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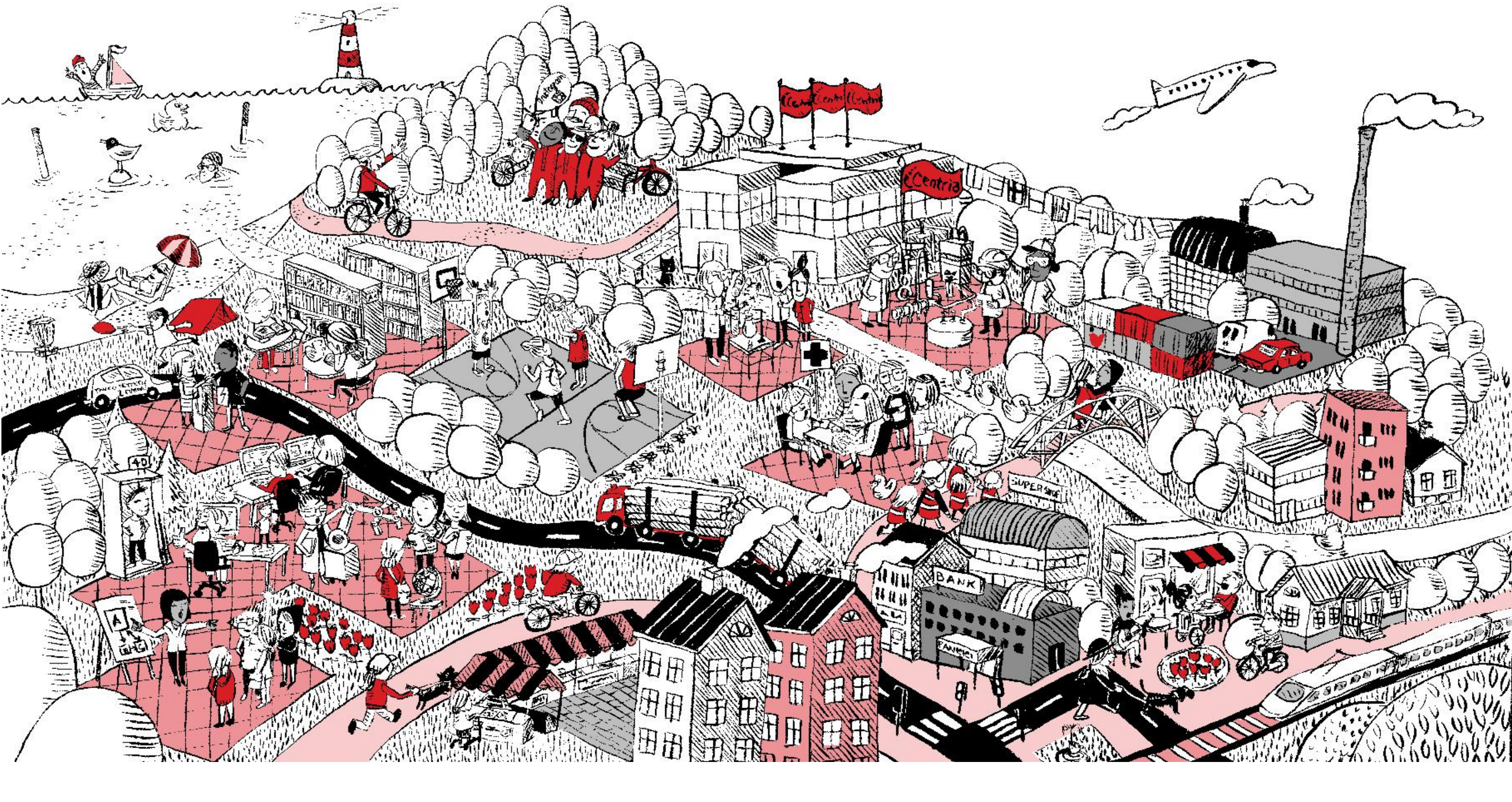
UTILIZE BURIED SEWAGE TREATMENT EQUIPMENT TO TREAT MUNICIPAL SEWAGE IN NORTHERN CHINA

Thesis
CENTRIA UNIVERSITY OF APPLIED SCIENCES
Bachelor of Engineering
May 2021



ABSTRACT

Centria University of Applied Sciences	Date		Author
	June 2021		Mingxin Dong
Degree programme			
Bachelor of Engineering			
Name of thesis			
UTILIZE BURIED SEWAGE TREATMENT EQUIPMENT TO TREAT MUNICIPAL SEWAGE IN NORTHERN CHINA			
Centria supervisor			**Pages**
Risto puskala			52

At present, environmental changes and resource shortage are some of the hot issues in the world, and how to make better use of resources is a problem those are now eager to solve. Better use of resources is equivalent to saving resources. So they make some brief introduction for buried sewage treatment equipment. Give them a new understanding of the method of wastewater treatment, the gradual rise of SBR process and MBR process, slowly, the advantages and disadvantages have emerged. those improved the two processes by many methods, such as chemical methods to strengthen or solve some pollution problems brought by the processes, and after that, those analyzed the municipal wastewater composition in northern China, and showed the possibility of using the two processes in northern China. They also predict and extrapolate the application of these two processes in china and worldwide.

Key words
Activated sludge method, membrane treatment, nitrogen and phosphorus removal, wastewater treatment equipment

CONCEPT DEFINITIONS

SBR:Sequencing batch reactor activated sludge process

MBR:Membrane Bio-reactor

A/O: Anoxic/Oxic

MSBR:Modified Sequencing Batch Reactor

IDEA:inter

DO:Dissolved oxygen

BOD5:Biology Oxygen Demmand

COD:chemical oxygen demand

PH: Potential of Hydrogen

ICEAS:Intermitent Cyclic Extended Aeration System

CASS:Cyclic Activated Sludge System

BHP:Broken Hill Proprietary Billiton Ltd

SEGERS:name of the company

ASBR:Anaerobic Sequencing Batch Reactor

UCT:Universal Time Coordinated

TP:Total Phosphorus

EPS:Electric Power Steering

PAC:poly aluminium chloride

SMP:Sludge mixture particles

HRT:hydraulic retention time

WRP:Windows Resource Protection

WWTP:waste water treatment plant

SNWTP:South-to-North Water Transfer Project

ABSTRACT
CONCEPT DEFINITIONS
CONTENTS

1 INTRODUCTION

Qualitative research gathers data about lived experiences, emotions or behaviours, and the meanings individuals attach to them. It assists in enabling researchers to gain a better understanding of complex concepts, social interactions or cultural phenomena. This type of research is useful in the exploration of how or why things have occurred, interpreting events and describing actions. Quantitative research gathers numerical data which can be ranked, measured or categorized through statistical analysis. It assists with uncovering patterns or relationships, and for making generalizations. This type of research is useful for finding out how many, how much, how often, or to what extent. Mixed methods research integrates both qualitative and quantitative research. It provides a holistic approach combining and analyzing the statistical data with deeper contextualized insights. Using mixed methods also enables triangulation, or verification, of the data from two or more sources. The inductive method and the deductive method, induction is to generalize the general conclusion principle from individual facts, and deduction is to draw individual conclusions from general principles and concepts, induction is the method from individual to general, while deduction is the method from general to individual. Comparative analysis, also known as analogy or analogy, is a method of dialectical logic that distinguishes between things or problems in order to recognize their differences, characteristics and essence. When there is not much information, not enough inductive and deductive reasoning, the comparative analysis method is more valuable. And next is the literature research method. The scientific method of cognition by collecting and organizing literature and studying it to form facts and this method is the oldest and most vital method of scientific research. It is used in all disciplines to obtain information from the literature for a correct and comprehensive study of the problem according to the research objectives and the subject. It can help to identify the research topic by recognizing the current situation and past of the problem. It helps us to form an initial impression of the research subject and helps us to observe further and deeper. It allows them to make comparisons from realistic and direct information to get a more comprehensive understanding of the research subject or the comparative analysis method.(University of Nescastle Library 15 12 2020.) I choose a method that is most suitable for the development of this process by considering the past, present and future trends of MBR technology. For the literature research method, I have studied a large number of papers, journals and books to get some ideas on improving the process technology and eliminating pollution.

Seventy years ago, human life spans were extremely short because people were always drinking raw, untreated water. But after the industrial revolution in 1840, the economy took off and brought people happiness and a better quality of life, while the waste water from factories flowed directly into rivers. In the beginning, it was the developed countries that discovered the importance of sewage treatment, which later developed the activated sludge method. At first the Lawrence Laboratory invented the activated sludge method, the prototype of the SBR method, during a chance aeration experiment, but this method was abandoned due to various disadvantages. At the same time, while the world was busy with the "industrial revolution" in their own countries, the issue of sewage treatment was put on the secondary position. Poisoning incidents and water shortages have occurred in many cities. therefore people have a new understanding of resource conservation and sustainable development and how they can treat wastewater efficiently and bring the effluent quality to a high level. therefore SBR technology and MBR technology were advanced with the times, SBR technology benefited from the end of the 20th century. The rapid development of the computer industry, coupled with a significant increase in the level of automation, combined with SBR technology to form a new and efficient method of wastewater treatment. SBR has many advantages, such as good purification, a very stable operating condition, and resistance to shock loads, and because of the combination with computers, the water quantity can be adjusted at any time and the operation is very flexible. It requires less equipment and less labour, which is very cost effective. MBR is also a new type of wastewater treatment, which uses biofilm technology to treat wastewater more efficiently than SBR, which was invented later than SBR, around 1960. The membrane module was invented by a company. The membrane modules were then used to try to treat wastewater. A great success was achieved. Now that the method is available, China is a large industrial country and has been developing heavy industry since the 1850s, but the absence of wastewater treatment technology on the same scale as the development of factories has led to the fact that wastewater treatment in China has always been a shortcoming. they have carefully analysed the differences between biological wastewater in the north and south of China to select the most suitable technology for application in the north of China, and they have briefly analysed some of the processes of the SBR and MBR processes, as the future trend of wastewater treatment plants must be towards miniaturisation and decentralisation. therefore processes that are too cumbersome and occupy too large an area are not suitable for the future trend and will be eliminated. therefore by introducing the two process flows to prove that both processes can be applied to the problem of treating wastewater in northern China, however SBR technology and MBR technology have many advantages but also many disadvantages, such as the MBR membrane contamination problem, because as time passes, there will always be some large molecules will remain on top of the membrane module, blocking the membrane pores and making the membrane flux lower, so that in this case, they recommend membrane cleaning or the addition of additives. For SBR technology, they can strengthen the nitrogen and phosphorus removal capacity of SBR by chemical reinforcement. At the moment. there is a lot of room for development of SBR and MBR technologies, they should make use of their advantages.reduce their disadvantages, and slowly develop them by applying them in northern China. (Sun & Lin 2019, 1–11.)The whole article starts with the origins of MBR and SBR, then goes on to describe the workflow, followed by improvements to each process, and finally the future outlook for both methods.

2 CONCEPT OF BURIED SEWAGE TREATMENT EQUIPMENT

Buried sewage treatment equipment is a comprehensive treatment equipment that combines the current more mature biochemical treatment technologies and is buried below the ground.There are many branches of buried sewage treatment equipment, each of which has its own different characteristics, advantages and disadvantages, and can handle wastewater containing different pollutants in different areas and different environments.
(YLHB 2018.)

2.1 Classification of buried sewage treatment equipment

Since the advent of the activated sludge secondary biological treatment technology in Manchester, England in 1914, this method has been widely adopted by countries all over the world. At present, many developed countries have popularized secondary biological treatment technology. However, in view of the problems existing in the activated sludge method, researchers from various countries have continuously reformed and developed this technology. The ordinary activated sludge method, anaerobic/anoxic/aerobic activated sludge method (A/O, A/ A/O), batch activated sludge method (SBR method), modified SBR (MSBR) method, integrated activated sludge method (UNITANK), two-stage activated sludge method (AB method),and they have various types biofilm method.(Jenkins D 2014.)

Sewage treatment technology in developed countries has evolved from the end treatment in the 1960s to the combination of prevention and control in the 1970s, from the centralized treatment method in the 1980s to the cleaner production in the 1990s. Over the years, treatment technology, facilities and equipment have been constantly updated. At present, the main development trend of sewage treatment technology is a combination of new technologies and new processes, such as simultaneous nitrogen and phosphorus removal aerobic granular sludge technology, electric/biological coupling technology, adsorption/biological regeneration process, and biological adsorption technology
(David jenkins 2014.)

2.2 Features of buried sewage treatment equipment

The treatment process adopts the combination of sludge adsorption and advanced contact oxidation technology. At the same time, it can achieve the purpose of dephosphorization and ammonia removal. The sewage treatment volume is large, the application range is wide, and the water output effect is good. Buried directly below the ground surface, it can be used as gardens, highways, or some public facilities, or under the basement or garage. It does not occupy ground surface area, does not waste public resources, has low noise during operation, and has no impact on the surrounding environment. Isolation and protection distance, no need to add insulation layer, programmable control system can be used during operation, the equipment has novel structure, high reliability, does not need special manned management, maintenance, high processing efficiency, good purification degree, and the internal content of the equipment.In the sludge treatment system, the amount of sludge produced is small, the energy consumption and management costs are low, and the operation is very convenient. It can be manufactured with three different materials according to the different requirements of different customers. It can also carry out unique process design according to different water quality conditions provided by customers.
(Ren&Zhao 2000.)

In addition to the many advantages of underground sewage treatment equipment, there are also some unavoidable disadvantages. For example, it is not conducive to maintenance. When the equipment fails, it is inconvenient to repair and replace, which is usually the most annoying for people. When using equipment in the north, they need to buy a deeper place.
(Jin 2021.)

2.3 Principle of buried sewage treatment equipment

The working principle of buried sewage treatment equipment includes three parts, anaerobic biological filter, contact oxidation bed, and sedimentation tank. The working principle of anaerobic biological filter includes filtration, hydrolysis, absorption, and denitrification. The principle of contact oxidation bed includes adsorption and uptake, decomposition. The working principle of the sedimentation tank is to use gravity to make the suspended sludge of the effluent contacting the oxidation bed sink to the bottom of the tank so that pollutants are removed from the water, ensuring better effluent water quality.
(Lu 2009.)

3 THE ORIGIN OF SBR AND MBR

In 1914, the activated sludge method used intermittent water intake and drainage at the beginning of its production, but at that time the operation was very cumbersome, and there was a lack of automated equipment and technology, so it was used by the continuous activated sludge method. replace. After the 1980s, the rapid development of computers brought the SBR process back to life. Because of its simple process, high efficiency, flexible operation mode and low sludge expansion, it has become one of the most popular sewage treatment methods.
(Shui 2019.)

3.1 The origin of SBR

The activated sludge method was born in the United States and England, and has been the mainstream technology for people's sewage treatment for more than 100 years. Around 1912, in Manchester, England, Fowler used the aeration method to treat the sewage in the reaction tank with the mud in the pond. After the aeration, the sewage is precipitated. The organisms in the sedimentation tank return to the aeration tank. In 1914, two students of Fowler, Ardern and Lockett, conducted experiments. Finally, Ardern and Lockett named the precipitate formed during the reaction "activated sludge". With the development of the following decades, the SBR technology became more and more perfect.
(Shui 2019.)

3.2 The revival of SBR

In the United States until the end of the 1940s, with the gradual maturity of automatic control technology, SBR was once again recognized by people. From 1951 to 1953, laboratories in the eastern United States used SBR technology for the first time to treat industrial wastewater from dairy plants. In 1959, Pasveer introduced the SBR process to the Netherlands. From 1965 to 1975, the SBR process derived many auxiliary processes. In the 1970s, Australia applied the IDEA system, which is an improved SBR process.
(Shui 2019.)

With the continuous improvement of the discharge standards of nutrients in industrial wastewater and urban sewage, including nitrogen and phosphorus, the advantages of the SBR process for nitrogen and phosphorus removal have become more distinct. Therefore, the SBR process is more used in their daily production and life. In the 1990s, in order to remove nutrients in wastewater, people made improvements to the IDEA system. It become more effective to control sludge expansion. In 1985, China's first sewage treatment plant with SBR process for sewage treatment was completed in Shanghai Wusong Roulian Plant.
((Shui 2019.)

3.3 The origin of MBR

The research on MBR originated in the 1960s, and the development of the next few decades provided a solid scientific and technological foundation for large-scale MBR industrial and commercial applications. In 1969, Smith first created the bench. The membrane separation system is combined with the aerobic activated sludge method to treat urban sewage. The first membrane bioreactor was developed commercially by Dorr-Oliver in the late 1960s. Afterwards, it apply to ship sewage treatment.
(Li Liu &Wu 2011.)

The original design intention, especially the flow-measuring MBR configuration, was to directly control the hydrodynamics of membrane fouling, and to provide the advantages of easier membrane replacement and high-efficiency production, but the energy consumption became very high. In 1989, Yamamoto invented the immersion MBR. By the early 1990s, Zenon had launched a series of immersion MBR products. In 2003, a double-layer design was introduced.
(Li,Liu &Wu 2011.)

4 PROCESS CHARACTERISTICS AND PROCESS

After we understand the origin of MBR and SBR, they should have a deeper understanding of the workflow and some characteristics of SBR and MBR, so that they can choose which process to treat for different environments and different pollutants, therefore what they need is an increasingly simple process. since this can improve the efficiency and it can also save on costs.
(Lenntech 1998.)

4.1MBR process characteristics and processes

The MBR process is a new wastewater treatment technology that organically combines membrane separation technology and biotechnology. It uses membrane separation equipment to intercept the activated sludge and macromolecular organic substances in the biochemical reactor, thus eliminating the secondary sedimentation tank, and the concentration of activated sludge becomes higher because of this operation.
(Lenntech 1998.)

In conventional biological wastewater treatment technology, the separation of mud and water is accomplished by gravity, with the operation completed in a secondary sedimentation tank. Its separation efficiency relies on the settling properties of the activated sludge, the better the settling properties. The better the settling properties, the higher the separation efficiency of mud and water. And the operation of the aeration tank determines the settling properties of the sludge.they must strictly control the operating conditions of the aeration tank. This also limits the scope of application of the method to a certain extent. Due to the characteristics of the solid-liquid separation requirements of the secondary settling tank, the sludge in the aeration tank cannot be maintained at a high concentration, which generally ranges from around 1.5gl to 3.5gl. This serves the purpose of limiting the biochemical reaction rate.
(Lenntech 1998.)

The MBR process is achieved by combining membrane separation technology with traditional biological wastewater treatment technology. This means that the biodegradable organic pollutants in the water are removed by activated sludge. The purified water is then separated from the activated sludge using membranes for solid-liquid separation. The hollow fibre membrane filaments are tubular in shape and the microporous walls intercept the activated sludge and most of the suspended matter, resulting in clear and transparent effluent with excellent water quality. In addition, in order for the membrane to operate stably over a long period of time, a certain amount of aeration should be carried out under the membrane to meet the biological oxygen demand and to keep shaking the membrane filaments to prevent the activated sludge from adhering to the membrane surface.
(Stauffer 2019.)

All in all, MBR provides efficient solid-liquid separation, and this separation is far better than that of a conventional sedimentation tank. The quality of the effluent is excellent, with near-zero suspended solids and turbidity in the effluent. It can be used immediately. The resourcefulness of the effluent is got realized In line with contemporary sustainable development objectives, microorganisms are completely trapped in the bioreactor by the efficient retention of membranes. Operational control is flexible and stable. In terms of cost, the MBR reduces the footprint and saves on civil construction investment as it combines the aeration tank and secondary sedimentation tank of conventional wastewater treatment into one and replaces to some extent all the flat facilities of tertiary treatment. For nitrogen and phosphorus removal, because the system facilitates the retention and reproduction of nitrifying bacteria, the system has a high nitrification efficiency and improves the ability to remove nitrogen and phosphorus. This, together with the fact that it can be recycled, it can improve the degradation efficiency of difficult to degrade organic matter. And zero sludge discharge can be achieved.
(Stauffer 2019.)

4.2 The workflow of MBR

The specific process of the MBR process is probably the use of membrane separation technology to strengthen the function of the bioreactor, where the ultrafiltration membrane is usually directly submerged in the aeration tank.(stauffer 2019.)so that it is directly in contact with the biological reaction mixture. through the negative pressure of the filter pump pumping the filtered water through the external pressure hollow fiber membrane to achieve solid-liquid separation. The differential pressure of the negative pressure pumping is very high, with a maximum head of only 2.2 metres, and the energy required to process the water per unit is very small. In the filtration process,it pass air through the blower at the bottom of the membrane. On the one hand, the turbulence generated by the rising airflow has a scrubbing effect on the outer surface of the hollow fibre membrane, because in this way the solids adhering to the membrane surface can be continuously removed, preventing or reducing the pollution or blockage of the membrane. On the other hand, the air flow also has an aeration effect. This provides the majority of the oxygen consumption required for biodegradation. In addition to this, a small proportion of the other oxygen required for biodegradation is supplied by the Crowthorne aeration system. The large amount of sludge produced in the biological reaction is discharged directly from the ultrafiltration membrane reactor.
(Stauffer 2019.)

MBR technology has been chosen in the form of anoxic and aerobic composition, firstly the waste water enters the anoxic zone. At this stage, the large molecular weight long-chain organic compounds are split into smaller organic compounds that are easily biochemically reactive, and then the wastewater enters the aerobic zone to start the biodegradation of organic compounds. The biological nitrification reaction starts at the same time as the degradation, completing the denitrification function.
(Stauffer 2019.)

In the aerobic zone, the following chemical reaction takes place in the presence of nitrifying bacteria.
$2NH_4^+ + 3O_2 \rightarrow 2NO_2^- + 4H^+ + 2H_2O$
$2NO_2^- + O_2 \rightarrow 2N0_3^-$.
Anoxic zone. The following chemical reactions take place in the presence of denitrifying bacteria.
$6NO_3^- + 2CH_30H \rightarrow 6NO_2^- + 2CO_2\uparrow + 4H_20$
$2N0_2^- + 3CH_3OH \rightarrow 3N_2\uparrow + 3H_20 + 60H^- + 3C0_2$

4.3 Process characteristics and flow of SBR

After they specifically talk about MBR process, they want to introduce the workflow of SBR process. Compared with MBR process, SBR process is relatively tedious, but it will also be more efficient in nitrogen removal and phosphorus removal, and the workflow will become relatively simple with the combination of computer industry and increased automation in the future.
(Huan 2019.)

4.3.1Process characteristics of SBR

Unlike traditional wastewater treatment processes, the main feature of SBR technology is its orderly and intermittent operation. The core of SBR technology is the SBR reactor, which combines a series of functions such as homogenisation, primary sedimentation, biodegradation and secondary sedimentation in one tank, without a sludge return system.
(Huan 2019.)

The SBR process has many advantages in different aspects and perspectives. First of all,the ideal push-flow process makes the biochemical reaction propulsion increase, making the efficiency higher,and the anaerobic and aerobic processes in the pool are in an alternating state and the purification effect is good. The operation is stable and the effluent settles in an ideal state of stillness, the time required is very short, so the efficiency is high and the quality of the effluent is good.
(Huan 2019.)

In terms of impact resistance, the reaction tank has stagnant treatment water.which has a dilution and buffering effect on the effluent and can effectively resist the impact of water quantity and organic pollutants.and in terms of flexibility, the various processes in the process can be adjusted according to the water quality and quantity. and the operation is flexible enough.
(Huan 2019.)

The presence of a DO, BOD5 concentration gradient in the reactor can effectively control the expansion of activated sludge. The SBR system itself is suitable for the combined construction method, and for the current trend of wastewater treatment plants, the SBR process is beneficial for the expansion and renovation of wastewater treatment plants. The largest advantage of SBR is its nitrogen and phosphorus removal, through proper control of the operation method, to achieve the alternation of

aerobic and anoxic anaerobic state, with good nitrogen and phosphorus removal effect. The main equipment is only a sequential batch intermittent reactor.there is no secondary sedimentation tank, sludge return system.conditioning tank, primary sedimentation tank can also be omitted.the overall layout is compact, saving a lot of floor space.
(Huan 2019.)

4.3.2 The workflow of SBR

The working process of SBR is that the effluent is added to the reactor in a relatively short period of time. After the reactor is filled with water, they start aeration and after the organic matter in the effluent has been biodegraded to meet the government discharge requirements, and they then stop aeration and discharge the supernatant after settling for a certain period of time. A brief summary has the five stages, and inlet stage, reaction stage, sedimentation stage, drainage stage, standby stage.
(Dowater 2018.)

The water inlet stage is the period of time from the start of the water inlet to the reactor until it reaches its maximum volume. The time used in the water inlet stage is determined according to our actual drainage situation and the specific conditions of the equipment anaerobic reaction and resting. In the aeration state the organic matter is already being oxidized in large quantities during the water intake. In the case of stirring, the aerobic reaction is inhibited, and these three methods correspond to unrestricted aeration, semi-restricted aeration and restricted aeration. they use unrestricted aeration, semi-restricted aeration and restricted aeration for the water intake. By controlling the environment of the influent stage, they can achieve a wide range of treatment functions while keeping the reactor intact. However, in continuous flow it is relatively difficult to change the reaction time and conditions as the parameters such as the size of the Russian structures and pumps in the system are already set.
(Dowater 2018.)

The reaction stage is the most important stage of the SBR process system, in which pollutants are removed by the degradation of microorganisms, depending on the needs of the wastewater treatment. Depending on the needs of the wastewater treatment, the corresponding technical parameters can be adjusted and the reaction stage can be determined according to the raw water quality and the specific conditions of the relevant government discharge standards to determine whether the continuous aeration method is required.
(Dowater 2018.)

In the sedimentation phase, there are three purposes of sedimentation, solid-liquid separation, sludge flocculation and supernatant separation. The so-called solid-liquid separation is equivalent to the function of a secondary sedimentation tank in the traditional activated sludge method. By stopping aeration and agitation, the mixture is left in a static state. In order to complete the separation of mud and water, the separated supernatant obtained after sedimentation can be discharged directly because of the good effect of static sedimentation. the reactor is completely stationary during the precipitation process. In SBR systems this process is very efficient and the settling process is generally time-limited, with settling times generally ranging from half an hour to an hour, and may even sometimes take up to two hours, in order to facilitate the next drainage process. And the sludge layer has to be kept below the drainage equipment. The most important point is that the water level must not rise above the drainage equipment until the discharge is complete. Currently, with the development of measuring instruments, it is possible to automatically detect the sludge slurry level. Because of this technology, they can vary the settling time according to the settling properties. they can set a value in advance on their automatic control system and once the sludge interface meter detects that the sludge clean surface height has reached this value, they can end the settling process of the system.
(Dowater 2018.)

The fourth stage, the drainage stage, which aims to drain the sludge clarifier from the reactor and bring it all the way back to the lowest water level at the start of the cycle, which, in addition to this, has to be at a certain protective height from the sludge layer. Most of the sludge that settles at the bottom of the reactor is used as return sludge for the next cycle. Excess sludge in this stage can be removed in the drainage stage or in the final standby stage, SBR drainage is generally done with a decanter and the time used for decanting is determined by the decanting capacity. This process generally does not affect the sludge layer below. It is also possible to start draining the sedimentation, while at the same time we must control the decanting speed, above all in such a way that the sedimentation is not affected with priority. In this way the sedimentation and decanting phases can be integrated, resulting in a higher efficiency.
(Dowater 2018.)

The last stage is the standby stage. They call the period from precipitation to the beginning of the next cycle as the standby process. they can stir or aerate as needed in a multi-reaction tank system. The purpose of standby is to provide time for a reactor to complete its entire cycle before moving to another unit. The standby stage is not a necessary step, they can go to the point. During the standby

period, they can aerate, mix, and remove the remaining sludge according to the process and treatment purposes. The length of the standby stage is determined by the amount of water to be treated to remove the remaining sludge. Another important step in the operation of SBR during mud.
(Dowater 2018.)

5 POLLUTANT COMPONENTS IN WASTEWATER

There are many wastewater treatment plants in the world, and there are also many different components of wastewater. Some places have more developed industries, so there will be more toxic substances and difficult to remove organic substances in the wastewater, and industrial wastewater is divided into many kinds, such as petrochemical wastewater, wastewater from dye plants, and the premise of our choice of wastewater treatment methods is to find out what substances are contained in the wastewater we want to treat.
(Min K 2015.)

5.1 Composition of municipal sewage in northern China

Generally speaking, urban runoff is caused by rain and snow, which removes pollutants from the urban atmosphere and is formed when buildings, floors and rubbish are washed. In the early stages of rainfall with the amount of pollutants contained can be many times higher than that of domestic sewage. Municipal sewage generally contains organic pollutants such as COD and BOD5, as well as many carbohydrates, proteins, amino acids, fatty acids, oils and lipids. This is why it is often necessary to use BOD/COD to evaluate the biodegradability of wastewater when selecting a wastewater treatment process. In terms of research and testing methods, the change curve of biological respiration oxygen amount versus time is often used to indirectly express the degradation rate of organic matter, and can also indirectly react to biodegradability through this method, and for data, the content of urban sewage BOD5 is generally 100mg/l~500mg/l.
(Min K 2015.)

Urban sewage not only has organic pollutants and a large number of suspended solids (SS = 150mg/L ~ 500mg/L), including organic and inorganic substances. SS is also the main material constituting COD, BOD, SS contains a large number of inorganic particles and colloidal particles. the original organic compounds in the sewage.inorganic substances and pathogenic bacteria have adsorption effect. SS is a pollutant that should be considered for removal in the primary unit of the sewage treatment process. At present they can use a combination of sedimentation coagulation, sedimentation, filtration and other physico-chemical methods to separate and remove.
(Min K 2015.)

Next is the most important that nitrogen in municipal wastewater, which can originate from domestic and industrial wastewater. Firstly, the nitrogen contained in domestic wastewater such as human excreta (faeces) is discharged through sewers to sewage treatment plants. For example, industrial production discharge wastewater from fertilisers, foodstuffs, coking, which all contain high levels of nitrogen. This tends to cause a serious imbalance in the carbon to nitrogen ratio in the wastewater treatment plant, and the problem of incomplete biological denitrification arises. There are many forms of nitrogen throughout the wastewater treatment process. Raw water contains ammonium salts and organic nitrogen.
(Min K 2015.)

These pollutants come from a variety of sectors, for example, cyanide wastewater from electroplating, gas, coking, metallurgy, metalworking, chemical fibres, plastics, pesticides, chemicals.Both inorganic and organic cyanide are highly toxic and can cause acute poisoning when ingested, with cyanide being lethal to humans at 0.18 and potassium cyanide at 0.12g.
(Min K 2015.)

The biological section is converted into nitrate. The product of biological denitrification, which is nitrogen is discharged outside the water treatment system. The phosphorus in municipal wastewater comes from domestic sewage and surface runoff. Domestic wastewater contains about 30-75% of elemental phosphorus. As municipal wastewater is always mixed with pollutants carried by industrial wastewater or surface runoff. As a result, some municipal wastewater may often contain non-conventional inorganic and organic pollutants such as heavy metals such as fluoride, arsenic, cyanide, pesticides and polycyclic aromatic hydrocarbons.
(Min K 2015.)

5.2 Northern urban domestic wastewater

They have also carried out a lot of research in the area of domestic wastewater.It is mainly a variety of detergents and sewage, rubbish, faeces,used in urban life, generally non-toxic inorganic salts. The first is pathogenic contamination. It is characterized by large numbers, wide distribution and a long survival time. The reproduction rate is rapid. It is easy to produce resistance, and it is difficult to eliminate, the traditional secondary biochemical sewage treatment, and certain pathogenic microorganisms can still survive in large numbers, causing human disease. There is also aerobic organic pollution. Organic

pollution of this kind all have a common feature, that is, these substances are directly into the water body after. Through the biochemical is action of microorganisms.and it can decomposed into simple inorganic substances, that is, carbon dioxide and water. his decomposition process requires the consumption of dissolved oxygen in the water. The pollutants decompose under conditions of oxygen deprivation and deteriorate the water quality. Often these organic substances are referred to as aerobic organic substances. The more oxygen-demanding organic matter there is in the water, the more oxygen is consumed. The poorer the water quality, the more polluted the water is.
(Min K 2015.)

Eutrophication is a phenomenon where too much nitrogen, phosphorus and other plant nutrients can cause water pollution. Eutrophication in aquatic ecosystems can occur through chemical pollutants and occurs in two ways. One is through an increase in the amount of inorganic nutrients used to qualify plants under normal conditions. In addition to the increase in organic matter as a decomposer, malodour is also a common pollution hazard. It is also often released in polluted water bodies, and there are about 4,000 different types of malodour that can be detected. Of these, there are about a few dozen that are very harmful. The dangers of bad odours are manifested in the fact that they impede the normal breathing function of people. It also impairs digestive function. Mental irritability is a significant reduction in productivity. Judgement and memory are also reduced. and long-term exposure to bad smells can damage the central nervous system. therefore it can also produce the toxic hazards of hydrogen sulphide and formaldehyde.
(Min K 2015.)

Acid and alkali pollution is also very typical of pollution, acid and alkali pollution makes the PH of the water body change, destroying the buffering effect of the water body, to destroy or inhibit the growth of microorganisms. To a certain extent, it hinders the self-purification of the water body. Acid and alkali pollution can also corrode bridges, ships,This pollution often enters the same body of water at the same time and, when neutralised, can produce certain salts. From a PH point of view, acid and alkali pollution are self-cleaning because of the neutralisation effect. However, various salts are produced at the same time. These salts in turn become new pollutants in the water body, as the increase in inorganic salts in turn increases the osmotic pressure of the water. For freshwater organisms, plant growth has a negative impact. Especially they are in saline areas. The various inorganic salts contained in surface water and groundwater will further harm the quality of the soil.
(Min K 2015.)

As with acid, alkaline and salt contamination, groundwater hardness increases and high hardness is achieved. The dangers of particularly hard water are manifested in many ways. In addition to being difficult to drink, it can also cause digestive disorders and diarrhoea, among other things. It is very harmful to people's daily lives.consumes a lot of energy and also affects the life of kettles and boilers, which are prone to scaling and can be more prone to explosions. Softening and purification are required.
(Min K 2015.)

6.PROCESS IMPROVEMENT METHODS

they have introduced some characteristics of SBR process and MBR process in the previous article.that is in the chapter 3, that is, some advantages and disadvantages. they have to expand the advantages of the two processes and overcome the disadvantages of the two processes. they have many ways to improve these two processes. below it rite some improvement methods that have been successful and will be successful. and some suggestions and insights I have for these improvement methods.
(Zhuo Wang 2018.)

6.1 Analysis of the disadvantages of SBR

The entire operation of the SBR process is mainly controlled by the time sequence. Each operating cycle is divided into 5 stages: influent, reaction, sedimentation, discharge and inactivity. In practice, the SBR process is mostly designed or controlled in the most basic way, but when we require the simultaneous removal of organic matter, nitrogen and phosphorus, the efficiency of the organic matter removal is very high. However, because of the environmental conditions required for nitrogen and phosphorus removal, the basic substances required are different and the products interact with each other. This makes it difficult for the SBR process to achieve our ideal results in terms of nitrogen and phosphorus removal.
(Zhuo &Wang 2018.)

The first is that the various stages of an operating cycle are carried out in a chronological mode, and the whole cycle of sedimentation, drainage and sludge discharge is extremely detrimental to ensuring low phosphorus concentrations in the effluent. And not only that, the stages of sedimentation and drainage are both quite time consuming, usually around 2 hours,The sludge is in an anaerobic and anoxic state. Therefore, some of the phosphorus in the sludge is released early. This leads to an impact on the phosphorus concentration in the system effluent.
(Zhuo Wang 2018.)

In terms of phosphorus removal, the SBR process operates in a flexible mode throughout, although the influences of substrate concentrations and toxic and harmful substances on the treatment effect are taken into account. For example, non-limited aeration is used to increase the resistance of the process

to shock loading, but this idea runs counter to the environmental conditions required for nitrogen removal or phosphorus removal. therefore when they use SBR technology in practice they often choose to weaken the effect of nitrogen removal or phosphorus removal. For phosphorus removal, a non-limited or semi-limited influent is used. On the other hand, for nitrogen removal, the denitrification of nitrogen in the nitrate state will be affected, Therefore, if the traditional SBR process is to achieve both organic matter removal and nitrogen and phosphorus removal and we need to improve its operating conditions.
(Zhuo &Wang 2018.）

6.2 SBR process improvement method

they consider the feasibility of these improvements in four ways. Mainly for adding some stages to the SBR process, or changing some parameters,To achieve the results they want. In summary, the aim is to improve the effectiveness of nitrogen and phosphorus removal.
(Zhuo &Wang 2018.）

6.2.1 Improved process for operating methods with phosphorus removal

The specific process of the improvement is, firstly, the inlet stage, then the aeration stage, followed by the sedimentation and discharge stage and finally the drainage stage. In the inlet stage, they have strict control over the operating practices of the dissolved oxygen content in the reactor. This allows the sludge to make full use of the substrate in the influent water under anaerobic conditions, further to the full release of phosphorus. however, It is advisable to set up a stirring device. Allow for good agitation at this stage.and they allowing the influent stage to be fully mixed and in contact with the sludge left in the reactor from the previous cycle. therefore maintain and control a good anaerobic environment with a DO not greater than 0.2mg/L
(Zhuo &Wang 2018.）

they can improve the timing and operation of the three stages after the aeration stage, the settling, the draining and the sludge discharge. The sedimentation stage will be first, followed by the drainage stage and finally the sludge discharge stage. This will be changed to a sedimentation stage followed by a drainage stage and finally a dewatering stage, i.e. the drainage and dewatering stages will be changed. This means that the sedimentation stage is followed by the discharge stage. The dewatering stage is the

final process.There are a number of reasons why we have modified the process to look like this. The purpose of this is to allow for the timely discharge of mud. This prevents the early release of phosphorus from the sludge during the two hours between the settling and draining stages. This allows the phosphorus collecting bacteria to drain the entire system in the form of residual sludge before the phosphorus is released, thus ensuring the quality of the system's effluent.
(Zhuo &Wang 2018.)

6.2.2 Operation with nitrogen removal Improved process

The specific improvement process is to start with the inlet stage, then the aeration stage, then stopping the aeration and mixing, settling, draining and discharging the mud. This is the improved way of operating the SBR process for denitrification. It compare to the basic operation of a normal SBR. An additional stop aeration and mixing stage is added. The specific flow of this stage is that in the stop aeration stage, although the organic substrate in the mixture has been largely oxidized after aeration. The denitrification effect is not very significant, but compare to the basic operation method. therefore it is a mixture that has been denitrified. Therefore it is very beneficial for the overall denitrification effect. In general, this operation and process can increase the total denitrification efficiency of the improved SBR by 70 to 80 %.
(Zhuo &Wang 2018.)

6.2.3 Improved process for operation with both nitrogen and phosphorus removal

In practical engineering applications, we often need to have both nitrogen removal and phosphorus removal at the same time. However, the SBR method is used to complete two different processes, nitrogen removal and phosphorus removal, in different operating stages in one reactor, so in order to obtain good treatment results. And it obtain good treatment results, it is important that the operation is controlled properly. Taking into account the operating conditions they need to achieve both nitrogen and phosphorus removal, they have improved the SBR operation.
(Zhuo &Wang 2018.)

The specific operating process is including dewatering and mixing aeration deaeration and mixing sedimentation and discharge dewatering. At the same time, the nitrogen and phosphorus removal is improved in order to ensure that the phosphorus is fully released during the anaerobic phase. In

addition to the basic decomposition of organic matter during the aeration phase, they also strictly control the dissolved oxygen DO to be no greater than 0.2 mg/L. they also need to ensure operating conditions for nitrification and phosphorus uptake, and they need sufficient operating time.they explain the aeration phase.after that they need to ensure a good denitrification effect. This is why they add a stop aeration stirring, on the one hand to fully mix the contact, and on the other hand to carry out denitrification at this stage, as at this time the mixture contains a higher concentration of NO a N. This not only improves the efficiency of denitrification, but also reduces the concentration of NO a N in the mixture at the inlet stage, which is more conducive to the full release of phosphorus.
(Zhuo &Wang 2018.）

6.2.4 Improved operation to enhance nitrogen and phosphorus removal

They intend to improve the overall nitrogen and phosphorus removal. The first is to reasonably control the drainage volume. Reasonable control of the drainage volume not only makes full use of the effective volume of the reactor, but also controls the key of the effluent SS. If too much water is drained, or if the drainage rate is too fast, there will be a situation where the discharge water carries a lot of suspended SS at the later stages of drainage. This can affect the effectiveness of the treatment of organic matter and also, in turn, phosphorus. Numerous studies have shown that if the phosphorus content of the sludge is 6%, an increase of 10mg/L in SS will increase the phosphorus mass concentration in the effluent by approximately 0.6mg/L.
(Zhuo &Wang 2018.）

After that is the reasonable control of the sludge discharge will directly affect the sedimentation effect of SBR wastewater treatment. therefore each time the sludge volume needs to be strictly calculated, or the sludge discharge volume Qw of the SBR process, they generally control according to the age of the sludge.
(Zhuo& Wang 2018.）

Finally, there is the enhancement of the effectiveness of nitrogen and phosphorus removal, based on the principles of denitrification and phosphorus release, as well as the required environmental conditions. In SBR reactors a space with a residence time of roughly 1 hour is provided to return the mixture to this area, or a small zone with a residence time of 30 minutes is separated to allow the influent water and the returning sludge to mix and come into contact, with the same effect as adding an

agitator. Good nitrogen removal or phosphorus removal can be achieved. Improved methods and processes for SBR such as ICEAS and CASS are now available in practical engineering. The aim is to develop them for different problems and treatment objectives.
(Zhuo &Wang 2018.）

6.3 Modified SBR process method

For some improvement methods of MBR process other than what we wrote before. there are still some problems that need to be improved, they are shifting our attention to SBR process.there are a lot of improvements to be made in SBR process.and as long as the improvements are successful. SBR technology will have a great improvement and the efficiency will become higher.but they still can not forget to pay attention to the pollution that comes with it while improving the technology.
(lv 2008.)

6.3.1 ICEAS method

The ICEAS method is a second generation variant and development of the SBR process. It is a modified version of the SBR process and the ICEAS method allows for continuous influent, biological oxidation, nitrification, denitrification and solid-liquid separation in a single reactor. This improved technology was developed in 1968 in collaboration with Australian universities and the American company ABJ. The world's first ICEAS wastewater treatment plant was built in 1976. In 1988 the Australian company BHP incorporated computer technology into the technology. The process was further developed. It is now the most advanced biological phosphorus and nitrogen removal process using a computer-controlled system.
(lv 2008.)

Compared to the normal conventional SBR process, the ICEAS process has changed from the original five stages of influent, reaction, precipitation, effluent and idle to only three stages of reaction, precipitation and decantation. There are also some different features. The new process has an additional pre-reaction zone at the inlet port of the reactor and operates on a continuous inlet and intermittent discharge basis, without a particularly distinct reaction or idle phase. A system with such an operating structure will be more cost effective and relatively easy to manage than a conventional SBR system for the treatment of municipal and industrial wastewater it is more in line with the current trend of the times.(lv 2008.)

6.3.2 CASS Method

The CASS method is a third generation variant and development of SBR. It was developed and researched from the SBR process and oxidation ditch technology and the developers were Professor Goronszy and his colleagues. This third generation technology is the most advanced process for the treatment of domestic and industrial wastewater that has gained international recognition in recent years. The main principle of this method is to divide the entire reaction tank of the SBR, along its length, into two parts, the front half being the biological selection zone, also known as the pre-reaction zone, which is the pre-reaction zone added in the ICEAS method, and the rear part being the main reaction zone. In the rear part of the main reaction zone, the CASS method is again installed with a liftable skimming device, aeration, sedimentation, making it possible to have it in the same reaction tank cycle. This eliminates the need for a secondary sedimentation tank and sludge return system of the conventional activated sludge method.
(lv 2008.)

The CASS process is based on the principles of bioreaction kinetics and relatively reasonable hydraulic conditions. New processes for wastewater treatment have been developed based on these, together with the SBR system process itself, which deals with nitrogen removal and phosphorus removal. It is therefore well suited to cities with a high level of industrial wastewater, such as northern China, where there is a lot of heavy industry. The wastewater is treated to a level that meets national standards. With the progress of the times, the level of automation is increasing and the process research for CASS has become more and more in-depth and constantly improved. At present the main application of this process method is still the large European wastewater treatment plants, characterised by low investment, very easy operation and management, which can be built in stages. These characteristics are very suitable for China's national conditions. CASS technology is now gradually being extended to China, with the Space City project in Beijing being an early application of the CASS process in China.
(lv 2008.)

6.3.3 UNITANK method

The UNITANK method can also be called the alternating biological treatment method. It is a third generation variant and development of the SBR method. Together with the CASS method it is also the third generation and it originated in the 1990s when it was developed by the Belgian company SEGERS. This new method has the advantages of both the SBR method and the traditional activated sludge method. Its integrated design brings together the main features of the SBR method. It can also be operated continuously at a constant water level, like the traditional activated sludge method. The UNITANK system is very much like a three-trench oxidation ditch system in terms of the form of the structure. It is made up of three rectangular tanks. In these three tanks the outer rectangular tanks on both sides can be made into both aeration and sedimentation tanks, while the middle rectangular tank is only an aeration tank. A large amount of construction costs are reduced and the design is more rational.
(lv 2008.)

UNTANK is a lower load wastewater treatment process. the effluent quality is very good, because the load is very low. generally do not set up a separate primary sedimentation tank. secondary sedimentation tank and aeration tank is often combined. combined into one, due to the long age of the sludge, sludge is more stable. generally can not do stabilization treatment. can be directly treated or applied. The facilities used to stabilize the sludge were omitted. The overall simplification of the process makes operation and management very simple, but the relatively low load and long sludge age can also make the biochemical part much higher. The UNTANK process is economical, scientific and practical. they have adapted to the miniaturisation and centralisation of factories in the future.It will have an important place in wastewater treatment. There are already nearly 200 projects around the world using UNTANK technology. In Asia, urban wastewater treatment plants of a certain scale have been built in Singapore.in China it has not yet been applied to a large extent. there are small applications in the Macau region and Guangdong. which also get very good treatment results.
(lv 2008.)

6.3.4 MSBR method

The MSBR method is known as the Modified Sequential Batch Reactor (MSBR). The discovery was made by C, Q, Yang et al at 2009. who developed a more ideal method of wastewater treatment based on the technical characteristics of SBR and also combined it with the traditional activated sludge technology. The process principle is that phosphorus is released in the anaerobic zone and absorbed in the aerobic zone. Repeatedly, phosphorus is removed and the pollutants are oxidized in the aerobic zone. Thus they can remove COD and BOD5. under the action of nitrifying bacteria. The organic nitrogen continues to convert itself into ammonia nitrogen and nitrite nitrogen. Afterwards a large amount of the mixture containing nitrate nitrogen is returned to the anoxic zone for the denitrification denitrification stage. This method is suitable for larger scale wastewater treatment plants. Although not in line with future trends, it can still be applied in the last decade.
(lv 2008.)

6.3.5 A number of other SBR improvement processes

Immobilized cell technology combined with SBR, a technology that has been rapidly developing worldwide since the late 1960s, relies on chemical or physical methods to locate free cells in a defined space and keep them active so that they can be used again. Immobilized cell technology has considerable promise in the field of wastewater treatment, especially for specialized wastewater treatment. Li Feng (Feng 1995.) used immobilized cell technology in SBR to treat ammonia nitrogen wastewater with a COD removal rate of 92.43%, which is compared to the general suspended biological method SBR. The main advantages of this technology are the high removal rate of the substrate and the small amount of remaining sludge. They understand that treatment of difficult municipal wastewater through a combination of biological and chemical techniques.
(Zhao 2001.)

ASBR, also known as the Anaerobic Sequencing Batch Reactor, was developed in recent years at the University by Dague and Ciworks, who first published the basic principles of the ASBR process. Later they had further studies on the treatment of highly concentrated industrial and agricultural wastewater by ASBR under medium temperature conditions. This was later found to have good treatment results. This process has advantages that other anaerobic processes do not have. It provides a high concentration gradient of substrate for the bacteria in the influent stage, enhances the reaction power and can maintain a high degradation rate at low temperatures for a period of time. It also does not

require added heat, which can save costs. In addition to foreign scholars, Chinese researchers are also working on this process.
(Zhao 2001.)

6.4 Chemically enhanced SBR process for biological nitrogen and phosphorus removal

Under normal conditions, single reactor biological nitrogen and phosphorus removal has the problem of the different sludge ages required for phosphorus and nitrogen removal and the conflicting competition for organic matter in the low molecular carbon source. On the contrary, in multi-reactor biological phosphorus removal and nitrogen removal systems. they have to increase the number of reactors in order to solve the inhibition of anaerobic phosphorus release from phosphorus collecting bacteria by refluxing nitrate. which in turn leads to an increase in the overall investment and operating costs of the system. so they consider the use of chemical enhancement methods to enhance biological phosphorus removal on the premise of biological nitrogen removal in single-reactor biological phosphorus removal systems.
(Du Xu&Chen 2008.)

At present, many secondary sewage treatment plants in foreign countries use coagulants to assist in phosphorus removal. making the original design with the ability to remove nitrogen and phosphorus in the sewage plant more effective phosphorus removal function. in the Netherlands, the application of normal conventional sewage treatment technology in the sewage treatment plant can only remove 40% of the phosphorus. and the remaining phosphorus in the effluent generally rely on calcium, iron, and aluminum salts to remove. the final effluent phosphorus should be less than 1mg/L(Kortstee.1994.) the AnnArbor wastewater treatment plant in the USA developed the traditional activated sludge method into the A/O process. After the conversion, the addition of ferric chloride was required most of the time to ensure an annual average phosphorus concentration of 0.6 mg/L in the effluent. However, after the conversion, the amount of ferric chloride was reduced significantly.
(Du Xu&Chen 2008)

In Finland, Valve and other staff studies have shown the mixture technology. then they used the modified UCT process for simultaneous nitrogen and phosphorus removal, the phosphorus concentration in the effluent ranged from 0.2 to 2.5 mg/L, which exceeded the 0.5 mg/L standard. they added ferrous sulphate for enhanced denitrification and phosphorus removal. The phosphorus concentration in the effluent reaches the standard when ferrous sulphate is added at a dosage of 5mg/L. The phosphorus concentration decreases as the dosage increases. China is also developing the effectiveness of chemically enhanced denitrification and phosphorus removal. Through experiments they have concluded that the best operating process and working conditions of the denitrification SBR system are: instantaneous influent - aeration for 3 hours - anoxia for 2 hours - sedimentation for 1 hour

- drainage for half an hour, under this operating process the removal rate of NH_3-N, TN can reach. 95%, 60% or more, and for phosphorus also has the ability to remove, when the dosage of aluminium trichloride is selected as The TP concentration of the effluent from the biological denitrification SBR system is 1.68~4.23mg/L. when the dosage of aluminium trichloride is selected as 20mg/L, which can meet the local effluent discharge policy.
(Du Xu&Chen 2008.)

6.5 MBR process improvement method

They all know current high pollution and high load wastewater treatment systems. The MBR is almost always used because of its high retention efficiency, which allows the reactor to maintain a high sludge concentration inside. The MBR has been used in a growing number of wastewater treatment applications, both in China and abroad. However, in addition to these obvious advantages, there are many pressing issues, such as the high cost of membranes. the tendency for membranes to clog and membrane cleaning.which are also limiting the development of membrane bioreactors. One of the main problems is membrane contamination. Therefore, the main direction for improving the MBR process is how to deal with membrane contamination.
(Guo 2019.)

6.5.1 Methods of dealing with membrane contamination

Membrane contamination is the deposition of certain components of the filtrate on the surface of the membrane or in the membrane pores, resulting in a reduction in membrane flux. For example, the membrane pores may attract small molecules of solute, or the membrane pores may be blocked by large molecules of solute, resulting in an increase in membrane filtration resistance. The formation of filter cake on the surface of the membrane increases the resistance. Increased resistance to mass transfer. The pressure across the membrane becomes greater and the retention effect becomes weaker. Membrane contamination can be divided into reversible membrane contamination and irreversible contamination. It can also be divided into biological contamination, organic contamination and inorganic contamination. Of these, both biological and organic contamination are related to the nature of the activated sludge in the system. For example, bacterial metabolism, or the production of extracellular polymers by bacteria.
(Guo 2019.)

6.5.2 Control of membrane contamination by changing the nature of the sludge

they can control membrane contamination by changing the nature of the sludge, they can first change the nature of the sludge through additives. adding adsorbents and flocculants to the activated sludge, which can reduce the solubility. or alternatively the concentration, or increase its flocculation capacity, which can delay membrane contamination. and the addition of adsorbents and coagulants can also prevent membrane contamination caused by the expansion of filamentous bacteria.(Guo 2019.)

One of the main influences on the degree of contamination of the membrane is the EPS, or fixation concentration. Bacterial extracellular polymers are derived from the polymeric material of microbial cells. EPS is composed mainly of polysaccharides and proteins. They account for 70 to 80% of the total mass of EPS, with lower levels of nucleic acids, lipids and amino acids. In many studies, EPS is an indicator of contaminants, microorganisms that form fine bacterial clusters by adhering to each other through substances. EPS is an indicator of contaminants, with microorganisms forming fine bacterial agglomerates by adhering to each other and showing strong tightness in the filtration process, resulting in lower membrane fluxes and higher filtration resistance, which in turn increases the degree of membrane contamination.
(Guo 2019.)

They can add powdered activated carbon and zeolite, adding powdered activated carbon is a very simple way to control membrane contamination.PAC not only wraps the biofloc to form bioactive carbon, and also adsorbs SMP from the sludge suspension. at the same time the PAC floc is very strong and can flush the surface of the membrane to prevent more particulate matter from accumulating on the surface again. Akram investigated the effect of PAC dosing on the submerged anaerobic membrane bioreactor. At a PAC dosing rate of approximately 1.67 g/L, the combined effect of colloid and SMP adsorption resulted in the formation of an ultra-thin layer of filter cake on the surface of the membrane. This led to an increase in membrane flux, but when the PAC dosing amount reached 3.4 g/L, the membrane flux decreased again. This indicates that there is an optimum value for the dosing amount in the middle. The degree of membrane contamination can be reduced.
(Guo 2019.)

They can also add inorganic flocculants, sludge bacterium colloid deflocculation will cause the supernatant organic matter, there is an increase in colloidal particles that is SMP. resulting in serious membrane pollution. and coagulants can also be used to neutralise and bridge the effect to remove SMP, at the same time. can destroy the stability of the colloid in the mixture. enhance the flocculation of the sludge. so that the supernatant of the number of small particles to reduce the membrane pollution caused by such substances.
(Guo 2019.)

The flocculants they currently use are basically aluminium and iron salts. The average particle size of the sludge in the MBR increased from 80 microns to 400 microns and the resistance of the sludge was one tenth of the original. At the same time the biological phase in the mixture became more abundant. The effect of reducing membrane contamination is got realized.
(Guo 2019.)

6.5.3 Changing sludge properties by optimizing MBR operating conditions

Changing sludge properties by optimizing MBR operating conditions, in addition to adding additives to change sludge properties. they can also reduce the amount of SMP produced by optimizing the operating process parameters of the MBR system, and this is the most economical solution, as sludge age is the main parameter affecting MBR operation for membrane contamination reasons.
(Guo 2019.)

6.5.4 Resolving membrane contamination with membrane cleaning

In addition to these means, they can also adopt membrane cleaning methods to solve the problem of membrane contamination. When the membrane reactor has been in operation for a long time. membrane cleaning can help us to control membrane contamination and restore membrane flux. generally speaking, membrane cleaning is divided into physical and chemical cleaning, physical cleaning generally refers to hydraulic cleaning. mechanical scrubbing with sponge balls, and backwashing.
(Tang.Duan&Ye 2017.)

Chemical cleaning is mainly done by adding chemical reagents, including alkaline cleaning, acid cleaning and oxidizing agents. In addition, there are other methods. Suction cleaning, for example, is characterized by good cleaning results and low costs. The membrane reactor is flushed by ultrasonic vibration or by flushing with anaerobic oxygen. It has been found that when the HRT is > 5 d, flushing with nitrogen gas gives good flushing results. At a gas flushing intensity of 0.23 Nm3/(h-m2), the contamination rate is almost zero, but the best method is a combination of physical and chemical cleaning. The best cleaning results can be achieved.
(Tang Duan &Ye 2017.)

6.6.Other aspects of MBR

In addition to the main problem of membrane contamination, there is the poor resistance to water shock loading and the technical barriers that still exist. In addition to the technical aspects there is of course the economic aspect which is the main concern. The investment costs are high, the energy consumption is not low and the operating costs are also high. At the same time, however, MBR is a process that deserves to be improved.
(Polaris Water Treatment Network 2016.)

In terms of technology we can improve the manufacturing of membranes, membrane materials are the overall core of membrane separation technology, especially as the MBR process needs to work in a sewage system where the biofilm is in a high concentration of sludge for a long time. How to ensure its flux and lifetime is the most critical. therefore intend to be able to bring out the maximum advantages of the MBR process. they need to improve the overall level of membrane manufacture as much as possible, and afterwards work on developing new membrane materials for municipal wastewater treatment, and modifying the membrane materials that are now available. This can be used to produce membrane materials with high flux, high strength and high hydrophilic properties at low cost.
(Polaris Water Treatment Network 2016.)

In addition to improving the level of membrane manufacturing, they can also improve the MBR process by improving the membrane components. For the operation of the actual device, the degree of optimization of the membrane module is very important for the MBR process, which is a constraint on the future membrane technology. They mention thatt the key factor of development. In order for the MBR process to be more widely used, they need to open up and develop excellent performance and good anti-fouling ability. And they create a new type of membrane module that can save energy.
(Polaris Water Treatment Network 2016.)

In addition to these, they can optimize the overall process, mainly focusing on two aspects, one is to strengthen the removal of pollutants, and the control effect of membrane pollution. The two processes are optimized as a whole. They need to ensure the processing effect of the MBR process, and they must ensure that there is a process that can run steady for a long time. There are probably six small directions. The first is to combine membranes with the latest generation of sewage treatment technologies, such as MSBR. There are measures and technologies to reduce energy consumption, and the third is to control membrane pollution and stabilize operating conditions. The fourth is to improve

the removal capacity of nitrogen and phosphorus through enhancements. The fifth is to improve the oxygen balance distribution technology of each section of the reactor. The last is the overall optimization of the control of the operation mode.
(Polaris Water Treatment Network 2016.)

The MBR process is becoming more widely used around the world. However, overall, there is no single national standard specification. First of all, there are many different types and forms of membrane products, and there is no reliable comparison between membrane products produced by different membrane manufacturers. There is also a lack of reliable basis for selection. Secondly, each membrane manufacturer has its own comprehensive database and its own design parameters and specifications. However, there is a big difference between them. There is no unified design manual and specification for the whole wastewater treatment industry. There is no adequate design or theoretical basis for technicians. At the same time, the MBR process requires a high degree of operation and management. Therefore, they should establish a set of specifications and standards for MBR process from 3 aspects: membrane components, design, and operation, and to a certain extent, reduce the cost and improve the economy and competitiveness. To a certain extent, it reduces the cost, improves the economy and competitiveness, and plays a role in promoting the wide application of MBR process .(Polaris Water Treatment Network 2016.)

They can also invoke market evaluation and access mechanisms to control MBR process systems from an economic and regulatory point of view, because the number of membrane manufacturers and the variety of membrane module designs make it difficult for users to choose in the first place. Normally, membrane products that have been in operation for a year do not differ very much at first, but after offline cleaning, the recovery is very poor, and after 1 or 2 more years of cleaning, the difference will get bigger . Therefore, they need to do an evaluation of membrane manufacturers' products that will be applied to each wastewater plant for about one year by establishing a unified evaluation organization. The stability of membrane flux, shock load tolerance, recovery after cleaning, and stability after low temperature will be recorded, and a rating system will be established for membrane products that have been put into use to track and evaluate the actual operation within 5 years.
(Polaris Water Treatment Network 2016.)

7.DEVELOPMENT PROSPECTS AND TRENDS

The MBR process and the SBR process, as an efficient and environmentally friendly technology, are in line with current world trends in environmental protection and have to some extent changed people's perceptions of sustainable development and emerging technologies, making people more respectful of new technologies. Both technologies are in use in almost every developed country in the world, but there are still many opportunities and challenges in China.
(Li,Wu&Lei 2018.)

7.1 Prospects and challenges of MBR process development in China

The application of MBR first started in China in 1990. (Zheng et al., 2003; Zheng et al., 2010; Huang et al., 2010; Abass et al., 2015; Xiao et al., 2014) in 1999. The first medium-sized MBR for industrial treatment was tested in China. Since that time, the research and experimental application of MBR in China has been growing substantially. After a few years, the MBR applications have reached a new height with a large increase in capacity and quantity. The number of large MBRs in China is close to 192 according to a survey conducted in that year. The total capacity has nearly reached 11.17 x 10 6 m. By 2017, including projects under construction, the number of large MBR projects will reach 210 and the capacity will increase further, and by 2018 the capacity will continue to increase.
(Li,Wu&Lei 2018.)

MBR has gained the attention of more Chinese researchers because of its great advantages in terms of membrane lifetime, fouling mitigation and energy consumption reduction. Since the beginning of the 2000s we know that many membrane materials have been adopted in municipal and industrial wastewater treatment facilities in China. For example, hollow fibre membranes and flat sheet membranes,tubular membranes are including in it Since the 2010s we get various MBR processes have been applied in various fields of wastewater treatment.
(Ping 2018.)

From an economic point of view, from the reform and opening up of China in 1978, which was a major economic reform, to 2014, China's economy grew by about 9.7 percent per year and is still the second largest economy in the world. In addition to the significant economic growth, the poor environmental performance has caused many problems, such as SARS and the current new

coronavirus, and China has strengthened its public health management. Greening has become an important policy in China.
(Ping 2018.)

The application of MBR in China is divided into five time periods.he summarised data is shown in Fig .1. depending on the wastewater treatment capacity of MBR. (Xiao et al., 2014) The first stage was the beginning of MBR technology, the laboratory and experimental stage. 1990 saw the publication of the first paper on the MBR process in China by Li Keqiang. Laboratory testing of MBR was soon afterwards, and in 1999 Zheng completed experiments on MBR to test the relevant performance (Ping 2018.)

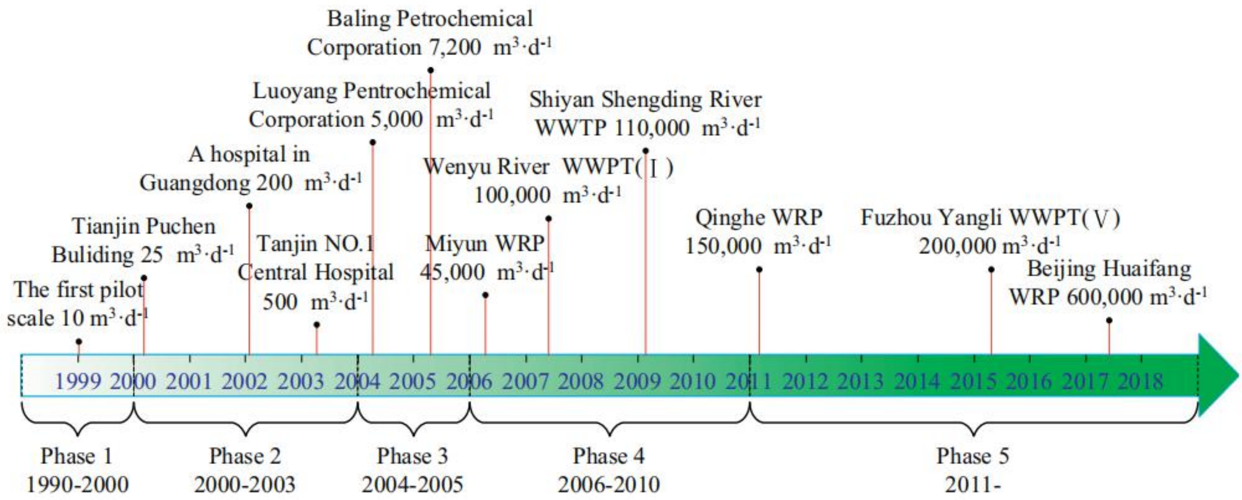


Figure. 1. The development history of MBR applications in China (ping 2018.).

The second phase, from 2000 to 2003, saw the application of MBR technology to the printing and dyeing wastewater of Kangda Glove Company Limited in 2000, with a not particularly high treatment capacity of 11 m3/d (Liu et al., 2017), which marked the beginning of the commercialization of MBR applications in China. In 2000, the commercial application of MBR was also carried out in Tianjin with a treatment capacity of 25 m3 /d, and in 2002 a hospital in Guangdong used MBR technology to treat difficult hospital wastewater with a treatment capacity of 100 m3 /d. In the second phase, the

main commercial application of MBR was still focused on treating hospital wastewater with a treatment capacity of approximately hundreds m3/d.
(Ping 2018.)

In the third stage, the treatment capacity changed from a few hundred to a few thousand, (2004-2005) and in 2004 the first MBRs with a treatment capacity of several thousand were completed and successfully treated approximately 5,000 m3 of petrochemical wastewater. Since then, the focus of MBR technology has shifted from hospital wastewater to industrial petrochemical wastewater. Examples include the Luoyang Petrochemical Engineering Company and the Baling Petrochemical Engineering Company.
(Ping 2018.)

The fourth stage, from a few thousand m3 to 10,000 m3 (2006-2010) The Miyun WRP applied the MBR application in 2006 to treat 45,000 m3/d of municipal wastewater. Since that time, many wastewater treatment plants (WWTP) have been using MBR technology to treat municipal wastewater. The geographic distribution of MBR applications in 2010 is show in Figure. 2. The main locations for MBR applications in this period were Beijing, Jiangsu, Guangdong, Hubei, and Beijing. By the end of 2017, there were 192 large enterprises using MBR to treat wastewater.
(Ping 2018.)

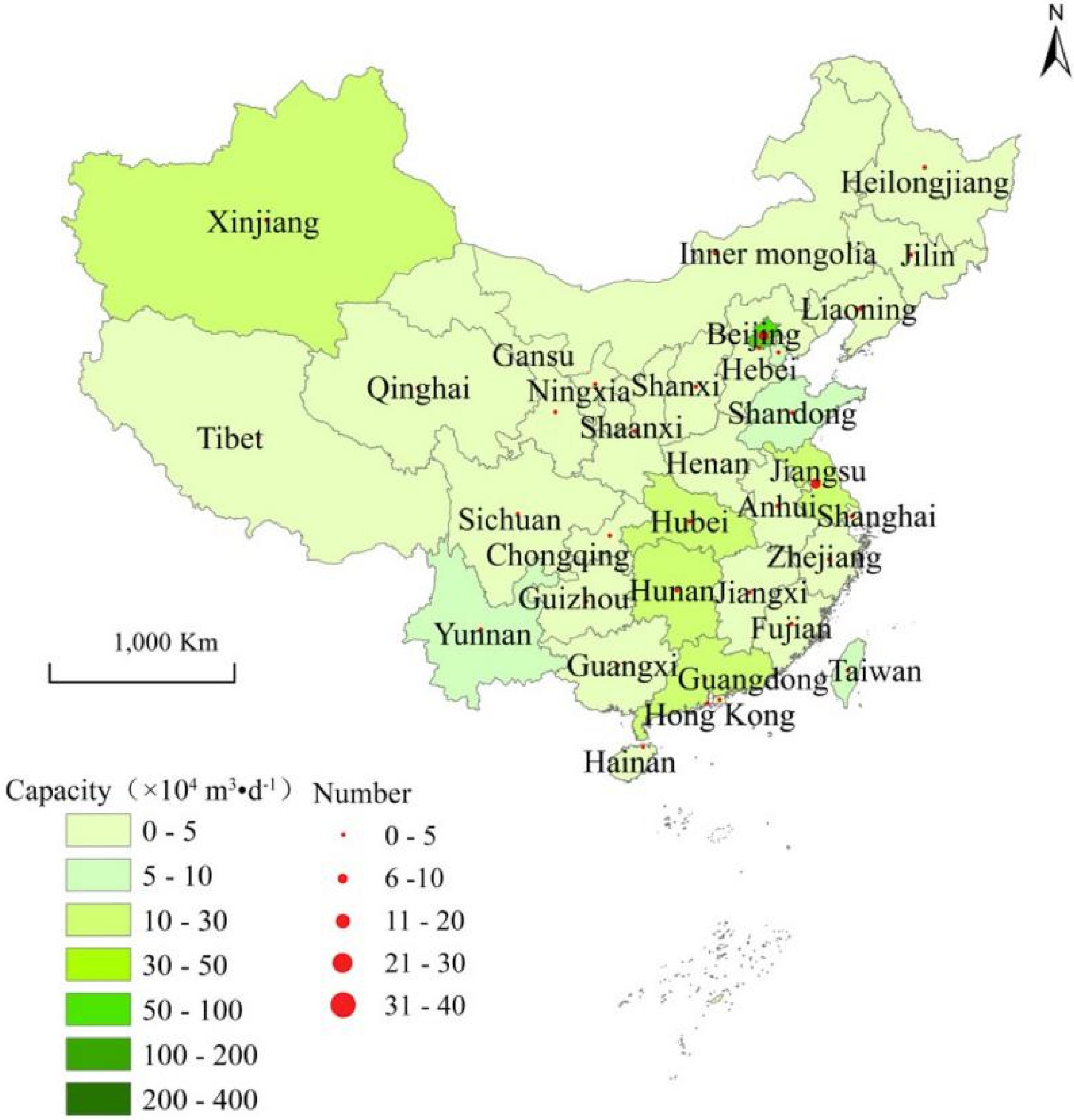


Figure. 2 The geographic distribution of MBR applications based on treatment capacities in 2010. (Ping 2018.)

In the fifth stage, the capacity leaps from tens of thousands to hundreds of thousands, as the MBR engineering technology progresses over the years, the shortcomings of MBR are overcoming and the advantages are developed. Since 2007, 35 MBR projects of 100,000 m3 have been completed in China. This accounts for a large proportion of the 51 MBR applications worldwide (Dong, 2017). Figure fig.3 below shows the application of MBR technology in 2017. In 2010, the application of MBR extended from the southeast to the southwest, northeast, and northwest, with most of the MBR technology being used to treat municipal wastewater, due to soaring urban land prices.
(Ping 2018.)

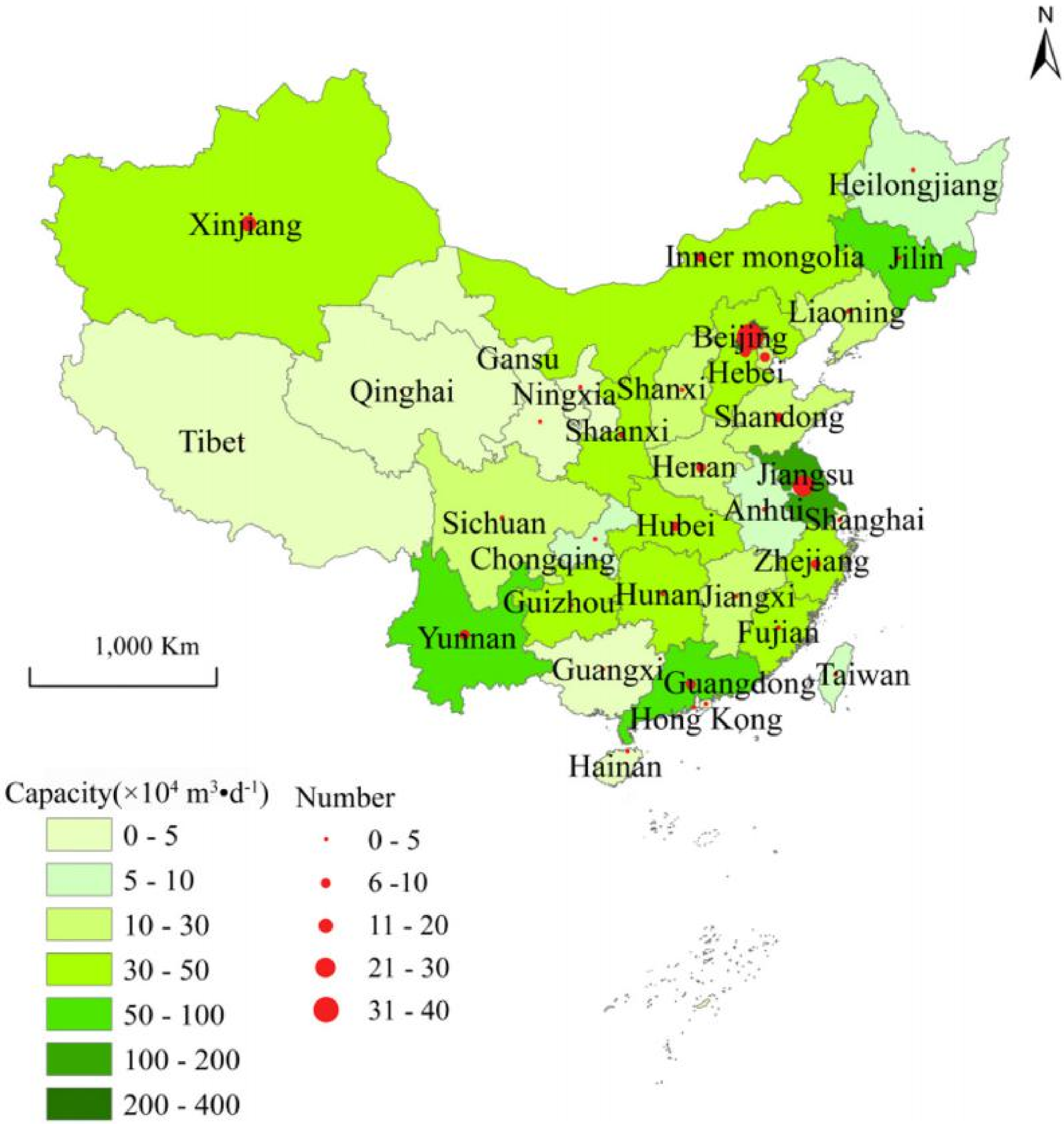


Figure. 3. The geographic distribution of MBR applications based on treatment capacities in 2017. (Ping 2018.)

The main drivers of MBR in China are municipal policy, petrochemicals, water and environmental pressures, resource pressures, and the advantages and benefits of MBR technology, and China has introduced a number of policies to facilitate the application of MBR. For example, the 12th Five-Year Plan for the Development of High Performance Membrane Material Technology and New Materials Industry (Abass et al., 2015; Xiao et al., 2014), which promotes environmental protection and resource

conservation. Overall, the quasi-annual increase in government policy in China has been very positive for the application of MBR.
(Ping 2018.)

There is also the issue of the petrochemical industry. The petrochemical industry itself requires large amounts of water, and the amount of water used is limited. It also discharges large amounts of wastewater containing toxic pollutants and it is difficult to biodegrade. To make matters worse, 60 per cent of petrochemical companies are located in areas with severe water shortages and drought. MBR technology has therefore become even more important for the petrochemical industry, in combination with policy. China is now strongly demanding energy saving and emission reduction. Petrochemical companies must treat their wastewater. A dischargeable effluent quality standard is got realized. They intend to increase the reuse rate of wastewater in China (Yu et al., 2017). And MBR is an effective technology for oil refineries, physiological brines, and phthalates. Table 1 shows MBR applications in the petrochemical industry from 2004 to 2009.
(Ping 2018.)

Table 1 Representative MBR applications in petrochemical industry
(Ping 2018.)

Representative MBR applications in petrochemical industry (Zheng et al., 2010; Li, 2008).

MBR applications	Capacity (m^3/d)	Commission year	Location
Luoyang Petrochemical Engineering Co.	5000	2004	Henan
Yueyang Petrochemical Engineering Co.	7200	2004	Hunan
Jinling Petrochemical Engineering Co. (phase 2)	6000	2005	Jiangsu
Jinling Petrochemical Engineering Co. (phase 1)	6000	2005	Jiangsu
Baling Petrochemical Engineering Co.	7200	2005	Hunan
Xiaohudao Fine Chemical Industry Park	10,000	2006	Guangzhou
Hainan Shihua Petrochemical Engineering	12,000	2006	Hainan
Huizhou Dayawan Petrochemical Industrial Park	25,000	2006	Guangdong
Harbin Petrochemical Engineering Corporation	10,000	2006	Heilongjiang
Changqing Petrochemical Engineering	9600	2008	Shaanxi
Jiujiang Petrochemical Engineering Co.	12,000	2009	Jiangxi
Taixing Fine Chemical Industry Park	25,000		Jiangsu

As we know with the water environmental stress in China. Since the reform and opening up in 1978, the pressure has become more intense after the rapid economic growth. But this has also driven the urgent trend towards the use of MBR technology in China. Many of China's freshwater lakes, such as Dianchi and Chaohu, have experienced numerous large-scale cyanobacterial outbreaks (Wu et al., 2014). The 2007 algae bloom in Taihu Lake left many people in Wuxi without access to drinking water, causing a water crisis (Zhang et al., 2010). The main culprits of eutrophication are nitrogen and phosphorus, and MBR is a technology for removing crude nitrogen and phosphorus. MBR is currently used in various freshwater lakes for water treatment.
(Ping 2018.)

Finally, there is the strain on water resources. China's per capita water resources are only a quarter of the world average. It is ranked 108th in the world. It is a country with severe water shortage (Li et al., 2017). This is coupled with the extremely uneven geographical distribution of precipitation, and freshwater resources in China. This adds to the pressure on water resources in arid as well as moderately arid regions of China. More than 400 of China's 600 cities have severe water shortages. The water resources in China are relatively more in the south and less in the north, but many cities in the south are also facing serious water shortages due to water pollution. The Chinese government initiated the South-North Water Transfer Project (SNWTP) for the problem in northern China (Ma et al., 2016). As MBR slowly becomes more widespread, the pressure on water resources will slowly decrease.
(Ping 2018.)

7.3 Development prospects and trends of SBR

The SBR process has come to a stage of rapid development in the last two decades, as researchers and scientists have conducted in-depth research into the biological reaction and purification mechanisms of the SBR method, and as the SBR process has been continuously improved and refined in production. (Liu,Wang 1998.)

For the world, in 1990 Japan published the first edition of a guide on how to design the SBR method and in 2007 in Malaysia the government built the world's largest SBR wastewater treatment plant with a treatment capacity of 2 million tons per day. The SBR process is now recognized by most governments worldwide and is widely used, with 30-40% of urban wastewater treatment plants in China using the SBR process to treat wastewater.
(Liu 1998.)

The SBR process has made a comeback as a hot topic in wastewater treatment. Apart from the fact that the technology itself works well for the treatment of wastewater, there is also some objective background of demand. For example, urban wastewater treatment plants are now becoming progressively smaller and more decentralized, as land in cities is too expensive and land resources are scarce. Decades ago, China was moving towards larger, even mega-scale, treatment capacities of up to 0X104 m3 /d, 100X 104m3 /d, 200X104m3 /d and even 500X104m3 /d levels in order to municipal wastewater treatment plants were everywhere. Not only are the infrastructure costs very high, but the management systems are also very cumbersome and complex. The outlet for the purified water is also limited by the large system. There is a growing awareness of ecological protection and a trend towards decentralization of residential areas. The trend is for wastewater treatment plants to become smaller and medium-sized, or decentralized. This new condition makes SBR technology, which is suitable for miniaturization, even more popular in China. It is easy to operate and manage, and the investment in infrastructure is not so large.
(Liu 1998.)

Compared to the traditional activated sludge method, the SBR process still needs constant development and improvement. Its method of operation is still not perfect at present. It is not yet mature enough in terms of operation and governance. The future challenges are mainly in several areas, one being, when the microbial activity and population distribution in the activated sludge during each

operating cycle of the reactor, as well as the metabolic theory of microorganisms, these issues still need to be studied in depth. The microbial mechanisms of biological denitrification and phosphorus removal also need to be studied in depth. There is also the issue of determining the operating parameters of SBR. All in all, the SBR process is a highly efficient method of wastewater treatment. However, precise operating parameters are required in terms of sludge retention time, water filling time and reaction time. A great deal of research work is still needed.
(China Town Water Network 2011.)

8 CONCLUSION

Through a whole thesis, they realized the importance of MBR and SBR processes and the current challenges they are facing in terms of environmental degradation and the gradual miniaturization and decentralization of wastewater treatment facilities and institutions. The application of these two technologies has become imperative, but there are some disadvantages of these two processes, such as serious and large membrane contamination, and it is uneasy to clean. They can use chemical reinforcement, or change the shape of the sedimentation tank.to make both technologies more sustainable. They combine with the unique environment and pollutants in northern China, where there are many heavy industrial plants, iron mills, steel rolling mills. Chemical plants, paint factories,discharge industrial wastewater with nitrogen and phosphorus levels that are severely excessive. The traditional SBR process and MBR process are less effective in removing nitrogen and phosphorus, so they innovate these two processes and improve them into new generation SBR and MBR processes, such as ICEAS, CASS, UNTANK, MSBR.But this new wastewater treatment process will also have problems in the future development, and their main thing is to keep improving and innovating the process on it. The main improvement lies in two aspects, one is the innovation of efficiency, the original efficiency of nitrogen removal and phosphorus removal will be more improved. The other is for the reduction of environmental pollution, and they reduce the discharge of pollutants, the pollutants will be treated. The whole process will be either discarded or improved in terms of possible pollution. The new generation of wastewater treatment process, nitrogen removal and phosphorus removal is more effective. It is more suitable for northern China where there are many heavy industrial plants. Moreover, the current policy of Chinese government supports the research and development of wastewater treatment equipment. At present, China's population is too large, which makes land resources also become very expensive, and both processes can save land cost, so it occupies a very important position in the future sustainable development. And there will definitely be a great range of promotion and use in the world.

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