

Review of New Sewage Treatment Processes

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ABSTRACT

At present, the world is still in a shortage of fresh water resources, and the increasing sewage treatment standards reflect the importance of governments to sewage purification. This paper proposes an integrated sewage treatment method. The main pollutants in sewage are COD, BOD₅, SS, NH₄⁺-N, TN and TP. According to the water quality characteristics of sewage, several popular treatment processes are listed, and several processes are analyzed and compared to select the best treatment method. This paper lists several mainstream sewage treatment methods. Through comparison, the conclusion is drawn that the existing sewage treatment methods are difficult to further improve the sewage water quality, the bottleneck is reflected in the treatment of nitrogen and phosphorus. This paper proposes a new sewage treatment process, can realize the deep removal of nitrogen and phosphorus.

Keywords: *Sewage treatment; chemical coagulation; denitrification filter*

1. INTRODUCTION

With the improvement of the urban economic level, the urban population also gradually increases, leading to a significant increase in the discharge of urban domestic sewage. At present, the treatment methods of domestic sewage are mainly physical, chemical and biological methods, the core technologies are activated sludge and biofilm methods, in which the improvement and development of activated sludge method has formed a variety of different domestic sewage treatment processes. According to the sewage water quantity, water quality, effluent requirements and the local actual situation, choose the appropriate sewage treatment process, to the normal operation of sewage treatment, treatment effect has a decisive role. In recent years, more and more provinces and cities have issued more stringent sewage discharge standards, most of the existing sewage treatment process is difficult to meet the standard because of the depth treatment, this paper puts forward improvement measures for sewage treatment process, that is, to have the deep treatment device in the traditional treatment technology, so as to improve the efficiency of sewage treatment. This paper compares the nitrogen and phosphorus treatment efficiency of AAO process, MBR process and CASS process, which provides a theoretical basis for the improvement of sewage treatment process. This study improves the bottleneck of traditional process.

2. CONVENTIONAL SEWAGE TREATMENT

At present, the traditional methods of treating domestic sewage mainly include physical, chemical and biological [1]. The activated sludge and the biofilm are the most common methods in the biological method. Nowadays, most sewage treatment methods are improved by the activated sludge method. In the world, there are mainly AAO (anaerobic-hypoxia-aerobic) process, MBR biochemical tank process, and the CASS process.

AAO process is composed of an anaerobic pool, an anoxic pool, an aerobic pool, etc., which can make the process of nitrogen and phosphorus removal in sewage proceed simultaneously, among which polyphosphorus bacteria play an important role. The sludge returned by the sewage is mixed with the secondary sedimentation tank and enters the anaerobic tank, and releases phosphorus in the anaerobic environment. Phosphorus in sewage absorbs phosphorus in the form of ions in the aerobic tank and removes phosphorus in the form of sludge. In the oxygen tank, nitrogen compounds in sewage are nitrified, nitrite bacteria, and ammonia nitrogen are converted into nitrate or nitrite nitrogen. The sewage is returned to the anoxic tank for denitrification reaction, and nitrogen is released into the atmosphere, and the nitrogen treatment of sewage is completed [2]. The AAO process flow chart is shown in Figure 1:

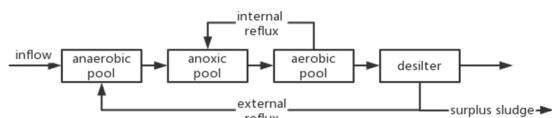


Figure 1 AAO process

The AAO process has many advantages for nitrogen and phosphorus removal treatment for domestic sewage. First of all, the decomposition of organic matter in sewage by microorganisms can provide carbon sources, which helps to promote the denitrification of anoxic areas, and then reduce the release of external carbon sources, which is more economical and environmentally protective. The substance that acts as electron acceptors in the anoxic pool is nitrate, and the oxidation of refractory organic matter can provide nitrate. The aerobic area in the hypoxic area, can supplement a part of the alkalinity consumed in the aerobic pool, reducing the amount of alkali cast. In the bioreactor, the push current flow with a high reaction rate efficiency is used, and the anaerobic and aerobic reaction are conducted alternately, which delays the sludge expansion speed.

Liu Shaofei et al. [3] analyzed the normal operation data of the Chengdu Fourth Sewage Treatment Plant for

four years. Finally, the removal rate of the AAO process is 92% -95%, BOD from 95% -97%, SS from 95% -96%, TN from 63% -70%, and TP between 92% -97%, so that the traditional AAO nitrogen removal process can make most of the municipal sewage reach the qualified discharge standard, which is also the most widely used sewage treatment technology.

The MBR process is a biologically activated sludge process. The unique feature of the MBR process is that the biofilm can function as a secondary sedimentation tank, even if the sludge is separated from the water and the sludge is returned, which also saves the cost of building a secondary sedimentation tank. The biofilm component is equivalent to a high-efficiency filtration membrane, which has a good desilting and purification effect. The MBR process does not need to consider sludge settling. The sludge concentration in the reactor is high, so the volume of the reactor is very small and small, and it is usually used in small and medium-sized 10,000-ton sewage treatment plants. However, the membrane modules of the MBR system are expensive and easy to block, which increases the operation and maintenance costs [4]. The MBR process flow chart is shown in Figure 2:

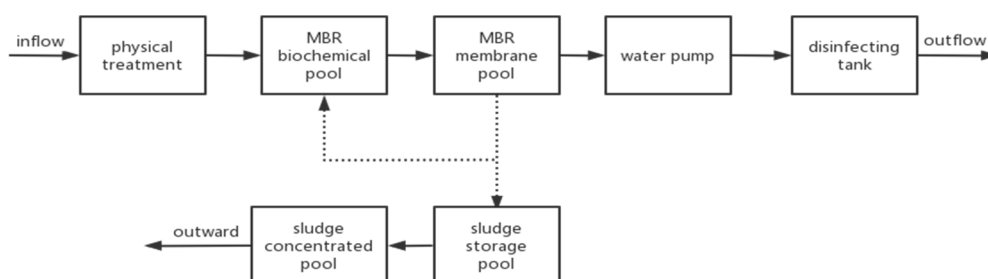


Figure 2 MBR process

Compared with many traditional biological water treatment processes, MBR has the following main advantages:

To begin with, the effluent quality is high quality and stable.

Membrane separation also allows microorganisms to be completely trapped in the bioreactor, allowing the system to maintain a high concentration of microorganisms. This not only improves the overall removal efficiency of pollutants by the reaction device, but also ensures good effluent quality. At the same time, the reactor has good adaptability to various changes in water load (water quality and water), and can obtain high-quality effluent quality.

Then, Ammonia nitrogen and refractory organic matter can be removed.

Because the bioreactor is completely trapped, favors the growth of slow proliferating microorganisms such as nitrification bacteria. At the same time, the hydraulic retention time of some refractory organic matter in the system can be increased, which is conducive to the improvement of the degradation efficiency of refractory organic matter.

Further more, Convenient operation and management, and easy to achieve automatic control.

This process realizes the complete separation of hydraulic retention time (HRT) and sludge retention time (SRT), the operation control is more flexible and stable, is a new technology easy to achieve equipment in sewage treatment, can realize the automatic control of microcomputer, thus making the operation and management more convenient.

The CASS process is widely used [5], due to its low construction cost, small footprint, easy sludge expansion

and stable water quality. The CASS process flow is shown in Figure 3, and the reaction pool consists of the prereaction area and the main reaction area. The whole process is recycled through the four stages of water inlet, precipitation, drainage and idle, eliminating the use of

secondary sedimentation tank in the traditional activated sludge method and the setting of sludge reflux pipeline, thus simplifying the process flow, and is a process system that can be continuous water inlet and intermittent drainage. CASS process flow chart as shown in Figure 3:

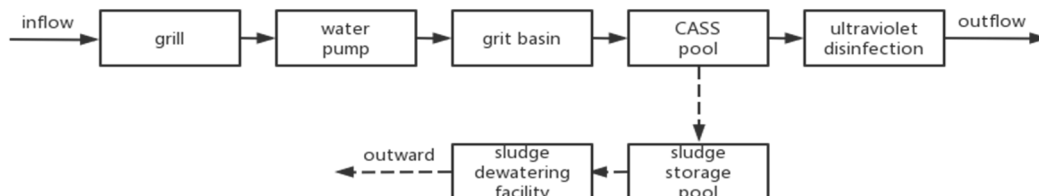


Figure 3 CASS process

The sewage treatment technology has the following advantages and advantages in its application:

Small footprint,

The CASS process is a circulating process, that is, the sewage is treated in the reaction tank. It does not need external work and equipment, which avoids the phenomenon of large area caused by external equipment. The CASS process circulation system can also avoid the use of two sedimentation tanks and sludge return equipment, and the process layout is relatively compact, which is suitable for urban sewage treatment plants with high land costs.

Strong biochemical reaction energy

From the current situation of the process of reaction analysis, it is from the process of work. When the sewage enters the reaction pool for treatment, the dilution mode

is based on the efficient microbial reaction. With the passage of time, the sewage water quality promotes the biochemical reaction to a certain extent, forming a complete system in the process structure, and having a good treatment effect on the sewage.

Stable and flexible in handling

The CASS process can be adjusted according to the water quantity of sewage, such as controlling the residence time of sewage, controlling the sludge concentration, etc. The process can adjust the operation cycle to adapt to the changes of water quantity and water quality, so as to achieve the purpose of improving the treatment effect.

The pollutant treatment efficiency of the above three technologies (take N, P as an example) [6] is shown in Figure 4 and Figure 5.

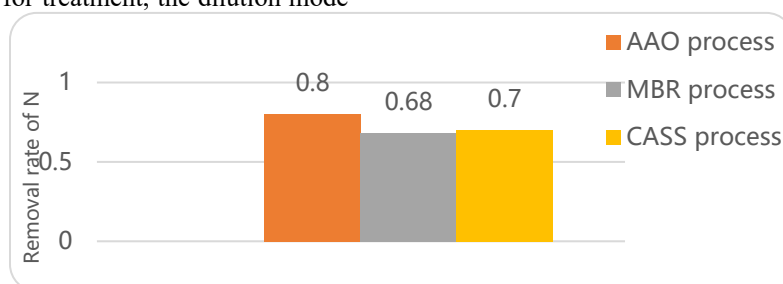


Figure 4 the removal rate of nitrogen

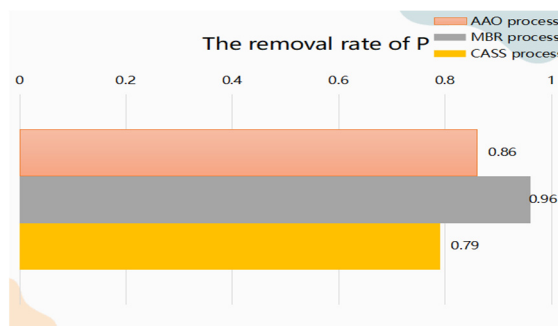


Figure 5 the removal rate of phosphorus

It can be seen from the figure that the AAO technology has a good effect on N and P, the MBR process has a high removal rate of P, and the CASS has a limited effect on N/P removal [7]. The existing sewage treatment technologies have their own advantages and disadvantages. We can find that: According to the latest urban sewage treatment landmark A standard in Kunming, the government has higher and higher requirements for sewage treatment, and the existing technology is difficult to meet the increasingly strict discharge requirements. Standard. Therefore, this paper designs an integrated sewage treatment process, which provides a reference scheme for the upgrading of sewage plant in the future. The integrated sewage treatment process is shown in Figure 6:

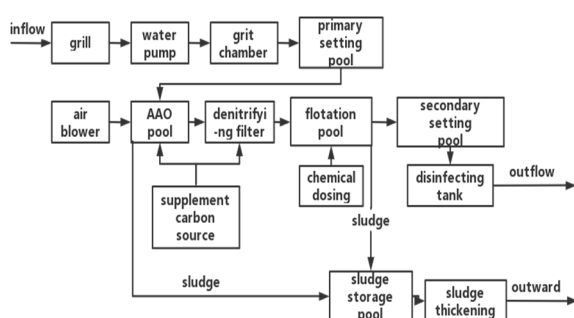


Figure 6 The integrated sewage treatment process

A denitrification filter is a biological filter that converts nitrate and nitroso nitrogen into nitrogen by using the biofilm attached to the abundant nitroso bacteria under anaerobic conditions. There are some advantages: covering a small area, high processing efficiency, low engineering cost and so on. The purification principle is as follows.

Denitrifying bacteria remove $\text{NO}_3\text{-N}$ or $\text{NO}_2\text{-N}$ with $\text{NO}_3\text{-N}$ as the electron acceptor and organic carbon as the carbon source [8]. Under the metabolic activities of denitrifiers, there are two ways of nitrate nitrogen transformation, assimilation and denitrification (synthesis). The final product is the denitrifying bacterial somatic cell material (organic nitrogen compounds), to maintain the continuous denitrification reaction. Alienatory denitrification (decomposition), the final product is gaseous nitrogen, so as to achieve the purpose of nitrogen removal, mainly dissimilatory denitrification.

The air floating coagulation tank can further reduce the concentration of organic matter and ensure a good water outlet. The air flotation coagulation tank is divided into two parts: chemical agent and air flotation. These two parts form large flocs, which are then connected to the air flotation separation equipment to make a large number of dense and fine air bubbles.

Municipal sewage first undergoes physical treatment to reduce total suspended particulate matter, BOD_5 and

other indicators, and then passes through the AAO biochemical reaction tank to complete the preliminary treatment of nitrogen, phosphorus and other elements. The removal rate of pollutants is about 80%. The treated water then enters the denitrification filter. The structure of the denitrification filter is composed of water distribution layer, support layer, packing layer, and clean water layer from bottom to top. In the denitrification filter, the organic carbon source of denitrifying bacteria is used as electron donor, and nitrate and nitrite are used as electron acceptor. In this way, deep denitrification of sewage can be achieved, and the denitrification rate is about 95%. In addition, due to the specificity of the reaction of the AAO reaction tank and the denitrification filter, the reaction requires the application of a carbon source system, and then the sewage enters the air flotation tank. In the flotation tank, the coagulation sedimentation method is used to further remove the suspended solids and phosphorus elements in the sewage. The coagulant is selected from PAC polymer aluminum chloride. During this process, the COD is significantly reduced, and the phosphorus removal rate is about 99%, which also truly realizes the advanced treatment of sewage and achieves the purpose of high-standard treatment [9].

3. CONCLUSION

This paper provides a feasible treatment process for advanced sewage treatment: nitrogen, phosphorus, BOD_5 , and COD indicators can meet the increasingly stringent high emission standards. However, in practical applications, there are some imperfect aspects of the treatment process, such as carbon sources. In addition, economical efficiency needs to be considered, that is, which carbon source is the most economical and feasible, the addition interval, the amount of sludge and the ratio of sludge return.

In future research, the following aspects need to be investigated:

Firstly, The choice of carbon source.

The mainstream carbon sources are methanol, sodium acetate and acetic acid. When the amount of treated water is large and there are many carbon sources, methanol should be used as the carbon source because it is more economical and environmentally friendly. When there is an emergency, sodium acetate is the best carbon source because it reacts faster.

Secondly, The washing strength of the denitrification filter.

The denitrification filter is treated with biofilm nitrogen. Excessive washing intensity will lead to the destruction of the biofilm. For example, it will affect the reaction rate. If the washing intensity is too light, it will lead to sludge accumulation and biofilm aging. Therefore,

long-term debugging is required to obtain a suitable Wash strength.

For the development of sewage treatment, this paper believes that the main research direction in the future is to further improve the water quality, and finally have the large-scale sewage treatment capacity and reach the drinking standard, so as to realize the real sewage recycling. The current state of the world's environment is not optimistic, and each of us needs to make suggestions and contribute to improving the environment.

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