# USING LOW-COST MATERIALS FOR REDUCING THE AVAILABILITY OF CERTAIN HEAVY METALS IN POLLUTED SOIL

By

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B.Sc. Agric. Sc. (Soil Science.), Ain Shams University,2008

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# ABSTRACT

**Shaimaa Yahia Saber Oraby. Using Low-Cost Materials for Reducing the Availability of Certain Heavy Metals in Polluted Soil. Unpblished M.Sc. Thesis, Department of Soil, Faculty of Agriculture, Ain Shams University, 2013.**

The problem of pollution by heavy metals is currently attracting global attention because of the deleterious effects on the environment and especially on human health. The prohibitive cost of the contemporary methods of their removal coupled with the fact that such methods are usually unsustainable has prompted the quest for environmentally friendly, sustainable, readily available and cost effective methods for the removal of heavy metals from contaminated wastewaters and soils.

In situ application of some organic byproducts such as, cooked tea dust coffee husk, sawdust, sugarcane bagasse, eggshells, as well as some nature products such as, zeolite, rock phosphate, bintonite, gypsum, and industrial byproduct such as cement by-pass kiln dust are considered to be a low cost-effective remediation technique for immobilizing Cu, Ni and Cd and reducing health and ecological risks associated with contaminated soils. The current study involving three different experiments, i.e. batch kinetic studies and two pot experiments were carried out to explore the feasibility of using some byproducts and minerals to remove Cu, Ni and Cd from aqueous solutions.

Results demonstrated that all of the different treatments highly reduced bioavailability and phytoavailability, of Cu, Ni and Cd in the aqueous solutions and contaminated soil. Thus, the in situ remediation of metal contaminated soil using different amendments is considered to be a practical remediation strategy with long-term benefits. The maximum sorption capacity (b) remained the highest for Cu and followed

the order: bintonite> eggshell> sawdust> cement by-pass kiln dust > gypsum> zeolite> tea dust > rock phosphate> sugarcane bagasse > coffee husk. While, for Cd the sequence showed that gypsum> coffee husk > tea dust > zeolite > bintonite> rock phosphate> eggshell> sawdust> sugarcane bagasse > cement by-pass kiln dust. But, for Ni the maximum sorption capacity (b) remained as followed: rock phosphate > zeolite > cement by-pass kiln dust> sawdust> tea dust> coffee husk > sugarcane bagasse> bintonite> eggshell.

The results showed that all amendments decreased Cu, Cd and Ni extractability with increasing incubation time compared to control. The results indicate that the most effective treatment in reducing the concentrations of Cu and Cd was sawdust in the different levels of treatment. Values of chemically available Cu, Cd and Ni extracted from the tested soil generally decreased with all treatments.

The distribution of the studied heavy metals forms in soil was different depending on heavy metal and amendments types. The applied amendments reduced Cu, Cd and Ni concentration in wheat plants compared to control.

**Keywords**: Low-cost materials, Cu, Ni, Cd, adsorption, desorption, polluted soil, reducing heavy metals, bioavailability, fractionation, wheat plant.

## CONTENTS

**TITLE** **Page**

## List of Tables

**Table No.** **Page**

## LIST OF FIGURES

**Fig.No**. **Page**

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# 1- INTRODUCTION

As today's technology progresses, the natural environment suffers from the detrimental effects of pollution. The natural process of transportation of metal ions between soil and water consolidates metal contamination in high concentrations that affect the areas of natural ecosystems **(Runnells and Shepherd, 1992). Bewley (1980)** studied the effects of heavy metal contamination that get into the environment, by conducting site simulations of smelter contamination. Heavy metal contamination that does get into the environment could cause permanent negative ecological effects **(Micera and Dessi, 1988)**. These contaminants can be retained by plants and enter the food chain of animals and humans. Studies have found that cattle which graze on metal contaminated plants will accumulate the toxic metals in their bodies which could then be passed to humans **(Chamberlain and Miller, 1998).**Therefore; heavy metal contamination of the environment has become an area of increasing concern.

Many methods are now being utilized to remove or reduce the metal concentrations in the environment, but most have shown to be somewhat impractical and costly. Cost is an important parameter for comparing the sorbent materials **(Bailey et al., 1999).** A low-cost adsorbent is defined as one which is abundant in nature, or is a byproduct or waste material from another industry. Various biomass materials and agricultural by-products have been utilized in the removal of toxic heavy metals from waste water, such as; sunflower stalks **(Sun and Shi, 1998),** coconut fibre and sawdust (**Raji & Anirudhan, 1997and Igwe et al., 2005**), maize cob and cassava waste **(Abia et al.,2003 and 2005**), banana pith **(Low et al., 1995**) medicago sativa (Alfalfa) **(Gardea-Torresdey et al., 1998)**, Sphagnum moss peat **(HO et al., 1995)**, Fungal, bacteria, algae **(Hussein et al., 2003 and Liu et al., 2004)** and so on. The immobilization of biomaterial has also proven to be a good method for metal