

Study on Heavy Metal Pollution and Remediation Technology in Farmland

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Abstract

Farmland soil is the basic guarantee for people's survival. With the increasing heavy metal pollution, the soil quality has declined, which has seriously affected the quality and output of agricultural products, and also destroyed the ecological balance. Therefore, in view of the problem of heavy metal pollution in farmland soil, heavy metal remediation technology should be actively explored and effectively applied to reduce the impact of heavy metal pollution on farmland soil.

Keywords

Cultivated Land Protection; Heavy Metals; Soil Pollution; Repair Technology.

1. Introduction

Heavy metals originally mean metals with a density of more than 4.5 g/cm^3 , which are difficult to be degraded through the natural environment. Common heavy metals include gold, silver, copper, iron, mercury, lead, cadmium, etc. When heavy metals accumulate to a certain amount, they will worsen the environment and cause pollution to rivers and groundwater sources. Not only will soil fertility decline, which will reduce crop yields, but also they can directly poison plants, which will seriously reduce the quality of agricultural products. If farmland soil is polluted by heavy metals, it will cause great harm to human health. High concentrations of heavy metals contained in soil will enter the plant with the growth of crops. Once heavy metals are contained in wheat, rice and corn, the staple food of people, they will be brought into the human body through diet, causing serious impact on the human body.

2. Harm of Heavy Metal Pollution to Farmland Soil

Heavy metals can enter the farmland soil in many ways. The initial accumulation amount is small and has not been shown, but the long-term accumulation will lead to enrichment. When the enrichment reaches a certain concentration, it will seriously affect the growth and development of crops, resulting in crop yield reduction, and even crop death. There are many kinds of heavy metals, and the toxicology produced by crops is directly related to the types of heavy metals, which vary with the types of heavy metals. The experimental results showed that there was chromium in the soil, and the concentration of chromium continued to increase until 0.1 mg/L , which inhibited the germination of rice seeds. In addition, cadmium also has a great impact on the development of rice. Higher cadmium content will lead to a significant decline in rice yield.

3. Status Quo of Heavy Metal Pollution in Farmland Soil

At present, the area of cultivated land polluted by Cd, Hg, As, Cr, Pb in China is about $2000 \times 10^4 \text{ hm}^2$, about 1000 grains lost annually due to heavy metal pollution $\times 10^4 \text{ t}$, up to 1200 contaminated grains $\times 10^4 \text{ t}$, economic loss of at least $200 \times 10^8 \text{ yuan}$. Statistical analysis of the

concentrations of Cr, Cu, Pb, Zn, Ni, Cd, Hg and as in farmland soil in China shows that most cities are higher than their soil background values. According to the land survey conducted by the Key Laboratory for Prevention and Control of Agricultural Product Pollution of the Ministry of Agriculture in 24 provinces and cities across the country, there are 320 seriously polluted areas in 24 provinces and cities, about 548×10^4 hm², the agricultural products with heavy metals exceeding the standard account for more than 80% of the total area of agricultural products with pollutants exceeding the standard. In addition, the area of sewage irrigation area in China is about 1.4 million hm², and the area of land polluted by heavy metals accounts for 64.8% of the total pollution area, of which the area of light pollution accounts for 46.7%, the area of moderate pollution accounts for 9.7%, and the area of serious pollution accounts for 8.4%, among which the area of Hg and Cd pollution is the largest. At present, 13000 hm² of arable land in China is polluted by Cd, involving 25 regions in 11 provinces and cities; About 32000 hm² of cultivated land is polluted by Hg, involving 21 regions in 15 provinces and cities.

4. Remediation Technology of Heavy Metal Soil Pollution

4.1. Physical Repair Method

Physical engineering measures such as deep ploughing, soil removal and soil replacement are mainly used to expand the coverage of heavy metals and reduce the concentration of heavy metals, which are suitable for soils with small pollution areas. This method is widely used in Britain, the United States and other countries. For the sandy soil with deep pollution degree and large pollution area, according to the nature and pollution degree of the polluted soil, select the appropriate leaching solution to separate heavy metals from the soil by leaching. It is an electrokinetic remediation technology to insert electrodes in heavy metal contaminated soil, and then remove and enrich heavy metal ions under DC voltage. It is a remediation technology that uses heat energy generated by high-frequency voltage to heat heavy metal contaminated soil and separate volatile Se, As, Hg, etc. from the soil. This electrothermal remediation method, also known as thermal desorption remediation technology, has a significant effect on Hg remediation. Under high temperature and high pressure, the heavy metal contaminated soil can form a glassy structure, and the heavy metal can be fixed and stabilized by vitrification technology. Electrothermal repair technology and vitrification technology are expensive and not widely used. Frozen soil technology is to place harmless frozen solvent in the pipe to form a frozen soil barrier after the pipe is vertically placed at an equal distance around the pollution source, which can effectively prevent the diffusion of pollutants.

4.2. Chemical Repair Method

Put lime, zeolite, calcium carbonate, phosphate and other modifiers into farmland soil to adsorb, precipitate, extract, redox and so on heavy metals, reducing the effectiveness and biological mobility of heavy metals, so as to control the process of heavy metal pollution on soil. This method is easy to operate, but it is not suitable for many regions in China because of its high requirements for soil quality. In addition, it should be noted that the leaching solution will cause secondary pollution to the soil. Another non-permanent remediation technology is the stable solidification remediation technology, which mainly reduces the release of heavy metals in the soil, reduces the mobility of heavy metals in the soil by using passivation, and reduces the migration of heavy metals to crops, thus effectively reducing the harm of heavy metals to human beings. Power plant ash, iron manganese oxide, lime and other passivating agents are the most commonly used, which not only has low cost, but also has obvious effect. However, this technology cannot eradicate heavy metals in the soil. Heavy metals are only passivated, and there is a great possibility of second pollution. Therefore, it is necessary to monitor the soil for a long time to apply this technology.

4.3. Agricultural Ecological Restoration Technology

The main way of agricultural ecological restoration technology is to absorb and remove heavy metals in the soil by changing the farming system and selecting plants that are difficult to enter the food chain and have strong absorption of heavy metals in the agricultural production process. Agronomic remediation is mainly to remove heavy metals from soil by adjusting crops and applying chemical fertilizer and organic fertilizer reasonably. Ecological restoration measures are mainly to regulate heavy metal pollution by changing factors such as soil pH, soil nutrients and soil moisture. Compared with other repair technologies, this technology has low cost, simple implementation and mature technology. However, the obvious disadvantage of this technology is that it has a long repair cycle.

5. Concluding Remarks

In general, the soil environment can slowly decompose the pollutants entering its interior, which has a self purification function to a certain extent. However, when heavy metals are enriched too much, which seriously exceeds the bearing capacity of the soil itself, the balance of the soil environment will be broken, causing a large amount of pollution to the soil, greatly changing the nature of the soil itself, making its function gradually disappear, and reducing the soil fertility. As a result, crops will suffer from yield reduction and even death. Crops grown in this environment will also have a great impact on human health after being eaten by people. Therefore, great attention should be paid to the problem of soil heavy metal pollution and its remediation technology.

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