FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

FINAL YEAR RESEARCH PROJECT REPORT

INVESTIGATING THE RECOVERY EFFICIENCY OF ALUM BY ACIDIFICATION OF ALUMINIUM HYDROXIDE SLUDGE

Case Study: Gabba water treatment plant

BY

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BU/UP/2014/552

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A Final year Project report Submitted in Partial Fulfillment for the Award of a Bachelor of Science Degree in Water Resources Engineering

ABSTRACT

Alum has been used for the treatment of water for millennia to flocculate negative colloidal particles, organic substances, other contaminants and a variety of ions. Alum sludge produced from water treatment plants contains aluminum hydroxide mixed with suspended solids in raw water. Existing practices for the subsequent handling of this sludge regard it as a waste product rather than a potential resource. However, the disposal or efficient re-utilization of the derived alum sludge has, until recently, not been considered to be a major imperative. Disposal of sludge is routinely performed either to landfill, or via sewer to a municipal wastewater treatment plant; with some small-scale options also used in various cases. With the increasing cost of disposal, the declining availability of landfill and the need for 'greener', more sustainable and much more efficient reuse options to be implemented, new technological solutions are required.

The aim of this research is to study aluminium sulphate (alum) recovery efficiency from alum sludge in aqueous solution by acidification process using sulphuric acid.

The results of the experimental works showed that the recovered alum volume produced from the sludge after acidification process is the best value with percent recovery 64%.

DEDICATION

I dedicate this project report to my family especially my mother Achom Alice, my siblings Alupo Doreen, Alupo Martha, Osauro Gabriel, Among Theresa and Eropu Isaac.

ACKNOWLEDGEMENT

First and foremost, I want to thank God the almighty for the gift of life, guidance, love and care he rendered to me during my title identification period and the strength he gave to carry on with the research project till I accomplished it.

I would also wish to extend my sincere appreciation to my supervisor(s) Ms. Engole Marion and Mr.Badaza Muhamad who tirelessly advised and encouraged me towards the success of my research project. May the almighty God bless them.

I am very grateful of the selfless efforts of my classmates towards the making of this report, special thanks goes to Ndimulodi Kasakya and Namale Caroline.

I am also very greatful to the department of Mining and Water resources engineering for the knowledge given to me concerning my field of profession.

DECLARATION

I Aanyu Caroline Memory, hereby declare that this work has been presented to you from my own knowledge and prepared by myself. And I hope and believe that no other individual or institution has presented this work.

Signature: ……... Date: …….

APPROVAL

This research report is ready to be approved by;

Main supervisor

Ms. ENGOLE Marion

Signature: ……..

Date: ……

Co-supervisor

Mr. BADAZA Muhammad

Signature: …….

Date: ……

LIST OF ACRONYMS

NTU	Nephelometric Turbidity Unit
BOD	Biochemical Oxygen Demand
BOD_5	Five day Biochemical Oxygen Demand
PAC	polyaluminium chloride
PACH	polyalumium chlorohydrate
m	meter
ms/ cm	milliseconds per centimeter
m/ s	meters per second
mg/ l	milligrams per liter
ml	milliliter
mm	millimeters
gpd/ft	gallons per day per feet
NWSC	National Water and Sewerage Corporation
P^H	Power of Hydrogen ion

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1.0 CHAPTER ONE: INTRODUCTION

1.1 Background of Study

Availability of clean drinking water is very vital, a resource important for our survival and growth. Most of the fresh water bodies all over the world are getting polluted due to unplanned urbanization, industrialization and anthropogenic activities (Monty, 2005). The surface water sources serve as the best sinks for the discharge of domestic as well as industrial waste. The unscientific disposal of waste has caused immense problems not only to human beings but also to aquatic environment worldwide.

The composition and properties of the water treatment sludge depends typically on the quality of treated water as well as on types and doses of chemicals used during the water treatment. Depending on the quality of the treated water, the water treatment sludge contains suspensions of inorganic and organic substances. Typically hydrated alumina oxides and iron oxides are present.

Alum is generally used in water treatment plants (WTPs) as a coagulant. Alum reacts with water forming an insoluble aluminum hydroxide flock which removes the fine suspended and colloidal impurities, the insoluble aluminum sludge settle and then they are directed out through the clarifiers and these form the sludge.

Daily a large quantity of fresh alum is required in water treatment plants due to the increased pollution of surface water and the demand of a lot of water by the populations where large amount of sludge generated as waste water which cannot be discharged in surface water without proper treatment.

This sludge consists near about 40-50% of unused alum (Xu, Yan, Wang, & Wang, 2009). If alum coagulant can be recovered efficiently from WTP Sludge, then it will solve the problems of sludge disposal, water pollution and daily huge requirement of fresh alum. In this way, it can provide a greener approach for water purification in which according to the principals of Green Chemistry, which seeks to reduce and prevent the pollution at the source.

According to research, the main approach for recovering alum from WPS is acidification method. Since aluminum hydroxide, $Al(OH)_3$, is an amphoteric compound, it can be dissolved in acid solutions. If the pH of alum sludge is reduced by adding H2SO4 to between 1 and 3, then an aluminum recovery rate of approximately 70% to 90% Ca.

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