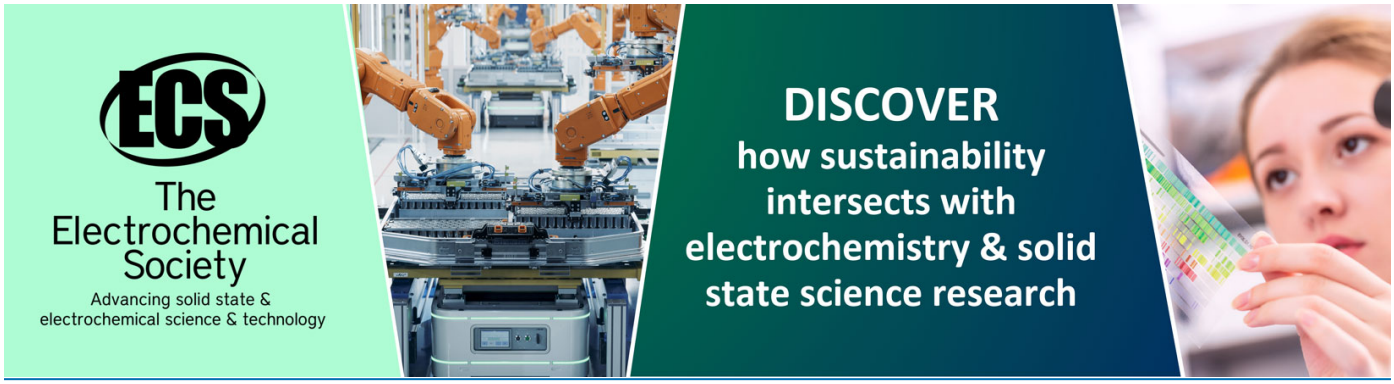
Application Research on Soil and Water Environmental Pollution Remediation Technology



Application Research on Soil and Water Environmental Pollution Remediation Technology

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Abstract. With the continuous acceleration of economic development, the scale of industrialization in China has been expanding, and a large amount of industrial wastewater has been discharged into the soil, resulting in serious heavy metal pollution in soil and water sources. The paper summarizes the physical repair technology, chemical repair technology and bioremediation technology of heavy metals and organic pollutants in water and soil, and analyzes the applicable conditions and influencing factors of various repair technologies. The results provide reference for the selection of site water and soil pollution remediation technology, and provide a theoretical basis for the development of the industry.

1. Introduction

Water and soil are the key natural resources for life and an indispensable resource for human social and economic development. With the rapid development of urbanization, the transition of land resources and water resources, resource recycling/redevelopment and utilization are seriously inadequate, and environmental pollution accidents caused by improper disposal of production and living pollutants are not uncommon. Soil and water pollution have become a process of sustainable socio-economic development. The global problem is also a hot spot in the research of pollution remediation industry in various countries. The types of pollutants produced by human activities are complex and diverse in form. They are easily enriched by organisms and affect human health through the food chain. They are the most common source of pollution in water and soil environments. In order to avoid the harm caused by heavy metals to humans, it is necessary to find out the pollution status, existing form and biological effectiveness of soil and water, and develop scientific and reasonable pollution remediation technology. Further, improving the degree of development and utilization of land resources, especially before the development of large numbers of abandoned industrial sites, conducting site environmental surveys, and repair and treat sites with heavy metal and organic pollution until they meet the water environment and soil environmental quality requirements for the intended use. For heavy metal and organic pollution remediation technologies in water and soil

environments, there are mainly physical repair techniques, chemical repair and repair techniques and bioremediation technologies.

2. Technology of physical remediation

Soil and water environmental pollution physical remediation technology, by changing the nature of soil and water environment logistics, separating pollutants from damaged media, or curing/stabilizing into low-toxic, low-harm, low-risk substances, thereby effectively controlling heavy metals Pollution. Soil and water environment physical remediation technologies mainly include gas phase extraction technology, thermal desorption technology, barrier landfill technology, electric repair technology, and soil mixing/dilution technology [1].

Gas phase extraction and repair technology is an in-situ remediation technology that effectively removes Volatile organic compounds (VOCs/SVOCs) in soil unsaturated regions. It is mainly composed of extraction system, exhaust gas treatment system and central control system [2]. Among them, the drawer system has shafts, gullies or horizontal wells, excavated mounds, etc. The special shafts are the most widely used, with the characteristics of large influence radius, uniform flow field and easy compounding. The gas phase extraction technology is relatively simple in design and has no special equipment requirements. It is suitable for the treatment of pollution to the deeper parts below the surface, caused by gasoline, JP-4 oil, kerosene or diesel oil and other volatile petroleum pollutants. Thermal desorption technology utilizes direct or indirect heat exchange to heat organic pollutants in soil and water to a certain temperature (150~540°C), control bed temperature and material residence time, selectively evaporate and contaminate Media separation, mainly divided into direct contact thermal desorption repair and indirect contact thermal desorption repair two types [3]. It's mainly used to treat some areas that are difficult to carry out ectopic environmental restoration, heavy pollution (high concentration, non-aqueous phase) soil and water environment areas, in petrochemical plants, underground oil depots, wood processing plants and pesticide warehouses, etc. It is widely used in the repair and treatment of pollutant sources. Barrier landfill technology is applicable to heavy metal, organic matter and heavy metal organic compound contaminated soil types [1]. However, it has high requirements on the physical and chemical properties of the soil. It is not suitable for polluted soils with high water solubility or high permeability of pollutants and areas with frequent geological activities and high groundwater levels

Table 1. Applicability and influencing factors of physical remediation

Remediation	Applicability	Influencing factors
Gas phase extraction	Repair of low water-soluble VOCs and SVOCs, mainly due to soil uniformity and permeability, as well as contaminant types and groundwater depth limits	Soil structure, stratification, humidity, ambient temperature, air conductivity, water permeability, pollutant form, water solubility, vapor pressure, Henry's constant, groundwater depth
Thermal desorption	Wide range of pollutant treatment, reusable soil and water after remediation, and equipment movable, widely used in in situ/ectopic repair of soil, water and sediment in sites with serious organic pollution	Soil texture, particle size distribution, water content, pollutant concentration, boiling point
Block landfill	It's suitable for the repair of contaminated sites of heavy metals, organic matter and composites. The water solubility of pollutants is good and the groundwater level is high	Barrier material properties, barrier system depth, soil cover thickness
Electric remediation	Extract heavy metals from contaminated soil and water, remove organic matter	Water electrolysis, soil chemical properties
Mixing/dilution remediation	Used for non-hazardous, low-pollution seepage areas	Contaminant properties, concentration, migration, additive properties, soil structure, water content, permeability

3. Technology of chemical remediation

Chemical remediation of soil and water environment, using chemical remediation agents added to the defaced soil to cause certain chemical reactions with contaminants, so that the pollutants are degraded and the toxicity is removed or reduced. According to the physical and chemical properties of the contaminated soil, the type of pollutants and the degree of pollution, the treatment method, the scope and characteristics of the pollution [4].

The chemical repair technology is the earliest development relative to other repair technologies. The chemical repair uses a chemical reaction agent added to the contaminated land to cause a certain chemical reaction with the pollutant, so that the pollutant is degraded and the toxicity is removed or reduced [5]. Chemical repair technology mainly includes chemical leaching repair, chemical reduction and reduction dechlorination, chemical oxidation, electrochemical power and improver repair. The applicability and influencing factors of various repair techniques are shown in Table 2. Different repair chemical repair techniques are basically applicable to the repair of heavy metals and organic matter in different types and scales, and they are all related to the nature of chemical reagents, the characteristics of pollution receptors, and the types and concentrations of pollutants

Table 2. Applicability and influencing factors of chemical remediation

Remediation	Applicability	Influencing factors
Chemical leaching	It's suitable for large area, heavy pollution, light/sand soil repair, easy to operate, low cost, large processing capacity and quick effect. Low permeability soil is poorly applicable	Physicochemical properties such as eluent properties, concentration, rinsing time, soil texture, organic matter, cation exchange capacity, pollutant concentration, existing form
Chemical redox dechlorination	Remediation of heavy metal and organic pollution in groundwater	Soil permeability, organic matter, groundwater pH
In-situ chemical oxidation	Using for soil and water pollution repair, low energy consumption, fast degradation of pollutants and complete degradation	Oxidant type, contaminant properties
Electrochemical power	Suitable for soil and groundwater heavy metal and organic pollution restoration, especially for heterogeneous and low permeability soil restoration	Soil type, electrode, current, voltage
Amendment remediation	Using for heavy metal and organic pollution water and soil remediation	Modifier type, contaminant nature, concentration, pollution receptor size

4. Technology of bioremediation

Bioremediation uses the life activities of living organisms to reduce the concentration or detoxification of toxic and hazardous substances present in the environment, thereby allowing the contaminated environment to partially or completely return to its original initial state. According to different repair objects, it is mainly divided into three types: microbial repair, phytoremediation and animal repair [6]. The comparative analysis of the applicability and influencing factors of various types of repairing techniques is shown in Table 3. Among them, microbial remediation technology focuses on solving and controlling pollution problems from an engineering perspective. In situ biodegradation is usually applied to the diffusion of pollution sources to water-saturated soil or groundwater remediation [7].

Heterotopic microbial remediation of heavy metal pollution using fluidized bed, biological turntable, and biochemistry when in-situ microbes are not suitable.

Phytoremediating relies on the theory of plant tolerance and over-accumulation of certain or certain chemical elements to remove water and soil contaminants through plants and their coexisting microbial systems. It has a wide range of phytoremediation applications. It can be used to treat soil pollution, water purification and clean air. It does not occupy the site, has small environmental impact, can stabilize the surface for a long time, control wind erosion, water erosion, and reduce soil erosion. However, it also has a long repair cycle. Restoration of plant disposal is prone to such contamination as [8]. In addition, animal repair, especially sputum repair technology, is also widely used in the repair of water and soil pollution in the site.

Table 3. Applicability and influencing factors of bioremediation

Remediation		Applicability	Influencing factors
Microbial remediation	In-situ	Suitable for soil and water remediation of soil or groundwater where the pollution source spreads to water saturation	Temperature, bioavailability, physical properties of pollution
	Ectopic	Diverse methods, high cost, often used for water and soil remediation with high pollutant content and small amount of engineering	Nutrients, electron acceptors, microbial domestication, pollution receptor properties and environmental conditions, surfactant properties
Phytoremediating		Simple operation, in-situ repair, widely used for heavy metal and organic pollution repair, can make the surface stable for a long time, but it is difficult to repair plants	Contaminant properties, bioavailability, soil and water properties, plant species, enrichment capacity, growth environment conditions
Animal remediation		Used in conjunction with other biological, physical, and chemical remediation technologies	Soil and water types, characteristics, pollution degree, animal growth environment, toxic effects

5. Conclusion

This paper summarizes the characteristics and application scope of heavy metal/organic pollution remediation technology in the soil and water. The applicable scenarios of physical repair techniques such as gas phase extraction, thermal desorption, barrier landfill, electric repair and mixing/dilution repair were analyzed. It is concluded that the soil structure, groundwater depth and pollutant properties are the key influencing factors affecting the application and repair of remediation technology. Technology of chemical remediation is the most mature and widely used repair technology. It is rich in chemical reagents and can be more selective. The chemical repair technology is based on the principle of chemical reaction and application characteristics, such as leaching, redox, and modifier repair. Finally, the generality, ecological effectiveness and corresponding secondary pollution of microbial remediation (in situ microbial remediation, ectopic microbial remediation), phytoremediation and animal remediation techniques were analyzed. The article provides reference for the selection and application of various soil and water body remediation technologies.

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