# REMOVAL OF COPPER(II) IONS FROM AQUEOUS SOLUTION BY ADSORPTION ON SWEET POTATO PEELS CHARCOAL

**BY**

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## DECLARATION

I Mutesi Janat declare that the information here is my original work unless where reference has been cited. The work has never been submitted to any other institution for any award or publication.

Signature..... Date.....

MUTESI JANAT

APPROVAL

This work has been supervised and approved by Mr. Oyege Ivan

Signature..... Date.....

Mr. OYEGE IVAN

Supervisor

# DEDICATION

I dedicate this work to my lovely parents for their sacrifice towards my upbringing and all efforts put in towards the payment of my tuition and all the necessary requirements during my research.

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WHO: World Health Organization.

BOD: Biological Oxygen Demand.

pH: Hydrogen of potential.

## ABSTRACT

In this study, sweet potato peels charcoal powder was used as an adsorbent for removal of $Cu^{2+}$ ions from aqueous solutions. The effect of pH, equilibrium time and initial concentration of $Cu^{2+}$ ions on adsorbed amount of $Cu^{2+}$ ions were investigated. The Study showed that; The amount of $Cu^{2+}$ ions adsorbed increased with increasing bulk solution pH, the amount of Copper adsorbed increased as pH increased from 2.0 to 6.0. This is due to the surface complexation reactions, which are mostly influenced by the electrostatic force of attraction between Copper(II) ions and the surface of the adsorbent.

Adsorption of Copper ions increased with increase in initial concentration of adsorbate. This can be attributed to large amount of sweet potato peel charcoal powder used which provided very many adsorption sites sufficient enough for removal of Copper (II) ions from water even at their higher concentration. Adsorption of Copper increased with increase in time. This probably due to larger surface area of finely ground charcoal being available at all times for the adsorption of Copper (II) ions.

The experiments showed that the highest removal of $Cu^{2+}$ ions was at solution pH 6.0, contact time 8 hours and initial concentration of $0.1 mol/dm^3$. The experimental data were fitted by the Langmuir adsorption isotherm, suggesting that the adsorption process is presumable a chemisorption

# CHAPTER ONE: INTRODUCTION

## 1.1 Background

The discharge of heavy metals into water sources is a serious pollution problem which can affect the quality of water supply (Wong *et. al,* 2003). Higher concentrations of these metals in water results into severe health hazards which are mainly due to their non-degradability and toxicity (Adedrani *et. al*, 2007)

Copper metal is a widely used industrial metal for electrical wiring, plumbing, machinery, metallurgy and in transportation industry. It is also used for anticorrosion and as a decorative coating on metal alloys (Cary, 2003). Copper(II) ion is found in waste waters of industries such as metal cleaning, electroplating industry, refineries, wood preservatives, paper and pulp (Khalid & Ahmad, 2000). Copper is an essential micro element of the human body but excessive intake of Copper(II) ions by human beings causes hepatic and renal damage, gastrol intestinal irritation, difficulty breathing and central nervous problems (Ashtoukhy *et al*, 2008)). Copper(II) ion is toxic to lower organisms and farm crops but has greater toxicity to crops and is particularly considered the heaviest metal ion basing on its degree of toxicity to crops. The maximum acceptable concentration of Copper(II) ion in drinking water as recommended by world health organization(WHO) is 1.5 mg/L. Since the presence of high levels of Copper in water may cause long term health risks to humans, it is therefore necessary that their levels must be reduced to within allowable concentrations as recommended by national and international health authorities such as the World Health Organization (WHO) (Benjamin, 2002). The removal of Copper from water can be principally achieved by application of various processes such as chemical precipitation, adsorption, electroplating, chemical coagulation, ion exchange, membrane separation and electro kinetics (Yiacoumi & Rao, 1996) . The choice of the method to be employed depends on effluent characteristics such as pH, temperature, concentration of Copper in water, biological oxygen demand (BOD), costs involved and social factor like standard set by government agencies (Stumm, 1992).

Adsorption refers to the phenomenon of attracting and retaining the molecules of a substance on the surface of a liquid or solid resulting into higher concentration of the molecules on the surface

(Cary, 2003). The substance which gets adsorbed on any surface is called the adsorbate and the substance on the surface of which adsorption takes place is known as adsorbent The properties such as surface charge, type of surface functional groups, specific surface area and pore size distribution affect the adsorption capabilities of metal ions such as Copper(II) ion on solid adsorbents like sweet potato peels charcoal (Gart *et al*, 2003). This research was aiming at examining how pH of Copper (II) solution, contact time and initial concentration of the adsorb ate vary with adsorption on sweet potato peels charcoal.

## 1.2 Problem statement

People living in industrial areas for example near Tororo cement industry drink water from the natural sources of water for example wells, swamps etc. containing heavy metals for example Copper which can cause complications like malfunctioning of some parts of the human body such as the nerves, kidneys among others (Ajmal *et al*, 2000). Therefore, Copper needs to be removed from water before it can be assimilated by human beings so that its dangers are minimized.

The use of activated charcoal as an adsorbent in removal of Copper(II)ion from water is very popular and different grades are available, but are quite expensive and the regeneration of carbon is not always possible. Therefore, there is a great need to provide a cheap locally available but effective adsorbent alternative to activated charcoal which is the core of the present study. In this study sweet potato peels charcoal shall be used since it is relatively inexpensive to develop and can be easily made from natural materials.

## 1.3 Objectives

### 1.3.1 General objective

To determine the adsorption ability of Copper(II) ions in aqueous solution on sweet potato peels charcoal.

### 1.3.2 Specific objectives

- To study the effect of pH on adsorption of Copper(II) ions from aqueous solution by adsorption.
- To study the effect of initial concentration of Copper (II) ions on adsorption of Copper(II) ion on sweet potato peels charcoal.

- To determine the effect of contact time on adsorption of Copper(II) ions.

## 1.4 Significance of the study.

Copper(II) ions present in various water sources has little significance to the human health but rather brings about several long term health risks to humans such as hepatic and renal damages among others.

Several researchers have developed different adsorbent materials such as activated charcoal for removal of Copper(II) ions from water but they are used by a small population due to their high costs of preparation, low availability and inability to be recycled.

Sweet potato peels when adopted as an adsorbent for removal of Copper(II) ions from water, a higher population can easily access it because its raw materials are readily available within the environment and involves low costs of preparation.

It is expected to enable the researcher establish the optimum pH for removal of Copper(II) ions from water by adsorption on sweet potato peels.

## 1.5 Scope of the study

The study was performed in Busitema University chemistry laboratory. Some materials such as the sweet potato peels were got from Nagongera trading center. Distilled water from the Busitema University chemistry lab was used to prepare the solutions of Copper(II) ions. The pH of the solution was measured using pH meter from physics laboratory, the weight of copper (II) was measured using the analytical balance of Busitema university chemistry laboratory. The results were got by gravimetric titration.

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