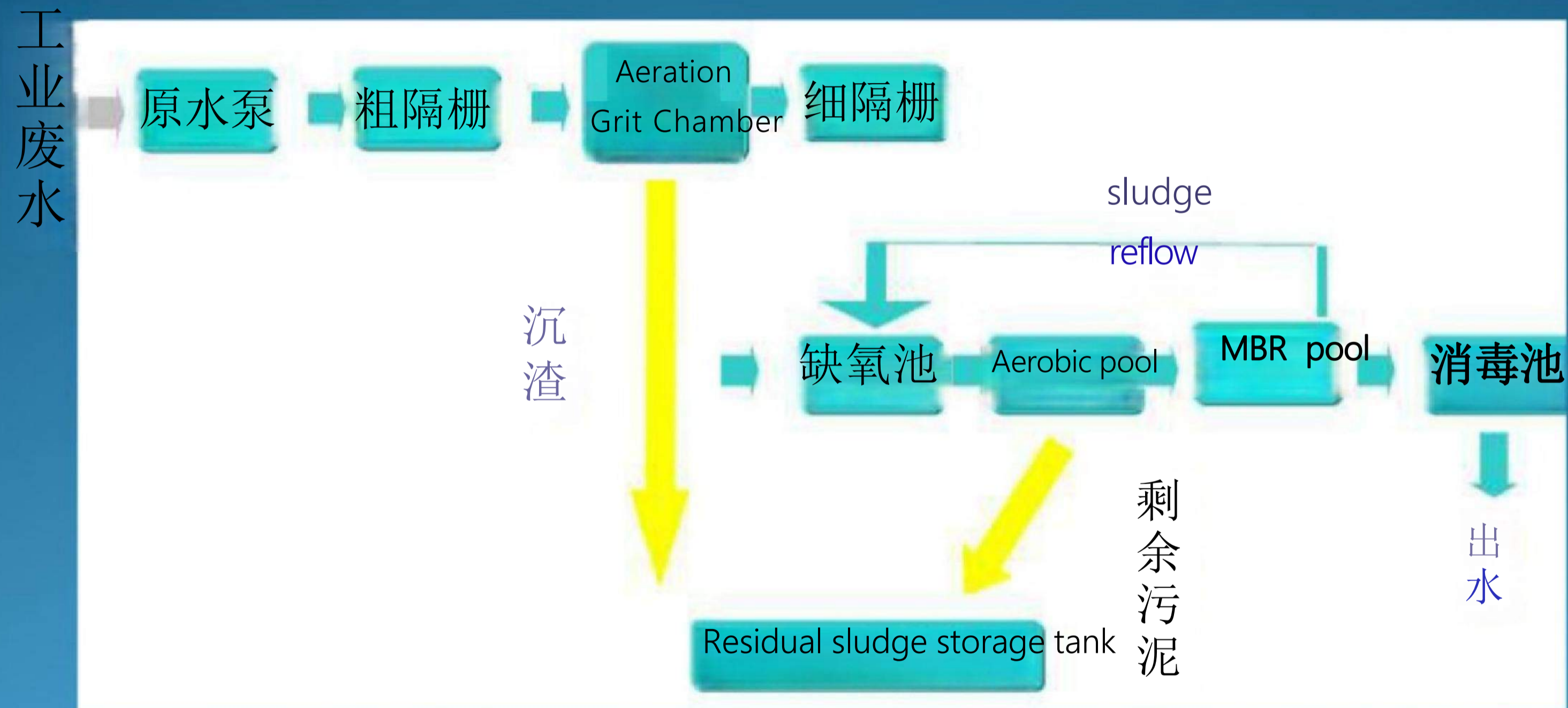
三、MBR technological design

1, Process route selection



Recommended Process Flow for Domestic Wastewater

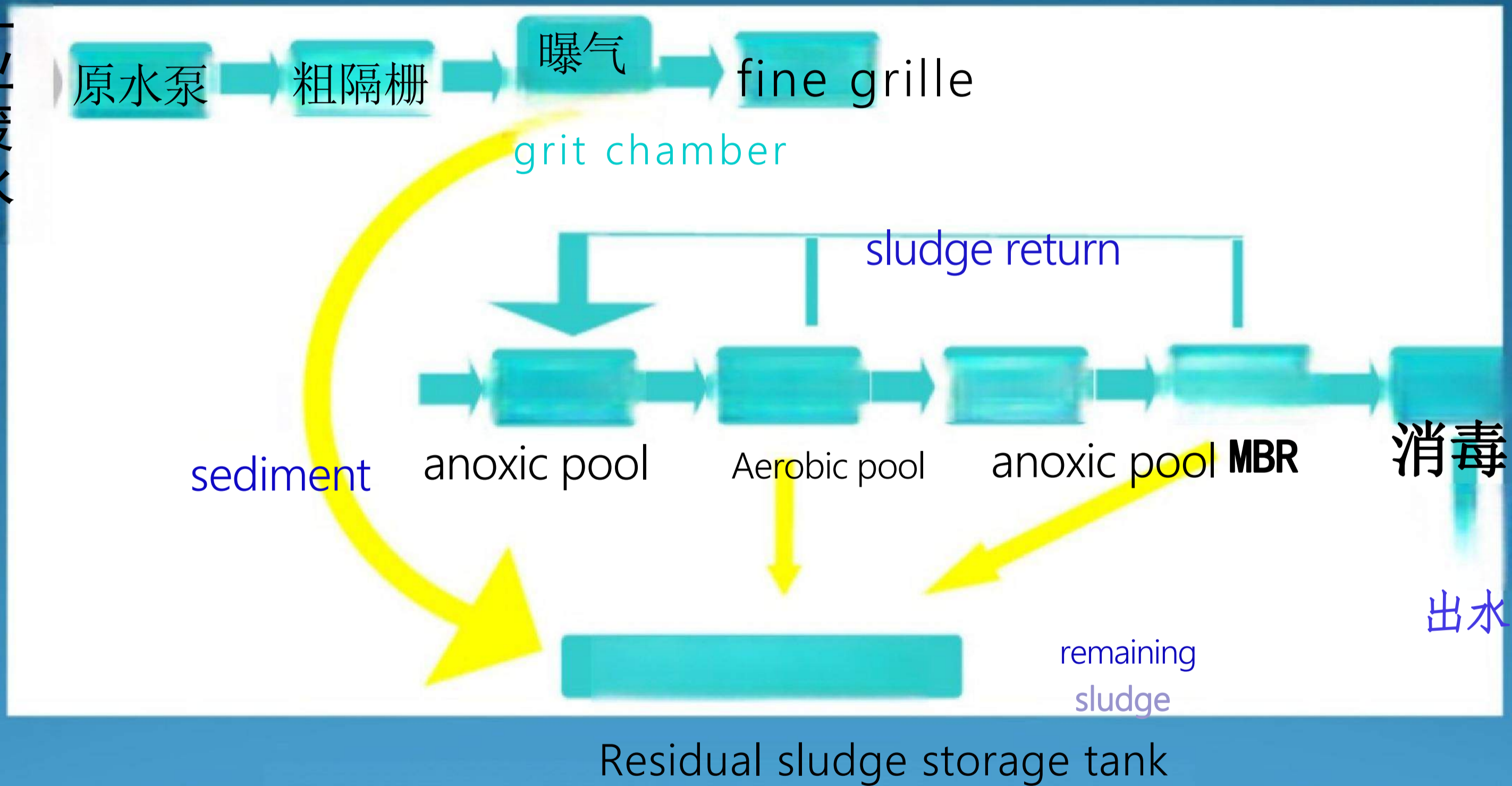
三、MBR technological design



The recommended process for the removal of organic matter in industrial wastewater

三、MBR technological design

工业废水



Recommended process for the removal of ammonia nitrogen from industrial wastewater

三、MBR technological design

2, Membrane cell design

(1) Hypoxic pool volume

Design principles: nitrogen volume load is set below $0.2\text{kg-N}/(\text{m}^3\cdot\text{d})$;

The nitrogen content of the influent anoxic pool water is $Q_1 \times C$ nitrogen nitrogen;

Requires a hypoxic pool volume of $Q_1 \times C$ ammonia nitrogen $\div 0.2$ or more.

(2) Membrane bioreactor volume

Design Principles: BOD volume load at $2.0 \text{ kg-BOD}/(\text{m}^3\cdot\text{d})$ or less

BOD in the design anoxic pond isn't $(20\% \sim 50\%)$,

Then the concentration of BOD flowing into the membrane bioreactor is $C_{aop} \times (1-20\%)$;

The required volume of the membrane bioreactor is $C_o \times (1-20\%) \div 2$ above.

三、MBR technological design

3. Selection of Membrane Elements

Number of membrane elements

Choose the right membrane flux

Determine the required membrane area

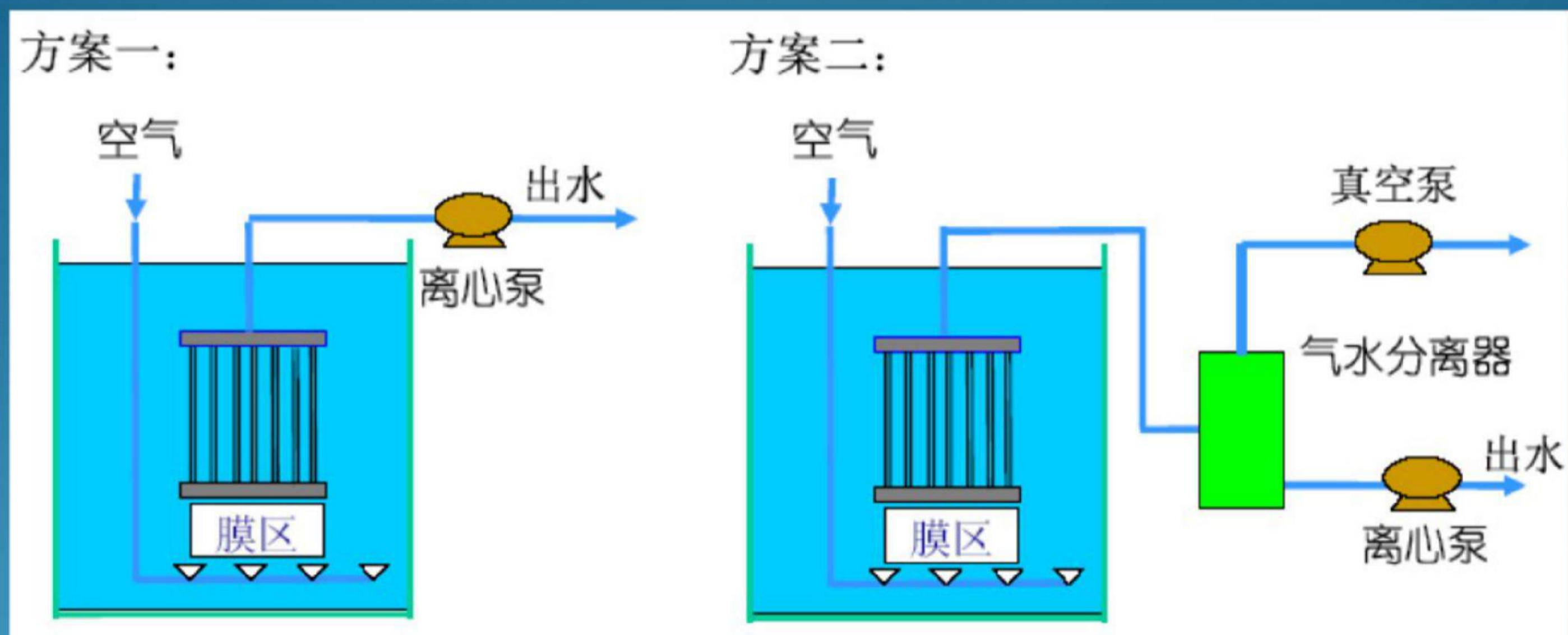
Determine the number of membrane elements according to the membrane area of a single element

MBR Membrane involves operations such as backwashing during operation, so it must be integrated

Consider water utilization and component downtime

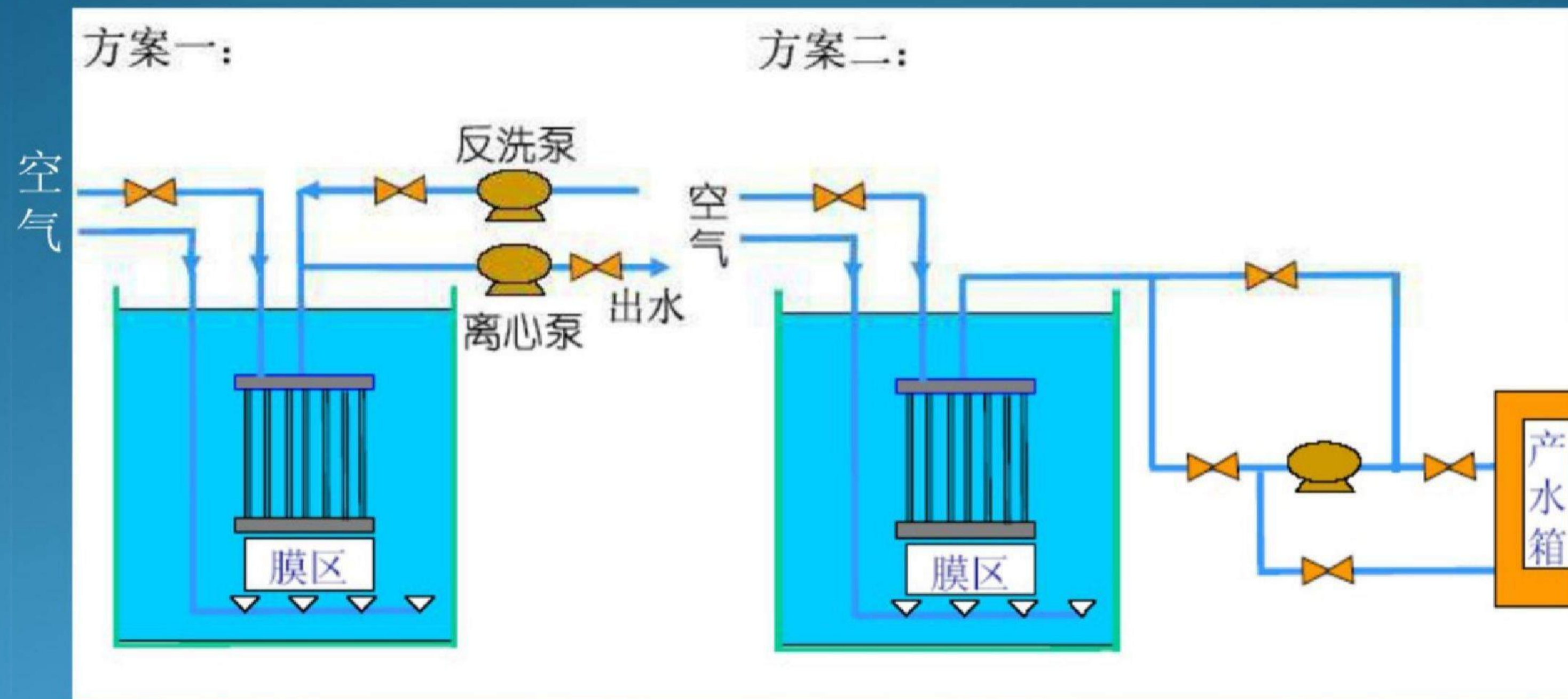
三、MBR technological design

4. MBR water production system



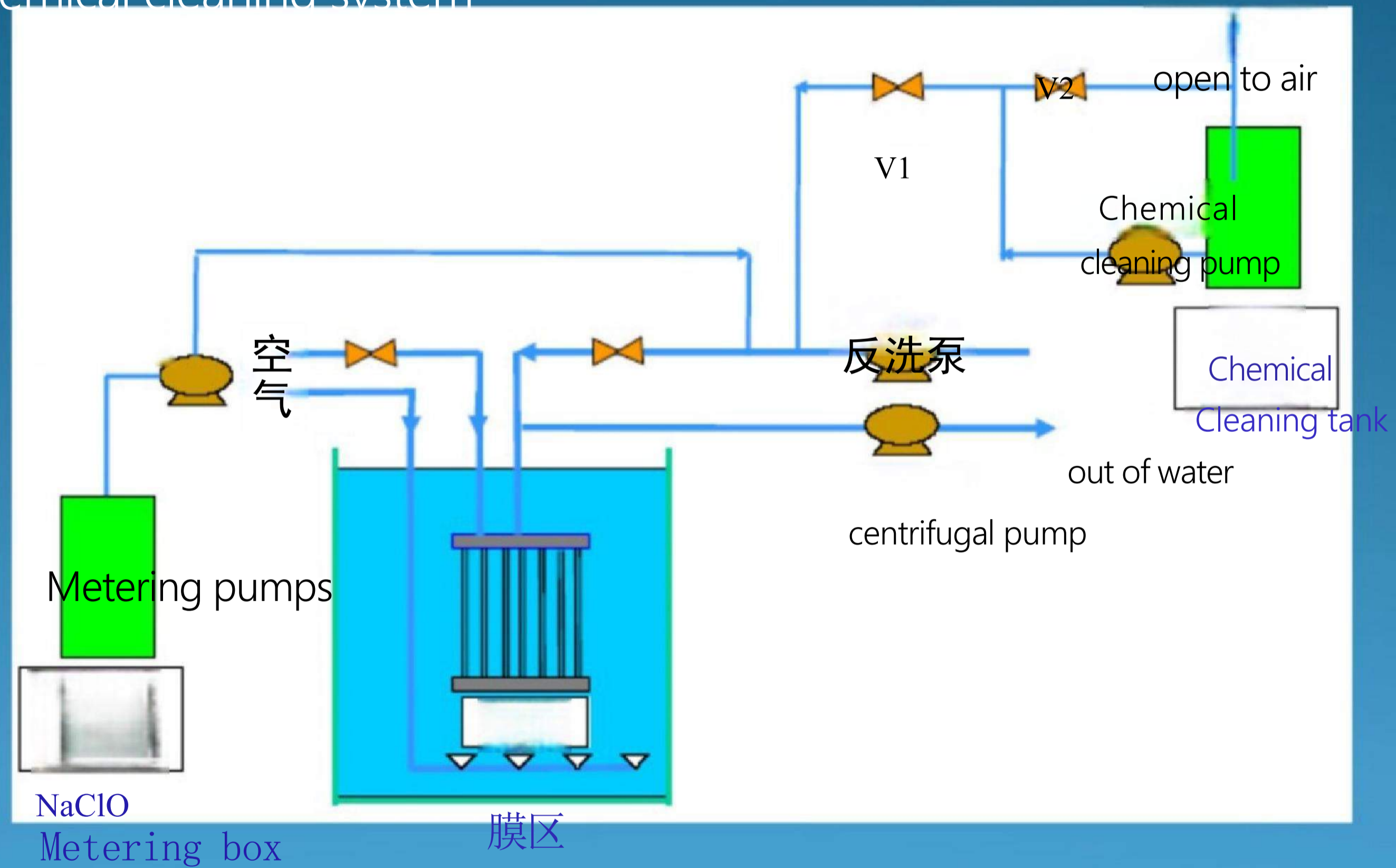
三、MBR technological design

5. MBR backwashing air washing system



三、MBR technological design

6.chemical cleaning system



三、MBR technological design

When the filtration is carried out for a long time, the membrane will be polluted to a certain extent, and the chemical cleaning is only to remove the pollution and the substances that block the membrane. The frequency of chemical cleaning and operating conditions are related to It is related to the water quality of the influent. Usually run for 1 to 3 months or under the same operating conditions Chemical cleaning should be performed when the pressure difference across the membrane rises by 0.5 bar or more than the initial rise. Depend on It is more effective to carry out chemical cleaning when the membrane fouling is relatively light, and to carry out chemical cleaning in time and regularly Cleaning will make the system run more stable.

Recommended cleaning chemicals

Pollutants	Chemicals	concentration	cleaning time
organic matter	Sodium hypochlorite (concentration 10%)	1000~5000mg/L	1~2h
organic matter	sodium hydroxide	pH<12	1h
Inorganic matter	hydrochloric acid	0.1mol/L	1~2h

Pollutants	Chemicals	concentration	cleaning time

三、MBR technological design

7. Automatic Control System

	state	run						shutdown
Lightning	serial number	1	2	3	4	5	6	7
	step sequence	run	air water backwash	stop pumping	CEB into medicine	soak	rinse	shutdown
Pump valve condition surface	Suction pump	o						
	backwash pump		0		0		0	
	chemical pump				o			
	Permeate valve	o						
	Backwash valve		o		o		o	
	Intake valve		o					
time		15-30min	30-60S	2-8min	30-60S	5-10min	60-90S	

三、MBR technological design

Aerobic membrane-bioreactor treatment of municipal and industrial wastewater some parameters

project	city sewage	Industrial wastewater
Enter Water COD(mg/L)	44.2~800	1333~68000
COD removal rate (%)	90~98	90~99.8
Sludge concentration (g/L)	10~20, up to 50	>20
volume load (kg COD/(m ³ d))	1.2~5.78	0.25~16
Sludge load (kg COD/(kg VSSd))	0~0.34	0.012~2.72
Sewage mud Produce Rate (kg MLSS/kg COD)	2~24	0.05~0.35
Hydraulic retention time (h)	5~c	14~389
Sludge age (d)		6.2~600

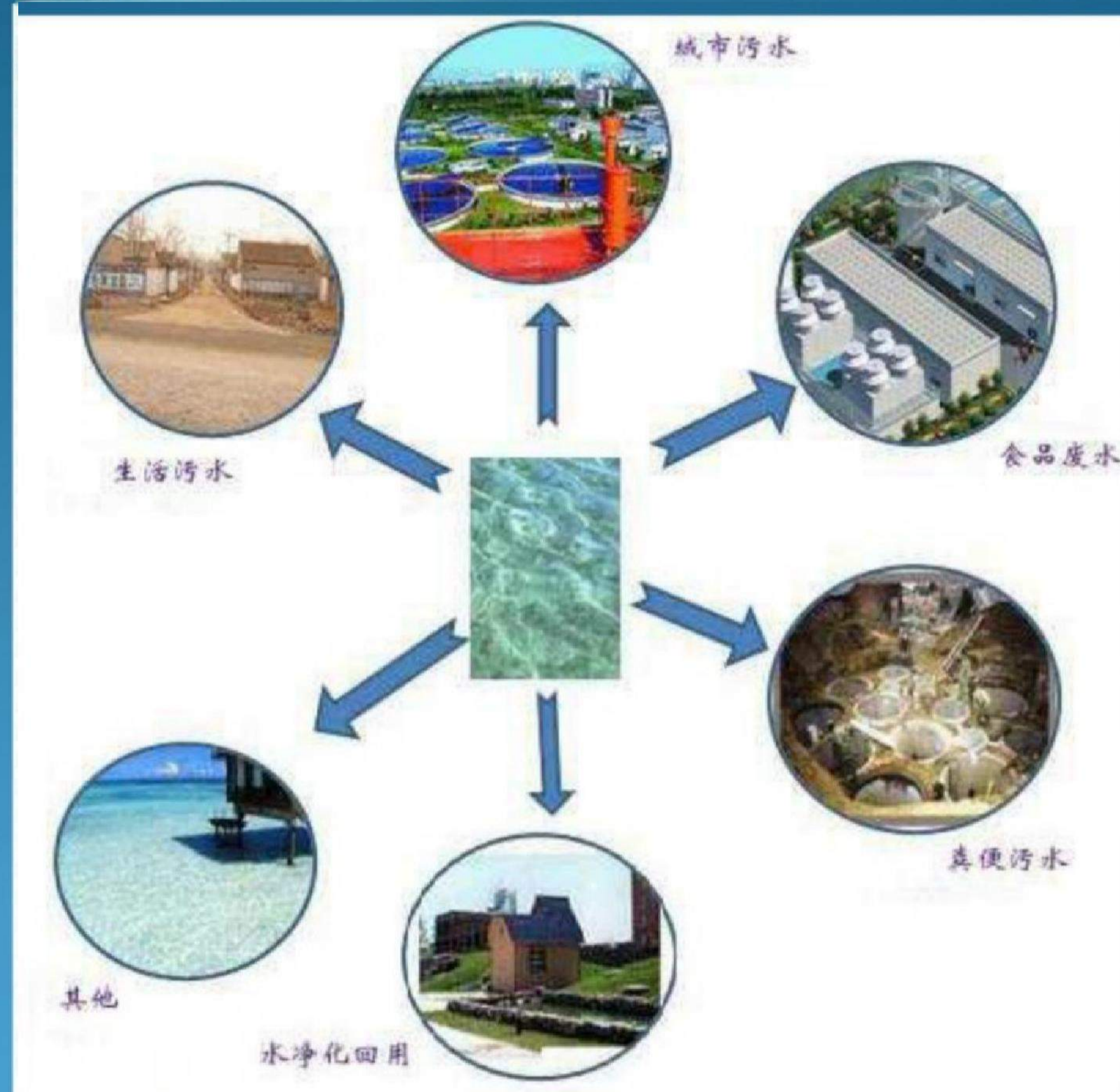
Traditional activated sludge method:

Volume load: 0.6~1.8 kg COD/(m³d)

Sludge load: 0.4~0.8kg COD/(kg VSS-d)

Sludge age: 5~15d

四、MBR application



四、MBR application

China's per capita water resources are only 2250m³ /person.years , less than the world average Flat 1/4. Among the more than 600 cities in China, more than 300 are short of water.

Per capita water resources in North China are less than 1/5 of the national average level.

Almost all cities in China are facing water shortages. Membrane bioreactor technology is known for its

High-quality effluent water quality is considered to have good economic, social and environmental benefits.

Water technology has attracted much attention. Although there are still high operating costs, but with

The advancement of film manufacturing technology, the improvement of film quality and the reduction of film manufacturing cost,

MBR investment will be reduced accordingly.

四、MBR application

On the other hand, the development of various new membrane bioreactors also makes the operation cost a lot

large reduction, such as gravity submerged MBR operating at low pressure, Anaerobic MBR and so on

Compared with the traditional aerobic pressurized membrane bioreactor, its operating cost is greatly reduced.

Therefore, from a long-term point of view, the application range of membrane bioreactors in water treatment

The circle will become wider and wider. In today's increasingly stringent water environment standards, MBR has been displayed

Showing its huge development potential, it will be an alternative to traditional wastewater treatment technology in the new century

strong competitor.

四 MBR application

The following areas are considered to be the most promising areas for MBR application:

- >Upgrading of existing sewage treatment plants

Areas with no drainage system and fragile ecology

- >Regions or places that require wastewater reuse, such as hotels, car washes

- >Treatment of high concentration and refractory industrial wastewater

- >Treatment of Landfill Leachate

四. Aikeli State MBR specialty

(1)

Special HDPE film is manufactured by unique stretching technology

The slit film holes made by this unique stretching method can be more dense than the circular film holes, which can effectively remove microorganisms, avoid clogging, and can provide more stable membrane flow quantity.

(2)

Asymmetric Hollow Fiber Membranes

The inner surface of the asymmetric hollow fiber membrane produced by us using our patented technology

The surface gap is much larger than the outer surface gap. Such a special structure

The hollow fiber membranes produced by us have perfect filtration performance and high output

四、MBR application

(3)

The main process adopts the industry's first modular design

The box-type model we launched has a simple shape, convenient loading and unloading, and is easy to operate. It has the advantages of flexible operation and convenient maintenance. Also according to different customer requirements, modular design can be adopted. According to the different scene environment, different combination modes are adopted.

(4)

Optimal Design of Aeration System

Patented Arkley State (ECONITY) Aeration tubes provide more efficient aeration. Aeration is evenly distributed, saving energy consumption and correspondingly reducing operating costs. And cooperate with the box-type membrane to generate a closed space and promote lateral flow. The moving air velocity is maximized, which significantly reduces membrane surface fouling.

五 MBR Comparison

1. MBR Comparison with traditional activated sludge process

1.1 Introduction to Activated Sludge Process

The traditional activated sludge method is the basic mode of the activated sludge method to remove organic matter and suspended

things as the main purpose, **Applicable to situations where phosphorus and nitrogen removal do not need to be considered, its core processing**

It consists of unit aeration tank and sedimentation tank. Due to different operating modes and parameters, traditional activated sewage

The mud method has evolved into traditional aeration, complete mixing, stage aeration, adsorption regeneration, delayed aeration,

High-load aeration, deep well aeration, pure oxygen aeration and other processes

五 MBR Comparison

1. MBR Comparison with traditional activated sludge process

project type	MBR	Activated sludge + secondary settling tank	Advantages of MBR
Water way	intercepted effluent	Free sediment effluent	Suspended solids and turbidity are close to zero; Bacteria and viruses are largely removed.
residual sludge age		many	The output of excess sludge is low, reducing pollution mud disposal costs.
scope of application	secondary treatment Advanced processing	secondary treatment	MBR can be used for deep processing, Realize the reuse of sewage treatment.
Floor area	Small	big	High volume load, saving space, Not limited by the setting site.
Operation and management	full braking	manual operation	HRT and SRT can Realize microcomputer automatic control.

五 MBR Comparison

2. MBR and SBR Comparison

2.1 Introduction to SBR

The batch activated sludge process or the sequenced batch activated sludge process is referred to as SBR process, which is the active sludge process in the past ten years

One of the more eye-catching wastewater treatment processes in the sludge treatment system. SBR is the current active
A variant of the sludge process, its reaction mechanism and the removal mechanism of pollutants and traditional

The activated sludge method is basically the same, only the operation is different. **SBR The mode of operation is entered by**

It consists of 5 basic processes of water, reaction, precipitation, water discharge and standby. from sewage flow

From the start of input to the end of standby time is counted as one cycle. In one cycle, all process
In a reaction tank equipped with an aeration or stirring device, this operation is repeated again and again.
Repeatedly, in order to achieve the purpose of continuous sewage treatment.

五、MBR Comparison

2. MBR and SBR Comparison

2.2 MBR to SBR The advantages

project type	MBR	SBR	Advantages of MBR
Water way	intercepted effluent	Port water outlet	Flexible water outlet and continuous water outlet; Bacteria and viruses are largely removed.
Residual sludge age		many	The output of excess sludge is low, reducing pollution mud disposal costs.
scope of application	secondary treatment Advanced processing	secondary treatment	MBR can be used for deep processing, Realize the reuse of sewage treatment.
Floor area	Small	big	High volume load, saving space, Not limited by the setting site.
Types of organic matter removed		one	SRT is large, which is conducive to the generation of sludge diversification, increase the scope of processing

五 MBR Comparison

3. MBR Comparison with Biological Contact Oxidation

3.1 Introduction to Biological Contact Oxidation

Biological contact oxidation method - set filler in the main reaction area, through continuous cultivation to make Microorganisms attach to the filler, increase the biomass through the filler, and improve the mass transfer efficiency .

it has a high removal effect on COD, BOD, SS and other pollutants in process Oxygen required by microorganisms is usually supplied by artificial aeration. After the biofilm grows to a certain thickness, The microorganisms near the filler wall will perform anaerobic metabolism due to lack of oxygen, and the gas and aeration produced The scouring effect formed will cause the shedding of biofilm and promote the growth of new film, forming Biofilm metabolism. The types of fillers include granular fillers, honeycomb fillers, soft Fillers, semi-soft fillers, combined fillers, etc.

五、MBR Comparison

3. MBR Comparison with Biological Contact Oxidation

3.2 Advantages of MBR for biological contact oxidation + secondary sedimentation tank

Project type	MBR	Contact oxidation + secondary sedimentation tank	Advantages of MBR
Water way	intercepted effluent	Free sediment effluent	Suspended solids and turbidity are close to zero; Bacteria and viruses are largely removed.
residual sludge age		many	The output of excess sludge is low, reducing pollution mud disposal costs.
scope of application	secondary treatment Advanced processing	secondary treatment	MBR can be used for deep processing, Realize the reuse of sewage treatment.
Types of organic matter removed	many	one	SRT is large, which is conducive to the generation of sludge diversification, increase the scope of processing
Operation and management	full braking	manual operation	HRT and SRT can Realize microcomputer automatic control.

五、MBR Comparison

4. MBR Comparison with biological aerated filter

4.1 Introduction to biological aerated filter

Biological aerated filter (BAF for short) Also known as submerged biological aerated filter (SBAF for short), yes

A membrane treatment process that appeared in Europe in the late 1970s and early 1980s. Should

After the technology was initially used in the secondary treatment of sewage treatment, due to its good treatment performance,

The scope of application continues to expand. Biological aerated filters are divided into upflow and downflow. **aeration**

The main body of the biofilter can be divided into water distribution system, air distribution system, support layer, biological filler layer,

Backwashing system and other five parts. Sewage enters the filter from the upper part of the pool and passes through the packing of

The formed filter layer forms a biofilm inhabited by microorganisms on the surface of the filler. filter at effluent rate

At the same time, the air passes through the bottom of the filler, and rises from the gap of the filler, and the air that flows down

Oxygen in the sewage is transferred to the sewage when it is in contact with the air, providing the microorganisms on the biofilm

Sufficient dissolved oxygen and rich organic matter. Under the action of microbial metabolism, organic

Pollutants are degraded and sewage is treated.

五、MBR Comparison

4. MBR Comparison with biological aerated filter

4.2 Advantages of MBR for biological aerated filter

project type	MBR	Biological Aerated Filter	Advantages of MBR
residual sludge age		many	The output of excess sludge is low, reducing pollution mud disposal costs.
Types of organic matter removed	many	one	SRT is large, which is conducive to the generation of sludge diversification, increase the scope of processing
Operation and management	full braking	manual operation	HRT and SRT can Realize microcomputer automatic control.

五 MBR Compared

5. MBR and A2/O Comparison

5.1 Introduction to A2/O

A2/O consists of anaerobic section, anoxic section, aerobic section and sedimentation tank.

1. Anaerobic reactor, the raw sewage and the phosphorus-containing return sludge discharged from the sedimentation tank enter simultaneously, The main function of this reactor is to release phosphorus, and at the same time, part of the organic matter is ammonified;

2. Anoxic reactor, the primary function is denitrification, and nitrate nitrogen is reacted by aerobic reaction through internal circulation

Sent by the device, the amount of circulating mixed liquid is relatively large, Generally $2Q$ (Q is the raw sewage flow);

3, Aerobic reactor - aeration tank, this reaction unit is multi-functional, removes **BOD**,

Nitrification and phosphorus absorption are carried out here. Flow is $2Q$ The mixed solution flows back from here to the anoxic reactor.

4. Sedimentation tank, the function is to separate mud and water, part of the sludge is returned to the anaerobic reactor, and the supernatant The liquid is discharged as treated water.

五、MBR Compared

5. MBR and A2/O Comparison

project type	MBR	A2/O+secondary settling tank	Advantages of MBR
Water way	intercepted effluent	Free sediment effluent	Suspended solids and turbidity are close to zero; Bacteria and viruses are largely removed.
residual sludge age		many	The output of excess sludge is low, reducing pollution mud disposal costs.
Nitrification efficiency	high	Low	Microorganisms are completely trapped in biological inside the reactor, which facilitates the increase of Slow growth of nitrifying bacteria, Increase the rate of nitrification.
Floor area	Small	big	High volume load, saving space, Not limited by the setting site.