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Study on Harm and Evaluation Method of Heavy Metal Pollution in Soil

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Abstract

The problem of soil pollution has become a worldwide problem, and the current situation of pollution is in a trend of deepening in various countries. Up to now, heavy metal pollution has become an important source of affecting soil quality. Through the comprehensive investigation and evaluation of soil heavy metal pollution in the early stage, it can provide strong data support for the next step of remediation of heavy metals, and has a significant role in preventing and remediating soil contaminated by heavy metals. This article summarizes the main sources and hazards of heavy metal pollution in my country, and proposes two effective methods for evaluating soil heavy metal pollution, in order to provide the necessary reference for the further development of soil remediation work in my country.

Keywords

Soil heavy metals; soil quality; hazards; evaluation methods.

1. Introduction

China is a large developing country in agriculture. In the process of vigorously promoting China's industrialization, a large amount of heavy metal pollution has been generated through the discharge of toxic substances such as waste gas and waste residue. , soil microorganisms, as well as animals and humans can have adverse effects. Heavy metal pollutants in soil widely exist in human production and living spaces. Studies have shown that heavy metal pollutants are more likely to accumulate around mining areas, which not only adversely affects the survival of animals and plants in the area, but also significantly inhibits the number of microbial communities. The impact of heavy metal pollutants on plants and crops is mainly manifested in the impact on their entire growth period. For example, excessive cadmium (Cd) can inhibit the activity of protochlorophyllate reductase, causing plant photosynthesis disorders and even death. Heavy metals accumulated in plants and crops will be transmitted to the body through direct consumption of humans and animals or through the food chain, which will damage the nervous system, immune system and skeletal system of the human body to a certain extent. cause greater damage. In addition, due to the characteristics of heavy metal elements themselves, it is difficult to degrade or decompose in the natural environment, and the impact on the environment and human beings exists for a long time. When the heavy metal content accumulates to a certain level, it will cause irreversible consequences. Therefore, the harm caused by soil heavy metal pollutants has become an important hindering factor affecting soil health.

2. Heavy metal pollution in soil

2.1. The pollution hazards of cadmium

Due to the large-scale application of chemical fertilizers and pesticides, cadmium (Cd) has become one of the main factors of heavy metal pollution in agriculture in my country. When a

large amount of cadmium pollutants enters the soil, along with surface runoff and other effects, cadmium migrates and transforms in the soil and passes through the soil. A large number of physical, chemical and biological reactions accumulate in the soil, making the area of cadmium pollution continue to increase, and the degree of pollution damage is also deepening. The accumulation and accumulation of cadmium in the soil will firstly have toxic effects on the microorganisms in the soil, and then destroy the normal function of the soil. Cd pollution in soil will also adversely affect the crops in it. Cd can hinder the root growth of plants, affect the rate of plant absorption of nutrients, lead to plant malnutrition, metabolic disorders, and ultimately cause toxicity to plants. In addition, cadmium-containing pollutants can migrate to other areas through surface runoff and surface infiltration, resulting in larger-scale cadmium pollution. Sewage irrigation is also a major factor causing serious cadmium pollution in soil. Although sewage irrigation can solve the problem of lack of water resources in farmland and can bring a lot of nutrients to the soil, part of the sewage is directly discharged into the soil without any safety treatment. , thus causing a large area of soil cadmium pollution.

2.2. Arsenic pollution hazards

The main sources of arsenic (As) are divided into natural sources and anthropogenic sources, among which anthropogenic factors are the main reason for the sharp increase of As in soil. In human activities, As mainly comes from agricultural and industrial production activities. In agricultural activities, pesticides, chemical fertilizers, pesticides, etc. are used in large quantities, especially pesticides contain a large amount of inorganic and organic arsenic, such as sodium arsenite, calcium arsenate, and rice arsenic. In industrial production, waste residues and wastewater generated from industrial activities such as smelting, electroplating, and chemical industry also contain a large amount of As. These wastes are directly discharged into the soil without treatment, resulting in a large amount of As enrichment in the soil and As pollution. my country is one of the countries with serious As pollution. As has a strong inhibitory effect on the activity of enzymes in the human body, and the rate of fat metabolism is also deeply affected by it. It may also cause symptoms such as anemia and polyneuritis. Zeng Xibo et al. made a statistical analysis on the distribution of As in farmland in different regions of my country in the early days, and found that the content of As in vegetable fields in my country is generally high. Among the statistical samples, 44.2% of the samples have different degrees of arsenic pollution, and 9.2% of them have arsenic pollution. The arsenic content of the sample exceeded the standard. The arsenic content in the farmland near the realgar mine in Shimen County, Hunan Province and the arsenic-contaminated area in Chenzhou City was as high as 932.1 mg/kg and 300 mg/kg, respectively, causing serious harm to the living and production environment of local residents.

2.3. The pollution hazards of copper

The background value of copper (Cu) in soil in my country is about 22.6 mg/kg. Cu mainly exists in the soil as divalent ions, and the precipitation and hydroxyl oxidation of carbonate are the main stabilization methods of Cu. The availability of Cu in soil is related to physicochemical properties such as carbonate, organic matter, pH, and redox potential. The toxicity of Cu to plants mainly affects the photosynthesis, cell organization, cell structure and enzyme activity of plants. Some studies have found that high concentrations of Cu can inhibit the division of root cap cells, which leads to the inhibition of plant root growth, resulting in plant dwarfing, yellowing and wilting of leaf edges. The excess Cu accumulated in the soil will have a strong stress effect on the microorganisms in the soil. Reports on agricultural soil, especially soil Cu pollution in orchards and vegetable producing areas are increasing year by year. Lu Shuchang et al. investigated and studied the Cu pollution of soil in orchards in the suburbs of Tianjin and found that the total Cu content in the topsoil of the vineyard was 216.7 mg/kg, which was slightly polluted. , and the Cu content in the soils of Taoyuan and pear orchards also has

potential risks. The investigation shows that a large number of Cu-containing fungicides and the use of livestock and poultry manure are the main reasons for the accumulation of Cu content in the study area exceeding the standard. The sources of Cu in agricultural soil in my country mainly include livestock and poultry manure, atmospheric deposition, sewage, etc. Among them, livestock and poultry manure is the most important way to transport Cu to soil.

2.4. The dangers of lead pollution

China is not only a major lead (Pb) producer, but also a major lead consumer. The main consumption modes of Pb are batteries, lead materials and lead oxide. Batteries are the most important way of consuming Pb, because the industrial process is rough, the equipment is outdated, a large amount of Pb steam is produced during the production process and a large amount of Pb-containing substances contained in the wastewater have caused serious damage to the soil. Pb is very toxic and can cause great harm to the human body, especially to the human kidney, reproductive system and cardiovascular system. In addition, Pb has a great impact on the intellectual development of the human body, especially the intellectual development of children. Children poisoned by Pb are often difficult to concentrate and have difficulty talking with others. There are also studies showing that Pb may cause cancer in people. Pb also has a great impact on the growth and development of plants. Excessive Pb will affect the mitosis of root cells and cause slow growth of plants. It will affect the ability of roots to absorb nutrients from the soil, resulting in root rot, chlorosis of plant leaves, and eventually crop death. The research results in the national soil background value survey show that the highest Pb in my country is 1143 mg/kg. After investigating and analyzing the Pb content around the lead mining area in Guangxi, Zhang Yunxia et al. concluded that the excess Pb rate in the soil around the area was 22.73%. It is reported that the excess rate of Pb in vegetables in Shanghai has reached 81.97%.

3. Evaluation method of heavy metal pollution in soil

3.1. Potential Ecological Hazard Index Method

The advantage of the potential hazard risk assessment method proposed by geologist Hakanson is that it can reflect the comprehensive risk pollution effect of multiple pollutants. Li Ruiping used this method to explore the distribution law and pollution status of hazardous heavy metal elements in farmland. The disadvantage of this evaluation method is that it ignores the interaction between various heavy metals. The study by Lu Cong et al. found that they ignored the differences in potential ecological risks between different forms of heavy metals in soil, and only paid attention to the ecological risks when the heavy metal content was higher than the reference value, but did not consider the situation when the heavy metal content was lower than the reference value. The evaluation results under specific circumstances cannot reflect the actual ecological risk well, so it is necessary to create the Hakanson potential ecological risk index method with wider applicability. Qin Wenshu et al. used the potential ecological hazard index method to assess the risk of heavy metal pollution in the urban soil of Huangshan City. Combined with the results of the field investigation, it was concluded that the garbage and waste generated by the daily production and life of local urban and rural residents was the main cause of heavy metal pollution in the local soil. The local government should pay attention to the use of pesticides and fertilizers, sewage irrigation and fuel combustion.

3.2. Health Risk Index Method

The application of the health risk assessment method was originally derived from the evaluation criteria for suspected carcinogens proposed by the US Environmental Protection Agency, which was used to evaluate the carcinogenic risk of common toxic chemicals. The human health risk index method can be directly applied to evaluate the health and safety risks

faced by human beings in daily life. Human health risk assessment specifically refers to the quantitative calculation of the content of harmful heavy metals that can be exposed to and ingested by the human body by measuring the content of harmful heavy metals in the environment of residents in the study area, in this way, the human body and the environment are related and targeted. Evaluate the toxic effect of each heavy metal on the human body. In the specific process of human health risk assessment, in addition to calculating the final content of each heavy metal entering the human body, the toxicological characteristics of each heavy metal and the factors actually exposed in the environment should be combined to determine the impact of heavy metals on human health. Safety Injuries and Hazards. Yang Gang et al. conducted a sampling survey of the cultivated soil and main grain products in a lead-zinc mining area in the Southwest Mountains, and evaluated the health risks of heavy metals caused by eating local grain products to adults and children. Xu Youning et al. took seven heavy metal elements in the farmland soil of a gold mining area as the research object, and explored their contents in the local soil, food and water bodies, and used the human health risk assessment model recommended by USEPA to calculate the risk of oral ingestion, skin Probability of health risk to adults by exposure routes such as exposure.

4. Epilogue

Heavy metal pollution in soil has become an important issue affecting soil safety and ecological safety due to its characteristics of high concealment, easy accumulation, difficulty in migration, and great harm to humans and crops. Although various measures have been taken around the world to control soil heavy metal pollution, the problem of soil pollution has not been effectively eradicated. The relationship between heavy metal pollution evaluation and heavy metal prevention and restoration is very close. Through a comprehensive investigation of soil heavy metal pollution in the early stage, various evaluation methods are used to evaluate the pollution degree and accumulation characteristics of various heavy metals and analyze the main pollution sources. One-step repair of heavy metals provides data support, so that prevention and repair programs are more scientific and directional.

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