Current Situation and Remediation Cases of Soil Heavy Metal Pollution: Taking CD Pollution as an Example

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Abstract: CD pollution control plays an important role in soil heavy metal pollution control, but there is a problem of imperfect pollution control. The traditional soil remediation algorithm cannot solve the problem of heavy metal treatment and remediation in soil heavy metal pollution control, and the treatment effect is not satisfactory. Therefore, this paper proposes soil heavy metal pollution control and remediation based on spatial interpolation algorithm, and analyzes soil heavy metal pollution control. In the development of modern society, the rapid process of industrialization and urbanization has brought about economic prosperity, but it has also brought unprecedented pressure to our living environment. Especially, heavy metal pollution in soil has become an environmental problem that can not be ignored in the world.

1 INTRODUCTION

Heavy metal pollution in soil has become an environmental problem that can not be ignored in the world. As the foundation of nature, once polluted, soil will not only affect the growth of crops, but also pose a serious threat to human health through the food chain. Globally, more and more countries and regions begin to pay attention to the problem of heavy metal pollution in soil, and take active measures to deal with it (Yao and Yang, et al. 2022). In addition to strengthening industrial pollution control and promoting environmental protection agricultural technology, people pay more and more attention to ecological environment protection, advocate low-carbon life and reduce the occurrence of heavy metal pollution from the source (Peng and Wu, et al. 2023). With the continuous improvement of environmental awareness and technology, we have reason to believe that the problem of heavy metal pollution in soil will be effectively controlled and the ecological environment will be better protected in the future (Peng and Lin, et al. 2023).

2 RELATED CONCEPTS

2.1 Mathematical description of the spatial interpolation algorithm

The current situation of heavy metal pollution is worrying. According to statistics, a considerable part of farmland soil in the world has been polluted by heavy metals such as cadmium, lead and mercury (Zheng and Wang, 2022). These pollutants mainly come from industrial emissions, automobile exhaust, excessive use of pesticides and fertilizers and improper treatment of domestic garbage (Zhang, Fang). They accumulate in soil, are not easy to degrade, exist for a long time, and pose potential risks to ecological environment and human health shown in Equation (1).

$$\lim_{x\to\infty}(y_i \cdot t_{ij}) = \lim_{x\to\infty} y_{ij} \geq \max(t_{ij} \div 2) \quad (1)$$

Soil remediation technology in order to reduce or even eradicate this pollution. Among them, bioremediation technology has been widely concerned because of its environmental protection and sustainable characteristics (Xia and Gao, 2022).

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For example, plant extraction technology takes advantage of the ability of certain plants to absorb and accumulate heavy metals, and removes heavy metals from soil by planting these plants (Liu, 2023). In addition, microbial remediation uses specific microorganisms to transform or stabilize heavy metals in soil and reduce their toxicity. is shown in Equation (2).

$$\max(t_{ij}) = \partial \succ mean(\sum t_{ij} + 4)\mathsf{M} \tag{2}$$

Bioremediation and physical and chemical methods also play a role in the treatment of heavy metal pollution in soil. For example, chemical precipitation can reduce the activity of heavy metals in soil by adding chemicals to form insoluble precipitates as shown in Equation (3).

$$F(d_i) = \square \prod \sum t_i \bigcap \xi \cdot \sqrt{2} \to \oint y_i \cdot 7 \tag{3}$$

2.2 CD pollution Control Program Selection

Electrodynamic remediation is to use electric field to promote heavy metal ions to move and concentrate to the electrode, so as to realize their separation from the soil. Shown in Equation (4).

$$g(t_i) = \ddot{x} \cdot z_i \prod F(d_i) \frac{dy}{dx} - w_i \tag{4}$$

Heavy metal pollution in soil is a global environmental problem, which poses a serious threat to ecosystem health, food safety and human health is shown in Equation (5).

$$\lim_{x \to \infty} g(t_i) + F(d_i) \le \bigcap \max(t_{ij}) \tag{5}$$

With the rapid development of industrialization and urbanization, the problem of heavy metal pollution has become more and more prominent, and it has become one of the key points of environmental science research is shown in Equation (6).

$$\overline{g(t_i)} + F(d_i) \leftrightarrow \sqrt{b^2 - 4ac} mean(\sum t_{ij} + 4) \tag{6}$$

2.3 Analysis of CD Pollution Control Scheme

With the rapid development of industrialization and urbanization, heavy metal pollution is increasing day by day. Heavy metals, such as lead, cadmium and mercury, have attracted much attention because they are not easy to degrade in the environment and easily accumulate in the biological chain. shown in Equation (7).

$$No(t_i) = \frac{\overline{g(t_i)} + F(d_i)}{mean(\sqrt{2})} \sqrt{b^2 - 4ac} \tag{7}$$

Heavy metals, including lead, cadmium, mercury, arsenic, chromium, etc., have bioaccumulation and toxicity, can accumulate in the food chain, and finally have adverse effects on human health shown in Equation (8).

$$Zh(t_i) = \bigcap \prod \alpha [\sum \overline{g(t_i)} + F(d_i)] \tag{8}$$

Industrial emissions are one of the main pollution sources. Many industrial processes, such as mineral mining, metal smelting, chemical production, etc., will produce waste water and waste gas containing heavy metals shown in Equation (9).

$$accur(t_i) = \frac{\min[\sum \overline{g(t_i)} + F(d_i)]}{\sum \overline{g(t_i)} + F(d_i)} \times 100\% \tag{9}$$

Pollutants enter the soil environment through atmospheric sedimentation or water flow, causing pollution. Secondly, chemical fertilizers and pesticides used in agricultural activities are also important sources of pollution (Li and Sheng, et al. 2023). can be expressed as Equation (10).

$$accur(t_i) = \frac{\min[\sum \overline{g(t_i)} + F(d_i)]}{\sum \sqrt{2}} + randon(t_i) \tag{10}$$

Chemical fertilizers and pesticides used in agricultural activities are also important sources of pollution.

3 OPTIMIZATION STRATEGY OF HEAVY METAL POLLUTION CONTROL DETECTION

At present, many technologies have been developed to control heavy metal pollution in soil (Xiao, 2022). Chemical remediation technology changes the chemical properties of soil by adding chemical reagents, which makes heavy metals form insoluble compounds and reduces their activity. Physical remediation techniques, such as soil washing and electrodynamic separation, remove or stabilize heavy metals in soil by physical methods (Huang and Chen, et al. 2022). Bioremediation technology uses plants or microorganisms to absorb and transform heavy metals, which is an environment-friendly remediation method.

3.1 CD pollution Control Briefing

Heavy metal pollution mainly comes from industrial activities, such as metal processing, mineral refining, industrial wastewater discharge and so on. In addition, automobile exhaust emissions, the use of agricultural fertilizers and landfills are also important sources.

Table 1: Heavy metal pollution control testing CD pollution control requirements

Scope of application	Grade	Accuracy	CD pollution control
Farmland soil	I	85.00	78.86
	II	81.97	78.45
Industrial land	I	83.81	81.31
	II	83.34	78.19
Soil around	I	79.56	81.99
the mining isa	II	79.10	80.11

Pollutants diffuse in the environment through natural processes such as weathering, rainwater scouring and surface runoff, resulting in extensive pollution of soil, water and even atmosphere. is shown in Figure 1.

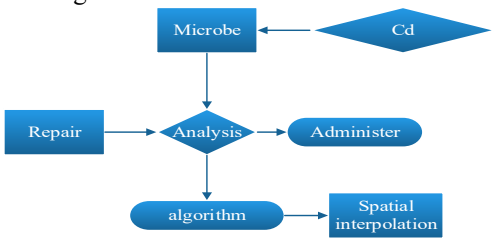

Figure 1: Analysis process of heavy metal pollution control detection

Heavy metals have various impacts on ecological environment. They will interfere with the normal growth of plants, inhibit photosynthesis and destroy plant cell structure; Only through the joint efforts of technological innovation, legal regulation, policy guidance and public participation, can we effectively control and reduce heavy metal pollution and protect human health and ecological environment. Water pollution is another key issue. Industrial wastewater is directly discharged into rivers, lakes and oceans without treatment or improper treatment, which leads to the accumulation of heavy metals in aquatic organisms and affects their growth, reproduction and even survival.

3.2 Heavy Metal Pollution Control Detection

The Cd pollution control scheme for heavy metal pollution control detection includes non-structural information, semi-structural information, and structural information. After the predilection of the spatial interpolation algorithm, the preliminary Cd pollution control scheme for heavy metal pollution control detection was obtained, and the feasibility of the Cd pollution control scheme for heavy metal pollution control detection was analyzed. In animals, heavy metals can cause nervous system diseases, damage kidney function, and have potential carcinogenic risks.

Table 2: The overall situation of the CD pollution control program

Category	Random data	Reliability	Analysis rate
Farmland soil	85.32	85.90	83.95
Industrial land	86.36	82.51	84.29
Soil around the mining isa	84.16	84.92	83.68
Mean	86.84	84.85	84.40
X6	83.04	86.03	84.32
		P=1.249	

3.3 CD Pollution Control and Stability

Heavy metal pollution is a complex environmental problem, which involves many factors and interests.

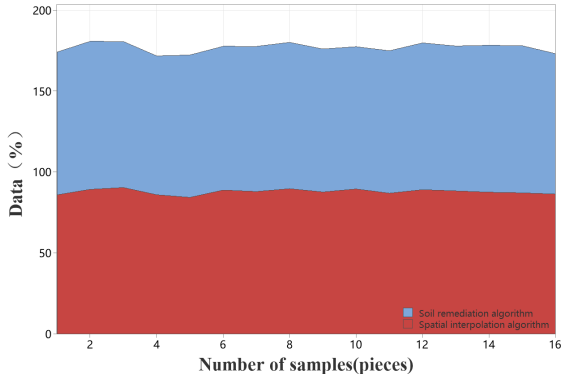

Figure 2: CD pollution control with different algorithms

The threat of heavy metal pollution to human health can not be ignored. Long-term exposure to excessive heavy metals can lead to a variety of chronic diseases, including nervous system disorders, digestive system diseases, circulatory system problems and various forms of cancer.

Table 3: Comparison of Cd pollution control accuracy of different methods

Algorithm	Survey data	CD pollution control	Magnitude of change	Error
Spatial interpolation algorithm	85.33	85.15	82.88	84.95
Soil remediation algorithms	85.20	83.41	86.01	85.75
P	87.17	87.62	84.48	86.97

The government should formulate stricter emission standards and supervision mechanism, and severely punish enterprises that violate the law. At the same time, public education and awareness raising are also very important, so that the public can understand the harmfulness and prevention knowledge of heavy metal pollution and encourage everyone to participate in environmental protection actions.

It can be seen from Figure 3 that the Cd pollution control Public education can not be ignored. Raising public awareness of environmental protection can fundamentally reduce the use and emission of heavy metals. Finally, international cooperation should be carried out to share cleaner production technologies and monitoring methods to jointly deal with this cross-border environmental problem.

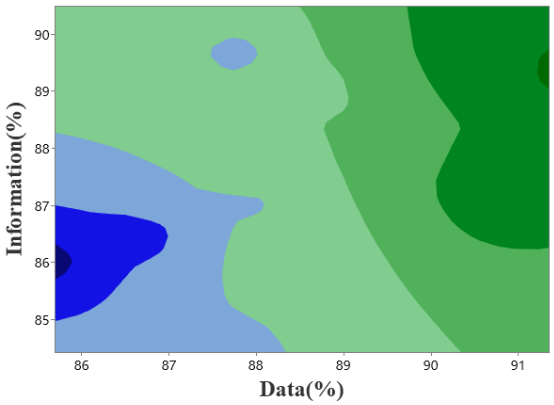

Figure 3: CD pollution control by spatial interpolation algorithm

3.4 CD Rationality of Pollution Control

Technical innovation is not everything. The prevention and control of heavy metal pollution also needs strict laws, regulations and policy support.

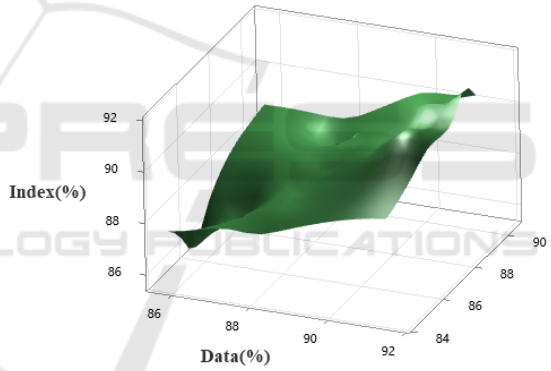

Figure 4: Cd pollution control with different algorithms

Facing the severe problem of heavy metal pollution, technical solutions are constantly developing. For example, chemical precipitation, ion exchange, membrane filtration and adsorption technologies are widely used in industrial wastewater treatment to remove heavy metals. In the field of soil remediation, physical methods (such as soil replacement and solidification stabilization), chemical methods (such as chemical precipitation and electrokinetic remediation) and biological methods (such as phytoremediation and microbial remediation) have also been studied and implemented to reduce the content and bioavailability of heavy metals in soil.

3.5 The Effectiveness of CD Pollution Control

The accumulation of heavy metals in aquatic food chain may eventually affect human health through drinking water or eating contaminated aquatic products.

Heavy metal pollution in the atmosphere mainly comes from industrial exhaust emissions, automobile exhaust and garbage incineration. These fine metal particles can enter the human body through the respiratory tract, causing damage to the respiratory system, and may cause cardiovascular diseases, nervous system diseases and other health problems.

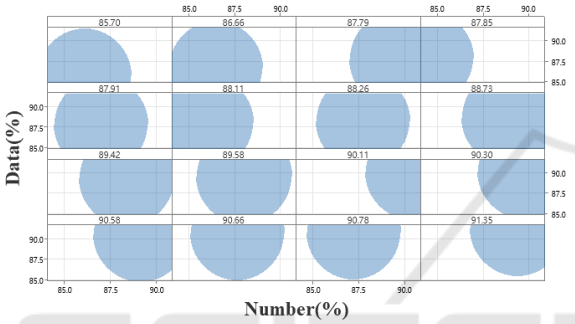

Figure 5: CD pollution control with different algorithms

Table 4: Comparison of the effectiveness of Cd pollution control of different methods

Algorithm	Survey data	CD pollution control	Magnitude of change	Error
Spatial interpolation algorithm	82.21	85.92	84.59	82.85
Soil remediation algorithms	83.73	84.23	84.41	83.55
P	84.20	87.39	84.76	83.90

Soil is one of the main recipients of heavy metal pollution. Industrial activities, mining, waste dumps and agricultural activities (e.g. the use of chemical fertilizers and pesticides containing heavy metals) can all lead to increased levels of heavy metals in soils. Once the soil is polluted, heavy metals can be absorbed into the food chain through crops, and finally affect human health.

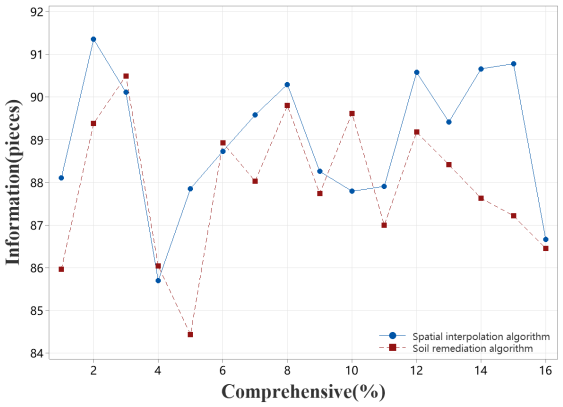

Figure 6: Spatial interpolation algorithm Cd pollution control

The accumulation of heavy metals in aquatic food chain may eventually affect human health through drinking water or eating contaminated aquatic products.

4 CONCLUSIONS

Heavy metal pollution is a complex environmental challenge, which requires scientists, governments and people to participate in the governance. Although some progress has been made, continuous efforts are needed to find more effective solutions through scientific research and ensure the sustainability of the global environment through international cooperation. Future research should pay more attention to the emerging heavy metal pollution problems, and devote itself to developing new removal and prevention technologies, so as to contribute wisdom and strength to the protection of our earth homeland.

REFERENCES

Yao Hongseng, Yang Taoming, He Liping, Wu Jianxun, Yang Zhao, and Wei Heng. (2022). Current Status of Heavy Metal Pollution in Farmland Soil in Cd and As High Background Value Areas in Eastern Yunnan Karst and Potential Ecological Risk Assessment. Journal of Northwest Forestry University, 37(4), 8.

Peng Rui, Wu Jian, Xie Yali, Li Qiwu, Xie Gao, and Jiang Yanping, et al. (2023). Study on Soil Pollution Risk Assessment and Accumulation of Heavy Metals: A Case Study in Changsha Area. Environmental Ecology, 5(1), 35-38.

Peng Weihua, Lin Manli, Yu Hao, Chen Song, and Gui Herong. (2023). Analysis and Treatment Method for the

Bioavailability of Heavy Metal Pollution in Sediments or Soils. CN115780500A.

Zheng Huihua, and Wang Jun. (2022). Device and Method for Remediation of Cadmium-Contaminated Industrial Soil. CN202111273628.5.

Zhang Zhiguo, Fang Chao, Hu Youbiao, Zheng Yonghong, and Deng Yongqiang. (2023). Characteristics of Heavy Metals and Risk Assessment in High Water Table Cultivated Land in the Huaihe River Basin. Journal of Anhui University of Science and Technology: Natural Science, 43(1), 26-35.

Xia Guangying, and Gao Gengqu. (2022). Effects of Biochar on Cadmium Absorption of Trifolium pretense, Soil Properties and Nitrogen Mineralization in Cadmium-Contaminated Soil. Jiangsu Agricultural Sciences, 50(23), 7.

Liu Huiting. (2023). Analysis of Soil Heavy Metal Pollution Remediation Technology and Prospects. Shanxi Chemical Industry, 43(3), 3.

Li Pu, Sheng Hongkun, Ruan Jiaqi, Tan Zijiang, and Li Guodong. (2023). Research Progress on Mechanism of Biochar Remediation of Heavy Metal Polluted Soil and Its Impact on Crop Growth. Soil Science, 11(3), 10.

Xiao Man. (2022). Techniques and Measures for Remediation of Heavy Metal Polluted Soils. Leather Production and Environmental Protection Technology, 3(11), 118-120.

Huang Lin, Chen Ruili, Jiang Feng, Yang Lei. (2022). Current Situation of Copper and Cadmium Pollution and Evaluation of Remediation Effects in Farmland around Smelting Plant. Environmental Protection Frontier, 12(4), 879-891.