BUSITEMA UNIVERSITY
Pursuing Excellence

DEPARTMENT OF WATER RESOURCES AND MINING ENGINEERING

FINAL YEAR PROJECT REPORT

INVESTIGATING THE EFFICIENCY OF MANGO LEAVES & WATERMELON RIND POWDERS TO REMOVE LEAD (II) IONS FROM INDUSTRIAL WASTEWATER

CASE STUDY: UGANDA BATTERIES LIMITED

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This report is presented to the faculty of Engineering as a partial fulfillment of the requirements for the award of a bachelor's degree in Water Resources Engineering of Busitema University.

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EXECUTIVE SUMMARY

The efficiency of the combination of mango leaves and watermelon rind powders as a low-cost adsorbent for the removal of Pb (II) ions from industrial waste water at Uganda Batteries Limited was investigated in this research. The influences of adsorbent load, pH, contact time, adsorbent ratios and agitation rate on a sample were studied in batch experiments at room temperature. The findings showed that the lead uptake increased with increasing adsorbent load, agitation rate, Ph and contact time. The maximum uptake of Pb (II) ions was at pH 5, contact time of 1hour, adsorbent load of 5grams with adsorbent ratio of MLP75:WMR25 and agitation rate of 200rpm.

Parameter values were chosen on basis of efficiency and implied cost. These values yielded an average efficiency of 97.02% when used to adsorb lead from UBL waste water.

The economic analysis showed that the combined adsorbent was more cost effective to treat leaded waste water compared to polyacrylamide. The cost of treatment was reduced by 90%.

The results showed that the combination of watermelon rind and mango leaves has the potential to be applied as alternative low-cost bio sorbent in the remediation of heavy metal contamination in waste water.

DECLARATION

I **NANNOZI REHEMA** hereby declare that this report is a true work of my hands and has never been presented by any person or institution for an academic award.

Signature: .....

Date: 26/05/2017.....

APPROVAL

This project proposal has been submitted to the faculty of Engineering for examination with approval of my supervisors mentioned below;

MAIN SUPERVISOR: Ms. NJUKI HOPE

Signature.....

Date.....

CO-SUPERVISOR: Mr. WANJI MARIO

Signature.....

Date.....

DEDICATION

This report is dedicated to my beloved family in appreciation for their selfless care and unflinching support provided to me since childhood, and for the spirit of hard work, courage and determination instilled into me, which attributes I have cherished with firmness and which have indeed made me what I am today.

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I am also grateful to the Uganda Industrial Research Institution staff for the help and assistance granted to me during the experiments.

I appreciate my parents for the support they have continued to offer me in order to attain quality education. May the Almighty God bless the work of your hands and may He make you live long enough to enjoy the fruits of your labors.

Finally, I thank all my friends and colleagues for the assistance they have given me in endeavors to see me through with my research.

LIST OF ACRONYMS

ATSDR	Agency for Toxic Substances and Disease Registry
FTIR	Fourier Transform Infra-Red
HCL	Hydrochloric
WMR	Watermelon rind
MLP	Mango Leaf Powder
NAADS	National Agriculture Advisory Services
NaOH	Sodium Hydroxide
UBL	Uganda Batteries Limited
NEMA	National Environmental Management Authority
rpm	revolutions per minute
US EPA	United States Environmental Protection Agency
WHO	World Health Organisation

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CHAPTER ONE: INTRODUCTION

1.1 Background

Excessive release of heavy metals such as lead due industrial activities and technological 56 developments has posed a great problem worldwide. Heavy metals pose a significant threat to the environment and public health due to their toxicity, resulting from their accumulation in food chain and persistence in nature (Kanawade and Gaikwad, 2011). Lead (II) ions introduced to the aquatic streams by means of electroplating, pigments, metallurgy, battery industries as well as mining have led to severe environmental pollution (Demirbas E, 2004). Lead interferes with a variety of body processes and is toxic to body organs and tissues. The Institute for Health Metrics and Evaluation (IHME) estimated that in 2013 lead exposure accounted for 853 000 deaths due to long-term effects on health, with the highest burden being in low and middle income countries(WHO, 2016).

Removal of Lead (II) ions from waste water is Crucial because of the public health hazards it exposes humans to as a result of its consumption. According to the World Health Organization (WHO), the maximum permissible limit (MPL) of lead in drinking water is 0.05 mg/L. The permissible limit (mg/L) for Pb (II) in wastewater, given by Environmental Protection Agency (EPA), is 0.05 mg/L (Goel et al, 2005). The conventional treatment processes used to remove Lead (II) ions include precipitation, ion exchange, filtration, membrane filtration, electrochemical treatment, and reverse osmosis (Stirk and Staden, 2000).

The need for economical and effective methods for removing heavy metals from wastewater has therefore resulted in the search for relatively cheaper materials that may be useful in removing the heavy metals in the environment (Okiemen, 1991). However the existing methods have a disadvantage of being expensive, sophisticated equipment, high cost of operation and high energy requirements (Ahalya, 2003). The need for environmental friendly and cost-effective methods for removing lead (II) ions from wastewater has therefore resulted in the search for relatively cheaper materials that may be useful in reducing the levels of heavy metals in the environment (Okiemen, 1991). A number of innovative methods have been used to remove lead (II) ions, such as biosorption (Volesky, 1987), biosorption on to biopolymers (Jang et al., 1998), adsorptive filtration using coated sands (Benjamin et al., 1996), and biosorption on magnetic iron oxides(Dean and Bosqui, 1972). Moreover, biosorption has aroused most interests

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