

THE ANCIENT WAYS VS TECHNOLOGICAL DEVELOPMENT IN CUSTOM GOLD PROCESSING

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INTRODUCTION

- Gold recovery in free milling ores in custom milling plants depend on:
 - (1) Liberation due to grinding equipment being used.
 - (2) Gravity concentration unit .

BACKGROUND

- Custom gold processing in Zimbabwe is on the increase.
- About 100 milling plants have been installed over the past 4 years in Matabeleland.
- 90% of the plants are stamp mills
- Miners are used to the old technology and are stiff to change “tshaya fanike zulo”.

BACKGROUND

- Miners disregard changes in technology
- Geological and metallurgical complexities of the ore they deal with.
- Extraction efficiency is compromised for what has been known and “what they see”.
- There is TRUST in old inefficient technology to better modern methods.
- Miners shun ball mills e.g. Shamva Mining Centre (ITDG), Hope Fountain, Filabusi.

BACKGROUND

- Stamp mills used in Southern Africa from 1885-1904 in South Africa.
- First tube mill used on 9 May 1904 and marked advent of rod and ball mills.
- No new plants installed stamp mills since 1912 (Michell 1950).
- The exact reverse is true for Zimbabwean custom milling in gold.
- Are we 100yrs lagging on technology?.

OBJECTIVES

- Highlight recovery loss due to grindability limitations.
- Recovery loss due to gravity concentration circuits.
- Recovery loss due to mineralogical definitions.
- Recommend best practices for enhanced recoveries.

GRINDING

- Grinding is the process of reducing the particle size of the ore after crushing to liberate the mineral of value.
- Grinding fineness or size varies with plant type whether stamp mill or ball mill.
- Extent of grind determines degree of liberation hence mineral recovery.
- Mineral particle size determines fineness of grind for an optimized operation.
- Grindability depends on the hardness of ore.

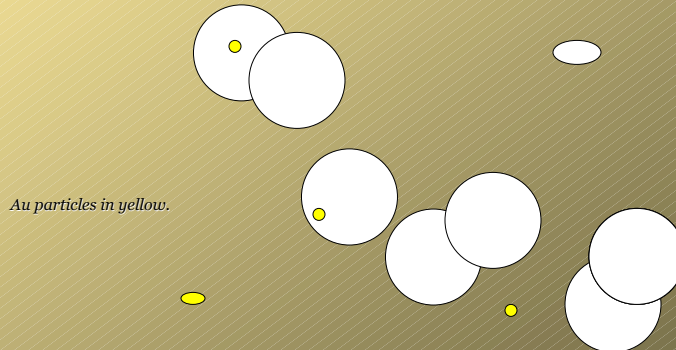
STAMP MILL

- Crushing & grinding done much by vertical impact and bit by particle attrition.
- Fineness of grind affected by mesh size
- Generally achieves a coarse grind
- Finer grind reduces throughput, increases milling hours, high energy costs.
- Good for coarse gold.
- Good for soft rocks.
- Liberation efficiency between 45-60%

STAMP MILL

- EFFECT OF COARSE GRINDING
- Gold still remains unliberated

Fig 1: Coarse milled ore with some unliberated gold.



BALL MILL

- Produces finer grind due to attrition between particles and steel balls
- Suitable for hard ore
- Suitable for both coarse and fine gold due to high degree of liberation.
- Liberation efficiency of 80-85%
- Higher throughput and quite , saves on milling hours.

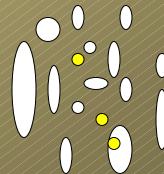
BALL MILL

- EFFECT OF FINE GRINDING/MILLING
- Most of the gold liberated during milling.
- High recoveries.

◦ Fig 2: Fine milling showing some liberated fine gold.



◦ Gold particles in yellow



“TSHAYA FANIKE ZULO”

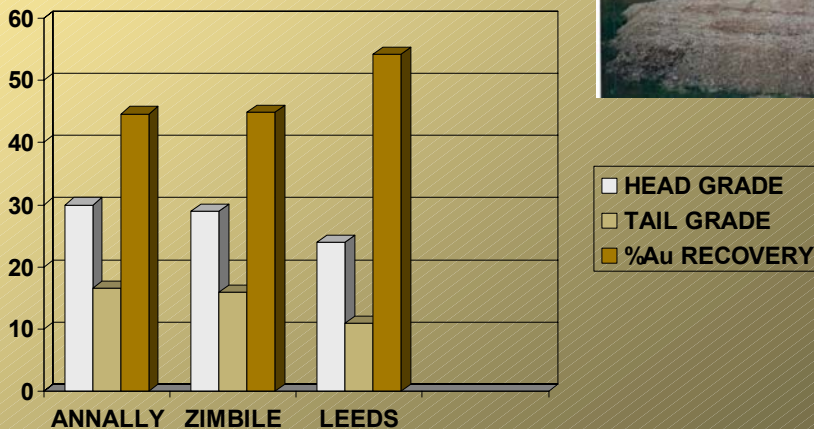
- Despite proven advantages of the ball mill, miners have a conceptual problem.
- Ball mills are closed vessels and they cannot see what is inside.
- Stamp mills are open.
- But does uninformed Trust bring economic results?.
- Who benefits?.

WHO BENEFITS?

- Does being able to clean the mortar box liberate more gold?.
- The miner loses because he wants to clean what is already his!!!
- More gold is left in the sands to benefit the mill owner.
- Has a miner ever wondered why millers would prefer to mill their own ore on ball mills with concentrators!!.

WHO BENEFITS?

FIG 3: Comparisons of head, tail grades and recoveries in different mines from a stamp mill.



WHO BENEFITS?

- REVENUE ANALYSIS
- Tonnes milled =5t
- Ore head grade 10g/t
- Stamp mill recovery 50%
- Ball mill recovery 80%
- Gold recovered stamp mill=25 grams
- Gold recovered ball mill=40grams
- Loss in revenue= \$2900 000,00
- Also loss in longer milling hours.



GRAVITY CONCENTRATION

- The separation of one mineral species from another by methods based on difference in relative density between the two. (Stanly 1987).
- Enhances recovery of the liberated gold.
- Different types in use and depend on TRUST.
- Range in age and efficiencies.
- Miners ignore mineralogical aspects i.e fine or coarse gold and technological advances in gravity concentration.

CONCENTRATORS

- Skin hides (used as early as 4000BC).
- Copper plates
- Corduroy/blanket /sisal strakes
- Rubber strakes
- James table
- Shaking tables
- Centrifugal concentrator



COPPER PLATES

- Pulp from mill passed over mercury coated plate.
- Length between 1.5 -4.5m depending on particle size of gold.
- Coarse gold, a short table will suffice
- Fine gold, up to 3m table required.
- Average slope of 18°
- Finely crushed ore require more water and less grade.

COPPER PLATES

● ADVANTAGES

- Slightly higher recovery than corduroy strakes.
- Good for fine gold as amalgamation depends on alloying properties rather than density.

● DISADVANTAGES

- Not suitable for coarser grind.
- Steep angle makes fine gold fly away.
- Mercury poisoning for operators.

CORDUROY/BLANKETS

- Layer of corduroy, blanket or sisal on inclined table, gold trapped in riffles.
- Carpets, towels and hides in the category.
- Recovery depends on flow rate of pulp.
 - Quantity of solids
 - Pulp moisture content
 - Slope of table
 - Effective width of table

CORDUROY/BLANKETS

● ADVANTAGES

- Good to collect coarser gold

● DISADVANTAGES

- Fine gold recovery less than copper plate.
- Labor intensive to wash the cloths
- Efficiency decreases if not changed rapidly

ANCIENT TECHNOLOGY

- Very difficult for a common agreement on the best method.
- Filabusi, blankets and mats widely used.
- Inyathi, copper plates used.
- Gwanda, blankets, mats
- Esigodini, blankets
- Hope fountain, copper plates, rubbers.

CENTRIFUGAL CONCENTRATORS

- Are of cylindrical shape,
- Consists of different types of shapes of settling chambers and manner undersize is extracted.
- Lined with corrugated rubber sheeting and has rotational motion.
- Pulp passes through cylinder and collects in ribbed surface.
- Very high recoveries for fine gold and nuggets.
- Recovery range 85-98%

CENTRIFUGAL CONCENTRATORS

- Higher throughput achievable
- Improved recovery of liberated & occluded gold.
- For more technical & economic efficiency

RECOMMENDATIONS

- Small scale sector to adopt better technology for enhanced recoveries.
- Financial resources to be put towards better processing technology.
- Ministry of Mines to ensure compliance with regulations S.I 329.
- Rigorous awareness campaigns to educate the miners with demonstrations, sampling tailings.

RECOMMENDATIONS

- It can be made law that all new plants should be ball mills with concentrators.
- Best practice circuits
 - Crusher
 - Ball mill
 - Concentrator
- Other
 - Crusher
 - Stamp mill
 - Concentrator

WHO BENEFITS?

