



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

Final Year Project Report

**DEVELOPMENT OF A STANDARD OPERATING PROCEDURE FOR DETERMINATION OF
GOLD GRADE IN ORE AND TAILINGS FOR ARTISANAL AND SMALL-SCALE GOLD
MINERS**

(Case Study: Tira Gold Field)

By

Busobozi Henry

Reg. No. BU/UG/2014/47

Email: busobozih@gmail.com

Tel: +256 787 895 929

+256 757 958 146



Main Supervisor: Eng. Wycliffe Tugume

Co Supervisor: Eng. Thomas Makumbi

*A Final Year Project Report submitted to the Department of Mining and Water Resources
Engineering as a partial requirement for the fulfillment of the award of Bachelor's Degree in
Mining Engineering for Busitema University*

May 2018

BUSOBOZI HENRY BU/UG/2014/47

Abstract

Determination of gold grade prior to mining investment helps to understand and determine the possible expenses and cash flows from the project. With the ore grade and commodity price in the market, the project proponents (investors) are able to make the rightful investment decisions. Several techniques and tools are employed worldwide to carry out this analysis.

A study was carried out to develop a standard procedure by (1) qualitatively analyzing the metal composition in the ore, (2) quantifying the ore, (3) validating the ore quantification and (4) carrying out an economic analysis for the developed procedure. Samples were obtained from around the Tira Gold Field and thoroughly prepared to ensure that the results are unbiased. The qualitative analysis showed that the metal composition in the ore was not significant enough to show presence after pre-leaching and ore opening using sulphuric acid but showed significance during the leaching process witnessed by excessive consumption of cyanide. The quantified ore grade was far higher than the actual grade as determined from the AAS. Validation was carried out to ensure that the higher values obtained from quantification be accounted for and this was done using excel spreadsheet. An economic analysis was carried out too to ascertain the economic viability of the new procedure as compared to the other existing methods. The results showed that this procedure was 6.8727 times cheaper than the use of the AAS machine and analyzing samples at different laboratories at Makerere University and the Department of Geological Survey and Mines.

The research recommended that further and more detailed ore opening be carried out to ensure that all the metal ions are completely dissolved into the solution and measures be taken to eliminate or suppress their significance on cyanide consumption to minimize on the costs involved in purchasing cyanide. A simplified approach was given that can be used by the local artisanal miners to apply the procedure without much technical challenges involved in carrying out the mole concept.

Declaration

I Busobozi Henry, hereby declare to the best of my knowledge, that this project report is an outcome of my original work and that it has not been presented to any institution of learning for any academic award.

Name: Busobozi Henry

Registration Number: BU/UG/2014/47

Signature:

Date: 20.05.2018



Approval

This final year project report has been submitted to the Faculty of Engineering, Busitema University for examination with approval of my supervisors.

Name: Eng. Wycliffe Tugume

Signature

Date

Name: Eng. Thomas Makumbi

Signature 

Date 

Dedication

This report is dedicated to my beloved parents Mr. Selemos Rwahwire and Mrs. Grace Kabasindi Rwahwire 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. I further dedicate this work to my beloved brother, Mr. Norbert Kiiza for both financial support and academic encouragement and guidance.

Acknowledgement

I want to reach my sincere appreciation to Eng. Wycliffe Tugume, Eng Thomas Makumbi and Eng Michael Nasasira Bakama for the committed support, guidance and directions towards the execution of this project work. I am so grateful to the management of Optima Mines and Minerals Ltd for support towards this work for allowing me use their laboratory for part of my tests. I appreciate my classmates for the team work and confidence built in me always. May the Almighty God bless the hands of whoever placed a hand on this good piece of work.

Great thanks to the department of mining and water resources for the guidance given to us through the execution of the project.

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Acronyms

AAS	Atomic Absorption Spectrometer
ASM	Artisanal and Small-scale mining/miners
ppt	precipitate
cm ³	cubic centimeters
ugs	Uganda shillings
USD	United States Dollar(s)

Symbols

NaOH	Sodium Hydroxide
H ₂ SO ₄	Sulphuric Acid
AgNO ₃	Silver Nitrate
HCl	Hydrochloric Acid
NaCN	Sodium Cyanide
Na[Au(CN) ₂]	Gold-Cyanide Complex
PI	Potassium Iodide
ACS	American Chemicals Society

CHAPTER ONE – INTRODUCTION

1.1 Background

Determination of the concentration of gold per ton of ore is a very important aspect that has to be attentively attended to. All mining and processing projects need this information available at hand before venturing into any investment. This will help to determine the capital and operating costs as well the cash flows from the project. In many occasions, some proponents have ventured into mining businesses without carrying out a proper ore/tailings evaluation. This eventually results into project failure and leaves many investors in losses. Once the quality of the ore is well established, all these challenges are overcome and this has been done in different ways by different technologies around the globe.

Several techniques and tools are being used and more improvements are available in order to ascertain the concentration of ore in grams per ton or otherwise (in other unit measurements like ounces and pounds). Globally, many tools such as handheld XRF analyzers, Atomic Absorption Spectrometry, Fire Assays, Free Gold Tests, stannous chloride color test and many more are being employed to determine the concentration of different ore minerals in ore samples. (Michaudi 2016)

Currently in Uganda, most CIC leaching plants can determine the presence of gold in tailings using color test method but cannot quantify the gold in grams per ton (g/t) that can be recoverable using these plants. The color test method gives results in terms of much gold, very little gold or no gold depending on the intensity of the colors and this does not establish the concentration of gold per ton in the tailings and ore. In other words, color test method is a rudimentary laboratory test that only helps to know whether there is gold in the ore or not. It does not actually give the grade of the ore.

In this context therefore using the knowledge from the existing other methods and the laboratory skills available, this study is aimed at developing a standard procedure that will help local miners establish the quality of gold ores they process before feeding them into the plants. The procedure will help do away with the much costs related to the use of AAS machines and yet provide results closely related to what these machines can give.

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