Occurrence and Effect of Microbes on the Flotation Efficiency of PGMs: UG2 Ore

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3. Aim
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6. Conclusion
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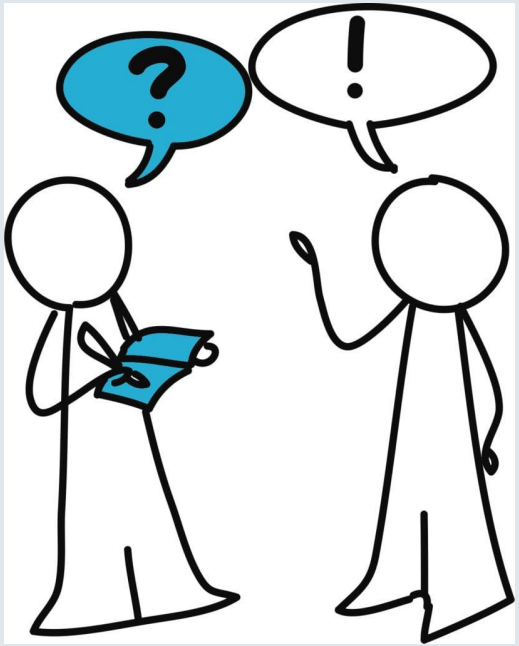
Background

- South Africa is a **water-scarce** country, and the mining sector is under pressure to **reduce freshwater use**.
- Recycling process water and using treated sewage water are common strategies in various mine operations, including concentrators.
- However, these water sources are **suspected** to introduce **microbial communities** that may alter mineral surface chemistry, reagent efficiency, and froth stability.
- Limited studies have examined the role of microbes in PGM flotation systems, highlighting a **critical knowledge gap**.

A du Plessis *et. al.,* 2017; Kinnunen *et. al.,* 2021; Ibekwe *et. al., 2018;*

Problem Statement

The **presence** and **accumulation of microbial communities** have the potential to negatively affect the **flotation performance** of PGM-bearing ores. Yet, their specific impacts and mitigation strategies remain **poorly understood**.



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Justification

Mining	Mining houses report reduced recoveries when using treated sewage water but lack scientific evidence and solutions.
Understanding	Understanding microbe–mineral–reagent interactions is essential to optimise flotation efficiency and ensure water sustainability.
Development	Developing targeted disinfection technologies offers potential for innovation, commercialisation, and environmental benefits through reduced freshwater demand.

Aim

Systematically characterise and develop mitigation strategies for the occurrence and subsequent effects of microbial communities on the flotation of PGM-bearing ores.

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Objectives

1. Evaluate and characterise the presence of microbial communities in the UG2 ore and process waters.

2. Assess the effect of dominant microbes on flotation performance to identify beneficial and detrimental species.

3. Determine threshold microbial populations that influence PGM recovery.

4. Evaluate chemical and physical disinfection technologies (Ozonation, UV, filtration, DAF).

5. Integrate the best-performing disinfection technology into existing flowsheets for improved process performance.

Methodology

1. Sample Collection:

- Feed ore was collected using a 1m sample cutter on various sections of the mill feed belt
- Slurry and water samples were collected using 2 L sample cutters with a 5 cm slit opening

2. Sample Preparation:

- Feed ore, Slurry and water for microbial assay
- Slurries were filtered and dried (solids and water kept)
- Feed ore was air dried, crushed to -1.7 µm and split

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Methodology

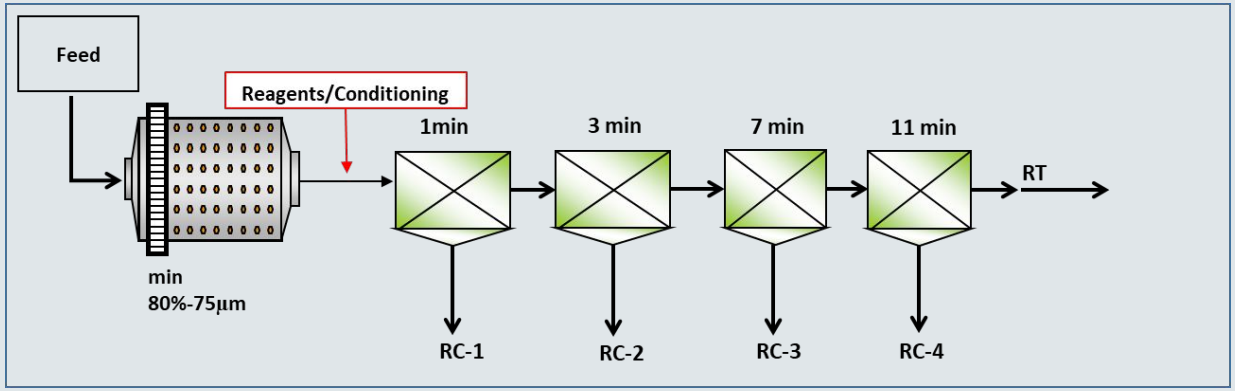
3. Microbial Assay (Detachment and pH/Redox Measurements)

- Suspend ore in 1mL of media containing 0.4% (v/v) Tween 20
- Vortex at high speed and transfer into an empty Eppendorf tube
- Dilute the solution appropriately, if necessary, before conducting cell counts

4. Flotation

- 3E and metal oxide analysis
- Milling curve conducted
- Baseline tests using tap water and various test conditions

Methodology



UG2-A				
Test#	**SIBX dosage**	**CMC dosage**	**Senfroth522 dosage**	**DOW400 dosage**
01	150	100	90	0
02	250	100	90	0
03	250	100	120	0
04	250	100	0	90
05	250	100	0	120
UG2-B				
06	200	100	90	0
07	250	100	120	0
08	200	100	0	60
09	250	100	0	90
10	250	100	0	120

1% solution strength and Dosage in g/t

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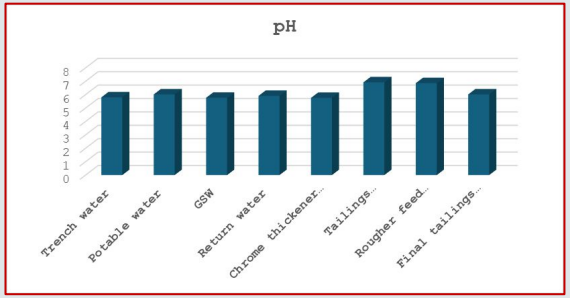
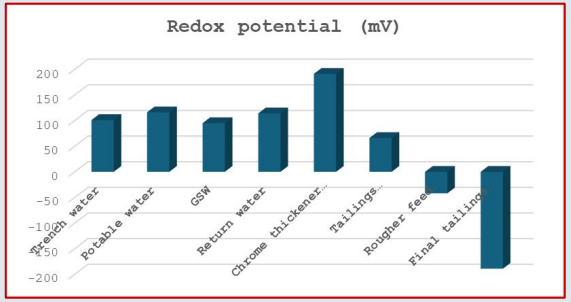
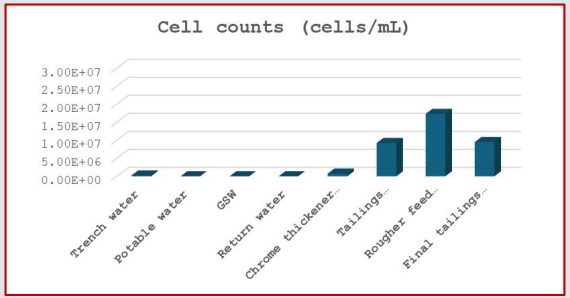
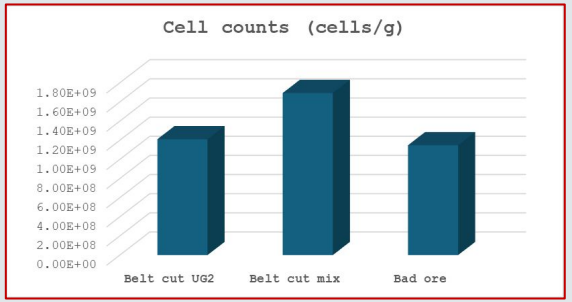
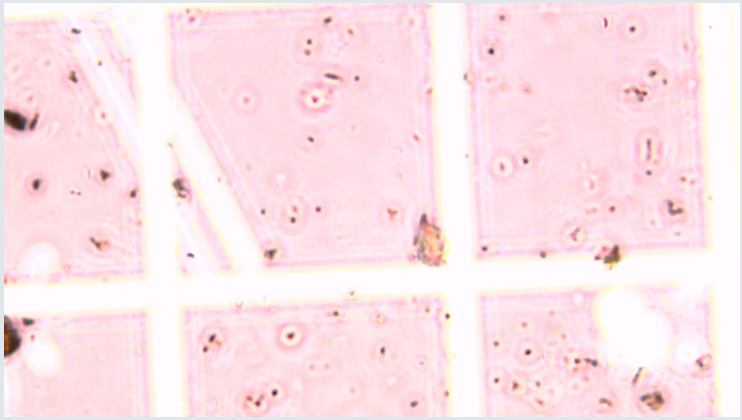
Results and Discussion - Microbial Analysis (Cell Counts)











Microbial view under the microscope

- Note that there is no treated sewage water, due to the lack of accessible sampling points

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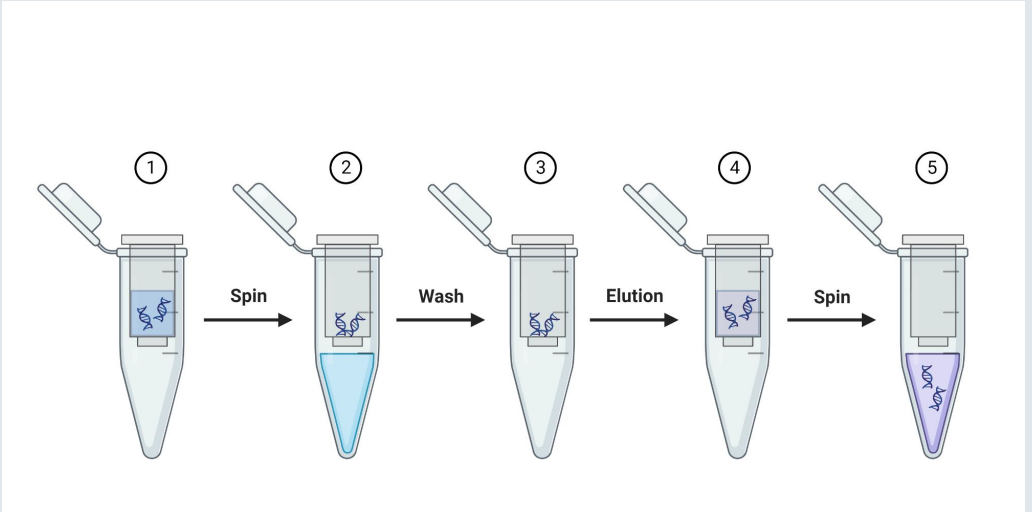
Results and Discussion - Microbial Analysis (DNA Extraction)

- A good quality DNA sample should have a A260/A280 ratio of 1.7-2.0.
- Lower A260/A280 ratios indicate that the sample is contaminated by residual phenol, guanidine, or other reagents used in the extraction protocol.

Sample	Concentration (ng/µL)	260/280 ratio
UG2-A	18.50	1.94
UG2-B	22.00	1.80
Rougher feed	26.75	1.80
Final tailings	38.28	1.81



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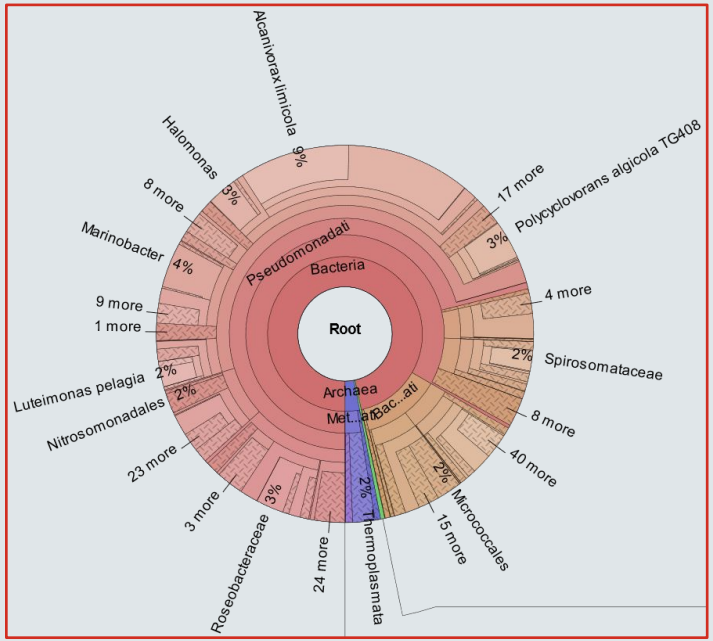
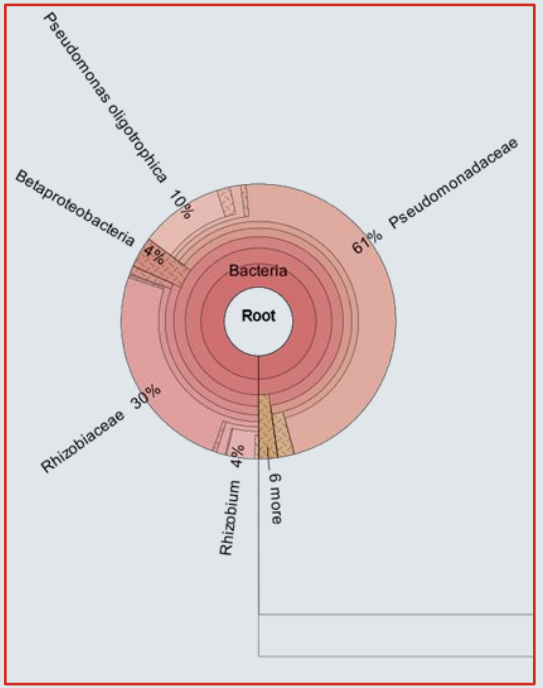
Results and Discussion - Microbial Analysis (Speciation)

UG2 B



Rougher feed

Final tailings



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Consegrua *et al.,* 2020; Consegrua *et al.,* 2020; Green *et al.,* 2015; França *et al.,* 2015

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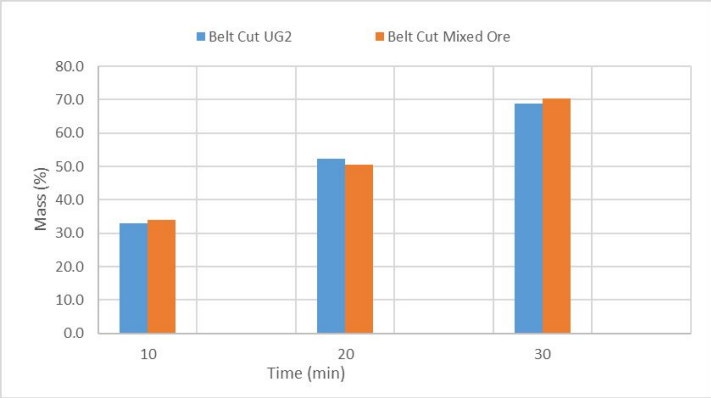
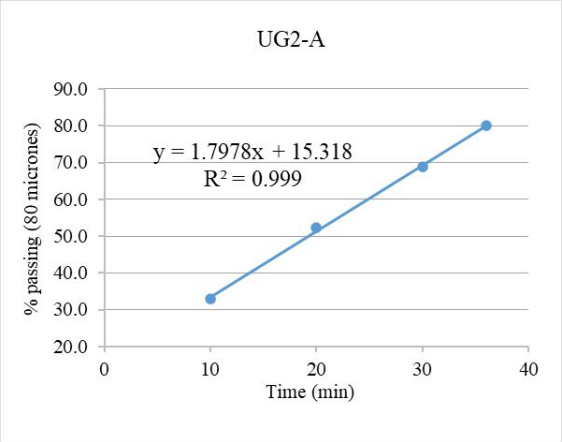
Results and Discussion – Head Assay

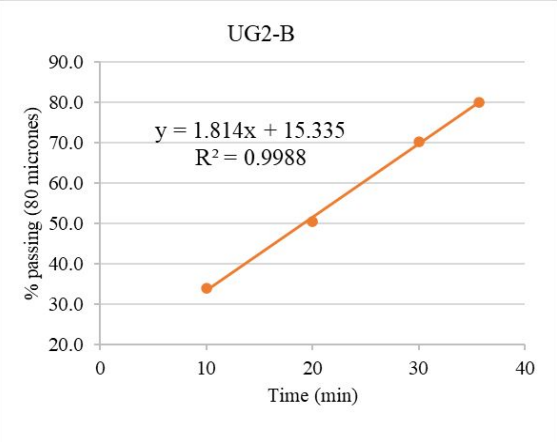
Sample ID	Mass (g)	Grade									
		Pt	Pd	Au	3E	Cr_2O_3	Al_2O_3	CaO	Fe_2O_3	MgO	SiO_2
		ppm	ppm	ppm	ppm	%	%	%	%	%	%
UG2-A	500	2.67	1.26	0.03	3.96	23.90	9.76	2.33	22.10	16.70	24.20
UG2-B	500	2.26	1.14	0.02	3.42	20.90	8.90	2.48	21.40	18.40	28.70
Rougher feed	500	2.26	1.16	0.03	3.44	19.90	8.76	2.48	20.10	17.65	28.00
Final tailings	500	0.49	0.30	0.02	0.81	20.05	9.07	2.54	20.15	17.40	28.05

Results and Discussion – Milling Curve

Belt Cut UG2-A			
Time (min)	Screen size (µm)	Mass (g)	%
10	-75	329.7	32.8
	+75	674.1	
20	-75	526.5	52.2
	+75	482.5	
30	-75	698.9	68.8
	+75	317.0	
36			80.04







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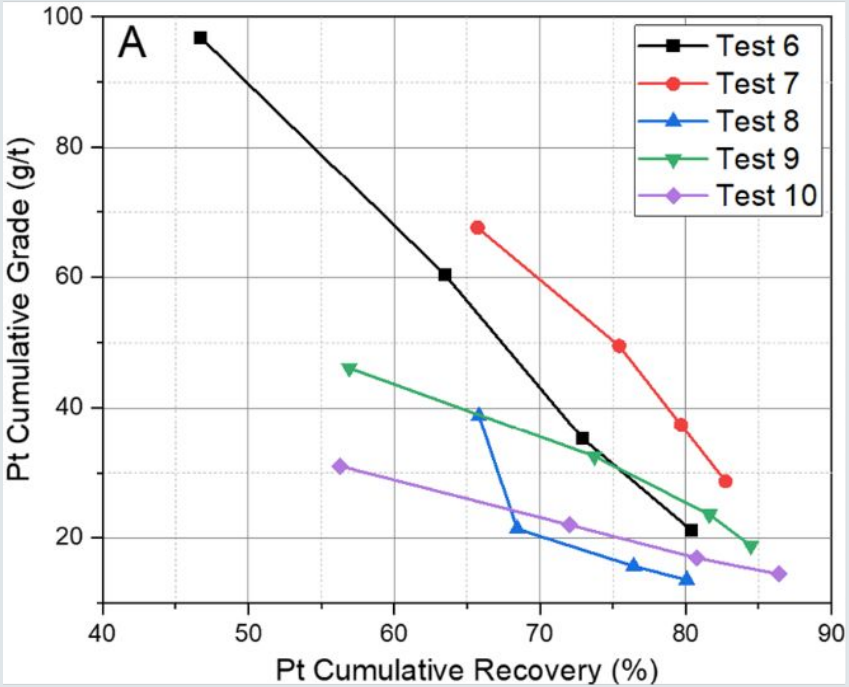
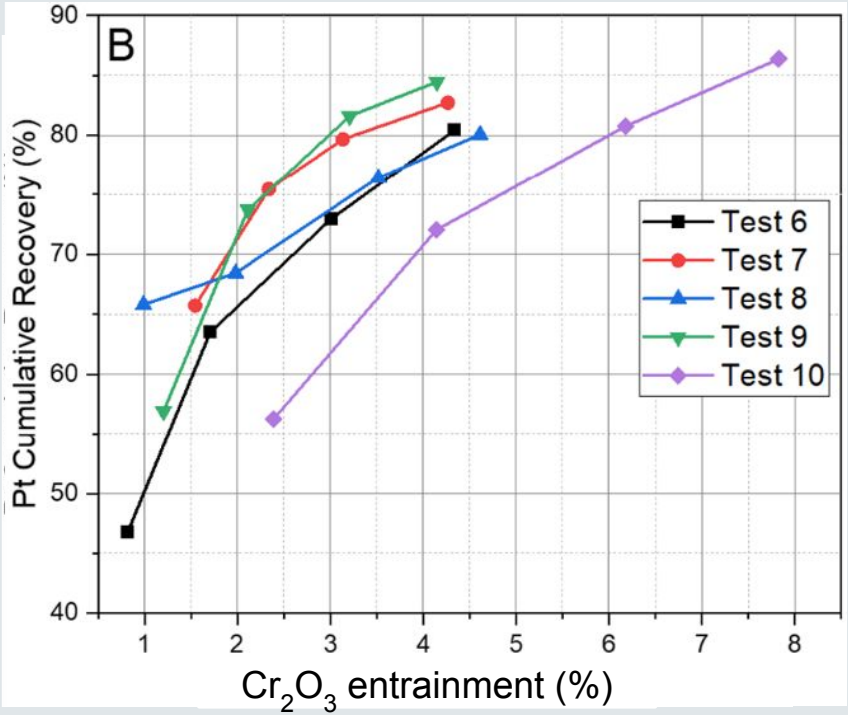
Results and Discussion – Flotation

Head	Pt	Cr2O3
	2.26 ppm	20.90%

UG2 - B										
	%		ppm			%				
TEST #	RC1 mass Pull	tRC Mass Pull	Calc. Pt Head	tRC Pt Grade	RT Pt Grade	tRC Pt Recovery	Calc. Head Cr_2O_3	tRC Cr_2O_3 Grade	RT Cr_2O_3 Grade	tRC Cr_2O_3 Entrainment
6	1.24	9.8	2.58	21.15	0.56	80.4	22.44	9.93	23.8	4.33
7	2.18	6.48	2.25	28.7	0.42	82.73	22.08	14.54	22.6	4.27
8	3.38	11.76	1.99	13.56	0.45	80.07	21	8.23	22.7	4.61
9	3.1	11.27	2.51	18.83	0.44	84.46	25.46	9.36	27.5	4.15
10	4.96	16.33	2.73	14.47	0.45	86.38	18.43	8.84	20.3	7.83

Results and Discussion – Flotation





UG2-B: : (A) Pt recovery vs grade and (B) Cr_2O_3 entrainment vs Pt recovery.

Conclusion

- Current water does not play a role in microbes occurrence.
- Feed ore is the main source of microbes.
- Microbes survive through the flotation process as they have been detected in the tailings samples.
- Speciation indicated a wide range of microbial species with different properties and functions – Microbes are most likely feeding on ore minerals and reagents
- Flotation has been optimised with good Pt recovery and grade, low concentration of Cr_2O_3 in the RC in UG2

Ongoing Work

1. Microbial assay, head assay and flotation optimisation of samples collected in summer
2. Plant water flotation tests
3. Introduction of microbes and concentration threshold optimisation
4. Development of mitigation strategy (should there be detrimental effects observed)
5. Only UG2 Ore will be used for future test.

“We are not a team because we work together, we are a team because teamwork leads to wonderful achievements”

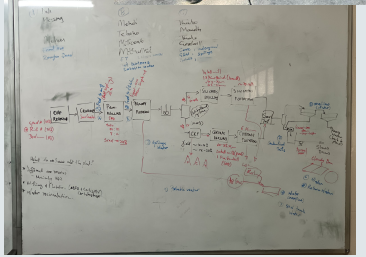
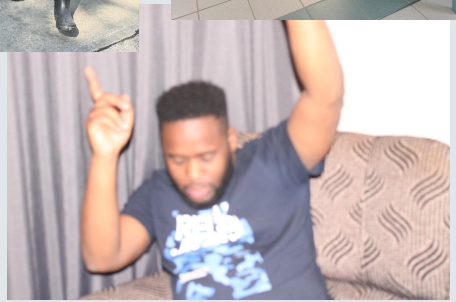










Xandla xi na matimba ku tlula rintiho – Tsonga Proverb

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