STUDY TO REDUCE HEAVY METAL CONTAMINATED SOIL BY ELECTROKINETIC REMEDIATION

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Abstract

Contamination of heavy metals in the soil is less likely to decompose or purify than organic and other pollutants. In particular, lead is often absorbed into the soil due to human activities (coal smoke, gasoline, gasoline, and wear and tear of automotive parts) and can cause disease. According to this study, the contaminated soil around the battery smelter of "Zalamt Gol" LLC located in "Khonkhor Urtuu", 11th khoroo, Bayanzurkh district of Ulaanbaatar and clean soil not contaminated with heavy metals away from traffic were selected and the lead content in the soil was determined conducted a reduction study. The results of this study were reduced to 41.96% for non-activated carbon and 45.01%, 58.29% and 95.2% for activated carbon. The results showed thatthe addition of activated charcoal helps to reduce lead pollution. Therefore,theuse of activated carbon adsorbents in electrokinetic methods appears to be aneffective, environmentally friendly, and economical simple method.

Introduction

As the country develops and production increases, human activities pollute the soil with heavy metals such as lead, silicon, copper, iron, arsenic, cobalt, and nickel. Lead from these heavy metals is toxic to the human body through inhalation and digestion. Soils are often directly contaminated with chemical fertilizers, plant pesticides, heavy metals, radioactive substances, hydrocarbons, and tiny amounts of bacteria and germs.[1] Urban soils are heavily contaminated with toxic chemicals, industrial waste, and petroleum products, especially heavy metals. Metals with a density of more than 7 g/cm3 are classified as heavy metals and are present in small amounts in living organisms.[2] The primary sources of heavy metals that accumulate in the soil are thermal power plants, ferrous and nonferrous metallurgy, coal mining, and the extraction and production of petroleum products. Soils contaminated with heavy metals can be cleaned by physicochemical and biological methods. In general, in-situ remediation methods are inexpensive and cause minor damage to ecosystems.[3] The soil is cleaned by replacement, isolation, silicification, and electrokinetic methods. Hence, the electrokinetic recovery method is an in-situ cleaning method that removes contaminants by passing a low direct current (DC) between the electrodes placed in the anode and cathode solution.

Methods And Materials

Soil samples were selected near the "Zalamt Gol" LLC located in "Honhor Urtuu". Contaminated soil samples were near the factory and traffic, and pure soil was not contaminated with heavy metals away from the factory and traffic. The high surface area and high micro-porosity make the activated carbon possible to remove heavy metals from industrial wastewater. The activated carbon adsorbent (ACA) is an excellent adsorbent that removes and cleans surfactants and is economically viable.

Experimental process: Electrokinetic reduction of lead contamination in soils and remediation studies were carried out on four different conditions in artificially contaminated soils by selecting an aqueous solution of 0.1 M citric acid as an electrolyte solution. The device was maintained at 50 V for 72h without interruption, and the relationship between electric current, soil pH, and the temperature was studied. [6]

Method for determination of lead adsorption in ADA: Activated carbon is an excellent adsorbent due to its high surface area and a large number of porous pores and is effective in reducing heavy metals.[5] **Electrokinetic Remediation Method:** The electrokinetic remediation method forms an electric field in the soil when the electrode is immersed in contaminated soil and connected to a small amount of direct current.

Experiments №	Time, hour	Voltage ,V	CurrentA ,	A soil sample ,gr	Solution ,ml	Activated carbon absorber	figure1
1	72	50	0.01-0.03	500	350	-	A
2	72	50	0.01-0.03	500	350	1	Б
3	72	50	0.01-0.03	500	350	2	В
4	72	50	0.01-0.03	500	350	3	Г

Table 1. Test conditions for electrokinetic remediation

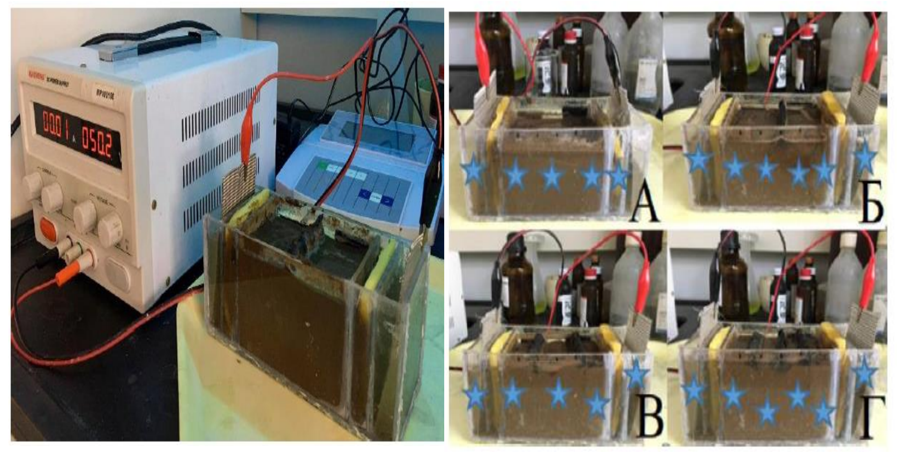


Figure 1. Electrokinetic remediation equipment

Results

Contaminated soil near "Zalamt Gol" LLC's plant and clean soil without heavy metal contamination away from production and traffic were selected. The lead content was determined in the samples using the X-ray fluorescence analysis method. Figure 2 shows the content of microelements in contaminated and clean soils. The Pb content in contaminated soils was 135 times higher than the Pb content in clean soils. This content is considered as hazardous content of Mongolian soil quality standard MNS5850: 2008. The activated carbon (IU) absorber had a lead content of 101.66 mg/kg prior to the experiment, and the element content in the ACA was shown in Table 2.

Element	Cu	Zn	Ga	As	Rb	Sr	Ag	Pb
Content (mg/kg)	25.58	63.31	4.56	10.85	16.58	153.05	75.1	101.66

Table 2. Elemental content of activated carbon.

In this study, four types of experiments were performed. As an essential condition, the first experiment did not use activated carbon absorbers . The second experiment used 1 ACA, the third experiment used 2 ACA, and the fourth used 3 ACA.

The experimental duration and current results: Electrokinetic reduction of lead in contaminated soils was performed for 72 hours, with lead levels in the cathode solution and electric current at 6-hour intervals, respectively. When sending an experiment at a voltage of 50 V, as shown in Figure 4, the lead content at the cathode is directly reflected from the electrical value. The greater the current in the electric field, the better the electrolysis, and the more lead ions are emitted at the cathode.

Figure 2. Lead content in contaminated and clean soils.

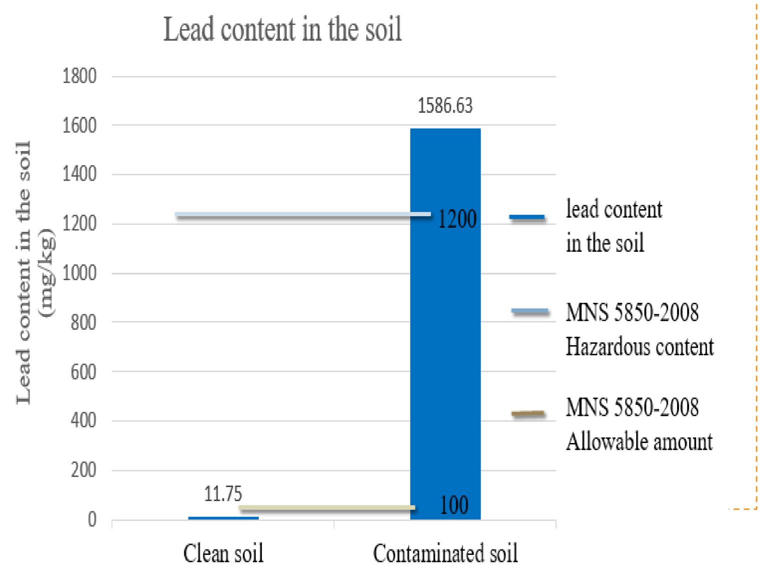


Figure 3. Lead content in activated carbon after test 4

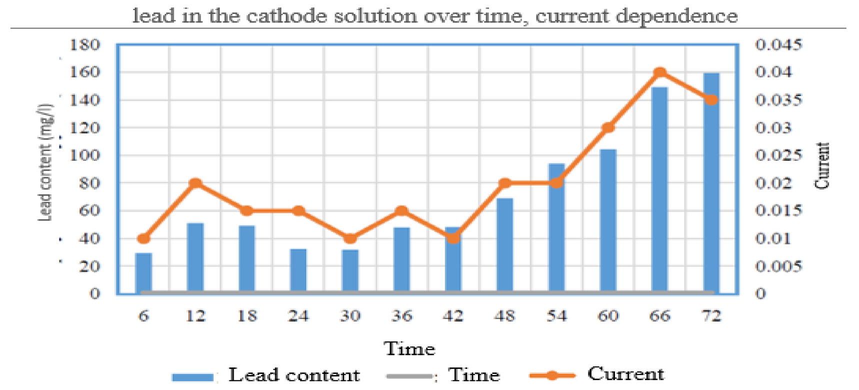
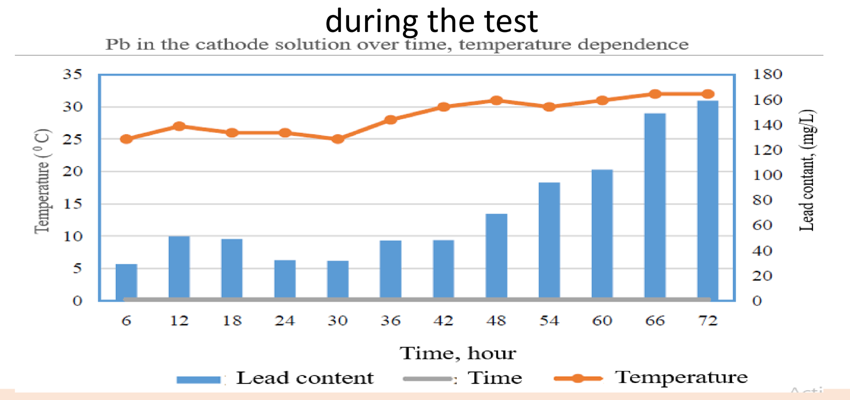
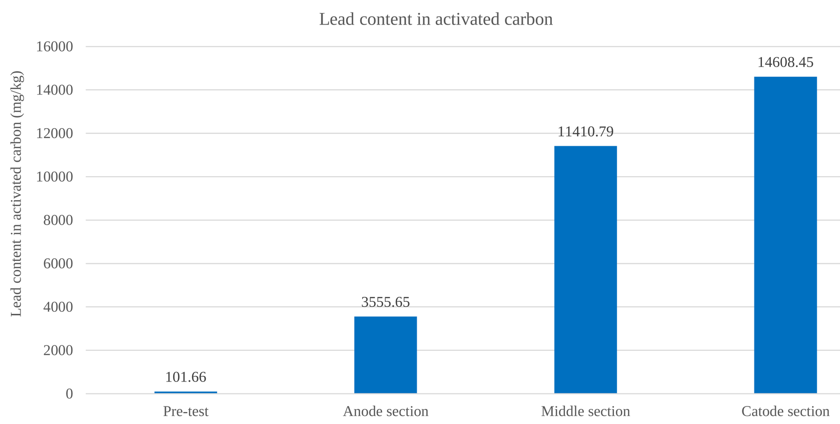


Figure 5. Temperature and current dependence over time during the test



The lead content of the three ACA used in Experiment 4 was determined using an XRF instrument, and the results were compared in Figure 3. As shown in Figure 3, the activated carbon insulators placed in the middle of the soil and cathode adsorb the lead ions very well . Therefore, this result confirms that ACA is an excellent adsorbent with high porosity and high surface area.

Figure 4. Time dependence of lead content and current



Lead content and temperature results depend on the duration of the experiments. Temperature is one of the most critical parameters in electrokinetic remediation methods. As the temperature increases, the electrical conductivity of activated carbon increases, the movement of ions in the soil increases, and heavy metals can be efficiently removed. Figure 5 shows the relationship between temperature and lead at the cathode, depending on when the contaminated soil is subjected to constant voltage of 50 V during a 72-hour test.

Discussion

Contaminated soil near "Zalamt Gol" LLC's plant and clean soil without heavy metal contamination away from production and traffic were selected. The lead content was determined in the samples using the X-ray fluorescence analysis method. Figure 2 shows the content of microelements in contaminated and clean soils. The Pb content in contaminated soils was 135 times higher than the Pb content in clean soils. This content is considered as hazardous content of Mongolian soil quality standard MNS5850: 2008. The activated carbon (IU) absorber had a lead content of 101.66 mg/kg prior to the experiment, and the element content in the ACA.

Conclusions

In this study, we selected contaminated soil with a grade of 1586.63 mg/kg. We reduced the lead content in the soil to an essential experimental condition of 72 hours continuously at a low DC voltage of 50 V. However; the pH value increased from the anode to the cathode. In this study, activated carbon adsorbent was used in the electrokinetic reconstitution method. The initialcontent of the sample was 101.66 mg/kg. Lead adsorption indicates that activated carbon to reduce metal contamination in the soil is adequate. In addition, the use of activated carbon in electrokinetic remediation methods was 2.27 times better than that of non-activated carbon. The study results were calculated to reduce the use of activated carbon by 41.96% in the first experiment. 45.01%, 58.29%, and 95.2% in the 2nd, 3rd, and 4th trials of the ACA, respectively.

Future Directions

This result shows that the more ACA is added, the better the reduction of lead contamination. Therefore, the use of ACA in electrokinetic methods appears to be an effective, environmentally friendly, and economical, straightforward method.

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