International Core Journal of Engineering Volume 6 Issue 7, 2020
ISSN: 2414-1895 DOI: 10.6919/ICJE.202007_6(7).0021

Study on the Migration Rule of Heavy Metal Cr in Compound Soil

Xiaoxiao Shu[1,2,3,4, a], Shaodong Qu[1,2,3,4,5,*]

[1]Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710075, China;

[2]Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710075, China;

[3]Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Natural Resources, Xi'an 710075, China;

[4]Shaanxi Provincial Land Consolidation Engineering Technology Research Center, Xi'an 710075, China;

[5]Shaanxi Key Laboratory of Land Consolidation, Xi'an 710075, China.

[a]shuxiaoxiao789@163.com

Abstract

In this paper, by studying the permeability and migration characteristics of heavy metals in different proportions of arsenic sandstone and sand mixed soil, it provides directions for the prevention and control of heavy metal pollution.

Keywords

Heavy metals; Chromium; Migrate.

1. Introduction

In recent years, with the increasing scarcity of land resources, it is very important for the research of contaminated soil remediation. The heavy metal soil pollution is an urgent scientific research problem to be solved. After entering the soil, heavy metals cannot be degraded by microorganisms, and it is difficult to eliminate them. Accumulation in the soil to a certain extent will cause toxicity to the soil-plant system, affecting the yield and quality of crops. Smith E et al [1,2] research showed that heavy metals in crops mainly come from contaminated soil, especially some crops that are easy to absorb heavy metals, such as vegetables, rice, etc. Heavy metal contaminated soil is more harmful to them [3,4]. Heavy metals in the soil such as Cd, As, Pb, Cu, Zn, etc. easily pass through the crops through the food chain and cause harm to human health, such as causing cancer, pain, blood diseases, skin diseases, etc. [3,4-7].

At present, many scholars are conducting research on heavy metal pollution.Liu Yong et al [9] found that adding lime can significantly reduce the migration capacity and leaching amount of soil Cu, Cd, Zn under moderate/severe treatment. Luo Le et al [10] found that the leaching amount of heavy metals in manganese slag under simulated acid rain conditions, the leaching amount of As, Cd, Cu, Pb gradually decreased with the increase of leaching amount. The research on heavy metals in soils focuses on the study of leaching rules, while the research on the permeability and migration characteristics in different soils is relatively few. Therefore, this study focuses on the new soil body of different proportions of arsenic sandstone and sand mixed soil, to carry out the study on the permeability and migration characteristics of heavy metals Cr^{2+}, and provide directions for the prevention and control of heavy metal pollution.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202007_6(7).0021

2. Test design

2.1 Test soil

The test material is a new type of "soil" formed by the combination of arsenic sandstone and sand. The detailed mixing ratio is shown in Table 1. The arsenic sandstone and sand are taken from Maowusu sandy land, and the soil bulk density is about 1.3g/cm^3. Collect the air-dried soil through a 2 mm sieve for use. Test the basic physical and chemical properties of arsenic sandstone and sand.

Table 1 Proportion of compound soil in each treatment

Setting name	Proportion
Pure loess	-
Arsenic sandstone: sand	1：1
Arsenic sandstone: sand	1：2
Arsenic sandstone: sand	1：3
Arsenic sandstone: sand	1：4
Arsenic sandstone: sand	1：5

2.2 Experiment method.

The indoor soil column leaching simulation test was used to fill the soil column with the compound soil in layers. The total height of the soil column is set to 50cm, the thickness of the soil cover is 40cm, the soil column is an plexiglass tube with an inner diameter of 8cm, the upper part is open, the bottom has a uniform mesh outlet, the bottom center is connected to the water device, and the bottom side mouth rubber tube is connected to the water. Before starting the test, add deionized water to the soil column to wet the soil to make it saturated. Inject the soil column into the permeate from the top, keeping the soil column with a 1cm permeate head. Manually sample the whole process of the infiltration at equal time intervals, that is, sample every 2-4 hours at the beginning of the infiltration, and record the corresponding sampling time. When the concentration of the outflow is equal to that of the solution, the penetration experiment ends. Samples are sent to the laboratory for testing immediately after collection. Research settings the Cr^{2+} osmotic solution level is 300 mg/L.

2.3 Date Processing.

The test index was measured by inductively coupled plasma mass spectrometry ICP-MS, and the data was plotted with Excel.

3. Results and analysis

In Figure 1, when the ratio of arsenic sandstone to sand is 1:1, Cr^{2+} migrates obviously at 32 h, and then it vibrates irregularly up and down until it reaches a greater concentration at 104 h, indicating that Cr^{2+} continues to penetrate the compound soil at this moment. When the arsenic sandstone and sand are 1:2, Cr^{2+} begins to migrate at 26 h, the concentration gradually increases, tends to be gentle, has completely penetrated within 100 h, and then gradually decreases. When the ratio of arsenic sandstone to sand is 1:3, Cr^{2+} starts to penetrate the soil at 20 h, and then increases slowly after decreasing. When the compound ratio of arsenic sandstone to sand is 1:4, the concentration of Cr^{2+} is the highest at 24 h, and all of them have penetrated the compound soil, and then changed oscillatingly. The migration concentration of Cr^{2+} in the loess soil is almost 0, indicating that the loess has a strong adsorption capacity for heavy metal ions Cr^{2+}, so the migration resistance is greater.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202007_6(7).0021

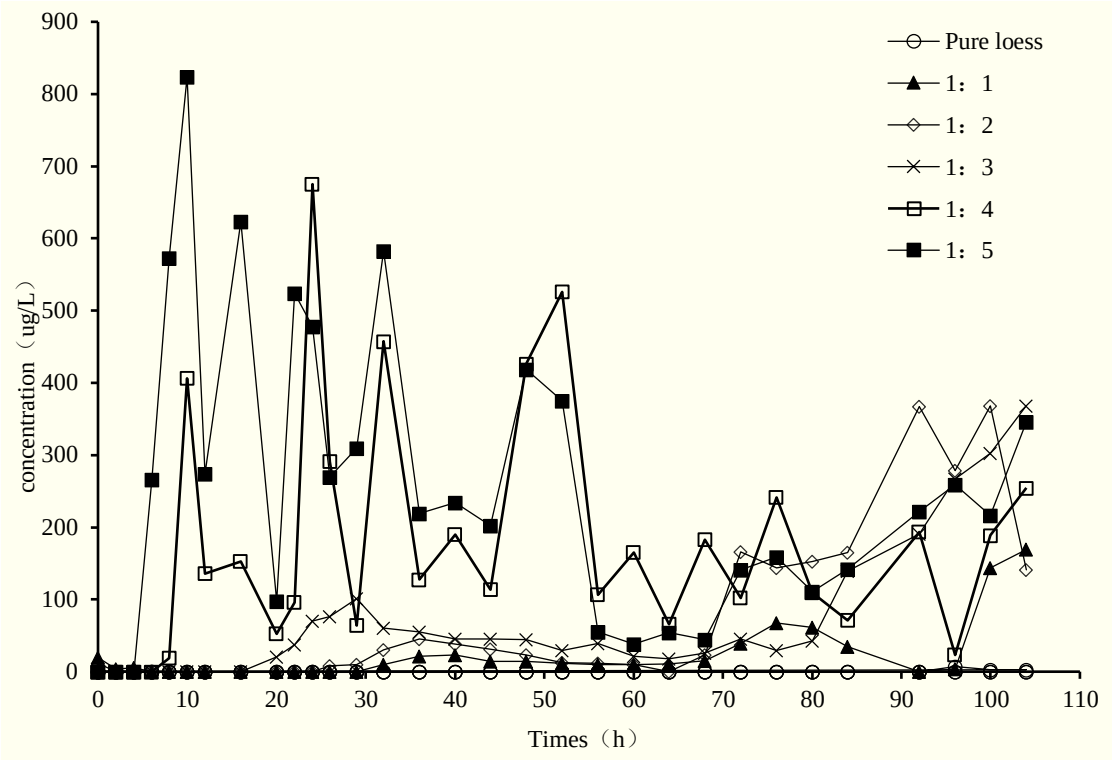

Fig.1 Cr^{2+} migration and change in different proportions of mixed soil

4. Summary

Under the conditions of this experiment, the migration of Cr^{2+} in different proportions of mixed soil is different. When the ratio of arsenic sandstone to sand is 1:4 and 1:5, the penetration time of Cr^{2+} is short, indicating that this ratio of Compound soil increases the migration of heavy metals Cr, and when the ratio of loess and arsenic sandstone to sand is 1:3, the adsorption capacity of heavy metals Cr^{2+} is stronger and the migration resistance is greater.

Acknowledgments

This research was supported by Fund Project of Shaanxi Key Laboratory of Land Consolidation “A Study on the Influence of Loess Physical Properties on Heavy Metal Migration: A Case Study of Pb Pollution in Weidong New Town(2019-JC06)”.

References

[1] Smith E, Juhasz A L, Weber J, et al. Arsenic uptake and speciation in rice plants grown under greenhouse conditions with arsenic contaminated irrigation water. Science of The Total Environment. Vol. 392 (2008) No. 2-3, p. 231-236.

[2] Khan S, Aijun L, Zhang S, et al. Accumulation of polycyclic aromatic hydrocarbons and heavy metals in lettuce grown in the soils contaminated with long-term wastewater irrigation. Journal of Hazardou Materials. Vol. 152 (2008) No. 2, p. 506-515.

[3] Yang Q W, Lan C Y, Wang H B, et al. Cadmium in soil -rice system and health risk associated with the use of untreated mining waste water for irrigation in Lechang China. Agricultural Water Management. Vol. 84 (2006) No. 1-2, p. 147-152.

[4] Arora M, Kiran B, Rani S, et al. Heavy metal accumulation in vegetables irrigated with water from different sources. Food Chemistry, Vol. 114 (2008) No. 4, p. 811-815.

[5] Samsoe-Petersen L, Larsen E H, Larsen P B, et al. Uptake of Trace Elements and PAHs by Fruit and Vegetables from Contaminated Soils. Environmental Science & Technology. Vol. 36 (2002) No. 14, p. 3057-3063.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202007_6(7).0021

[6] Tao S, Cui Y H, Xu F L, et al. Polycyclic aromatic hydrocarbons (PAHs) in agricultural soil and vegetables from Tianjin. Science of The Total Environment. Vol. 320 (2004) No. 1, p. 11-24.

[7] Bonten L T, Rmkens P F A, Brus D J. Contribution of heavy metal leaching from agricultural soils to surface water loads[J]. Environmental Forensics. Vol. 9 (2008) No. 2/3, p. 252-257.

[8] Bayraktar S， Yilmaz T. Measures to diminish leaching of heavy metals to surface waters from agricultural soils. Desalination, Vol. 9 (2008) No. 1, p. 89-96.

[9] Liu Y, Liu Y, Zhu G X. Effect of lime on chemical forms of heavy metals under combined pollution of Cu, Cd, Pb and Zn in soils. Environmental Engineering. Vol. 37 (2019) No. 2, p. 158-164.

[10] Luo L, Wang J X, Zhou H, et al. Leaching regularities of heavy metals in electrolytic manganese residue using simulation acid rain. Hydrometallurgy of China.Vol.38 (2019) No.5, p. 352-357.