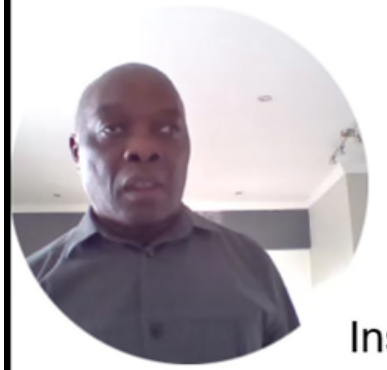
# Hybrid treatment of acid mine drainage using a combination of MgO-NPs and a series of constructed wetland planted with *Vetiveria zizanioides*

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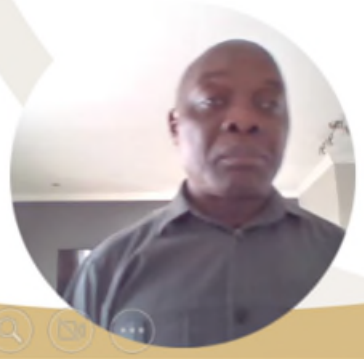
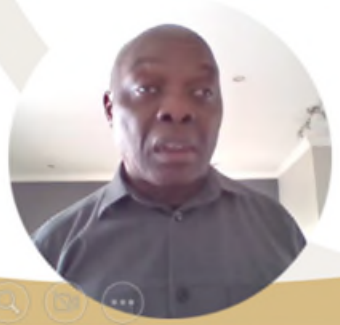
# Introduction



# Introduction

In South Africa, AMD is mostly prevalent in Gauteng Province (gold fields); Kwa Zulu Natal and Mpumalanga (coal fields); Northern Cape and Free State Province (gold/base metals)



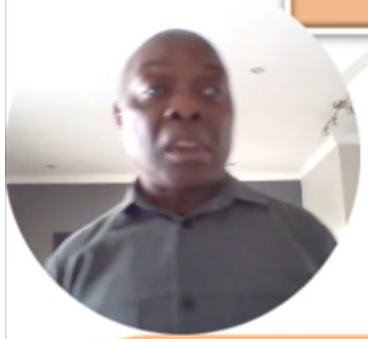
# Introduction

AMD pollutes water resources due to elevated salt and metal loads, destructive to environment and socio-economic development.

# Problem Statement

1. Huge volumes (≈ 202 ML/day) of AMD generated by actives and abandoned mines in SA
2. Deterioration of water quality
3. Degradation of soil quality due to corrosion
4. Risk of cancer due to the release of radioactivity substance

# Aims and Objectives



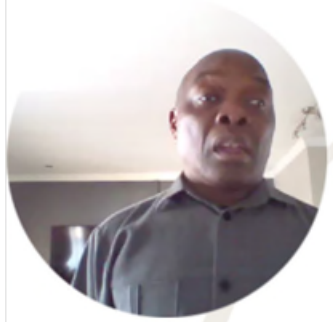
**Aim**

To evaluate the combination of neutralization using MgO-NPs and a bioremediation using a series of constructed wetland planted with *Vetiveria zizanioides* for the treatment of AMD.

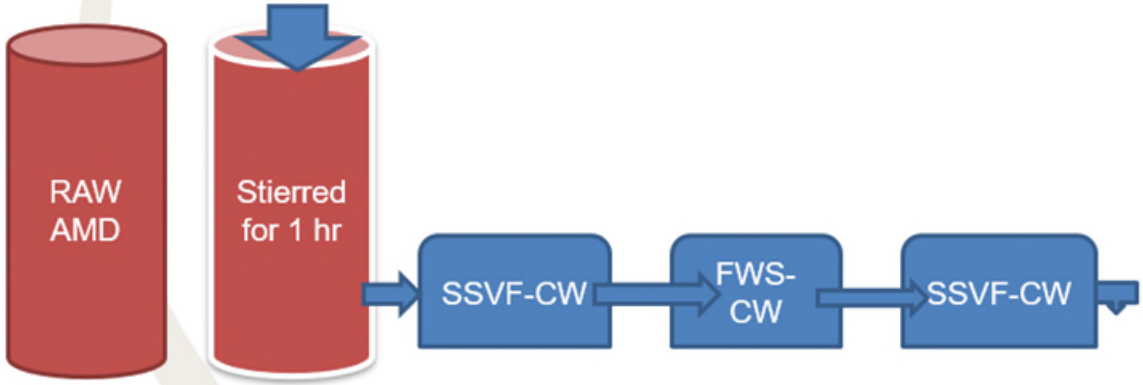
**Objectives**

- To characterisation of Feed and treated AMD water.
- To characterise the MgO-NPs, wetland substrate and plant roots using XRD and FTIR before and after contact with AMD

# Methodology



- Addition of MgO-NPs




Neutralization (step1) Bioremediation with constructed wetland (step 2)
30 days retention time

Characterization of MgO-NPs, substrate and roots using XRD and FTIR analysis. Aqueous samples ICP-OES for metals and IC for ions sulphate

**Fig 1: Schematic illustration of the hybrid system**

# Results

## CHARACTERISATION

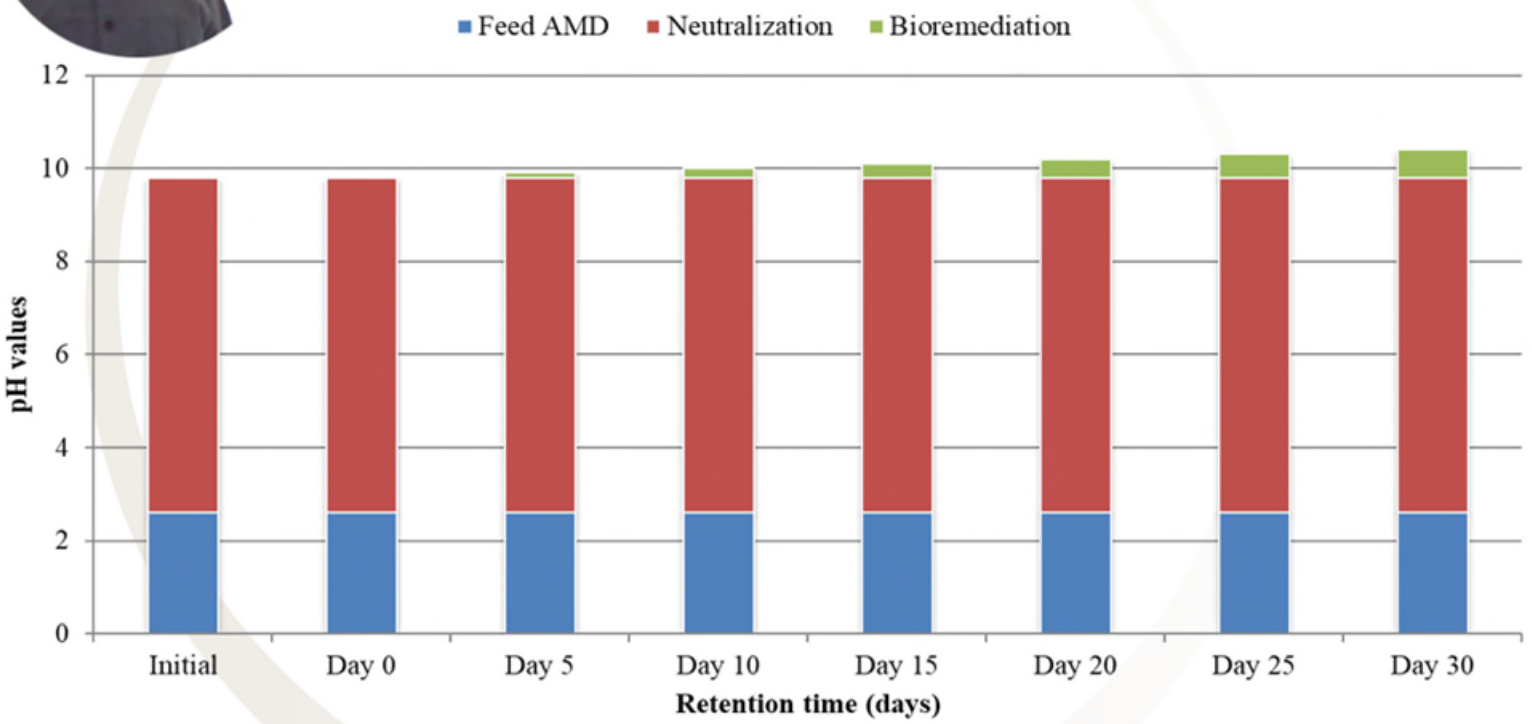
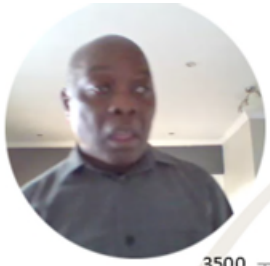



Fig 2: Variation in pH as a function of neutralisation with MgO-NPs and bio-remediation using a series of CWs planted with *Vetiveria zizanioides*



# Results Cont'd

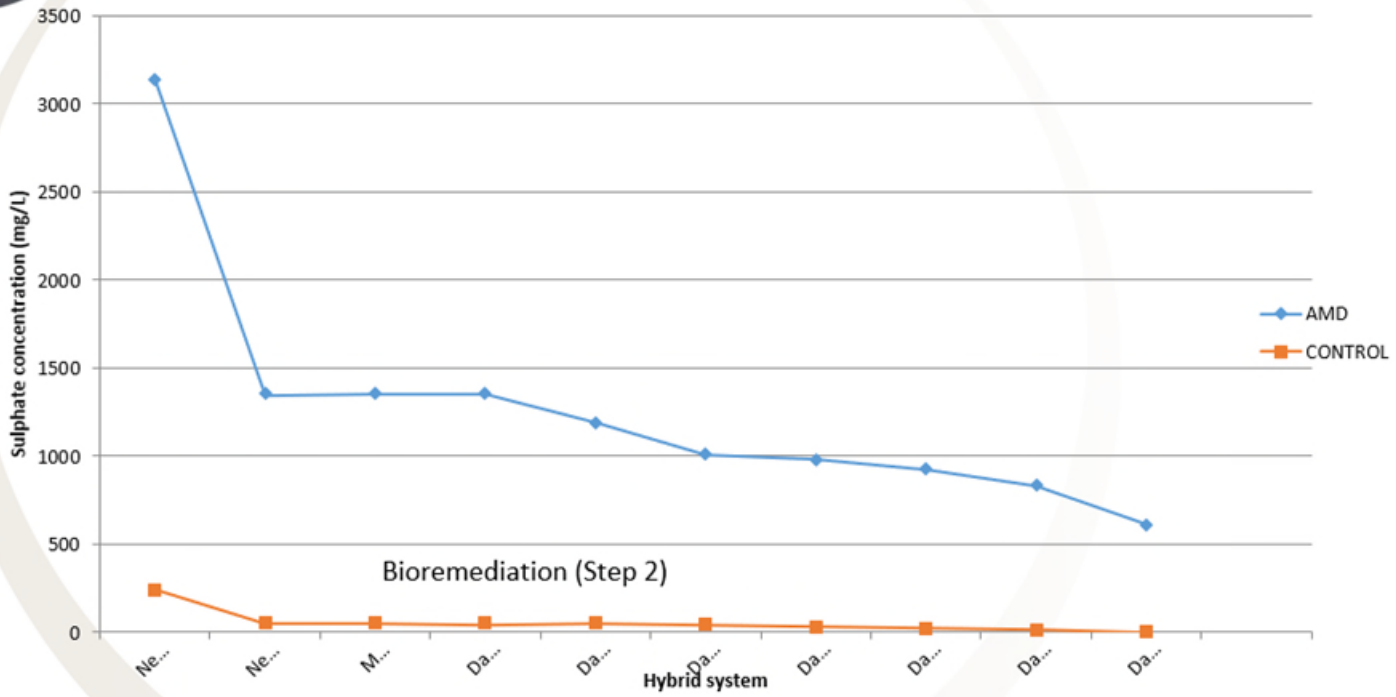
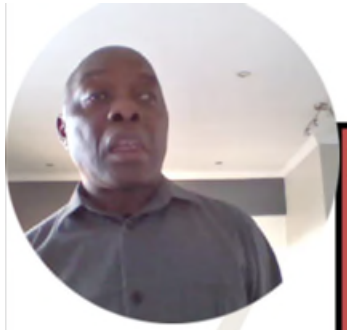



**Fig 3: Variation in sulphate concentration as a function of neutralisation and bio-remediation.**



# Results Cont'd

| Parameters | Feed AMD | Treated AMD | Removal efficiency | DEA guidelines for effluent discharge | DWS guidelines for drinking water |
|---|---|---|---|---|---|
| **pH** | 2.6 | 10.4 | 8.8 (increment) | 6-12 | 5.5-9.7 |
| **Al** | 158 | 0.71 | 99.5 | 20 | 0-0.9 |
| **Cu** | 4.2 | 0.11 | 97.59 | 20 | 0.1 |
| **Fe** | 341 | 0.66 | 99.80 | 50 | 0-0.1 |
| **Mn** | 37 | 0.28 | 99.24 | 20 | 0-0.05 |
| **Ni** | 3.92 | 0.09 | 97.3 | 10 | 0-0.07 |
| **Zn** | 8.55 | 0.14 | 98.36 | 20 | 0-0.5 |
| **Sulphate** | 3137 | 608.7 | 80.59 | 250-500 | 0-500 |

# Results Cont'd

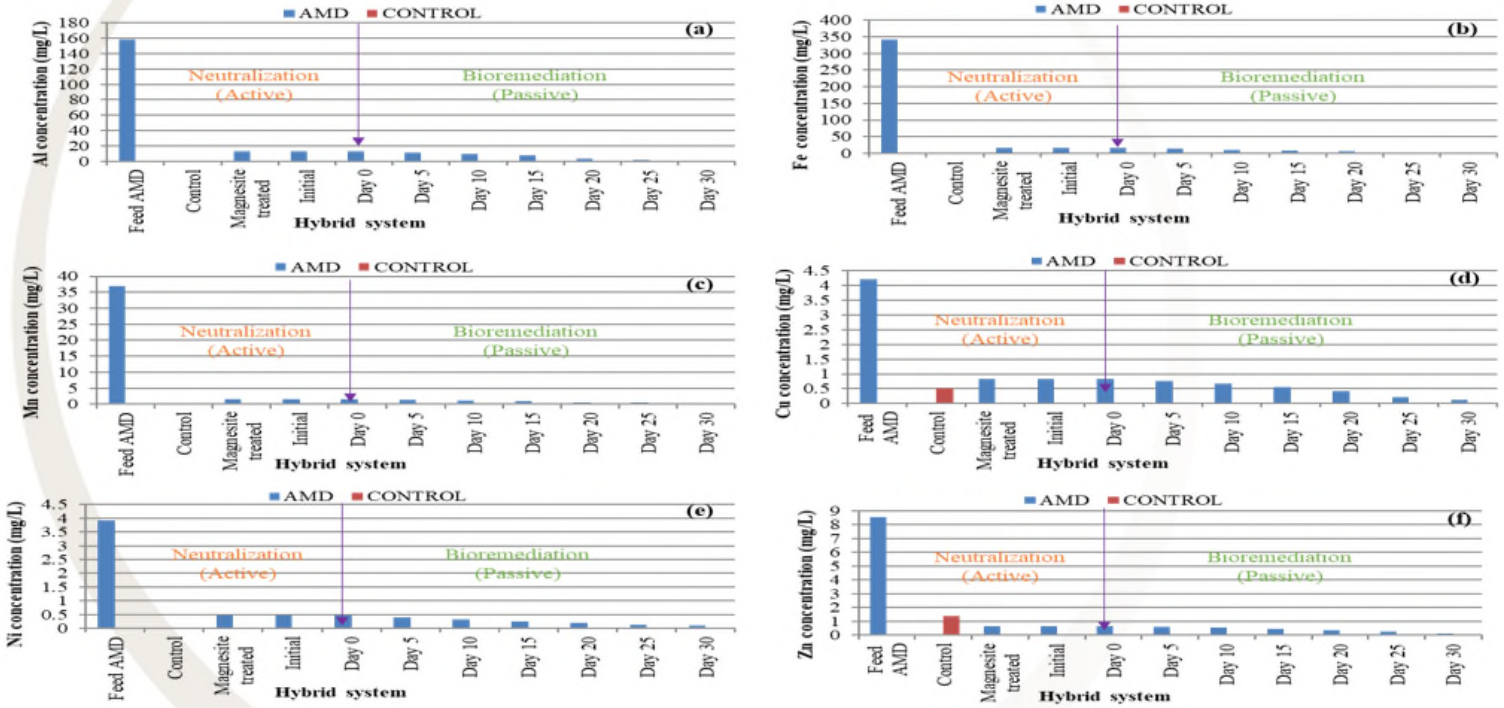



**Fig 4 (a-f): Variation in metals level as a function of neutralisation and bio-remediation**

# Results Cont'd

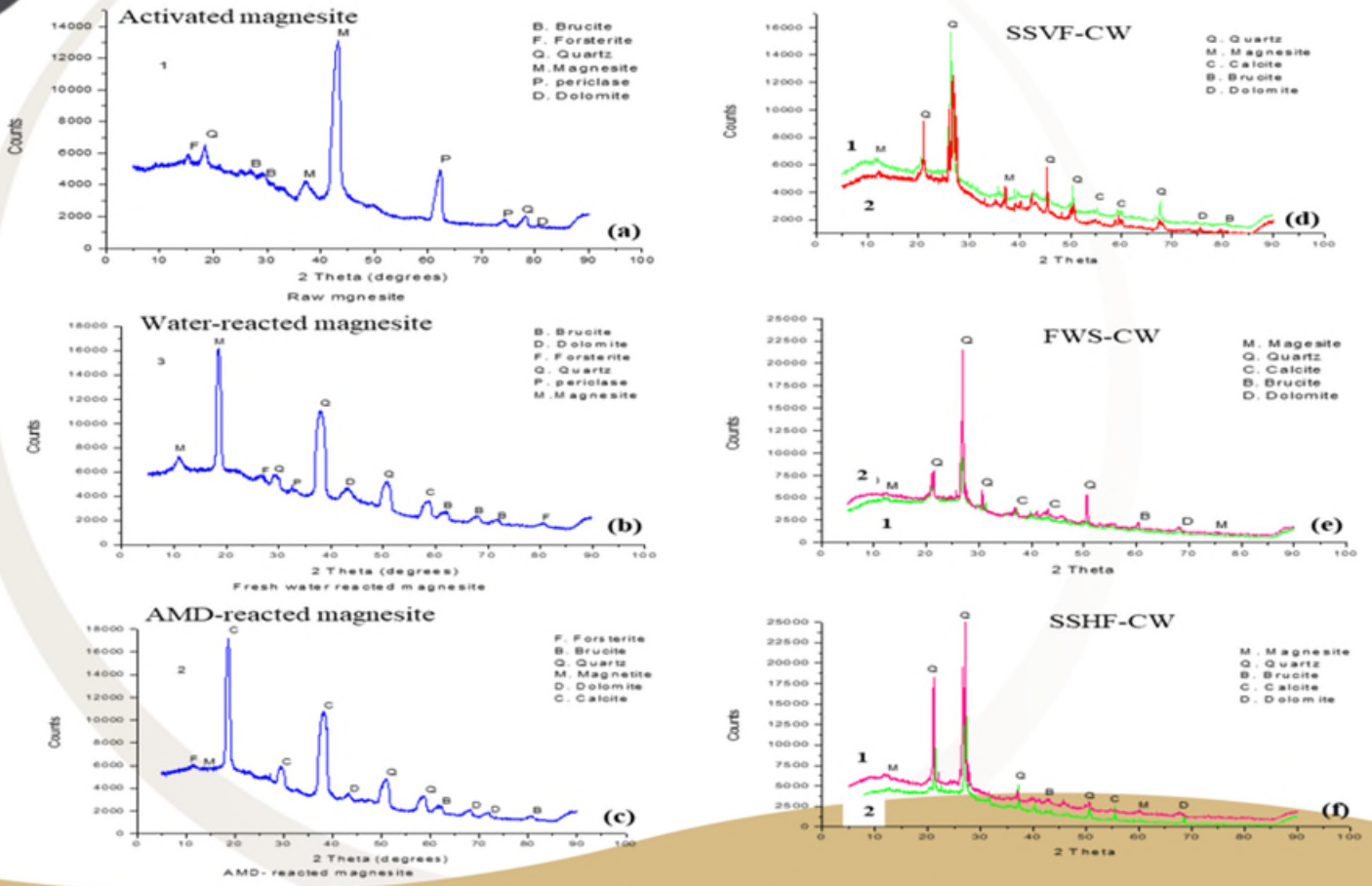
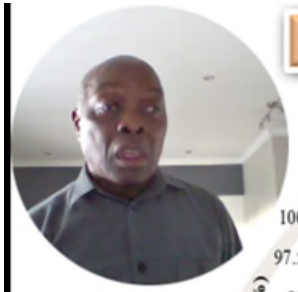
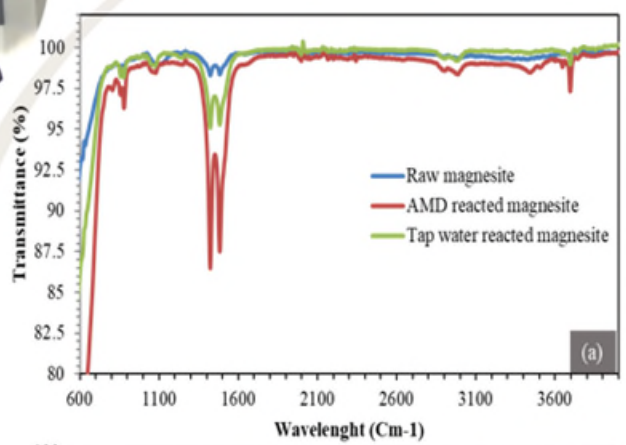
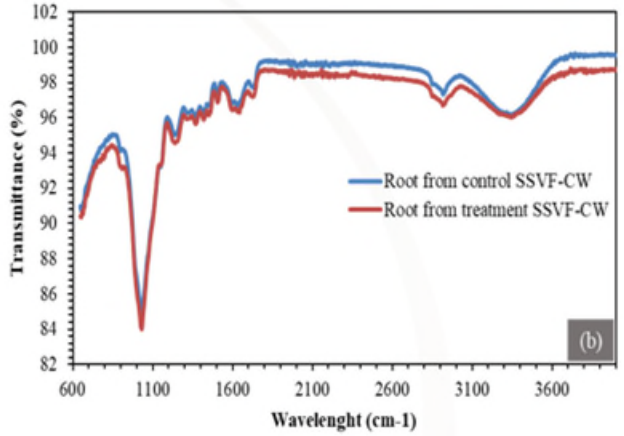


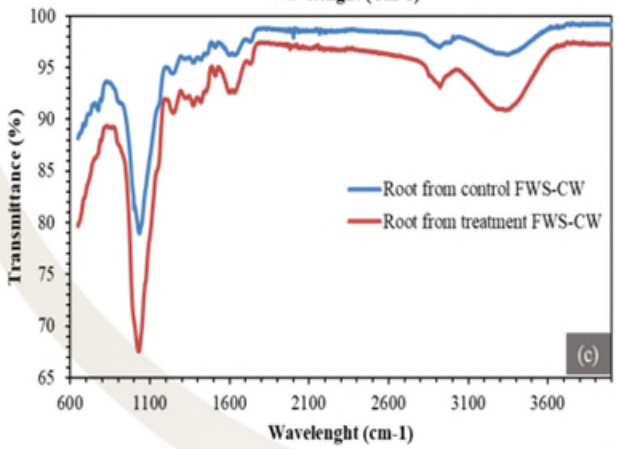

Figure 5 (a-f): XRD patterns of feed and product materials.



# Results Cont'd



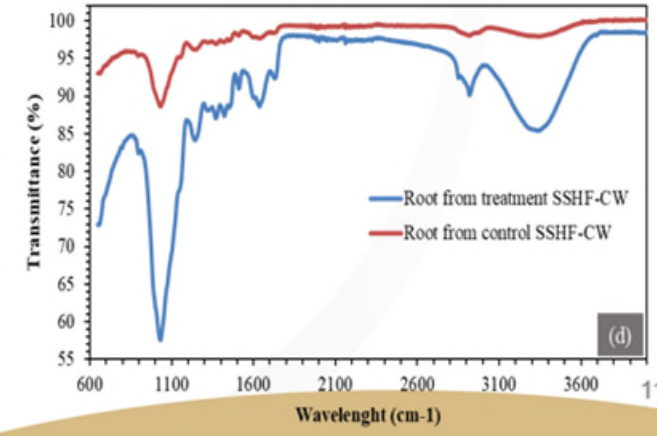
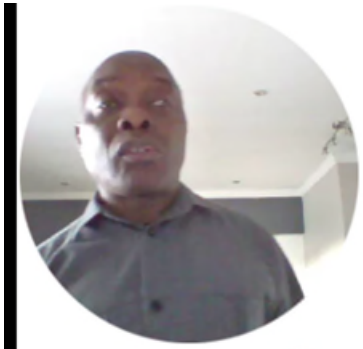






Fig 6 (a-d): Metal functional groups for raw and reacted magnesite and roots.

# Conclusion

This study successfully confirmed that the combination of MgO-NPs and a series of CWs planted with *Vetiveria zizanioides* was efficient to treat AMD removing close to 96,05% of toxic chemical species.



# Acknowledgements

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