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Application of immobilized microorganism technology in water environment treatment

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Abstract: *With the rapid development of social economy, more and more industrial wastewater is produced, and microorganisms play an important role in wastewater treatment.In recent years, with its unique advantages, immobilized microbial technology has become more and more popular in the field of environmental engineering, and has been widely used in the treatment of environmental pollutants.This paper summarizes the main applications of immobilized microbial technology in environmental engineering, analyzes a series of existing problems and gives corresponding countermeasures, in order to provide reference for the further application and development of this technology in the field of environmental engineering.*

Keywords: *Immobilized microorganism; Pollution control; Sewage*

1. Introduction

In recent years, China is in a critical period of rapid economic development.With the rapid economic growth, the demand for water resources is also increasing. In 2017, China's total sewage discharge was nearly 70 billion tons[1]. Although remarkable results have been achieved in total water pollution control in recent years, there are still some problems.At present, most of the local freshwater resources in China's cities and rural areas have been subjected to the pollution of pollutants, resulting in serious water deterioration.But the industrial, agricultural production process of wastewater directly, will not only directly harm aquatic life, intensify the shortage of fresh water resources in China will make farmland soil and surrounding environment deterioration, eventually lead to the deterioration of the ecological environment, affect the health of surrounding residents, thus leads to restricting the sustainable and healthy development of China's social economy.Therefore, develops effective water pollution control technology appears more and more urgent.

Immobilized microbial technology originated in the 1970s, is developed on the basis of the original fixase technology, with the technology to contaminated water repair and purification is the current hot spot of environmental engineering technology, has great advantages and potential: the technology has the advantages of fast reaction, strong antitoxicity, small microbial loss.In contaminated water, microorganisms can obtain the nutrients necessary for their growth and reproduction by breaking down organic pollutants in water, such as other residues and remains; this promotes the nutrient cycle of aquatic ecosystems and easy separation of products, small treatment facilities, effectively promote the development of environmental engineering[2].

2. Immobilized microbiology technology

2.1 Application advantages of microbiological technology in dealing with environmental problems

Microbial processing technology is an advanced technological means for separating biotechnological systems.The advantages of microbial treatment technology in practical application are mainly reflected in the following aspects:

(1) Microbial treatment technology not only has an excellent pollutant degradation capacity, but also has a strong pollutant adsorption capacity, which has a significant effect on the pollution control in environmental engineering construction.The control of water pollution can be done more thoroughly.

(2)Microbial processing technology is of low cost in practical application, especially compared with traditional physical and chemical methods.The technology does not require a large amount of money, and related research shows that the application cost of microbial processing technology is about

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30%~50% of the cost of physical and chemical processing technology.It can greatly save costs and resources, and improve the construction efficiency of environmental protection projects.

(3)There are a large number of microorganisms, and their metabolic types are also rich and diverse. Different kinds of environmental microorganisms have different catabolic functions for different substances, which makes them able to effectively degrade a variety of pollutants.At the same time, microorganisms have strong reproductive ability and short reproductive cycle, which can effectively adapt to the complex environment, so it is particularly easy to produce corresponding enzymes for different substances to meet the requirements of pollutant degradation.

(4)Microbial treatment technology has significant advantages in sewage treatment. In addition to removing impurities and pollutants in the water, it can also improve the transparency of the water and ensure the effect of sewage treatment.Microbial treatment technology is an effective technology for the construction and development of environmental engineering. Environmental pollution should be fully considered and the corresponding microorganisms should be cultivated.Give full play to the degradation role of microorganisms to create good conditions for environmental protection and pollution prevention and control.

2.2 Application method of immobilized microbiological technology

The fixation methods in immobilized microorganisms are mainly divided into embedding, carrier binding, adsorption, crosslinking, and carrier-free immobilization method[3].Common vectors are mainly divided into inorganic, organic, and a composite combination of the first two.From the current actual situation, immobilized microbial technology is mainly used in environmental engineering to control the water pollution, air pollution and soil pollution.

2.3 Characteristics of the immobilized microbiological technology

Immobilized microbial technology is compared to other environmental governance technologies, It has the following six characteristics: 1. Immobilized microorganisms can very effectively maintain the high concentration and activity of various microorganisms in the reactor, It has a good effect on improving the efficiency of microbial treatment of pollutants; 2. After the waste water treatment, How to handle the end of the remaining bottom mud, This is currently a big problem at present, If the immobilized microbial technology is used to treat the wastewater, The yield of the sludge can be effectively reduced, It greatly reduces the subsequent bottom mud burden of sewage treatment; 3. Granticle material formed after immobilization of microorganisms, Can promote the separation rate of solid and liquid phase in polluted water bodies, Improve the effect of polluted water body treatment; 4. Industrial wastewater is often of complex composition, It often contains a complex structure and difficult to degrade the organic matter, It is difficult to manage by using chemical methods, It may also bring in more pollutants, However, the use of immobilized microbial technology can effectively treat some industrial wastewater that is refractory to degradation; 5. For most of the toxic and harmful substances, Microorganisms are highly tolerant, Features of good stability, Can effectively deal with toxic and harmful polluted water bodies; 6. Treatment of sewage and wastewater with fixed microbial technology, Not only simplifies the process of conventional water treatment, It improves the efficiency and quality of water treatment, Also with reduced costs, With good economic benefits.Therefore, the immobilized microbial technology has been extensively studied and deeply discussed from the perspective of environmental pollution control.

3. Application of immobilized microbiology technology in water environment management

3.1 Advantages of immobilized microbes in sewage treatment

The main cause of most natural water pollution in the environment is the result of industrial, agricultural and urban and rural residents.For example, sewers usually have mixed polluted water bodies of heavy metals, high salt, high chemical oxygen demand (COD) and high ammonia nitrogen, which have a strong inhibitory effect on microorganisms when treated with microbes.The application of immobilized microbial technology greatly improves the survival rate of microorganisms in polluted water bodies, while the vector provides a small environment suitable for microbial survival, significantly improves the resistance of microorganisms to various pollutants, and improves the processing efficiency of the whole system.In the large-scale treatment of sewage, fixed microorganisms

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are often connected to various bioreactors.In the processing process, we not only improve the processing efficiency, but also solve the problem of large amounts of sludge production in some activated sludge process.The use of fixed microbial technology to control aquatic environmental pollution has become a hot topic in sewage treatment technology.

3.2 Application in heavy metal-contaminated water bodies

The wastewater containing heavy metals by microbial adsorption has the characteristics of low cost, high adsorption efficiency and good treatment effect.However, the traditional microbial management methods have problems such as low efficiency and significantly decreased microbial activity.Therefore, there are great advantages to use immobilized microbial technology to protect cells and improve cellular activity to control heavy metal contaminated water bodies.

Using immobilized microbial technology of heavy metal pollution water main mechanism is: most of the heavy metal ions in water poison most microorganisms in the environment, but microorganisms after immobilization treatment, the resistance to heavy metal toxicity has been greatly improved, which can greatly improve the microbial activity, its biological characteristics have also been effectively maintained, through highly active microbial enzyme will heavy metal elements in the water environment effectively enriched together, and then realize the role of purifying water environment.

Professor Xu Rong and others mainly studied Pb2+ in heavy metal polluted water bodies for the direction of heavy metal contaminated by microbial treatment Removal of ions.Professor Xu Rong's team adopted it Penicillium waste bacteria were used as raw material for immobilized microorganisms to adsorb the Pb2+, found in Within the range of optimal pH values of 5 to 5.5, Pb2+At the beginning of the experiment .The ratio of concentration to adsorbent has a great effect on adsorption; EDTA is the best elution agent for Pb2+ on fixed P. flavum particles.Michelle et al used polyacrylamide-embedded immobilized citric acid bacteria to enrich the metal Cd in the wastewater and achieve good results.The effects of pH, algal density, organic acids, and divalent cations on heavy metals removal were studied by Malik et al.[3]

3.3 Application in high nitrogen and ammonia

The main problems in water containing high concentrations of nitrogen and ammonia: first, by increasing the number of nitrification bacteria in aquatic environment, the influence of bacteria in polluted water will reduce the nitrification efficiency of the two elements; the production time is long, when the BOD concentration is high.

Therefore, increasing the concentration of nitrification bacteria is an effective way to improve nitrification is to use immobilized microbial technology to immobilize nitrorification bacteria. Therefore, many scholars have done extensive research on the application of immobilized biotechnology in nitrogen-containing wastewater treatment.This technical method increases the number of nitrification bacteria, but also well improves the activity of nitrification bacteria in the aquatic environment, and promotes the smooth progress of the nitrification reaction.

To verify the effect of the wastewater treatment of immobilized nitrosing bacteria containing high concentrations of ammonia nitrogen, many researchers have conducted experiments in aquatic environments containing ammonia nitrogen.Shang Tonget al used calcium brown alginate gel as the embedded carrier material to fix brown algae and control the hydraulic residence time to 4 hours and 30 min.After the experiment, through the detection and comparison of the ammonia nitrogen concentration in the water body, the ammonia nitrogen treatment rate was as high as 92.1%[4].

3.4 Application in printing and dyeing sewage treatment

Most of the wastewater discharged by printing plants or dyeing plants is characterized by the characteristics of drastic changes in water quality, high pollutant content, deep color, high concentration, large change in alkalinity and pH value, low biochemical ability and high treatment difficulty.It also contains benzene, nitrogen, amine and other toxic substances, to the printing and dyeing wastewater treatment and decolor treatment has brought more difficult.[4]Immobilized microbe technology can reproduce microorganisms that are capable of deccolorization or reducing dyes, and use microorganisms to degrade colored substances, so as to achieve the purpose of decolorization and wastewater treatment.

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At present, there are several immobilized microbial technologies used to treat printing and dyeing wastewater: 1. Aerobic biological immobilization technology.It is mainly to fix aerobic organisms, and then use aerobic biological cells to degrade pollutants and dissolve oxygen molecules, to achieve the purpose of sewage treatment, but its biggest technical problem is: aerobic technology requires a large amount of oxygen supply; 2, anaerobic bioimmobilization technology.In an environment without dissolved oxygen molecules in water, organic pollutants in printing and dyeing wastewater are degraded by cultivating anaerobic or facultative biological bacteria.However, anaerobic technology requires a very strict anaerobic environment, which requires a certain cost to create the environment, and may also produce toxic gases such as methane and hydrogen sulfide; 3. Comprehensive aerobic and anaerobic treatment technology.Aerobic and aerobic technologies avoid the disadvantages of two technologies, but also combine the advantages of two technologies, namely cultivating facultative biobacteria that can survive and reproduce in anaerobic and aerobic environments, and using this biobacteria to treat printing and dyeing wastewater.At present, most of the printing and dyeing wastewater has been purified by immobilized microbial technology.For example, the hydrolysis acidification process uses facultative microorganisms for wastewater treatment.

With the continuous development of economy, printing and dyeing industry and dyeing technology has made great progress, at the same time is the composition of printing and dyeing wastewater become more and more complex and the original biotechnology is difficult to completely treat more and more complex printing and dyeing wastewater, different dyes and additives of biodegradable microorganisms or microbial combination technology has been gradually developed and applied.The new microbial technology produced by combining immobilized microbial technology with other technologies will have broad development prospects[5].

4. Prospect of immobilized microbial technology

To sum up, with its own advantages, the immobilized microbial technology shows its unique advantages in water environment governance, but this technology still has many problems to be solved urgently.Among them, the most critical problem is some problems in immobilized cell vectors.At present, the vectors used by fixed microorganisms have problems with very limited service life, the risk of secondary pollution and high material cost; And the currently used immobilized materials have some resistance to the reaction of microorganisms, How to reduce the reaction resistance of immobilized microbial materials and improve the reaction efficiency is an urgent problem; There is also a concern to follow, It is the type of fixed microorganisms: the species of fixed microorganisms is relatively single, Although the treatment of some component in the sewage is extremely functional, But it is very rich in the kinds of sewage, And the ingredients are very complex; therefore, A single microorganism is difficult to handle multiple contaminating chemicals in multiple wastewater.

5. Conclusions

In short, the use of fixed microbial technology to treat wastewater has very good prospects, but then not only the advantages, but also many urgent problems to be solved will be widely used and further studied in environmental treatment.

References

[1] Ma Xinhong (2006).Study on the efficiency and mechanism of 2-MIB in smelly oxidation water catalytic by hydrogen peroxide [D].Harbin Institute of Technology.
[2] Jiang Yating et al(2022). Application of microbial immobilization technology for remediation of Cr(VI) contamination: A review[J]. Chemosphere, 286(P2) : 131721-131721.
[3] Li Wei, Wang Mingyu, Liu Liya, Liu Bo, Chen Yawei(2015).Research trend and hotspot analysis of underground water pollution control and restoration technology [J]. Hydrogeological Engineering geology, 42(02):120-125+131. DOI:10.16030/j.cnki.issn.1000-3665.2015.02.18.
[4] Qin Shengdong, Guo Jia, Liu Yucun, Ma Hui, Yin Zheng, Lu Ligang(2014). Research Progress in Immobilized Microbiology Technology and Its Application in Water Treatment [J]. Water Treatment Technology, 40(10):6-11.DOI:10.16796/j.cnki.1000-3770.2014.10.002.
[5] Wei Miao Jun (2021). Application of curing microbial technology in printing and dyeing sewage treatment [J]. Technology and Innovation, (09):173-174.DOI:10.15913/j.cnki.kjycx. 2021.09.075.