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Study on Physical Remediation Technology of Polluted Land

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Abstract

Cultivated land soil pollution has seriously affected food security and people's living and health level in our country. Therefore, this study discusses how to use engineering technology to restore polluted land into utilizable land. The author analyzed the present situation of soil pollution development in China by summarizing the domestic and foreign literatures on the treatment of polluted land. Based on the engineering and technical experience of polluted land control and restoration for many years, this paper discusses the engineering and technical points of polluted land physical restoration, and how to use physical measures to transform polluted land into utilizable land, and looks forward to the development trend of polluted land restoration in China. This study lays a theoretical foundation for proposing soil pollution remediation technology suitable for China's national conditions and regional characteristics, and provides technical support for national food security and ecological civilization construction.

Keywords

Soil Pollution; Development Status; Governance and Repair; Technical Points; Development Trend.

1. Introduction

China's social and economic construction has entered a period of rapid development, the amount of land defacement is increasing day by day, the scope is expanding, land defacement has become one of the main reasons for the reduction of land resources in China and even in the world. According to statistics, in recent years, China's production and construction activities and natural disasters destroyed a total of about 8.7 million hectares of land. Among them, about millions of acres of land are newly damaged every year due to production and construction activities such as mineral resources development, 60% of which is cultivated land or other agricultural land [1]. Therefore, in order to ensure the safety of 1.8 billion mu of arable land and construction land, and solve the social and environmental problems caused by land pollution, it is necessary to pay attention to the research and development of land engineering technology, improve the level of land engineering technology, and make it usable land through the restoration and development of defaced land.

There have been many studies on remediation technologies of contaminated soil [2,3]. However, due to the different soil properties, climate conditions and pollution levels in different regions,

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and the complexity, diversity and compound characteristics of soil pollution, the remediation of contaminated land is very difficult. No treatment technology has been found that can be applied to remediation of all contaminated soil. Therefore, the remediation of contaminated soil is very challenging, which has become a hot topic in the fields of environmental science, soil science, agricultural engineering and so on. Compared with foreign countries, China's research on land pollution control and restoration has just started, soil pollution detection and treatment technology is not mature, lack of economic and effective soil remediation technology, and lack of mature experience in industrialization, so it is urgent to break through the technical bottleneck of soil remediation. Therefore, this study strengthens the research on the basic theory of contaminated land rehabilitation engineering technology, in order to provide a reference for the research of contaminated land rehabilitation engineering technology.

2. Current Situation of Soil Remediation in China

In China's environmental protection tasks, air pollution control, sewage treatment and soil remediation are the three key work, and air pollution and water pollution received different attention, China's attention to soil pollution late, in China's environmental service industry, involving soil remediation enterprises accounted for only 3.7%.According to the National Soil Pollution Survey Communique released on April 17, 2015, about 5.48 million hectares of soil in China are seriously polluted, and about 320 soil pollution areas are affected. According to the following four types of soil, about 20 million hectares of soil is contaminated by heavy metals, nearly 2 million hectares of land is polluted by mines, up to 5 million hectares of land is polluted by oil, and nearly 50,000 hectares of land is polluted by solid waste stacking. The polluted land area in China is at least nearly 30 million hectares [4].

Under the severe situation, the policy began to favor the soil remediation industry. In 2014, the Soil Pollution Prevention and Control Action Plan was reviewed by the Ministry of Environmental Protection. The plan includes carrying out pilot projects for soil treatment and restoration of contaminated plots, and building six demonstration zones for soil environmental protection and pollution control. It is expected that the financial investment of a single demonstration zone for soil protection and pollution control will be between 1 billion and 1.5 billion yuan. In 2015, the central government allocated a special fund of 3.6 billion yuan for heavy metals to support 30 local key areas for the treatment of heavy metals and 37 demonstration projects for the treatment and restoration of heavy metal soil pollution. On September 28, Fujian issued the Measures for the Prevention and Control of Soil Pollution in Fujian Province, filling the gap in local soil legislation. At the 2016 National Environmental Protection Work Conference, relevant people learned that the soil pollution prevention and control action plan (" Soil ten ") will be introduced this year, with the introduction of "soil ten", China's soil remediation industry is about to show explosive development [5].

Contaminated land remediation engineering technology refers to the use of engineering measures and technical means to change the existence form of pollutants in soil or the combination with soil, so as to reduce the mobility and bioavailability of pollutants in soil, or to improve and transform contaminated soil to reduce the concentration of harmful substances in soil [6]. Physical restoration of contaminated land refers to the physical restoration process that adopts physical methods to adjust or control the physical properties of contaminated soil, that is, to separate pollutants from soil, or to transform pollutants in soil into low-toxic or non-toxic substances, so as to effectively control pollutants in soil [7]. The physical remediation technology of contaminated soil is applicable to most of the contaminated soil, the remediation effect is stable and thorough, and it is a common and root cure soil remediation measure. However, it is time-consuming and laborious, the repair cost is high, and the soil fertility is easy to reduce, so it is more suitable for small area of heavy land pollution area.

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3. Technical Points of Physical Remediation of Contaminated Land

3.1. Physical Engineering Measure

Physical engineering measures mainly include such engineering measures as guest soil, soil exchange and deep soil cultivation [8]. The guest soil technology is to add a large number of uncontaminated soil to the contaminated soil, and the two are mixed to cover the surface, thus reducing the contact between pollutants and plant roots, and reducing the concentration of pollutants to below the critical concentration of harm, so as to achieve the purpose of reducing the harm. Soil exchange technique refers to the partial or total removal of contaminated soil and replacement with uncontaminated soil. Deep tillage technology is a measure to turn the upper and lower soil layers through deep tillage to reduce the content of pollutants in the surface soil. The techniques of guest soil and soil exchange are often used in heavily polluted areas, while the deep-ploughing measures are more suitable for lightly polluted soil areas.

The restoration effect of guest soil and soil exchange technology is remarkable, which can solve the soil pollution problem quickly. However, these two technologies do not fundamentally remove the pollutants in the soil, but only reduce the concentration of pollutants in the soil surface, but the pollutants still remain in the polluted area and can pollute the groundwater through leaching. Therefore, these two technologies are mainly aimed at some pollutants with poor mobility. Guest soil and soil exchange technology will reduce soil fertility, so it is necessary to increase the amount of fertilizer applied to improve soil fertility. This technology is only suitable for the restoration of heavily polluted soil in a small area, and it is difficult to promote the treatment of polluted land in a large area.

3.2. Steam Extraction Technology

The steam extraction technology is a restoration technology that exhausts pollutants in the soil by injecting clean air into the contaminated soil to generate a driving force to reduce the vapor pressure in the soil and use the concentration difference between the solid, liquid and gas phases of the soil. Mainly for the removal of some unsaturated soil in the high volatile organic compounds and some semi-volatile organic compounds, such as benzene, gasoline and so on. Since soil physical and chemical properties have a great impact on soil vapor extraction technology, soil porosity, humidity, bulk density, texture, organic matter content, air conductivity, etc., should be measured before using this technology [9].

3.3. Solidification/Stabilization Technology

Solidification technology is the use of physical or chemical action to wrap up the pollutants, that is, to add a binder to the contaminated soil, so that it forms a massive solid, so that the pollutants in the soil in a relatively stable state. Stabilization technology refers to the process of using chemical reactions between chemical substances and pollutants to transform pollutants into insoluble, migratory or less toxic forms [10]. Stabilization techniques achieve harmlessness or minimization of toxicity by reducing the bioavailability of contaminants, which do not necessarily improve the physical properties of the soil.

Solidification/stabilization techniques can be used to treat a large number of inorganic contaminants, but can also be applied to some organic contaminants. The advantage is that the soil polluted by a variety of pollutants can be treated at the same time, the equipment is simple, easy to operate, and the cost is low. The disadvantage is that it cannot reduce the pollutants in the soil, but only limits the effectiveness of the pollutants on the environment. Over time, the fixed pollutants may be re-released, causing harm to the environment, so it does not have long-term effectiveness [11].

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3.4. Electrodynamic Technique

Electrodynamic technology is to apply direct current voltage through both sides of the contaminated soil to form an electric field gradient. Ions in the soil solution are carried to both ends of the electrode for enrichment under the joint action of electrophoresis, electrolysis, electromigration, electroosmosis and other methods, and then the pollutants are removed by precipitation/co-precipitation, electroplating or ion exchange resin. So as to achieve pollution reduction or cleaning of contaminated soil [12].

The electrodynamic technology uses the electric restoration process to directly remove pollutants from the contaminated soil site, without the need to dig out the contaminated soil solid phase or liquid phase medium from the contaminated site, thus significantly reducing the amount of engineering and cost. This technology is mainly aimed at low permeability and sticky soil, and can simultaneously remove heavy metals and organic pollutants in soil [13]. However, this method has poor effect on soil with high permeability and poor conductivity, so it is not suitable for the treatment of sandy soil pollution. Electrodynamics technology has a good application prospect in the treatment of large-scale contaminated soil.

3.5. Heat Treatment Technology

The heat treatment method of contaminated soil is to use direct or indirect heat exchange technology to heat up the contaminated soil. When the temperature reaches a certain degree, volatile harmful heavy metals or volatile organic compounds are decomposed by heat and removed from the soil. This method is mostly used to remove heavy metals and organic pollutants that can be thermally decomposed in soil [14]. The method can effectively remove volatile heavy metal pollutants from soil, but the heavy metal volatilized from soil is difficult to recover, which easily leads to secondary pollution.

4. Conclusion and Prospect

In view of heavy metal pollution in cultivated land, combined with different soil physical and chemical properties, develop efficient, rapid, economic and widespread passivation/stabilization remediation agents, and build professional pharmaceutical production lines; Determine the optimal dosage ratio, passivation/stabilization time, mixing method and other engineering parameters; Combined with high-standard basic farmland refining and leveling machinery, the supporting equipment for mixing chemicals and soil was developed [15]. Aiming at organic pesticide pollution in cultivated land, the screening of engineering strains with wide activation and degradation range and stable expression of indigenous microorganisms was studied, and the screening criteria and methods were established. Research and develop the preparation and adding engineering process of microbial inoculants and their nutrients; Study the soil properties and the detection and monitoring methods of microorganisms in the restoration process [16].

The above restoration technologies will help to solve the drawbacks existing in the current restoration process, such as soil structure destruction, high cost, and difficult technological industrialization and promotion, greatly reduce the restoration cost, promote the industrialization of passivation/stabilization restoration technology and microbial restoration technology of independent intellectual property rights, and open up more economical and efficient restoration ways of polluted farmland [17].

In view of the complexity, diversity and compound of soil pollution, it is necessary to comprehensively consider the nature of pollutants, soil properties and conditions, investment costs and other factors in the remediation of contaminated soil, so as to choose the most suitable contaminated soil treatment method or combination, so as to achieve the purpose of efficient, economical and thorough solution to soil pollution. While using chemical remediation

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technology to control soil pollution, it can also use seasonal replacement, land ploughing, efficient microorganisms, plant remediation and other remediation conditions to create assistance, and build a set of reasonable and feasible field remediation engineering technologies for contaminated soil. In short, with people's continuous attention to the environment and the introduction of the "Soil pollution Prevention and Control action Plan", economic and effective soil remediation technology is about to come out, and composite contaminated soil remediation technology will soon become a reality.

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