



FACULTY OF ENGINEERING

DEPARTMENT OF MINING ENGINEERING

**REDESIGN AND FABRICATION OF A SLUICE BOX FOR IMPROVED
PORTABILITY AND GOLD RECOVERY**

CASE STUDY: TIIRA GOLD MINE IN BUSIA

BY:

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*A final year project report submitted to the Department of mining Engineering as a partial
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ABSTRACT

The project addressed the critical inefficiencies in existing sluice box designs used by artisanal gold miners in the Tiira gold mines, Uganda. These inefficiencies included difficulties in feed and water delivery, suboptimal inclination angles and the use of materials that contributed to high mercury contamination, posing significant threats to both environmental health and miner well-being. To overcome these, the project aimed to redesign and fabricate a portable and efficient sluice box for artisanal gold miners in Tiira, Uganda, addressing inefficiencies in existing designs such as poor feed delivery, suboptimal inclination angles, and high mercury contamination.

The research focused on four specific objectives which included determination of optimal sluicing parameters for improved recovery efficiency, development of a portable and efficient sluice box design, fabricating and testing the new design to evaluate its performance then lastly performing financial analysis to which determined the economic viability of the project.

Through field surveys and laboratory analysis of ore samples, key sluicing parameters including slope angle, water flow rate, and feed rate were optimized using Response Surface Methodology (RSM) and Central Composite Design (CCD). The redesigned sluice box achieved a 20.1% increase in gold recovery (from 67.75% to 87.8%) by implementing an optimal slope angle of 13.5°, a sluice length of 1.3 m, and a width of 0.6 m. Sensitivity analysis revealed that slope angle contributed 40.65% to recovery efficiency, followed by velocity (22.76%) and flow rate (20.33%). Constructed from mild steel for durability and portability, the final prototype weighed 12.88 kg and featured foldable components for ease of transport. Financial analysis confirmed viability, with a 2.8-year payback period and a profitability index of 2.944. The project demonstrates that optimized sluice box designs can significantly enhance gold recovery while reducing environmental and health risks associated with mercury use in artisanal mining.

Future work should focus on material/rifle optimization for better performance and cost. Essential training for miners on optimal techniques and sustainable methods is crucial. Subsequent efforts must address scaling up the design for mass production and wider adoption.

Keywords: Sluice box, gold recovery, artisanal mining, optimization, portability, mercury reduction, Tiira mine, response surface methodology.

DECLARATION

I KUMIKI RADWAN SAID fully declare that the work presented in this research report is my own work except where due references are made. It has not been submitted before for any academic award to any institution of higher learning.

Signature.....

Date.....20TH...../.....MAY...../.....2025.....

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DEDICATION

I dedicate this report to my family specially my parents, siblings and relatives for the tireless efforts, advice, encouragement and all the necessary support during my academic journey. Not forgetting the lecturers and friends who have always been available and provided a shoulder to lean on in times of need for without them the journey would have been a very tough one.

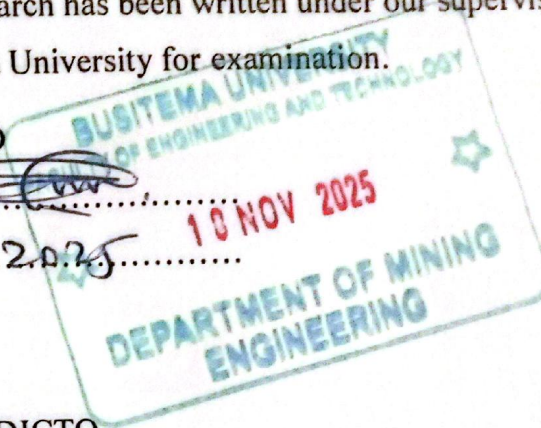
APPROVAL

I attest that the work reported in this research has been written under our supervision is presented to the Department of Mining at Busitema University for examination.

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LIST OF ABBREVIATIONS

et al.	And others (from Latin "et alii")
Fig.	Figure
m/s	Meters per second (unit of velocity)
cm	Centimeter (unit of length)
mm	Millimeter (unit of length)
m	Meter (unit of length) / mass (in equations)
kg	Kilogram (unit of mass)
kg/s	Kilograms per second (unit of feed rate)
m ³ /t	Cubic meters per tonne (unit of density for cassiterite)
Pa	Pascal (unit of pressure)
Ft	Feet (unit of length)
in	Inches (unit of length)
Sn	Tin (chemical symbol)
Ug.shs.	Ugandan Shillings (currency)
V	Velocity (in equations)
R	Hydraulic radius (in equations)
S	Bed slope / slope angle (in equations)
A	Cross section area of flow channel / Area (in equations)
n	Mannings coefficient
P	Wetted perimeter (in equations)
Q	Flow rate (in equations)

Fr	Feed rate (in equations)
C	Concentrate in Kg (in equations)
c	Concentrate grade (in equations)
F	Feed (in equations)
f	Feed grade (in equations)
N	Total number of experimental runs (in equations)
k	Number of independent variables (in equations)
n_c	Number of center points (in CCD experimental design)
Y	Predicted dependent variable (in RSM equations)
β_o	Constant coefficient (in RSM equations)
β_i	Linear coefficient (in RSM equations)
β_{ii}	Quadratic coefficient (in RSM equations)
β_{ij}	Interaction coefficient (in RSM equations)
RI	Reliability Index (in optimization equation)
UC	Uniformity Coefficient (in optimization equation)
W	Weight (in optimization equation)
C.R	Contribution Ratios
ρ	Density (Greek letter rho, in equations)
π	Pi (mathematical constant)
r	discount rate (in equations, context dependent)
h	Height (in equations)
C_t	Cash flows at a time, t in years (in NPV equation)

LIST OF ACRONYMS

ASM	Artisanal and Small-scale Miners
ASGM	Artisanal and Small-Scale Gold Mining
SDG	Sustainable Development Goal
RSM	Response Surface Methodology
CCD	Central Composite Design
RSO	Response Surface Optimization
CAD	Computer Aided Design
NPV	Net Present Value
IRR	Internal Rate of Return
PI	Profitability Index

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