



# Research Progress of Phytoremediation Technology for Heavy Metal Soil Pollution

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## Abstract

At present, China attaches great importance to environmental protection, in the process of economic development, always adhere to the principle of sustainable development, in order to effectively protect the natural environment while the economic development. Environment is an important guarantee to meet the basic needs of the people. Only by doing a good job in environmental protection can we better realize the sustainable development of China's society and economy. This paper analyzes the research progress of the phytoremediation technology of the heavy metal soil pollution, in order to promote the further development of the environmental protection technology in China, and better guarantee the quality of life of the Chinese people.

## Keywords

Heavy metals; Soil pollution; Phytoremediation technology

## Introduction

Soil is an important resource for human survival. All kinds of food that sustain human life activities require the support of soil. If the soil is polluted on a large scale, it will directly affect the quality and quantity of food. However, due to various factors in the process of economic development, soil pollution is inevitable, such as the development of various mineral resources, industrial production and other human activities. In this process, not only will the soil be polluted, but the degree of pollution is also relatively high. It is very difficult to achieve the control of this part of soil pollution [1]. In the actual control process and the research process of some scholars, it is found that the application of phytoremediation technology can achieve better results. In order to protect the soil on which the Chinese people depend for survival, China has launched research on phytoremediation technology for heavy metal soil pollution.

## 1. Heavy metal soil pollution

### 1.1 Sources of heavy metal pollutants

Heavy metal pollution mainly comes from natural activities and human activities. In general, the heavy metal pollution caused by natural activities does not cause a high degree of soil pollution, and the natural environment itself has a certain regulatory capacity. Therefore, the heavy metal pollution caused by natural activities does not have a significant negative impact on the environment. However, human activities are different. The heavy metal pollution caused by human activities seriously exceeds the regulatory capacity of the natural environment, resulting in a large amount of heavy metal pollutants entering the soil through various channels, thus causing heavy metal soil pollution.

Heavy metal pollution caused by human activities mainly comes from three aspects: industrial activity emissions, agricultural activity emissions, and production and living waste emissions [2].

Industrial activities involve the combustion of a variety of fossil fuels, which produce the most heavy metal pollutants. Although China has imposed certain restrictions on the heavy metal pollution emission standards for industrial activities in recent years, it has not fundamentally solved this problem. Heavy metal pollution in agricultural activities mainly comes from pesticides. The use of pesticides is inevitable in current agricultural production activities. At present, the composition of pesticides has been adjusted, and the heavy metal content in pesticides has been effectively controlled. However, heavy metal pollution in the soil caused by previous agricultural activities still has a certain impact on the environment. Heavy metal pollution in production and living waste emissions mainly comes from wastewater and waste discharged from industrial production and automobile exhaust. The current consumption level of the Chinese people is constantly improving, and more and more families own private cars, which has also led to a significant increase in automobile exhaust emissions.

## 1.2 Effects of heavy metal soil pollution on plants

Heavy metal pollution has a great impact on plants. Part of the heavy metal pollution generated by human activities is discharged into the air, and this part of heavy metal pollutants will enter the soil through dry and wet deposition. During this process, plants will be polluted multiple times. Plants generally have some structures directly exposed to the air. When heavy metal pollutants enter the soil, they will first pollute this part of the structure, and when heavy metal pollutants enter the soil, they will cause damage to the plants again. Most of the nutrients are mainly obtained through photosynthesis and soil. Heavy metal pollution has an impact on these two sources of nutrients, which ultimately leads to slow plant growth and even large-scale wilting.

## 2. Phytoremediation technology

Phytoremediation technology mainly uses the combined effects of plants and related microorganisms in the soil to control the concentration and toxicity of pollutants in the environment. Its principle is shown in Figure 1. This technology has been used to remove heavy metal pollution since its discovery. Currently, phytoremediation technology is widely used in China and has made outstanding contributions to China's environmental protection. Moreover, the cost of phytoremediation technology in the process of pollution treatment is extremely low, but the final effect can be obtained is very good, with a very high-cost performance. The phytoremediation technologies currently used mainly include plant extraction technology, plant root filtration technology, plant stabilization technology and plant volatilization technology [3].

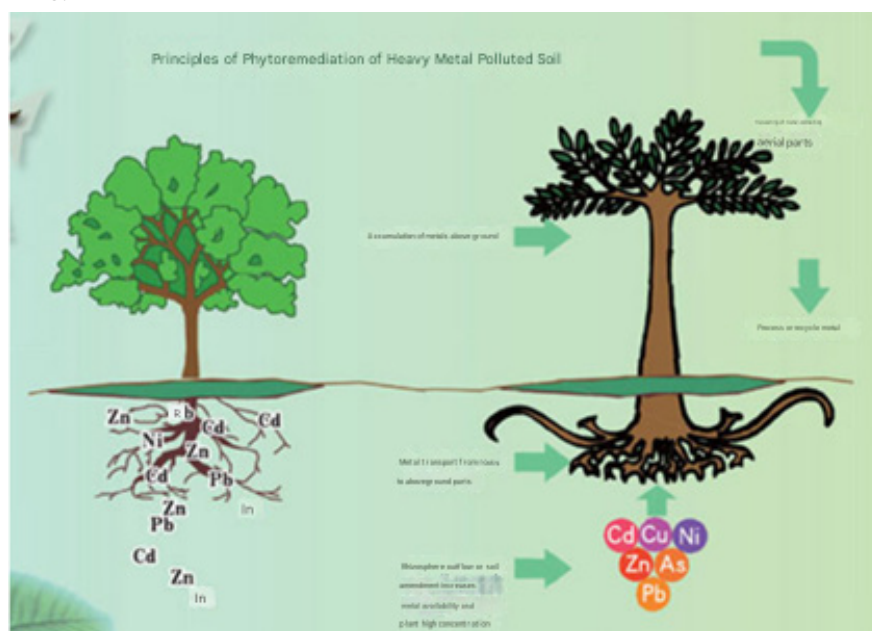


Figure 1. Principle of phytoremediation of soil heavy metal pollution.

### **3. Limitations of phytoremediation technology**

#### **3.1 Low efficiency of soil treatment**

Although the use of phytoremediation technology to control heavy metal soil pollution is very effective, the actual application process takes a very long time. The plants themselves need a certain amount of time to adapt after being exposed to soil contaminated by heavy metals. In addition, the fertility of the soil will also be affected after being contaminated by heavy metals. The growth of plants takes time, and the growth process also requires Supported by soil fertility, the growth rate of plants is greatly inhibited in this environment, which ultimately leads to a very long time required for treatment. Moreover, during the research of experts on the treatment effect, they found that the soil improvement and treatment effect of plants in the process of treating heavily polluted soil showed a trend of decreasing over time. In the current phytoremediation technology, plants with good repair ability are relatively short. Only through large-scale planting can the soil treatment effect be guaranteed. A certain amount of labor costs is also consumed in the treatment process, which ultimately leads to the inability to control heavy metal soil pollution. In the process, phytoremediation technology has not been more widely recognized [4].

#### **3.2 Secondary pollution**

First of all, it is necessary to make it clear that the plants mainly used in the current use of plant remediation technology are relatively short and have limited adsorption capacity for heavy metal pollutants. During the growth of plants, it is impossible to ensure the control of heavy metal pollutants. It is easy for heavy metal pollution to be brought to other areas due to wind, water and other human factors, and then pollute the soil in these areas. If this part of the factor is too strong, it is possible to directly bring these plants to other areas, affecting the soil quality of more areas. In the process of governance, it was also found that plants have their own growth patterns, and of course they will wither and die. When these situations occur, some of the heavy metal pollution originally collected and treated by the plants will remain in the withered and withered parts of the plants. Once these plants are affected by external forces, their movement distance will be very long, and they will continue to drop heavy metal pollutants during the entire movement process, causing large-scale soil pollution.

#### **3.3 Vulnerable to environmental influences**

Plants have their own suitable growth environment. Some areas with heavy metal soil pollution have very bad environments. Plants with good remediation effects cannot grow effectively in these areas, and it is difficult to apply phytoremediation technology to these areas. In addition, the tolerance of plants is limited. If the local heavy metal pollution is too serious, a large area of plants will die when the tolerance limit of plants is reached.

Because tall plants require a more demanding living environment, most tall plants cannot grow effectively in heavy metal polluted areas. Forcibly transplanting tall plants will only lead to the death of tall plants and waste biological resources. Most tall plants require a very long growth cycle and more nutrients during growth. Currently, there are basically no tall plants that can effectively treat heavy metal soil pollution. Although the short plants currently used have better repair capabilities, unlike tall plants, short plants have limited rooting ability and cannot deal with heavy metal pollution in deep soil.

### **4. Improving phytoremediation technology to control heavy metal soil pollution**

#### **4.1 Improve phytoremediation capabilities**

my country's current level of scientific and technological development has also been further improved, and many professional technical talents have been cultivated. Although the restoration ability of plants used in phytoremediation technology is currently limited, I believe that the team's in-depth research on these plants will further enhance the restoration ability of plants and achieve effective treatment of heavy metal pollution.

Among the plants currently used, their ability to handle heavy metal soil pollution mainly comes from the characteristics of the plants themselves. Based on this, professional and technical personnel can study the characteristics of these plants, strengthen the characteristics of the plants themselves, and thus effectively improve the ability of plants to handle heavy metal soil pollution.

## 4.2 Adjust the soil environment and improve plant adaptability

During the growth process of plants, their nutrients mainly come from photosynthesis and soil fertility. Although the soil in the areas that need to be treated is damaged by heavy metal pollutants and cannot provide plants with more abundant nutrients, technical means can be used to influence plant growth, such as adding surfactants, chelating agents, changing soil pH, Eh value, etc. Make the soil contaminated by heavy metals more suitable for the growth of repair plants and achieve the purpose of improving the repair efficiency.

Moreover, not every type of restoration plant cannot adapt to the adverse soil environment. It is just that the climate and hydrological conditions in some areas are not suitable for plant growth, which limits the use of phytoremediation technology. Therefore, we can study plants that adapt to the adverse soil environment, analyze the fundamental factors that enable them to adapt to the adverse soil environment, and determine whether this factor can be added to other plants. In this way, we can achieve the treatment of heavy metal contaminated soil in different regions.

## 4.3 Carry out in-depth research on phytoremediation technology

Phytoremediation technology for the treatment of heavy metal soil pollution requires the joint action of plants and related microorganisms. Although plants are currently effectively used to treat heavy metal soil pollution, the use of related microorganisms needs to be further improved. It must be recognized that related microorganisms also have a strong ability to treat heavy metal soil pollution. If effective control of the joint action of plants and related microorganisms can be achieved, the treatment effect of the current heavy metal soil pollution will definitely be greatly improved.

## 4.4 Improve the participation of human factors in the governance process

Although the phytoremediation technology for treating heavy metal soil pollution is mainly carried out by plants and related microorganisms, the influence of human factors on plants cannot be ignored. In the long-term development process of our country, agricultural practitioners have also had a strong influence on the growth and development of plants. Agronomic operations on plants can effectively improve the growth of plants. Therefore, agronomy can also be applied to the growth process of repaired plants. Through the influence of human factors, the growth cycle of the repaired plants can be shortened as much as possible and the growth and development of the plants can be adjusted.

## 4.5 Keep detailed records of the dynamic changes of plants and soil during the treatment process



Figure 2. Phytoremediation technology implementation and sample collection.

Although China currently has a large number of professional and technical personnel, any research on phytoremediation technology is difficult to complete without detailed data support. In the process of using phytoremediation

technology for heavy metal contaminated soil, soil management personnel should keep daily records of plant growth changes and soil heavy metal pollution, and take photos of heavy metal contaminated soil, and provide research data to researchers in a combination of text and images. Of course, this part of the information can only play an auxiliary role in the in-depth research of phytoremediation technology. More accurate information requires professional and technical personnel to go directly to the treatment area for observation and detection. Only in this way can the test results guarantee higher accuracy. As shown in Figure 2, managers in the treatment area are implementing phytoremediation technology and collecting samples. The research on phytoremediation technology is a rigorous process, and its data support is very important, especially the accuracy of the data. Once there is a problem with the accuracy of the data, it will seriously affect the research progress of phytoremediation technology.

## 5. Conclusion

In summary, although China attaches great importance to environmental protection, the heavy metal soil pollution in China is relatively serious due to the vast territory of China, the rich mineral resources in some areas, and the need to further improve the management of urban and rural development. As a major agricultural country, soil is of vital importance to the Chinese people. As the most cost-effective and simple restoration technology, phytoremediation technology must be promoted so that the heavy metal soil pollution in various regions of China can be effectively controlled. The treatment of heavy metal soil pollution is not achieved overnight. It is necessary to protect the soil as much as possible after the treatment is completed, and to conduct in-depth research on phytoremediation technology to effectively protect China's soil resources.

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