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# Remediation of Heavy Metal Contaminated Agricultural Soil

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***Abstract*— Heavy metal contamination is increasing day by day. Cultivation in this soil cause toxic effect on environment. Remediation is one of the most important techniques to remove all these trace elements. This heavy metal gets accumulated in the soil and is absorbed by plants. Dosage level of synthetic pesticide is higher and is one of the main reasons for accumulation of heavy metals. Electro kinetic remediation is used to remove the accumulated heavy metals.**

***Keywords*— Electro Kinetic Remediation, Heavy Metals, Synthetic Pesticides***

## I. INTRODUCTION

Emerging trends on industrialization and urbanization leads to increased pollution. The accumulation of heavy metal in soil is increasing day by day and has a great effect in agricultural sector now a day. The uptake of these heavy metals by plants above a permissible limit becomes a crucial effect related to cultivation. Conceiving the vegetables and fruits cultivated in these lands cause severe harmful diseases. The increased level of heavy metals causes contamination of soil. This increase is due to different factors and mainly the use of synthetic pesticide in agricultural land.

The soil sample collected from the region of Vechoochira in Pathanamthitta district, Kerala. The area having their main occupation as agriculture. The major crops are rubber, plantain, pineapple, bitter gourd, brinjal, tomato, pea, and cucumber. As agriculture is the main occupation, they use different kinds of fertilizers mainly chemical fertilizers. Hilban, Shakti, Ekalux are commonly used synthetic pesticides and these pesticides contain huge amount of different kinds of heavy metals.

Several types of remediation techniques are available and most important among them are electro kinetic remediation. It consist a compartment with soil sample and two reservoir with electrolytic solution. A pair of carbon electrodes is used and is connected with multimeter and current is measured at different time intervals.

### *A. Objective of the Study*

- to determine the chemical and physical properties of the contaminated soil
- to study the suitability of various electrolytic solution in this remediation

## II MATERIALS AND METHODOLOGY

### *B. MATERIALS*

#### *1) Soil Sample*

Soil sample collected from Vechoochira (Pathanamthitta district). It is dark brown in color. 'Fig 1' shows the soil sample.

Fig 1:Soil sample

The physical and chemical properties are analysed . "Table 1" shows the physical properties of soil sample

Table. 1: Physical properties

| Sl No | Properties | Values |
|---|---|---|
| 1 | Sand | 20% |
| 2 | Silt | 60% |
| 3 | Clay | 20% |
| 4 | Specific gravity | 2.34 |
| 5 | Liquid limit | 65% |
| 6 | Plastic limit | 40% |
| 7 | Plasticity index | 20% |

'Table 2' shows the chemical properties of soil sample. It is observed that cadmium uptake is higher in soil having high pH content. Increased cation exchange capacity shows decrease in uptake of heavy metals.

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Table 2 : Chemical properties of soil sample

| Sl No | Properties | Values |
|---|---|---|
| 1 | pH | 6.82 |
| 2 | Electrical conductivity ($dSm^{-1}$) | 0.16 |
| 3 | Nitrogen(kg $ha^{-1}$) | 786.46 |
| 4 | potassium(kg $ha^{-1}$) | 802.1 |
| 5 | Phosphorous (kg $ha^{-1}$) | 156.67 |
| 6 | Organic matter(%) | 3.11 |
| 7 | Organic carbon(%) | 2.31 |

Using AAS analysis, the heavy metals present in the soil and its concentration are determined. "Table 3"shows concentration level of heavy metals

Table . 3: Concentration of heavy metals

| Heavy metals | Concentration(mg/kg) |
|---|---|
| Iron | 653.2 |
| Copper | 789 |
| Zinc | 123 |
| Lead | 324 |
| Chromium | 567.8 |

*II) Electrolytic solution*

An enhanced electrokinetic remediation is done where unenhanced method is not suitable for agricultural soil. The anode compartment is filled with NaOH. The experiment is done with different electrolytes in cathode compartment. EDTA and citric acid are used as electrolytic solution in cathode compartment.

*III)Carbon electrodes*

Carbon electrodes have high electrical and thermal conductivity. These electrodes have less impact on properties of soil sample.

## *C. METHODOLOGY*

*I) Experimental Set up*

The electro kinetic cell set up of size 21cmx15cmx15cm. The soil is filled in this compartment as layers by saturating it with water. Anode and cathode compartment of size 4cmx15cmx15cm.The anode compartment filled with 0.1M NaOH. The first trial was conducted using 0.2M EDTA and then with citric acid. A constant voltage of 24V/cm is applied and varying current is measured. The experiment is continued till a stable electric current is obtained. "Fig 2" shows the experimental set up.

Fig 2: Experimental set up

## III. RESULTS AND DISCUSSIONS

The variation of current is measured in different time intervals. The reading shows 20mA at the start of experiment using EDTA. Then it reduced. After 15 days it comes to a stable current of 2mA. Using citric acid , the current starts from a value of 16mA. The current become stable after 20 days. "Fig 3" shows the variation current at different time intervals using EDTA and Citric acid.

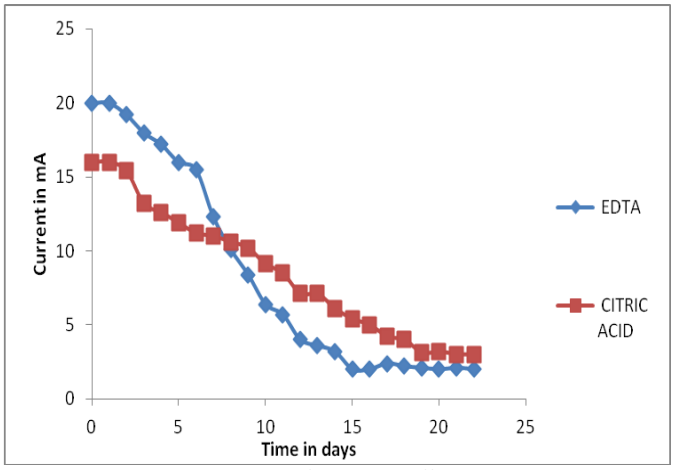


Fig 3:shows the variation of current at different time intervals

After the test completed,the soil is analysed to find out the efficiency of removal of heavy metals. Again AAS analysis is done to determine the removal efficiency. From the experiment it is obtained that chromium and iron move towards anode. So percentage removal of iron and chromium is more near anode compartment. "Fig 4"shows the percentage removal of various heavy metals using EDTA and citric acid.

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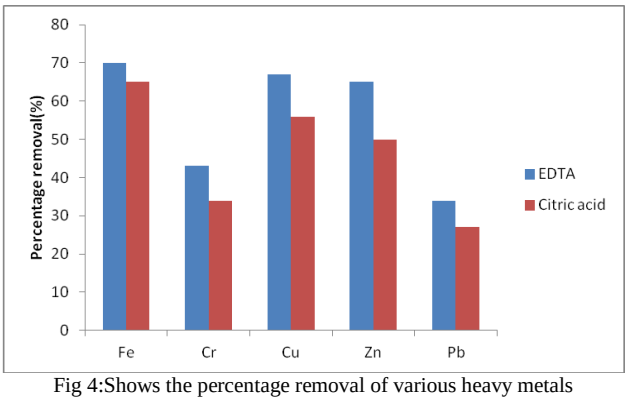


Fig 4:Shows the percentage removal of various heavy metals

## IV CONCLUSION

From the experimental study, it is obtained that using EDTA as a purging solution; it is more effective than citric acid. The soil having high content of organic matter which shows the complexation of metals. But its high content shows fewer uptakes by plants. Uptake of Iron and Copper by plants is high when K fertilizers are heavily added. It is observed that high content of fertilizers reduces the pH content causes accumulation of heavy metals. Leafy vegetables accumulate more heavy metals than grain crops. Liming is best method to reduce the uptake of heavy metals by plants. It supplies more calcium ions by increasing pH. Electro kinetic remediation is the best method to effectively remove all these trace elements.

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