10.18686/eph.v2i2.4145

Analysis of Soil In-situ Remediation Technique

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Abstract: Soil in-situ remediation technology is an important environmental protection effort that aims to reduce the content and toxicity of pollutants in soil.In this paper, the commonly used soil in-situ remediation technologies were analyzed, including plant extraction technology, in-situ adsorption technology, and in-situ jet injection technology.In-situ adsorption technology removes or reduces harmful pollutants in the soil by introducing adsorbents to physically or chemically adsorb pollutants.The technology is simple to operate, low cost, and does not require large-scale soil excavation and disposal.However, its effectiveness is affected by factors such as adsorbent selection and dosage, soil properties, etc.

Keywords: In-situ remediation technology; Soil remediation; In-situ adsorption technology

Introduction

"The people take food as the sky, and food is based on the soil".Soil is one of the most precious natural resources and a necessity for human survival.However, various man-made and natural factors have caused varying degrees of damage to the soil on which human beings depend, resulting in the degradation of the physical and chemical properties of the original soil, the loss of farming value, and the endangerment of the safety of the food chain and human health.Soil pollution remediation technology provides a remediation path for soil pollution.Soil pollution remediation technologies are mainly divided into bioremediation, chemical remediation and physical remediation in terms of types, and in-situ remediation technologies and ex-situ remediation technologies in terms of remediation methods.In-situ remediation technology refers to the direct injection of contaminated soil or groundwater into a treatment facility, where the contaminants are separated by treatment equipment before subsequent treatment.

1. Principles of In-situ Repair Technology

In-situ remediation technologies mainly include chemical oxidation remediation technology, reduction remediation technology, and bioremediation technology.Chemical oxidation remediation technology mainly oxidizes heavy metals and organic matter in the soil into non-toxic and harmless substances by adding oxidants.The reductive remediation technology mainly reduces the heavy metals in the soil by using reducible substances and converts pollutants into non-toxic and harmless substances by adding additives and oxidants.Bioremediation technology mainly uses microorganisms to decompose organic and inorganic matter in the soil and use the energy generated to convert pollutants into non-toxic and harmless substances[1].Bioremediation technologies mainly include phytoremediation, plant mulching, plant extraction, plant extraction, etc.

2. Analysis of Soil In-situ Remediation Technology

2.1 Scope of Technical Application

The types of soil pollutants in contaminated sites mainly include heavy metals and organic matter.For heavy metal polluted sites, phytoremediation technology is mainly used, for example, rice, rape, sugarcane, etc.have a strong adsorption effect on heavy metals, which can be used as subsoil or cover for phytoremediation.For sites contaminated with organic matter, bioremediation techniques can be used.For example, woody oil plants can be used to adsorb or degrade organic pollutants, such as tea cakes, camellia husks, jatropha bark, etc.When carrying out remediation, the migration and transformation of contaminants in the soil needs to be considered.In general, the availability of soil moisture and nutrients should be considered when performing phytoremediation, and phytoremediation technology is suitable for soils with high organic matter content and nutrient-rich soils.Phytoremediation techniques are not suitable for soils with low organic matter content and soils with low organic matter content.For example, in the process of municipal sludge treatment, some chemical amendments(such as alkali, lime, etc.) need to be added to adjust the pH value of the sludge to meet the requirements of subsequent incineration treatment.

2.2 Plant Extraction

Plant extraction is the process of using plant roots to absorb nutrients from the soil and remove pollutants from the soil during the plant's metabolism.Its principle is to use plant roots to absorb nutrients from the soil, and through root absorption and transport, the pollutants in the soil can be directly extracted from the soil without the need to degrade the pollutants, and the purpose of remediation can be achieved in a short time.

This plant extraction technology can purify the contaminated soil by cultivating or transplanting certain plants with super-enrichment or transport capacity to transfer the contaminants in the contaminated soil to other normally growing plants.In plant extraction and remediation, the contaminants need to be transferred from the soil to the plants, and a certain concentration of chemical agents is applied according to the degree of contamination to dissolve and concentrate them.There are some problems in the practical application of plant extraction and remediation technology, such as the slow growth of super-enriched plants, limited root absorption, and susceptibility to pests and diseases[2].

In terms of soil adaptability, the technology is suitable for various types of soil, but the disadvantages are high cost, large manpower required, and difficult operation.At present, commonly used extraction plants include tobacco, sugarcane, cassava, etc., which can remove organic pollutants through the control of their root growth conditions.In addition, plant extraction technology enables the rapid and efficient remediation of contaminated soils without contact, without causing secondary contamination of the soil.

2.3 Microbial Remediation

Microbial remediation is the process of degrading pollutants using microorganisms present in nature.In microbial remediation, the growth and reproduction of microbial cells require appropriate nutrients and water, so it is necessary to provide a good living environment for microorganisms.In general, microbial remediation needs to consider factors such as soil structure, physical and chemical properties of pollution, pollution degree, environmental temperature, etc., and comprehensively analyze and determine the appropriate microbial remediation conditions.There are a variety of bioavailable pollutants in soil, and in general, there are multiple available bioavailable pollutants in soil, such as petroleum hydrocarbons, polycyclic aromatic hydrocarbons, heavy metals, etc.[3].In the process of microbial remediation, the contaminated soil can be treated in different areas, and if the pollutant concentration is high, air stripping treatment can be used, and if the concentration is low, biological extraction treatment can be used.

2.4 In-situ Adsorption Technology

In-situ adsorption technology is a commonly used soil in-situ remediation technique to remove or reduce harmful contaminants in the soil.In-situ adsorption technology removes or reduces contaminants from the soil by introducing adsorbents that cause them to physically or chemically adsorb with them.In in-situ adsorption technology, choosing the right adsorbent is key.Adsorbents can be natural, synthetic, or modified materials, with a high degree of adsorption capacity and selectivity.Commonly used adsorbents include activated carbon, iron oxide, bentonite, silica gel, etc.These adsorbents can adsorb organic compounds, heavy metals, and other pollutants in the soil, thereby reducing their concentration.However, the effectiveness of this technology is affected by a variety of factors, including adsorbent selection and dosage, soil properties, environmental conditions, etc.Therefore, various factors need to be considered comprehensively in practical application to achieve a better repair effect.

For example, the plot of a petrochemical enterprise is located in Chaoyang District, Beijing, and there are a large number of pollutants such as petroleum hydrocarbons and benzene, as well as a certain amount of heavy metals and polycyclic aromatic hydrocarbons.The site was identified as a "heavily contaminated site".After analysis, the petroleum hydrocarbons in the plot mainly come from the petrochemical and refining industries, and the benzene mainly comes from the petrochemical industry.According to the site investigation results and the current pollution status, the in-situ remediation technology was used to treat the petroleum hydrocarbons and polycyclic aromatic hydrocarbons in the site.According to the survey results and the characteristics of the site pollution, the"permeable reactive wall"technology was used to remediate the contaminated soil.

In the implementation of the final in-situ adsorption technology, biochar and bentonite were mixed in a certain proportion to prepare a composite adsorbent.The ratio can be determined on a case-by-case basis, usually between 10:1 and 3:1 for the mass ratio of bentonite to biochar.After the adsorbent reacts with the contaminant, regular testing of soil samples or monitoring techniques can be used to evaluate the remediation effect and adjust and optimize according to the actual situation.Through the in-situ adsorption technology of biochar combined with bentonite, it can effectively adsorb organic pollutants in the soil and improve the quality and environmental sustainability of the soil.

2.5 In-situ jet injection technology

In-situ jet injection technology is a commonly used soil in-situ remediation technique to treat organic contaminants in soil and contaminants in groundwater.This technology achieves the purpose of remediating contaminants by injecting a remedial agent into contaminated soil or groundwater in liquid or gaseous form.This technology requires the design and construction of an appropriate injection system, including injection/injection equipment, piping, and monitoring devices.During implementation, the remediation agent needs to be sprayed/injected into the soil or groundwater at a certain pressure or flow rate.Injection can be spraying, pore filling, injection wells, etc., depending on the condition of the contaminated area.Conduct regular monitoring and evaluation to understand the effectiveness of the restoration.

In-situ jet injection technology offers the advantages of ease of operation and adaptability to a wide range of soil types and contaminant types.It can effectively deliver the remediation agent directly to the contaminated area, and chemically react, adsorption, and biodegrade with the pollutants to achieve the remediation of soil and groundwater.

3. Conclusion

In summary, soil in-situ remediation technology has a wide range of application prospects in solving the problem of soil pollution.However, different soil contaminants and soil environmental conditions may require different remediation techniques and strategies.Therefore, future research should further optimize the selection and delivery of remedial agents, and explore new and more efficient soil in-situ remediation technologies to minimize the impact of soil pollution on the environment.

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