Effect of Circular Steel Electrode on the Removal of Chromium(VI) from Soil by Electro-Kinetics Remediation Test

Sachin Gupta[1] Dr. S.M. Ali Jawaid[2]
[1]P.G. Scholar [2]H.O.D
[1,2]Department of Civil Engineering
[1,2]M.M.M.U.T. Gorakhpur, India

Abstract— Electro-kinetic experiments were conducted on soil contaminated from the chromium which is carcinogenic and very hazardous to public health and environment. This paper mainly tells about the removal of the chromium from chromium contaminated soil by changing the size of circular steel electrode in the electro-kinetics test for the removal of Cr(VI) from contaminated soil. The advantage of removal of chromium by the electro-kinetics remediation is, it is in-situ and cost effective process. In this paper taking the electrode diameter as a variable in the electro-kinetic testing and determine the effect of steel electrode diameter on the removal of chromium (VI).

Key words: Electro-Kinetics Remediation Test, Steel Electrode

I. INTRODUCTION

The chromium is listed 129 priority pollutants, according to the environment protection agency. In the present time the major soil contaminant is chromium, the chromium occurs mainly in two stable oxidation states, Cr(III) and Cr(VI), the Cr(III) is not harmful to the point of view of the human health and the environment.

The Cr(VI) is mainly carcinogenic causing lung cancer, skin cancer etc. The main source of the chromium in the soil is the leather tanning, metallurgy, electroplating, power generation industries and other industries. To removing the chromium from contaminated site is the very important task from the point of the view of human health and environment.

II. ELECTROKINETICS REMEDIATION

The electro-kinetics remediation mainly when the direct current is applied through electrode into the contaminated soil (soil contains toxic metal which can be ionized), the metal get ionized and moves towards the opposite electrode depending upon the charge they hold, that means anions moves towards the anode and cations moves towards the cathode.

III. ELECTRO KINETICS TESTING

A. Electro Kinetics Test Apparatus

The rectangular test cell, which accommodates the soil sample, the dimensions of the rectangular test cell ($3.5cm \times 10cm \times 10cm$).

This cell is connected to the anode at one end and cathode at one end, this electrodes are mainly made of steel, circular plate, diameter 3.5cm and diameter 5.5cm.

B. Sample Preparation

1.6 gram $k_2Cr_2O_7$ (potassium dichromate) is dissolved in the deionized water. By dissolving 1.6 gram $k_2Cr_2O_7$ in the 660 m.l. deionized water and mix with 1100 gram of soil (silt), to maintain the initial moisture content 60% and maintain the $Cr_{(VI)}$ concentration 500 mg kg^{-1}, contaminated soil mixed homogeneously and equilibrated and spread in the layer form in electro kinetics test cell.

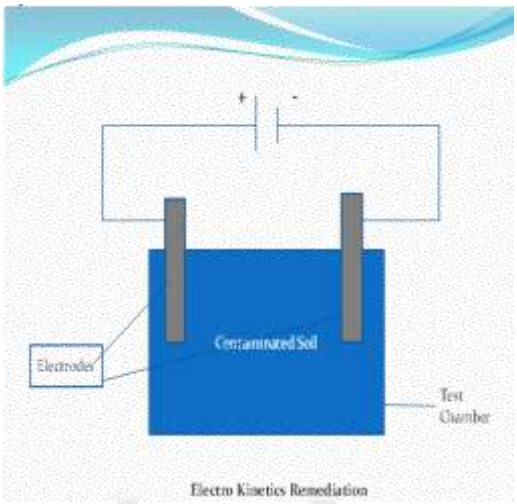

Fig. 1: EleEctrokinetics Remediation

C. Methodology

1) Case 1

When the circular steel electrode of diameter 3.5cm is used and constant electric field 30VDC is applied for four days to the soil, through the electrodes, there is the separation of ions di-chromate ion moves towards the anode and potassium ion moves towards the cathode. The movement of ions depending upon the charge they hold, that means positively charged ion moves towards the cathode and negatively charged ion moves toward the anode. In this experiment the distance between the electrode is 16.0 cm.

2) Case 2

Fig. 2: Setup of Electro-Kinetics Test

When the circular steel electrode of diameter 5.5cm is used and constant electric field 30VDC is applied for four days to the soil, through the electrodes, there is the separation of ions di-chromate ion moves towards the anode and potassium ion moves towards the cathode. The movement of ions depending upon the charge they hold, that means positively charged ion moves towards the cathode and negatively charged ion moves toward the anode. In this experiment the distance between the electrode is 16.0 cm.

D. Testing Procedure

At the end of the test the soil around the circular steel electrode in the 5 cm. range is carefully taken by the stainless steel spatula. The 40 gram soil taken from both anode and cathode area. The 40 gram of soil extruded from the middle of the both electrode anode and cathode. By using UV spectrophotometer examine the amount of chromium at each electrode and middle portion.

IV. RESULT AND DISCUSSION

For case 1, when the circular steel electrode of diameter 3.5cm is used: Concentration of chromium (VI) in soil sample at both electrode and middle of the electrodes is shown in the following table.

Sr No.	Electrode	Set1 (mg/10gm)	Set2 (mg/10gm)	Set3 (mg/10gm)
1	Cathode	4.0	4.2	4.2
2	Anode	6.4	6.0	6.2
3	Middle	4.1	4.0	4.1

Table 1: Electrode and Middle of the Electrodes

In the sample set 1 the Cr(VI) concentration is found to be 4.0, 6.4, 4.1 mg/10 gm of soil sample at cathode anode and middle of the electrodes respectively.

In the sample set 2 the Cr(VI) concentration is found to be 4.2, 6.0, 4.0 mg/10 gm of soil sample at cathode anode and middle of the electrodes respectively.

In the sample set 3 the Cr(VI) concentration is found to be 4.2, 6.2, 4.1 mg/10 gm of soil sample at cathode anode and middle of the electrodes respectively.

From the above table it reveals that the maximum chromium concentration found at the sample taken from anode.

For case 2, when circular steel electrode of diameter 5.5cm is used: Concentration of Cr(VI) in soil sample at both electrode and middle of the electrodes is shown in the following table.

Sr No.	Electrode	Set1 (mg/10gm)	Set2 (mg/10gm)	Set3 (mg/10gm)
1	Cathode	3.9	4.1	4.1
2	Anode	6.6	6.3	6.2
3	Middle	4.3	4.2	4.2

In the sample set 1 the Cr(VI) concentration is found to be 3.9, 6.6., 4.3 mg/10 gm of soil sample at cathode anode and middle of the electrodes respectively.

In the sample set 2 the Cr(VI) concentration is found to be 4.1, 6.3, 4.2 mg/10 gm of soil sample at cathode anode and middle of the electrodes respectively.

In the sample set 3 the Cr(VI) concentration is found to be 4.1, 6.2, 4.2 mg/10 gm of soil sample at cathode anode and middle of the electrodes respectively. From the above table it reveals that the maximum chromium concentration found at the sample taken from anode.

V. CONCLUSION

When steel electrode diameter using as a variable in the electro-kinetics test for the removal of Cr(VI) from the soil sample, it plays an important role. In case 1 average chromium concentration found at anode is 6.2 mg. For case 2, average chromium concentration found at anode is 6.36 mg. So we can conclude that when diameter of steel electrode which is 5.5cm in case 2, we found more concentration of chromium at anode.

A. Comparison of Removal Efficiency at Different Diameter Steel Electrode:

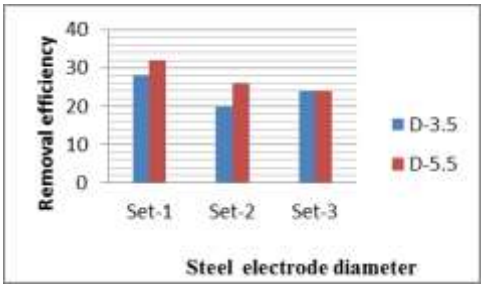

Fig. 3: Graphs

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