The current status of mercury repair technology in the environment

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Abstract. In recent years, due to the pollution of heavy metals in the environment, it has brought a serious crisis to my country's ecological balance, especially the pollution of heavy metal mercury (Hg), so the repair of mercury in the environment is crucial. At present, there are many technologies for repairing mercury in the environment. The main repair techniques include physical repair technology and chemical repair technology. However, there are many problems in these two repair methods, such as high repair costs, and it is easy to cause secondary pollution. Microbial repair method is a method of repairing the environment. It can not only adsorb and fix heavy metal mercury, and does not bring pollution to the environment. Therefore, using microorganisms to remove mercury in the environment is by far the most promising environmental repair technology.

Keywords: Mercury; physical repair technology; chemical repair technology; biological repair technology.

1. Introduction

Heavy metal pollution has become a serious environmental problem, and has received more and more attention in China in recent years[1]. Heavy metals generally refer to metals with a gravity of greater than 5, including lead (Pb), zinc (Zn), cadmium (Cd), mercury (Hg), chromium (Cr), etc[2,3]. Heavy metal has the characteristics of high toxicity, super long persistence, strong pollution ability, etc. As the level of release continues to rise[4], it destroys our living environment and has attracted great attention from people[5].

2. Source of mercury

There are two main sources of mercury: natural emissions and human activities[6]. The sources of mercury in different forms are also different. The natural sources of mercury emissions mainly include plant respiratory release, geothermal movement, forest fire, soil pollution, volcanic eruption, and seawater evaporation. In the nature, mercury can exist in a variety of chemical forms, and it has toxic effects on biology when a certain concentration is reached. Hg^0 is a shiny liquid or steam. $Hg^{2+}{}_2$ exists in the form of inorganic salts. Hg^{2+}exists in the form of inorganic salt or organic mercury compounds. Human activity emissions are the most important mercury pollution, about 5,000 tons per year[7]. The mercury emitted by human activity will not only cause harm to the environment, but also cause damage to its own living environment.

3. Mercury pollution repair technology

The technology of repairing Hg pollution in the environment mainly includes two technologies. One is to reduce its pollution to the environment by transforming the transforming armor mercury that is easy to volatile and transforming into a relatively stable monoclippocron mercury, reduce its migration and transformation in the environment Essence Another method is to directly remove mercury from the environment, and use some external media to carry or wrap mercury. The repair technology of mercury pollution currently commonly used currently includes physical repair, chemical repair and biological repair.

3.1 Physical repair method

The physical repair method is to remove the price of mercury or change mercury through technical measures. Methods include electric repair technology and isolation method [8].

3.1.1 Electric repair technology

Electric repair technology refers to the process of removing pollutants through the role of electric field. In the study of the relieving dynamic characteristics and electric repair of rice soil and dry soil in the southwestern region of our country, the development of electric repair technology that uses Ki+I2 oxidation-collapse to approach cathode in the soil Provides a efficient repair technology. The advantage of this technology is that the repair time is short, the amount of reagents is relatively small, but there are disadvantages, such as the pH near the yin and yang poles change too much, the concentration requirements for pollutants are relatively high, and the applicable range is relatively small.

3.1.2 isolation method

The soil isolation method refers to the division and isolation of the soil area with waterproofing the waterproof material. This method is mainly suitable for areas that are severe metal pollution and are not processed in the short term of heavy metals. In these places, high - concentration heavy metals can seep with the soil and migrate along groundwater, and the groundwater heavy metal pollution follows. Because these areas are difficult to recycle or need for a long time to deal with it, they areolate them to prevent further pollution from the outside. The disadvantage of this method is that it cannot cure heavy metal pollution, which can only transfer pollution and cause secondary treatment.

3.2 Chemical repair method

The principle of the chemical repair method is to add some chemical agents to the Hg pollution area to reduce the liquidity and toxicity of Hg by changing the shape or price of Hg. The current commonly used chemical repair methods include restoration and vulcanization. These two methods have higher efficiency of heavy metals and are currently widely used.

3.2.1 Restoration method

The reduction method includes sodium boridide reduction method and metal restoration method. The sodium sodium sodium reducing method refers to putting sodium boridide into a wastewater containing heavy metal mercury. After reacting with mercury, mercury and borne acid are mainly generated and hydrogen. The metal reduction method is to use the metal of the oxidized reduction potential than the Hg (II) into the filler tower, and the Hg (II) in the wastewater (II) is replaced. This method can quickly and effectively remove mercury in the water, but the consumption of financial resources is huge, and it will affect the ecological balance of the water environment.

3.2.2 vulcanization method

The sulfide precipitation method is a effective way to remove mercury pollution in water. The method is to invest lime milk and excessive sodium sodium sodium in wastewater, and to generate sodium sulfide solids that are difficult to dissolve, thereby achieving the purpose of removing[9]. The advantage of this treatment method is that high efficiency, but the disadvantage is that it is easy to cause secondary pollution.

3.3 Method of Biological Repair

Biological repair is to add some plants, some heterologous microorganisms, or some microorganisms that can be carried by themselves, through the metabolic effects of these microorganisms that can be carried by themselves, to achieve the purpose of restoring and removing Hg. At present, people have discovered some new ways of biological repair of Hg with potential. There are two main types: plant repair and microbial repair.

3.3.1 Plant repair

Plants can use the unique abilities of the root system, as well as the migration and transformation of pollutants in the entire plant, and remove and fix the pollutants in the environment[10]. The mechanism of plant repair Hg includes absorption, fixation, volatilization, and transformation. The plant root system can absorb and accumulate Hg and transport it to the ground part. Finally, the plant is harvested to the Hg pollution to recover the Hg source. Plant repair technology plays a very important role in the improvement of the ecological environment, especially the removal of mercury. But so far, only potential mercury wealth creatures have been discovered, and no Hg super wealthy creatures have been found. However, the existing plant repair technology still has problems such as long restoration time, climate, and mercury concentration, low value of the plant economy, large area, and serious mercury pollution.

3.3.2 Microbial repair

Microbial repair mainly reduces the affinity adsorption ability of heavy metals through the metabolism of functional microorganisms or directly converts it into a low -toxic form. Because of its low cost, high efficiency, and a significant effect under low Hg pollution, it is also a sustainable repair technology[11]. Common microorganisms mainly refer to the use of Hg restorease to restore Hg2+to Hg molecular bacteria, such as ferrite, mycelium fungus, Bacillus, and fake odor. Although microorganisms cannot degrade and eliminate heavy metals, heavy metals can be converted from high toxic forms into low toxic forms to achieve the purpose of repair.

However, the use of a microorganism of Hg alone to control mercury pollution is often unable to achieve the ideal effect in some cases. It must be combined with other technologies to achieve better control effects. It mainly includes genetic engineering, embedded fixed method, and biofilm method.

(1) Gene engineering

Microbiography has achieved varying degrees of success through MER manipulating sub -development of Hg. For example, Sone et al. Plugs in the MER gene cluster in the Mer's genes in the K-62 strain in the counterlasses of the fake singles to E. coli cells. Gene engineering technology is also used to develop strains with resistance to a variety of metals, such as Hg's wide -spectrum super bacteria *Cupriavidus metallidurans*, which can volatilize from other heavy metals such as Cr and Cu at the same time.

(2) Burid fixing method

In this method, the microorganisms embedded in the curing carrier have the advantages of strong stability and prevention of bacterial loss. For example, fixed nitrogen -fixed bacteria strains can detoxify higher concentrations of Hg than ionized cells; 1 enteric bacteria fixed in calcium alginate can completely remove 5 mg/L HgCl2 in the synthetic wastewater within 72 h. use. The problem with this technology is that the stability requirements of microorganisms are particularly high.

(3) Biofilm method

The biofilm is a good metal energy storage device. It has a fast accumulation process and has the characteristics of accumulation, fixing, easy to collect, and richness. Wagner-Dobler and others designed a biofilm reactor. The biofilm consists of seven different Hg pseudolytic bacteria. During the 8-month test period, 98% of Hg was removed from the wastewater[13]. This biofilm The reactor has a very good adsorption effect on Hg, which greatly reduces Hg pollution in the water environment.

4. Summarize

Comecar pollution seriously threatens human health, which has caused great harm to the environment. It should be found to find more effective technologies to control mercury pollution.

Physical chemistry and biological methods have gradually been used in Hg governance. Removing heavy metals in physical and chemical methods will produce a large amount of Hg pollution sludge, and the cost is high. The advantages of biological repair are short -term duration, low pollution, good effect, low treatment cost, and it is not easy to cause secondary pollution to the environment. Therefore, the biological repair method is a better choice than physical chemistry methods. However, there are certain problems with biological repair methods, which will be limited by their own characteristics. Therefore, it is urgent to develop a microorganism of Hg.

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