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Analysis of remediation methods for mercury pollution in soil

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Abstract

This paper systematically analyzed the remediation technology of soil mercury pollution, pointed out the existing problems in the treatment of soil mercury pollution, and put forward relevant suggestions, which provided a reference for the subsequent remediation and treatment of mercury pollution.

Keywords

Soil, mercury pollution, remediation methods.

1. Introduction

At present, heavy metal pollution is becoming more and more serious.Cadmium, mercury and arsenic are the top three inorganic pollutants.Mercury is listed as one of the priority control pollutants by EPA, which is persistent, migratory and highly bioenrichmented, and highly toxic to humans and organisms [1].

The harm of mercury to human body is typically cumulative[2] and will enter human body through the food chain.Among them, inorganic mercury and organic mercury can produce toxic effects on human body.At the same time, mercury also has a certain effect on plants. Low concentration of mercury can promote the growth of plants, while high concentration of mercury will have a toxic effect on plants, affecting the growth and development of plants, and seriously will lead to wilt and death.Soil is the loose surface of land that is fertile and capable of growing plants. It is also a good reservoir of pollutants.However, when soil pollution exceeds its self-purification capacity, it will release pollutants and become a potential source of pollutants.Therefore, it is very important to repair and control mercury in soil pollution.

2. Chemical method

There are physico-chemical and biological methods for remediation of mercury in soil.Among them, the physical and chemical method is one of the earliest developed restoration methods, which mainly includes the guest soil method, leaching method, heat treatment technology, electric repair technology and curing technology.

2.1. Method of replace with out-soil

The guest soil method, also known as the physical restoration method, is to add clean soil to the contaminated soil to reduce the concentration of pollutants in the soil or reduce the contact between pollutants and plant roots. It is an engineering physical treatment method in soil pollution control.Its advantages are quick effect, good effect, the disadvantage is large engineering, high investment cost, and in the exchange of soil seepage, environmental pollution and other problems, but also damage soil structure, cause soil fertility decline, so it is not suitable for large-scale promotion.

2.2. Leaching method

Leaching method, also known as soil washing method, is a method to remove mercury metal from the soil by chemical reaction between the leach and the metal ions in the soil, and to

recover the leach.The key of this method is to find the leach which can enrich the heavy metals without damaging the physical and chemical properties of the soil.Studies on the remediation of mercury showed that EDTA, iodide and thiosulfate compounds had little effect on soil physical and chemical properties, and the removal of mercury reached 30%.When combined with H_2O_2, Na_2S_2O and Na_2S, the mercury in soil can be reduced by more than 80%.The advantages of this method are that it can permanently control soil mercury pollution and realize mercury recovery with less time consuming, and the treated soil can be reused [2].But leaches can cause damage to the soil environment and need to be treated before they can be released.At the same time, leaching method is difficult to treat clay and soil with high humus content.

2.3. Heat treatment

Heat treatment is a technique to remove the pollutants from the soil and centrally treat them by heating or injecting hot vapors into the contaminated soil.Mercury will become elemental mercury at high temperature (600-800T), so that mercury contaminated soil can be repaired[3].Heat treatment has a good effect on the remediation of soil mercury pollution, and the waste can be precipitate out of the soil by injecting hot steam into the soil or heating the soil with frequency conversion [4].The advantages are that mercury can be quickly removed from the soil and can be recovered during the restoration process.The disadvantage is that the energy consumption is high and the soil will be greatly affected.

2.4. Electric repair technology

Electric remediation technology is a technology of engineering mercury collection by applying a direct current electric field to the soil to make the mercury in the soil move to a pole under the action of the electric field [4].Suitable for low permeability soil and silt soil, the advantages of mercury recovery, low cost, economic and reasonable, can be achieved in situ remediation, and does not affect soil fertility, will not produce secondary pollution;The disadvantage is that the removal effect of mercury on sandy soil with high permeability and poor conductivity is poor, the treatment time is long, and the basic properties of soil (organic matter, carbonate, acid and alkali) are greatly affected [5].

2.5. Curing method

The curing method, divided into physical curing and chemical curing, is to add the curing agent to the soil, so that the curing agent reacts with mercury, thus forming a solid mixture with low permeability.The advantages are that mercury toxicity in the soil is rapidly reduced, and cement, the commonly used curing agent, is cheaper.

3. Bioremediation

Bioremediation can be divided into phytoremediation and microbial remediation.

3.1. Phytoremediation

Phytoremediation is mainly through plant fixation, absorption, transpiration, transfer, transformation and degradation of pollutants, so as to transform them into substances that are harmless to the surrounding environment [6].Related studies have found that boxwood microphylla, Populus canadis and ramie can reduce mercury in soil.Phytoremediation is gaining favor among researchers because of its low operating cost and the ease of recycling and disposing mercury-enriched plants.

3.2. Microbial remediation

Microbial remediation uses microbial metabolism to reduce mercury adsorption in soil.Li Mei et al. [7] used evaporation and activated carbon adsorption to remove mercury from soil, and discussed the feasibility of microbial remediation of mercury-contaminated soil.

4. Conclusion

The remediation method of soil mercury pollution, China has mastered certain treatment technology, but there are some problems.First, the source of mercury pollution is complicated, and the source is not clear.Second, a unified standard mercury pollution detection network has not been established, and the data statistics are incomplete.Third, compared with the western developed countries, the repair technology is relatively single, the repair equipment is backward and the process is simple.It is because of the above reasons that there are few successful cases of remediation of mercury-contaminated soil in China, which restricts the development of remediation technology of mercury-contaminated soil.Therefore, it is necessary to find out the source of soil mercury pollution, and develop a remediation technology with short cycle, good stability and low cost as soon as possible.

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