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Study on Heavy Metal Pollution Status and Remediation Technology of Cultivated Soil

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Abstract

China's soil heavy metal pollution situation is serious. According to the actual situation of soil pollution in China, it has become a major practical need of the country to carry out the prevention and control and restoration of heavy metal pollution in the soil to ensure the ecological environment and food safety.This paper analyzes the research progress of physical remediation methods, chemical remediation methods and bioremediation methods, in order to provide technical support for soil remediation of cultivated land in China.

Keywords

Arable Land; Soil Quality; Soil Pollution; Remediation Technology.

1. Introduction

China's soil heavy metal pollution situation is serious. In recent years, China's soil heavy metal pollution incidents have occurred frequently, which not only poses a serious threat to the quality of cultivated land and agricultural products, but also directly damages people's health and affects social stability. The quality of soil environment is directly related to the quality of cultivated land, affecting the safety of agricultural products and the health of the living environment. With the prominence of soil environmental problems and the improvement of public awareness of environmental protection, the state has paid more and more attention to soil environmental protection. General Secretary Xi Jinping pointed out that efforts should be made to promote the comprehensive treatment of heavy metal pollution and soil pollution. Premier Li Keqiang proposed to take a heavy blow to strengthen pollution prevention and control. The current administration has identified soil pollution prevention as one of three major battles to declare war on pollution.

2. Current Status of Soil Pollution in Cultivated Land

The national total soil point exceeding rate was 16.1%, of which the proportions of slightly, lightly, moderately and severely polluted points were 11.2%, 2.3%, 1.5% and 1.1%, respectively. The main types of pollution are inorganic types, followed by organic types, and the proportion of compound pollution is small. From the perspective of pollution distribution, soil pollution in the south is more serious than that in the north; soil pollution problems are more prominent in some regions such as the Yangtze River Delta, Pearl River Delta, and old industrial bases in Northeast China. The content distribution of the four inorganic pollutants showed a trend of increasing gradually from northwest to southeast and from northeast to southwest. The cadmium, mercury, arsenic, copper, lead, chromium, zinc and nickel 8 inorganic pollutants exceeded the standard rate of 7.0%, 1.6%, 2.7%, 2.1%, 1.5%, 1.1%, 0.9% and 4.8% respectively. 666, DDT, polycyclic aromatic hydrocarbons 3 types of organic pollutants exceeded the standard rate of 0.5%, 1.9%, 1.4% respectively.

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3. Causes of Soil Pollution in Cultivated Land

The soil environment is an open system, and the quality of the soil environment is affected by the superposition of multiple factors. In a local area, the influence of human activities is more prominent. Soil pollution in my country is formed during the long-term accumulation of industrialization. Human activities such as industry, mining, agricultural production and high natural background are the main causes of soil pollution. The survey results show that the main cause of serious local soil pollution is the pollutants discharged by industrial and mining enterprises, and the soil pollution of large-scale cultivated land is mainly affected by agricultural production activities. It is the result of the superposition of industrial and mining activities and the natural background.

4. Research on Soil Remediation Technology of Contaminated Cultivated Land

4.1. Phytoremediation Technology

Phytoremediation technologies include phytoabsorption restoration using plant hyperaccumulation or accumulative functions, phytostabilizing restoration using plant roots to control the spread of pollution and restore ecological functions, phytodegradation restoration using plant metabolic functions, and phytovolatile restoration using plant transformation functions. Plant filtration remediation technologies such as adsorption by plant roots are used; the pollutants that can be remediated by phytoremediation include heavy metals, pesticides, petroleum and persistent organic pollutants, explosives, radionuclides, etc. Among them, the phytoabsorption and remediation technology of heavy metal contaminated soil has been widely studied at home and abroad. It has been applied to the remediation of heavy metals such as arsenic, cadmium, copper, zinc, nickel, and lead, as well as complex polluted soil with polycyclic aromatic hydrocarbons. A complete set of integrated technologies for combined induction and enhanced restoration, combined restoration of different plants and plant treatment and disposal after restoration. The key to the application of this technology is to screen plants with high yield and high decontamination ability to find out the adaptability of plants to soil conditions and ecological environment. In recent years, my country has begun to lead the international frontier research direction to a certain extent in the application of plant absorption and remediation technology for heavy metal-contaminated farmland soil.

4.2. Microbial Remediation Technology

Microorganisms can degrade organic pollutants by taking organic pollutants as the sole carbon source and energy or by co-metabolizing with other organic substances. Microbial remediation technology developed by microbial degradation is a common remediation technology in farmland soil pollution remediation. This bioremediation technology has been applied in pesticide or oil-contaminated soils. In China, the screening technology for efficient pesticide degrading bacteria, the preparation technology for microbial restoration agents and the field application technology for microbial degradation of pesticide residues have been established; a large number of petroleum hydrocarbon degrading bacteria have also been screened, and a variety of microbial restoration agents have been formulated to develop biological Remediation of prefabricated beds and bioslurry reactor proposed a bioremediation model.

4.3. Physical Remediation Technology of Contaminated Soil

Physical remediation refers to the removal or separation of pollutants, especially organic pollutants, from soil through various physical processes. Heat treatment technology is the main physical remediation technology applied to soil organic pollution in industrial enterprises, including thermal desorption, microwave heating and steam leaching. It has been applied to

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contaminated soils such as benzene series, polycyclic aromatic hydrocarbons, polychlorinated biphenyls and dioxins.

4.4. Chemical/Physicochemical Remediation Technology of Contaminated Soil

Compared with physical remediation, chemical remediation technologies for contaminated soil developed earlier, mainly including soil solidification-stabilization technology, leaching technology, oxidation-reduction technology, photocatalytic degradation technology, and electrodynamic remediation.

4.5. Combined Remediation Technology of Contaminated Soil

Synergizing two or more remediation methods to form a joint remediation technology can not only improve the remediation rate and efficiency of a single polluted soil, but also overcome the limitations of a single remediation technology, and realize the remediation of composite/mixed polluted soils with multiple pollutants. It has become an important research content in soil remediation technology.

5. Development Trend of Contaminated Soil Remediation Technology

In the decision-making of contaminated soil remediation, it has developed from remediation goals based on total pollutant control to remediation orientation based on pollution risk assessment; technically, it has developed from physical remediation, chemical remediation and physical-chemical remediation to bioremediation, plant Restoration and monitoring-based natural restoration have developed from a single restoration technology to a multi-technology combined restoration technology and a comprehensive and integrated engineering restoration technology; from the off-site restoration based on stationary equipment to the on-site restoration of mobile equipment; In terms of application, it has developed from the remediation technology for heavy metal-contaminated soil, pesticide or oil-contaminated soil, and persistent organic compound-contaminated soil to the combined remediation technology of multiple pollutants or mixed-contaminated soil; it has moved from a single site to a megacity. The mega-city site has developed from a single remediation technology to a multi-technology and multi-equipment coordinated site soil-groundwater integrated remediation that integrates atmospheric and water monitoring; it has moved from industrial sites to farmland and cultivated land. The off-situ fertility destructive physicochemical remediation technology has been developed into an in-situ fertility-maintaining green remediation technology suitable for contaminated soil in farmland.

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