Treatment Technology and Research Progress of Pesticide and Pharmaceutical Wastewater

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Abstract: China is a major agricultural country, with the production and use of pesticides ranking among the top in the world. Pesticides generate a large amount of wastewater during their production and use. Once these wastewater flows into the environment, it can cause harm to the environment, soil, vegetation, and human health.This article analyzes the characteristics and hazards of pesticide wastewater, analyzes the main technologies of pesticide and pharmaceutical wastewater in China, and proposes the use of physical, chemical, biological, and combination processes to treat pesticide wastewater, reduce harmful substances in pesticide wastewater, and reduce environmental hazards. Physical chemical, biological, and advanced oxidation methods are used to treat pharmaceutical wastewater, so as to meet discharge standards, standardize the treatment process of pesticide and pharmaceutical wastewater, and further improve the treatment technology of pesticide and pharmaceutical wastewater.

Keywords: Pesticide wastewater;Pharmaceutical wastewater;Processing technology;Research progress

Introduction

With the continuous progress of agricultural technology, the use of pesticides in the agricultural field has become increasingly widespread, effectively suppressing agricultural pests and diseases, and improving crop and vegetable yields. However, it has also brought some problems, among which the most prominent is the pollution of pesticide and pharmaceutical wastewater, which has attracted widespread attention in society.Pesticide production enterprises should attach importance to the treatment of pharmaceutical wastewater, actively introduce new technologies and equipment, continuously improve the level of pesticide production and pharmaceutical wastewater treatment technology, reduce the harmful and toxic substances generated in the pharmaceutical production process, treat pharmaceutical wastewater, reduce the content of toxic and harmful substances in the wastewater, make it meet the national discharge standards, prohibit illegal discharge of pharmaceutical wastewater, protect the surrounding environment, groundwater, etc., and reduce the harm to human health.

I. The characteristics and hazards of pesticide wastewater

1. Characteristics of pesticide wastewater

At present, the pesticides commonly used in the agricultural field in China include the following types: herbicides, fungicides, insecticides, etc. According to the types of pesticides, pesticide wastewater can be divided into benzene containing wastewater, organic phosphorus containing wastewater, high concentration salt containing wastewater, high concentration phenolic wastewater, and mercury containing wastewater.The pesticide wastewater studied in this article mainly refers to the production wastewater of pesticide pharmaceutical factories and the washing wastewater of pesticide application equipment. These pesticide wastewater have the characteristics of high organic pollutant content and strong toxicity.In addition, pesticide wastewater also has high water solubility and stability. Due to the strong toxicity of pesticide degradation products, there are very few drugs that can be used to degrade pesticide wastewater, which is also one of the reasons why pesticide wastewater is difficult to treat.

2. Pesticide wastewater hazards

Pesticide wastewater contains many harmful substances. If discharged directly without treatment, it can cause harm to the surrounding environment, groundwater, soil, air, and pose a threat to the ecosystem and human health.Firstly, the toxins in pesticide wastewater can affect the growth of animals and plants. For example, DDT can reduce the survival rate of vulture embryos, and heavy metals can inhibit crop growth and even cause crop death.Secondly, the levels of reproductive, neurological, and immune system toxins in pesticide wastewater are very high. Once they enter the environment, they can enter the food chain through aquatic animals, plants, etc., and then penetrate the toxins into crops and animals. Once consuming animal and plant products contaminated with pesticide wastewater, it is easy to cause poisoning, and in severe cases, it can even threaten human life.

II. Pesticide wastewater treatment technology

1. Physical method

The commonly used physical treatment technologies for pesticide wastewater currently include adsorption and extraction methods, which meet the treatment needs of different types of pesticide wastewater and help agricultural pharmaceutical plants and sewage treatment plants solve the problem of pesticide wastewater treatment.Firstly, the adsorption method utilizes porous solid materials to treat pesticide wastewater, allowing impurities in the wastewater to adsorb onto the solid and effectively separating pure gases.For example, pesticide pharmaceutical factories can use porous materials such as activated carbon, resin, and diatomaceous earth to adsorb impurities in pesticide

wastewater and quickly purify it, reducing impurities in pesticide wastewater.This pesticide wastewater treatment technology has low cost, high efficiency, simple process, and less regeneration pollution.Secondly, extraction method is also a widely used treatment technology. Its principle is to select a solution that is insoluble in the pesticide wastewater based on its components, and then prepare reagents based on the main pollutant components in the pesticide wastewater. By fully mixing, the pollutants are transferred to the prepared solvent.This treatment technology is relatively convenient to operate and can extract and separate harmful substances from pesticide wastewater. However, due to the use of other chemical reagents in the treatment process, it is necessary to control the amount of chemical reagents to avoid the generation of new pollutants.

2. Chemical method

Firstly, photocatalytic oxidation refers to the use of vacuum ultraviolet light generated by artificial ultraviolet lamps as a catalyst to oxidize pollutants in pesticide wastewater into carbon dioxide, water, or specific inorganic ions. TiO2, ZnO, and CdS can also be used as photocatalytic materials to treat pesticide wastewater, reduce toxic substances in the wastewater, and meet discharge standards.However, this pesticide wastewater treatment technology has a relatively high cost and weak stability, making it difficult to promote on a large scale. Secondly, Fenton oxidation method is used to remove organic pollutants from pesticide wastewater. Professional Fenton reagents are added to pesticide wastewater, and Fe2+in the reagents is used to catalyze H2O2. Through oxidation-reduction reaction, hydroxyl radicals with reduced potential can be effectively treated to remove organic phosphorus pesticides and organochlorine pesticides in pesticide wastewater. This treatment method is suitable for pesticide wastewater with a pH range of 2.5-4, and the treated pesticide wastewater contains a large amount of anions, which can easily form ferrous sludge, invisibly increasing the cost of pesticide wastewater treatment.

3. Biological method

Biological treatment technology refers to the use of biodegradation mechanisms to purify pesticide wastewater. Its principle is to use microorganisms such as algae and fungi to degrade organic pollutants in pesticide wastewater into small molecules, gradually mineralizing them into water and carbon dioxide.Biodegradation can be divided into anaerobic and aerobic processes, among which aerobic treatment technology mainly uses sludge method and membrane bioreactor to purify pesticide wastewater and further degrade harmful substances in the wastewater.Anaerobic treatment technology uses anaerobic sludge reactors and anaerobic membrane reactors to treat pesticide wastewater, such as using microorganisms such as yeast, bacteria, and algae to absorb and explain the pollutants in pesticide wastewater. However, due to the high cost and energy consumption of membrane bioreactors, they are also prone to membrane fouling and the high cost of activated sludge, making it difficult to promote biological treatment technology on a large scale.

4. Combination process

Due to the complex composition and high content of harmful substances in pesticide wastewater, it is difficult to achieve ideal results with a single wastewater treatment technology. Therefore, different treatment technologies can be combined to further improve the level of pesticide wastewater treatment.Firstly, technicians can use physical treatment methods to treat pesticide wastewater, separating colloids and suspended solids in the wastewater and removing solid impurities.Secondly, technicians can use chemical treatment methods to oxidize and degrade organic compounds that are difficult to explain in wastewater, improving its biodegradability and laying a solid foundation for subsequent biological treatment.Finally, technicians can utilize microorganisms, fungi, and other substances to degrade heavy metals, toxic gases, and other pollutants in pesticide wastewater, enabling the wastewater to meet discharge standards and reduce harm to the surrounding environment, groundwater, soil, and flora and fauna. This helps pesticide pharmaceutical manufacturers and wastewater treatment plants solve the problem of pesticide wastewater treatment.

III. Analysis of Pollution Characteristics of Pharmaceutical Wastewater

Pesticide pharmaceutical wastewater has the characteristics of complex composition, high pollutant concentration, strong biological toxicity, and difficult degradation, making it an organic industrial wastewater that is difficult to biodegrade.

1. Main production process drainage

The pesticide pharmaceutical process involves multiple chemical reagent reactions, generates a large amount of harmful gases and residues, and is accompanied by obvious pungent odors, which will discharge a large amount of wastewater in the production process.These wastewater include solvent recovery residue, waste filtrate, etc. These wastewater have unstable pH values, complex drug components, and strong toxicity.If pesticide wastewater is not treated in a timely manner or directly discharged into rivers or soil, it is easy to cause serious environmental pollution, leading to excessive levels of heavy metals and toxic substances in rivers, affecting the quality of farmland, groundwater, and soil around the river. The pollution range is very large. Therefore, timely treatment of pesticide and pharmaceutical wastewater is necessary.

2. Auxiliary production process drainage

In the pesticide pharmaceutical process, reagents, drug components, etc. are distilled, and power equipment needs to be cooled, which is called the auxiliary production process. This process requires a large amount of water and has strong seasonal characteristics.For example, pesticide pharmaceutical factories need to produce pesticides according to the growing season of crops, and may also alternate the production of multiple pesticides, which leads to a sharp increase in the amount of pesticide pharmaceutical wastewater, and the different components of pharmaceutical wastewater pose significant challenges to the treatment of pharmaceutical wastewater.

3. Rinsing water

Flushing water refers to the flushing water of filtration equipment, filling equipment, and production workshop floor during the pesticide pharmaceutical process. Relatively speaking, the toxic substance content in the wastewater of this pharmaceutical process is relatively low, and it is also the most easily overlooked pesticide wastewater treatment process.For example, the suspended solids content in the flushing water of pesticide pharmaceutical plant filtration equipment far exceeds the standard, accompanied by some solid impurities. If discharged directly without treatment, it is easy to cause serious pollution.

IV. Pharmaceutical wastewater treatment technology

In recent years, China has increased its supervision of pesticide and pharmaceutical enterprises, urged environmental protection departments to carry out professional treatment of pesticide and pharmaceutical wastewater, and formulated pharmaceutical wastewater discharge standards, standardized pharmaceutical wastewater treatment processes, improved pharmaceutical wastewater treatment technology, and effectively reduced the harm of pharmaceutical wastewater to the environment and human health

1. Physical and chemical methods

The coagulation method is currently widely used in the treatment of pesticide and pharmaceutical wastewater. It refers to the addition of coagulants and crosslinking agents to further neutralize the ZETA potential of colloids in the wastewater, destabilize these colloidal particles, and then use crosslinking agents to coagulate pollutant molecules into large particles, allowing these large particles to settle at the bottom of the pesticide and pharmaceutical wastewater tank, facilitating the rapid removal of pollutants from pharmaceutical wastewater.For example, technicians can use iron salts, aluminum salts, polyacrylamide, etc. as coagulants to meet the national COD discharge standards for pharmaceutical wastewater.In addition, technicians can use the microelectrolysis method to treat pesticide pharmaceutical wastewater. The principle is to use iron filings and inert carbon particles to make micro batteries, and put the micro batteries into the pesticide pharmaceutical wastewater to generate H2O2 with strong oxidation properties, which decomposes organic pollutants in the pharmaceutical wastewater.

2. Biological method

Due to the strong resistance of bacteria and poor biodegradability of pesticide pharmaceutical wastewater, technicians can use biological methods to treat pharmaceutical wastewater. Currently, more commonly used methods include aerated biofilters, anaerobic aerobic combination processes, and flow anaerobic sludge bed UASB reactors, which are suitable for different types of pesticide wastewater and further improve the level of pesticide pharmaceutical wastewater treatment.For example, technicians can use a flow anaerobic sludge bed UASB reactor to treat herbicide pesticide wastewater, remove sodium chlorate, borax, arsenic salts, and trichloroacetic acid from the wastewater, reduce the COD content in the wastewater, further purify pesticide pharmaceutical wastewater, and improve the level of pesticide pharmaceutical wastewater treatment technology.

3. Advanced oxidation method

The ozone oxidation method is a method that utilizes the self oxidation of ozone to generate active free radicals, which oxidize and reduce pollutants in pharmaceutical wastewater, thereby removing pollutants from it.For example, technicians can use hydrogen peroxide in conjunction with ozone catalytic oxidation and biological activated sludge method to treat pesticide pharmaceutical wastewater, quickly removing heavy metals, harmful gases, etc. in the wastewater, so as to meet the discharge standards of pesticide pharmaceutical wastewater. This pharmaceutical wastewater treatment technology has a short cycle, low cost, low energy consumption, stable effect, smooth and simple operation, and almost no new pollutants and toxic side effects are generated during the wastewater treatment process, making it a hot research topic in the future of pharmaceutical wastewater technology.

Epilogue

In summary, agricultural pharmaceutical enterprises and sewage treatment plants should attach importance to the treatment of pesticides and pharmaceutical wastewater. Corresponding treatment technologies should be selected based on the chemical composition and characteristics of different types of pesticide wastewater. This ensures the rapid removal of harmful substances and gases from pharmaceutical wastewater, as well as the discharge of pharmaceutical wastewater after meeting discharge standards, further reducing the impact on groundwater, environment, flora and fauna, and human health.With the continuous updating and upgrading of pesticide production technology, pesticide and pharmaceutical wastewater treatment technology also needs to be constantly innovated, promoting the combination of physical treatment, chemical treatment, and biological treatment methods, meeting the current needs of pesticide and pharmaceutical wastewater treatment, implementing sustainable development and green energy conservation concepts, and better solving the problem of pesticide wastewater pollution.

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