



**BUSITEMA  
UNIVERSITY**  
*Pursuing Excellence*

FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

FINAL YEAR PROJECT REPORT

**INVESTIGATING THE CONTAMINATION OF SOILS AND WATER BY CYANIDE  
AND MERCURY IN MINING.**

(CASE STUDY: TIIRA GOLD FIELD-BUSIA DISTRICT)

BY

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## ABSTRACT

Physico-chemical quality of ground and surface waters from Tiira mines and its environs was conducted between January , 2017 and April, 2017. This study was undertaken to determine whether physical, chemical and trace metal contamination of water sources in Tiira mines is as a result of mining or geochemical and biochemical processes within the environment. Levels of trace metals (mercury) physical parameters (pH, Total Dissolved Solids (TDS), E.C and Temperature) and chemical parameters (Alkalinity, and CN) in water resources were determined. Water samples were collected from 8 sampling points including stream, 2 boreholes and 2 hands dug wells for water quality tests. The results showed that groundwater (pH range 5.70-7.44) was slightly acidic (low pH) compared to surface water (pH range 6.60 – 7.80 pH units). Groundwater electrical conductivity ranged from 350 to 857  $\mu\text{S}/\text{cm}$  whereas that of surface water ranged from 451 to 777  $\mu\text{S}/\text{cm}$ . Mining contaminants detected in water samples in this study were As (ranging from values  $<0.0001$  to  $0.0027$  mg/l), CN (minimum and maximum) concentrations of  $0.0001$  and  $0.0026$  mg/l respectively).the relationship chemical and physical parameters in ground and surface water showed that there was a strong negative correlation ( $r = -0.911$ ) with significance between TDS concentration and temperature in groundwater samples. A weak positive correlation ( $r = 0.124$ ) was however observed between these variables in surface water samples.The correlation matrix showed a significant correlation ( $r = -0.866$ ) for TDS and Temperature concentrations in groundwater samples. TDS and Temperature concentrations in surface water exhibited a moderate positive correlation with no significance ( $r = -0.309$ ).PH and CN concentration in surface water correlated negatively with significance ( $r = -0.325$ ) implying both variables decreased together.Water and sediment samples of the River were analyzed for various parameters and compared with Environmental Protection Agency (EPA) and WHO permissible guidelines for drinking water. The water quality parameters included PH, EC Total Dissolved Solids (TDS), Total Suspended Solids (TSS), temperature ,Total suspended solids (TSS) , True Colour, CN and Hg concentrations. Metals (such as Mercury) in the water samples and the river sediments were determined using atomic absorption spectrophotometer (AAS) using AAS 220 model. The result of the study revealed that, the mean values for true colour and total suspended solids of the river water at the various sampling sites exceeded EPA permissible level for drinking water. However pH, total dissolved solid and E.C were below acceptable levels. The concentrations of CN and Hg recorded in the River water

and sediments were also below EPA and WHO standards, rendering the water unsafe for domestic use.

The study revealed that Small Scale Mining activities in the area have impacted on the water quality of River Namukobe and the soils in the mining concession considering the higher levels of True colour, Total Suspended cyanide and Mercury which exceeded the EPA and WHO Levels at the leachate points.

### DECLARATION

I Ninyikyiriza Willy, REG NO- BU/UG/2013/134, hereby declare that this project report is my original work except where explicit citation has been made and it has not been presented to any Institution of higher learning for any academic award.

Signature.....

Date.....*26th May - 2017*

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**APPROVAL**

This is to certify that the project report under the title “investigating the contamination of soils and water by cyanide and mercury in mining” has been submitted to the department of Mining and Water Resources Engineering for examination with approval from the following supervisors

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May the Almighty God shower his blessings on all contributors.

## LIST OF ACRONYMS

ASM	Artisanal and Small Scale Miner
UNEP	United Nations Environmental Programme.
AAS	Atomic Absorption Spectrometry
WHO:	World Health Organisation
EPA	Environmental protection Agency
ATSDR	Agency for Toxic Substances and Disease Registry.
NIOSH	National Institute for Occupational Safety and Health.
AGM	Artisanal and Small Scale Miners.
Hg	Mercury
CN	Cyanide
Au	Gold
CIP	Carbon in Pulp
CIC	Carbon in Column
CIL	Carbon in Leach
ASM	Artisanal Small Scale mining.
OSHA	Occupational Safety and Health Agency.
AMD:	Acid Mine Drainage
EC:	Electrical Conductivity
TDS:	Total Dissolved Solids
pH:	Potential of Hydrogen
GW:	Groundwater
SW:	Surface Water

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## CHAPTER ONE:

### 1.1 INTRODUCTION

This chapter describes the background information of the project, the problem statement, significance, purpose, objectives and scope of the study. The problem statement describes the research problem and identifies potential causes and a solution. The significance describes the importance of the project. The specific objectives presented to achieve the main objective.

### 1.2 BACK GROUND

Cyanidation is a process where cyanide is used as a solvent in gold recovery while amalgamation is where mercury is used to recover gold from its ores. Amalgamation results in excessive mercury emissions and is now illegal in many countries (Korte and Coulston, 1997). Cyanidation has been banned in the Czech Republic and in the US State of Montana. Some industrial accidents including the gold mine tailings pond overflow into a tributary of the Danube River in 2000 has prompted this more critical view of the process (Müezzinoğlu, 2003). Mercury has been well known as an environmental pollutant for several decades. As early as the 1950's it was established that emissions of mercury to the environment could have serious effects on human health. These early studies demonstrated that fish and other wildlife from various ecosystems commonly attain mercury levels of toxicological concern when directly affected by mercury-containing emissions from human-related activities. Human health concerns arise when fish and wildlife from these ecosystems are consumed by humans.

Gold mining in Uganda is being carried out by Artisanal and Small Scale Gold Miners (ASM). ASM Provides a source of livelihood for almost 200,000 women and men, over half of which are engaged in production of industrial minerals to serve the construction demands of the country's rapidly growing population (3.3% per annum). At least 20,000 of these miners are engaged in gold mining via ASM (Jenniffer Hinton, 2009), which has become a relatively important economic activity, mostly in the regions of Busia and Karamoja in the East and Northeast as well as in the Kigezi and Buhweju goldfields across the West and Southwest of the country.

**Cyanidation** is widely used in recovery of precious metals such as gold and silver because of its availability, effectiveness, and economics. More than half of all gold and silver mines in the world rely on the use of cyanide. It was first used on a large scale in the 1970s. Sodium cyanide

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