Technical Research on Environmental Engineering of Sewage Treatment

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Abstract. As the country implements the strategy of energy conservation and emission reduction and accelerates the cultivation and development of strategic emerging industries, the sewage treatment industry will face broad development space of the market. The research on the technical selection of environmental engineering of sewage treatment will help the engineering company to analyze and make decisions on the future market, so as to concentrate more resources on areas with potential development and pave the way for the subsequent growth of the engineering company's business. Therefore, it has important theoretical and practical significance.

Keywords: Sewage Treatment Technology; Environmental Engineering; Biodegradability.

1. Introduction

China's environmental protection industry is a typical policy-driven industry, which is significantly affected by the policy. As a new pillar industry of the national economy, the state attaches increasing importance to the development of environmental protection industry [1]. As a pioneer in environmental protection industry, sewage treatment has developed rapidly in recent years. Industrial sewage is an important cause of environmental pollution, especially water pollution. China has issued more than 10 industrial wastewater treatment industry related standards, more than 30 national environmental standards for the discharge of water pollutants, more than 20 local environmental standards for the discharge of water pollutants to regulate the development of the industry. With the continuous expansion of national investment in sewage treatment and recycling, the sewage treatment industry will face broad market development space [2].

The development of sewage treatment technology in the future, to a greater extent, is aimed at various kinds of polluted water bodies to form a comprehensive sewage treatment solution combining various technologies, showing the characteristics of diversification, integration and combination diversification, and the difficulty of technology selection is greatly increased than before. Therefore, for engineering companies, how to compare and choose technical solutions and how to grasp the direction of technology development are worthy of in-depth study.
2. Research status of sewage treatment technology

In recent years, the “LIVING MACHINE” ecosystem has emerged in the United States and other countries for the treatment of industrial and domestic sewage. The technology is based on activation technology, which is established in artificial devices using a variety of biological forms. The new species is linked to a certain purification treatment. Its design and construction principle are to use the natural ecosystem to purify the sewage, which is characterized by beautiful appearance, durability, small size and low cost [3].

Zheng et al. [4] summarized the main methods of sewage treatment in China: physical treatment, chemical treatment and biochemical treatment. Among them, the physical method for processing waste books has a small footprint and is convenient for automatic control, but the removal effect on high concentration and high toxicity organic matter is poor; the chemical treatment method is mostly used for treating production sewage, for example, using ferrous ion and hydrogen peroxide combination The oxidation method has high activity and can oxidize most of the organic matter in the wastewater, but the pH is very high, and a large amount of acid or alkali is needed to adjust the pH value of the wastewater, causing the water body to increase in salt, causing water pollution and increasing operating cost [5]; Biological treatment method is currently a widely used water treatment method, which has high treatment efficiency and good stability. In the future, the combination of biochemical treatment and physical treatment can further improve the biochemical treatment ability and efficiency. Wang Q [6] proposed that the composite application of activated sludge method and biofilm method is the main method for wastewater reclamation treatment technology in the future. The main technology of developing water treatment technology in China is to strengthen the fixed or non-fixed biofilm technology. Abramov [7] research shows that: now sewage treatment technology requires advanced control technology to achieve the reliability, flexibility and simplicity of the operation of sewage treatment systems, and the combination of modern control systems and advanced treatment technologies is to solve the problem of water scarcity and water. The main way of resource regeneration, so in the research and development of new technologies and new technologies for wastewater treatment, we should pay attention to the research and development of the corresponding control strategy and control software.

3. Existing problems in environmental engineering projects

China's environmental protection industry is in the early stage of development. The products are mainly environmental protection equipment such as water pollution control equipment and air pollution control equipment. With the expansion of the environmental protection market, the prelude of China's environmental protection industry transformation has been opened, gradually moving from industrial form to comprehensive service form. In the transformation, a group of environmental service companies came into being, but the development of the environmental service industry is still relatively lagging behind. Some environmental services such as facility operation and environmental information have just started. Some services such as environmental pollution liability insurance have not yet started. Some services such as environmental monitoring and environmental impact assessment are also part of government administrative functions or business functions. Therefore, China's environmental protection service market is still not perfect and imperfect.

The environmental technology development of environmental engineering projects lags behind and the choice of technology is limited. At present, the environmental protection industry is generally regarded as one of the high-tech industries in the world. However, in the fields of production of environmentally friendly products and development of environmental protection technologies, China still dominates its conventional technology, and solves its own investment, completes technology development and captures the market. Not yet high. Due to the rapid development of the environmental protection industry and the adoption of a complete supply or general contracting model for environmental protection projects, many environmental protection companies have experienced a direct leap from an environmentally friendly equipment manufacturing plant to an environmental engineering company. However, the resulting sequelae are the relative lag of its technological development. The lag
in technology development often makes the project's technical solutions rarely improve the existing technology and develop new technologies for specific projects, so that investors lose a lot of money and valuable environmental governance time.

4. Technical research on sewage treatment project

4.1. Classification of sewage

According to the source of sewage, sewage can be divided into two categories: domestic sewage and industrial sewage, which can be subdivided into multiple sub-sectors. As shown in Table 1 and Table 2.

| Table 1. Classification of domestic sewage |
|-------------------------------------------|
| Sewage name | Sewage characteristics | Processing technology |
|-------------|------------------------|-----------------------|
| 1) Urban domestic sewage | The water volume is large, the chroma is large, the organic matter concentration is large, and the biodegradability is good. | Materialized treatment and biochemical treatment technology |
| 2) Catering sewage | Complex composition and high organic content | Buried integrated machine |
| 3) Landfill leachate | The metal content is high, the water quality and quantity vary greatly, and the biodegradability is poor. | Fenton biochemical technology after materialization |

| Table 2. Industrial Wastewater Classification |
|---------------------------------------------|
| Sewage name | Sewage characteristics | Processing technology |
|-------------|------------------------|-----------------------|
| 1) Food industry sewage (low salt) | A large amount of protein, more metal ions | Aerobic and anaerobic biological treatment technologies |
| 2) Food industry sewage (high salt) | Large amounts of chloride, sulfate, sodium and calcium ions A large amount of suspended matter, also containing a variety of metal ions | Salt-tolerant bacteria for biochemical treatment Graphite evaporation cooling crystallization technology |
| 3) Steel industry sewage | Heavy metal | Redox-precipitation |
| 4) Electroplating industry sewage | Heavy metal extractant | Fenton after physicochemical coagulation |
| 5) Hydrometallurgical industry sewage | Large amount of water, polyphenol content, high ammonia nitrogen | Physicochemical and biochemical treatment after extraction |
| 6) Coking wastewater | Large amount of water, high pigment content, high cellulose content High water content, high content of dyes and additives | Biochemical and then Fenton physical treatment After coagulation and sedimentation, Fenton physicochemical treatment |
| 7) Printing and dyeing sewage | Large amount of water and high fiber content | Mr. treatment, Fenton oxidation treatment Regeneration after coagulation and weight removal. |
| 8) Viscose industrial wastewater | High in animal fat and protein | Re-materialization after biochemistry |
| 9) Petrochemical industry sewage | High salt content and poor biodegradability | Biochemical treatment by Fenton physicochemical treatment |
| 10) Leather industry sewage | Good biodegradability | Re-materialization after biochemistry |
| 11) Organic synthetic industrial wastewater | Poor biodegradability | Fenton physicochemical method |
4.2. Sewage treatment technology

Sewage treatment technology is complicated, but according to the treatment principle, it can be divided into two major categories: biochemical treatment technology and materialized treatment technology. As shown in Table 3 and Table 4.

**Table 3. Classification of biochemical treatment technologies**

| Biochemical treatment technology name | Meaning |
|--------------------------------------|---------|
| 1) Anaerobic biochemical treatment | Under the anaerobic conditions, a combination of various microorganisms causes the decomposition of organic matter to form CH\textsubscript{4} and CO\textsubscript{2}. |
| 2) Aerobic biochemical treatment | A method in which aerobic microorganisms are subjected to biological metabolism in the presence of oxygen to degrade organic matter to make them stable and harmless. |
| 3) Anaerobic aerobic combined treatment | Combine two types of technologies to remove organic substances that are difficult to biodegrade, and have good sludge sedimentation performance, low power consumption and drug consumption, and low operating costs. |

**Table 4. Classification of physical and chemical processing technology**

| Materialized processing technology name | Meaning |
|----------------------------------------|---------|
| 1) Solid-liquid separation | Removal of solids from liquids by screening or precipitation |
| 2) Extraction separation | The process of bringing the solution into intimate contact with another immiscible solvent, allowing one or more solutes in the solution to intervene in the solvent, thereby separating them from other interfering components in the solution. |
| 3) Rectification, stripping | Distillation is a separation process that separates the components by different volatility of each component in the mixture; the stripping method refers to making the volatile toxic and harmful substances in the wastewater be determined by directly contacting the wastewater with water vapor. The ratio spreads into the gas. |
| 4) Evaporation, concentration, crystallization | The solvent is removed from the solute by heating, and the separation and purification are required. |
| 5) Membrane separation | The membrane can be separated in the molecular range, and the process is a physical process, no phase change and additive addition |
| 6) Microelectrolysis | Refers to electrolysis under low-voltage DC conditions, which can effectively remove calcium and magnesium ions from water and reduce the hardness of water. |
| 7) Fenton reaction | A mixed solution of hydrogen peroxide and divalent iron ions oxidizes many known organic compounds to an inorganic state. |
4.3. Selection of sewage treatment technology

Before selecting the wastewater treatment technology process, seven factors should generally be considered, as shown in Figure 1.

Figure 1. Factors affecting the selection of wastewater treatment technology

(1) Wastewater quality. It is generally stable, and general treatment methods include acidification, aerobic biological treatment, and disinfection. Industrial wastewater should be rationally selected according to the specific water quality.

(2) Wastewater quantity. For sewage with large changes in water quantity and water quality, first consider the technology with strong impact load resistance, or consider setting up buffer tanks such as regulating tanks to minimize adverse effects.

(3) Wastewater treatment level. This is the main basis for the selection of wastewater treatment technology processes. The degree of sewage treatment depends in principle on the water quality characteristics of the sewage, the direction of the treated water and the self-purification capacity of the human body in the sewage.

(4) Construction and operating expense. Under the premise that the treated water meets the water quality standard, the technical process of low construction and operation costs should be taken seriously.

(5) Degree of engineering construction difficulty. It is one of the factors that influence the selection of technical processes. If the groundwater level is high and the geological conditions are poor, it is not suitable to use treatment structures with large depth and high construction difficulty.

(6) Local natural and social conditions. Natural conditions such as local topography and climate also have an impact on the choice of wastewater treatment process.

(7) Whether there are new conflicts. Attention should be paid to the secondary pollution problem during the sewage treatment process.

Considering the above seven factors, this paper selects biodegradability as a measure. Because the water quality and quantity of wastewater will affect the biodegradability of wastewater, the biodegradability will also affect the treatment level of wastewater, so the biodegradability is Being the primary measure is reasonable. The biodegradability of wastewater, also known as the biodegradability of wastewater, that is, the difficulty of biodegradation of organic pollutants in wastewater, is characterized by BOD/COD, and the wastewater with BOD/COD>0.3 can be directly used for maturity. The biochemical treatment technology greatly reduces the construction cost and the technical risk is relatively small. For example, when dealing with urban sewage, due to the high content of organic matter in urban sewage, the nitrogen source is rich in phosphorus source, which is very suitable for the production of microorganisms, often using activated sludge method. Oxidation ditch method, A/O
method, A2/0 method, sequential batch activated sludge method (SBR). For wastewater with BOD/COD<0.3, try to add physicochemical pretreatment section to reduce COD in wastewater to improve biodegradability. Further research found that the level of salt in the wastewater with biodegradability less than 0.3 will also affect the degree of sewage treatment. This paper selects the total mass fraction of salt as a measure to further subdivide the wastewater of BOD/COD<0.3. It is low-salt wastewater and high-salt wastewater. As shown in Figure 2.

![Figure 2. Low-salt wastewater and high-salt wastewater](image)

The low-salt wastewater directly passes the physicochemical method to reduce the COD value of the sewage, increase the BOD/COD to above 0.3, and then reduce the COD to a park take-over standard of less than 500 mg/L through biochemical treatment. Such sewage is generally industrial sewage. The process risk is high. Although the materialized treatment improves the BOD/COD ratio, the composition of the sewage fluctuates greatly, and the problem of excessive COD of biochemical effluent often occurs.

Because of high salt concentration and high osmotic pressure, high-salt wastewater will cause cell protoplasmic separation due to dehydration of biological cells and high chloride ion concentration is toxic to bacteria. Traditional redox method is difficult to effectively remove salt, so MVR technology is usually used. The wastewater is pretreated by low-temperature multi-effect evaporation technology and membrane separation technology, and the wastewater is subjected to concentrated crystallization and desalting, and then the evaporating liquid is subjected to biochemical treatment.

In this paper, the technology comparison method is adopted, and among the many processing technologies, the technical solutions that satisfy the needs of the owners and maximize the interests of the owners and engineering companies are selected. The specific comparison factors are shown in Table 5.

| Comparison project                  | Technology A | Technology B | Remarks |
|------------------------------------|--------------|--------------|---------|
| Construction Investment            |              |              |         |
| Operating temperature              |              |              |         |
| Operating expenses                 |              |              |         |
| Floor area                         |              |              |         |
| Pretreatment                       |              |              |         |
| By-product                         |              |              |         |
| Running operation                  |              |              |         |
| Equipment maintenance              |              |              |         |
| Limit removal effect               |              |              |         |
| Removal rate                       |              |              |         |

Comprehensive sewage classification and sewage treatment technology, this paper draws the following technology selection flow chart, as a reference for engineering companies to select technology. As shown in Figure 3.
When the engineering company selects the technology, it first analyzes the biodegradability of the sewage. If the biodegradability of the sewage is greater than 0.3, the biochemical treatment technology can be directly used, in the A/O method, the activated sludge method, the oxidation ditch method, etc. In the biochemical treatment technology, the technical comparison is carried out, and the appropriate technology is selected for the sewage treatment. After the sewage effluent water quality reaches the local discharge standard, it is directly discharged. If the requirements are not met, the physical and chemical technologies are selected, and the physical and chemical technologies are selected. After the biochemical treatment, the discharge is up to standard. If the biodegradability of the sewage is less than 0.3, then analyze the total mass fraction of the salt in the sewage. If it is a low-salt wastewater, after several physical and chemical treatments, reduce the salt content, improve the biodegradability, and discharge it after reaching the standard. In the process, technical comparisons are still required. If it is high-salt wastewater, it is compared in MVR and multi-effect evaporation technology to remove salt, improve biodegradability, and discharge it after multiple physical and biochemical treatments.

5. Conclusion and Outlook
The research results of technology selection methods show that in the specific project, the technical direction can be determined according to the biodegradability of sewage, that is, the difficulty of biodegradation of organic pollutants in wastewater, while considering the water quality, water quantity and sewage treatment index of sewage. Factors such as construction and operation costs, difficulty in construction, local natural and social conditions, etc., are selected to select appropriate wastewater treatment technologies.

This article takes the rapid development of the environmental protection industry in recent years as the entry point, and introduces the development situation of China’s environmental protection industry in detail. Most of the sub-areas of the environmental protection industry are in the introduction period or growth period, which is a veritable sunrise industry, and the sewage treatment industry does not. exception. Although the sewage treatment industry has experienced rapid development, the environmental protection industry is still an emerging industry in China, and it is inevitable to encounter
“growth troubles”. Environmental protection projects still have problems such as low technical level and disordered project organization.

References
[1] Thuan T H, Jahng D J, Jung J Y, et al. Anammox bacteria enrichment in upflow anaerobic sludge blanket (UASB) reactor [J]. Biotechnology & Bioprocess Engineering, 2004, 9(5): 345-351.
[2] Lai K, Wen J, Chen W, et al. Industrial Wastewater COD Degradation Technology Taiwan Solar Cell Plant [J]. CLEAN-Soil, Air, Water, 2016, 44(4): 333-338.
[3] Ahn D H, Chang W S, Yoon T I. Dye wastewater treatment using chemical oxidation, physical adsorption and fixed bed biofilm process [J]. Process Biochemistry, 2018, 34(5): 429-439.
[4] Zheng X, Zhang Z, Yu D, et al. Overview of membrane technology applications for industrial wastewater treatment in China to increase water supply [J]. Resources Conservation & Recycling, 2015, 105: 1-10.
[5] Lu J, Ma Y, Liu Y, et al. Treatment of hypersaline wastewater by a combined neutralization-precipitation with ABR-SBR technique [J]. Desalination, 2011, 277(1): 321-324.
[6] Wang Q, Wei W, Gong Y, et al. Technologies for reducing sludge production in wastewater treatment plants: State of the art [J]. Science of the Total Environment, 2017, 587-588: 510.
[7] Abramov V O, Abramova A V, Keremetin P P, et al. Ultrasonically improved galvanochemical technology for the remediation of industrial wastewater [J]. Ultrasonics Sonochemistry, 2014, 21(2): 812.