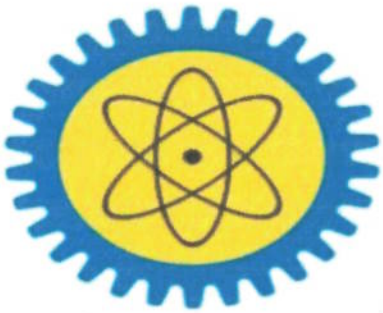

BUSITEMA UNIVERSITY

Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

ASSESSMENT OF THE RISKS OF EXPOSURE TO MERCURY USED IN GOLD MINING (CASE STUDY: KITUMBI-KAYONZA, MUBENDE).

BY

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REG. NO: BU/UG/2012/108

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ABSTRACT

Exposure to environmental toxins is a major contributing factor to the expected increase in chronic diseases within developing countries in the next 20 years. Due to its ubiquitous distribution and persistent nature, mercury (Hg) is an example of a toxic substance that has garnered global concern because of its known detrimental effects on human and ecosystemhealth.

The estimated daily intake (EDI) and the relative contribution of various sources of Hg to humans differ significantly between individuals, ethnic groups, and across continents. This thesis focuses on small scale gold mining as the major source of mercury exposure in Kitumbi-Kayonza, Mubende district. The project was completed based on the following tasks;

Firstly, operation owners and miners were involved in an interviewto obtain estimates of Hg used, gold obtained and Hg that was lost to the surroundings.

Secondly, a total number of sixteen (16) sediment samples (done in duplicates) were taken from tailings pond and processing areas in a mined out area in order to determine its vulnerability to becoming a mining hot spot. The area was then mapped using a GPS receiver in order to determine amount of area that has been mined out. These samples were taken to Auranda Minerals laboratory for analysis.

Thirdly, an exposure assessment model developed by D'Souza (2008) and Health Canada (2004) was used to identify the occupational sources of greatest concern for various age groups in Kitumbi-Kayonza, Mubende district.

The results show that in the course of a dry season, a total of 50,925g of gold is produced monthly and consequently 139,800g of Hg is lost to the surrounding. 83,925g of mercury lost per month are released as vapour. This is the quantity from which miners in Kitumbi-Kayonza are likely to be exposed via inhalation. 55,875g of mercury is released to tailings as free mercury and is likely to be methylated by bacteria and other organisms thereby accumulating within the food chain through plants and fish.

The sediment sampling results were very high in mercury concentration and were above the ERL value (0.15ppm). Subsequently, because of this mercury hotspots due to mining were found and delineated. The research area is considered to be contaminated as it relates to mercury contamination and is at a great risk. Highest absorbed doses due to exposure to mercury were realized when dealing with roasting where mercury is driven off from amalgam by heating.

DECLARATION

I Naulo Gilbert, 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 an academic award.

Gilbert

APPROVAL

This final research report has been submitted to the faculty of Engineering for examination with approval of my supervisor.

Mr. Mukiibi Ivan

Supervisor

Sign .....

DEDICATION

This report is dedicated to my beloved parents Mr. Naulo John and the late Ms. Katooko Jesca 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.

ACKNOWLEDGEMENT

My first and foremost gratitude is to GOD Almighty who has been with me all along giving me the strength to complete this project.

I would also like to acknowledge my deepest gratitude to my principal supervisors, Mr. Mukiibi Ivan and Dr. Jennifer Hinton for their guidance, constant attention, valuable suggestion, enthusiastic support and personal concern during the project. Furthermore, my appreciation also goes to my lab technicians; Mr. Mwesigye Daniel and Mr. Mukasa henry from Auranda minerals for their time, attention and guidance.

Special appreciation goes to my loving parents especially who brought me here, and have always on my side, riding along with me on my ups and downs as well as giving methe encouragement to pursue my dreams. I say a big thank you.

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AAS	Atomic Absorption spectrometry.
AD	Absorbed dose
AFS	Atomic Fluorescence Spectrometry
ASGM	Artisanal Small-scale Gold Mining.
ASM	Artisanal Small-scale Mining.
ATSDR	Agency for Toxic Substances and Disease Registry.
CVAAS	Cold Vapour Atomic Absorption spectrometry.
CVAFS	Cold Vapour Atomic Fluorescence Spectrometry
DMHg	Dimethylmercury.
EPA	Environmental Protection Agency.
ED	Exposed dose.
EDI	Estimated Daily Intake.
EF	Exposure factor.
GC	Gas Chromatography.
GPS	Global Positioning System
Hg^0	Elemental mercury.
HNO_3	Nitric acid.
HPLC	High Performance Liquid Chromatography.
HQ	Hazard Quotient
ICP-AES	Inductively coupled plasma–atomic emission spectroscopy
MeHg	Methylmercury.
MS	Mass Spectrometry.
NAA	Neutron Activation Analysis
ppb	Parts per billion.

ppm	Parts per million.
TDI	Tolerable Daily Intake
UNEP	United Nations Environmental Programme.
WHO	World Health Organization.
XRF	X-Ray Flourescenece.

SYMBOLS

Au	Gold
Al	Aluminium
Hg	mercury
Kg	Kilogram
µg/L	micrograms per litre.
Zn	Zinc

CHAPTER I

1.0 Introduction

This chapter briefly gives the general information relevant to the research whilst clearly showing the problem of interest for the intended research. It as well shows how this study will help reduce the problem through the fulfilment of a number of objectives listed therein.

1.1 Mubende gold district

Mubende District is in the Central region. It borders Mityana district in the East, Kiboga and Kyankwanzi in the North, Sembabule and Gomba in the South, Kyegegwa and Kibaale in the West. The district headquarters is located 160 Kilometres West of Kampala. It covers a total area of approximately 4,646 sq. kms (Mubende district local government, April 2011).

Mubende district has a tropical climate with moderate rainfall and temperature. The rainfall pattern is bi -modal with two seasons and the annual rainfall varying between 560 mm to 1,272 mm. The months of March to May and September to November receive very heavy and well-distributed rains of up to 1,200 mm. There are two dry seasons from June to July and December to February. This therefore, provides for two crop growing seasons. The high altitude ensures favorable climate with medium annual temperatures ranging from 17.2 degrees to 29 degrees centigrade (Mubende district local government, April 2011).

The regional geology consists of Buganda group meta-sedimentary and sedimentary rocks on gneiss basements. (Elepu et al, 2011b). These are intruded by arcuate dolerite dyke swarm. The figure 1 below shows location of Kitumbi-Kayonza within Mubende district.

CHAPTER VI

6.0 REFERENCES AND APPENDIX

6.1 REFERENCES

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