

Current Situation and Control Measures of Heavy Metal Pollution in Farmland Soil

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Abstract: With the acceleration of urbanization and industrialization, soil heavy metal pollution has become a widespread environmental issue of concern both domestically and internationally, and has seriously threatened the stability of the Earth's ecosystem and the safety of human life. Therefore, it is urgent to address soil heavy metal pollution. Based on the reality of soil heavy metal pollution in China, this paper analyzes the main sources of heavy metal pollution in farmland soil, and proposes targeted remediation measures for soil heavy metal pollutants through physical, chemical, and Bioremediation technologies, with a view to providing reference and reference for the alleviation of farmland soil safety problems in China.

Keywords: Heavy metals, Soil pollution, Pollution sources, Repair measures.

1. Introduction

Soil heavy metal pollution refers to the continuous entry and accumulation of heavy metal elements generated by human activities into the soil through various channels, leading to reduced soil quality and dysfunction, thereby affecting the growth and development of animals, plants, and soil microorganisms. Due to its diverse morphology, easy accumulation, and ability to migrate and transform without being degraded, it poses a serious threat to the safety of agricultural products, groundwater, and even human health. Heavy metal pollution in soil mainly includes mercury (Hg), cadmium (Cd), chromium (Cr), lead (Pb), arsenic (As), etc. Its main sources of pollution come from the use of fertilizers and pesticides, sewage irrigation, atmospheric sedimentation, and the discharge of "three wastes" from chemical plants. According to the survey conducted by the Ministry of Agriculture and Rural Affairs of China on 1.4 million hectares of sewage irrigation areas nationwide, 64.8% of the land in the sewage irrigation areas is contaminated by heavy metals. Therefore, the remediation of soil heavy metal pollution is urgent.

2. The Main Sources of Heavy Metal Pollution in Farmland Soil

2.1. Heavy metal pollution in soil caused by industrial waste discharge

Due to the rapid development of industrialization, a large number of chemical companies have emerged. These companies have a high demand for production water, so building factories by the river is the best choice. Despite strict national restrictions on the discharge standards of production wastewater, driven by economic interests and limited corporate governance measures, it is directly discharged into surrounding waters without any treatment, resulting in environmental pollution. Agricultural production takes rivers, lakes and other natural water bodies as the main water sources, while farmland irrigated with polluted water sources for a long time has caused a lot of pollution and soil pollution due to the natural degradation of pollutants. Especially heavy metal pollution, due to its long natural degradation cycle, will be intercepted by various methods. More than 85% of heavy

metal pollutants will be adsorbed by colloidal particles and roots in the soil, while heavy metal pollutants will deposit on the soil surface and gradually decrease as the soil deepens. Long term use of sewage for irrigation of farmland can increasingly cause heavy metal pollution in the soil of irrigation areas

2.2. Heavy metal pollution in arable soil caused by agricultural production

In recent years, farmers have extensively used agricultural production materials such as pesticides, fertilizers, and thin films. The use of these materials has greatly improved grain yields, but excessive use can also lead to soil pollution. Organic and inorganic pesticides contain a large amount of heavy metals, such as zinc, copper, and arsenic. Excessive use can cause significant pollution to heavy metals in soil. For example, Xinjiang Province is a large grape producing area. Bordeaux insecticides need to be sprayed 6-10 times a year during the grape growing season. In this way, the amount of copper entering the soil each year will reach over 5000 tons. In addition, the addition of stabilizers such as pots and lead to thin films during the production process has led to an increase in usage in recent years, not only causing white pollution, but also exacerbating heavy metal pollution in the soil.

3. Current Situation of Heavy Metal Pollution in Farmland Soil

In China's land resources, heavy metals such as mercury, zinc, lead, and pot have already invaded 20 million hectares? With the development of industry and urbanization, the problem of heavy metal pollution in farmland soil is relatively serious. Heavy metal pollution in farmland soil can directly lead to a decrease in crop yields, indirectly lead to a decrease in land use efficiency, and damage the natural environment. At present, the average annual loss of crops in China due to soil heavy metal pollution is about 12 million tons, greatly hindering the effective development of crops in China. According to statistics, the excess rate of heavy metal sites in arable soil in China reached 19.4% in 2014, but by 2018, this number had increased by nearly 2% to 21.49%, and this number is still increasing by 47% year by year. The occurrence of events such as the 'Blood Lead Incident', 'Rice',

and 'Pick Wheat' has also sounded the bell for the prevention and control of heavy metal pollution in China's farmland. The soil problems in farmland in the Pearl River Delta region are mainly reflected in the prominent arsenic pollution in the pot, which presents a complex and regional characteristics! s: The average content of heavy metal pots in farmland soil in Henan Province exceeds the standard, which inhibits the growth of crops and affects human health. Therefore, China needs significant efforts to control soil heavy metal pollution.

4. Remediation Methods for Heavy Metal Pollution in Farmland Soil

4.1. Physical repair process

Physical soil remediation technology mainly uses physical methods to separate and fix heavy metals, and then uses chemical methods to reduce the content of heavy metals, thereby achieving the goal of improving comprehensive soil treatment. The traditional physical treatment method is to replace soil and fill it with other non polluting soil on contaminated land, which can reduce the content of heavy metals in the soil and also control the damage to the environment. This approach is more suitable for the restoration and management of small-scale land. Technically, it is necessary to scientifically control the thickness of soil and combine it with the characteristics of surface pollution to improve its characteristics and adapt to local agricultural production and land use needs. However, the drawbacks of this approach are also quite obvious, such as the need to increase investment in the environment, and there is serious waste in the use of funds, making it difficult to fundamentally eliminate heavy metal pollution. Meanwhile, for land with less pollution and smaller area, deep tillage technology can be adopted to renovate the contaminated land and remove heavy metal elements. However, this is only temporary and cannot solve the problem, and it will cause more secondary pollution. The remediation effect of leaching method is related to Soil type. The leaching method uses leaching solution to wash the soil and remove excess heavy metals. Chemical agents can be used for large-scale treatment, especially for some soils with high permeability, which has obvious advantages. During use, it is necessary to detect the characteristics and pollution level of the soil, and at the same time, ion exchange can be used to improve the effectiveness of governance. However, when selecting pesticides, full consideration should be given to the absorption characteristics of plant nutrients to avoid affecting plant growth. If the soil permeability is not strong, the leaching effect will be reduced, therefore, it is mainly used for sandy soil and light soil. In addition, the types of leaching agents can also have a certain impact on the soil. A good leaching agent has better soil remediation effects than cheap leaching agents, but its cost is much higher. Moreover, some leaching agents can wash away heavy metal elements such as calcium and magnesium, which cannot be absorbed by crops enough nutrients, causing poor growth and affecting the final harvest.

4.2. Chemical remediation technology

The soil leaching technology utilizes relevant solvents that can cause heavy metals to migrate or dissolve, inject them into soil contaminated with heavy metals, convert heavy metal ions, and effectively solve the problem through extraction and separation. This technology can be applied to the pollution treatment of sandy soil, but it cannot achieve

good results for soil with relatively poor permeability and is difficult to operate under the premise of causing damage under soil conditions. The United States once used acidic solvents for extraction, and appropriate addition of reducing or oxidizing agents during operation can effectively treat soil contaminated by heavy metal substances in mines, ensuring reasonable control of heavy metal content. The principle of modified remediation with amendments is to react with heavy metal elements in the soil, reduce the activity of heavy metal elements through redox and antagonistic effects, and effectively reduce the toxicity of heavy metal elements in the soil, thereby reducing their impact on crop growth. At present, the commonly used modifiers are lime, phosphate, zeolite, calcium carbonate, etc., which can promote the Redox of heavy metals and achieve the treatment effect quickly, but the defects are also very obvious. They can not effectively remove the heavy metals enriched in the soil, and it is difficult to achieve the fundamental and long-term treatment effect.

4.3. Bioremediation technology

Nature has strong self-regulation and self-healing abilities. Once the pollution source is effectively controlled, heavy metal pollution will naturally decay over time. During this process, plants, animals, and microorganisms in the soil play an important role in diluting heavy metal elements and reducing their activity, but the natural decay cycle is longer and requires more time. The biological treatment measures are to amplify the Catharsis effect of plants, animals and microorganisms on soil, shorten the time of natural attenuation of heavy metal pollution, and achieve good treatment effect. Microbial remediation technology refers to the use of microbial growth and metabolism to purify heavy metals in soil. In practical application, it is necessary to select microbial types with strong purification capacity for heavy metals, and place them in a large number in contaminated soil, so as to obtain good treatment effect. It should be noted that microorganisms have strict requirements for their growth environment, and different microorganisms have different tolerance to pollution. Selection should be based on the actual situation of the contaminated area. At present, microbial remediation technology still needs further research and development by researchers, striving to screen and domesticate microbial species with good environmental adaptability and pollution degradation ability as soon as possible, so as to improve the survival rate and life span of microorganisms in contaminated soil and improve the soil remediation effect. Compared with chemical treatment and physical treatment, this treatment method has a long cycle and slow effectiveness. In the later stage, it is necessary to deal with the problem of excessive microorganisms in the soil to restore the Balance of nature of the soil.

Phytoremediation is to absorb heavy metals by planting plants with strong enrichment capacity in polluted areas, such as Dongguan, chlorophytum comosum, various rattan plants, etc. Phytoremediation can use the adsorption and absorption of plant roots to enrich the heavy metals in soil on plant roots, branches and leaves, and then use relevant technologies to extract heavy metals from plants. This is an environmentally friendly and effective biological treatment technology that can gradually reduce the concentration of heavy metal pollution in soil, and also has green functions. It has advantages such as simple operation and low cost, and is widely used in soil heavy metal pollution control.

5. Conclusion

The main mechanism of soil heavy metal pollution control is to remove toxic substances of heavy metals in the soil, and achieve control of heavy metal pollutants in the soil based on the restoration of the essence of the soil as much as possible. The basic method is to repair contaminated soil based on the principles of physics, chemistry, and biology. China proposed the "Action Plan for Soil Pollution Prevention and Control" in 2016, which provides a policy basis for the development of heavy metal pollution remediation technology in farmland soil in China. This article starts from the main sources of heavy metal pollutants in soil, analyzes the current situation of heavy metal pollution in farmland soil, and proposes targeted remediation technologies for heavy metal pollutants in soil, in order to better serve the heavy metal remediation work in farmland soil and effectively ensure national food safety.

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