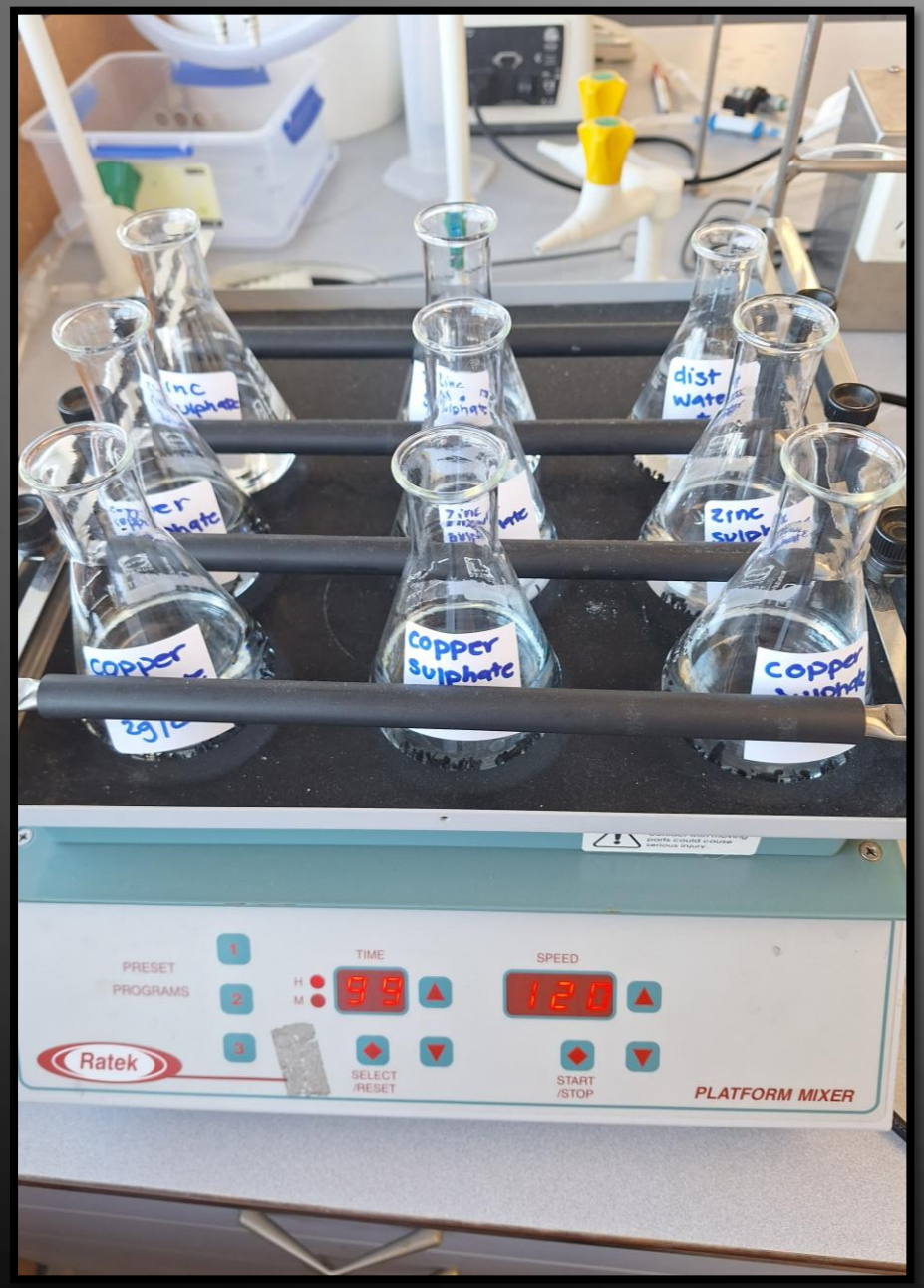
BIOCHAR ADSORPTION FOR HEAVY METAL REMOVAL FROM WATER

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THE PROJECT

- Engineering problem
- Reactor Modification
- Adsorption Removal testing

HEAVY METALS IN MINING WASTEWATER

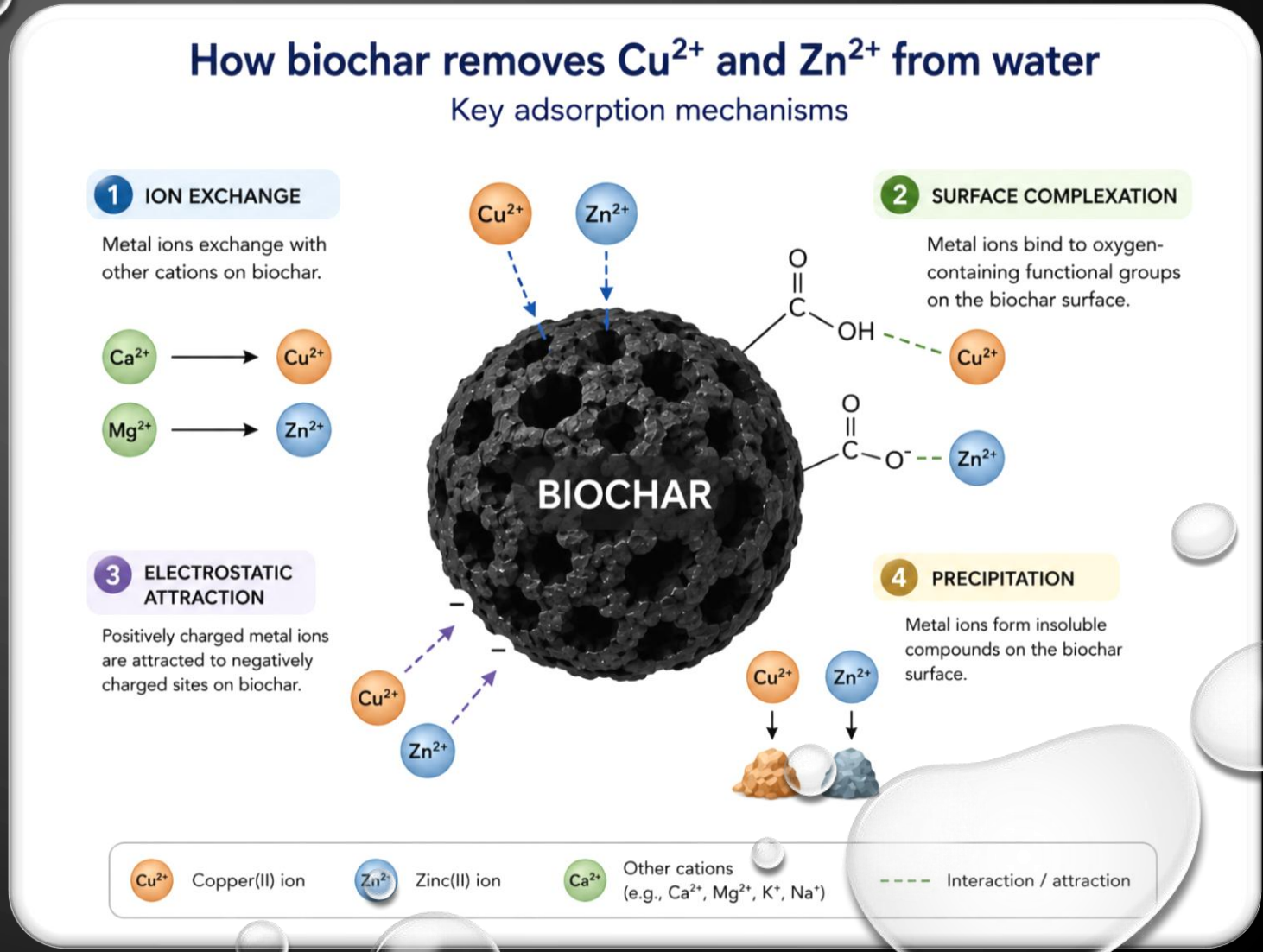
- DISSOLVED METALS IN MINE-IMPACTED WATERS
  - COPPER AND ZINC
- MANAGEMENT BEFORE DISCHARGE
- CONVENTIONAL TREATMENT METHODS
  - REQUIRES CHEMICALS, ENERGY, ONGOING OPERATIONS
- MACRAES PASSIVE WATER TREATMENT TRIAL



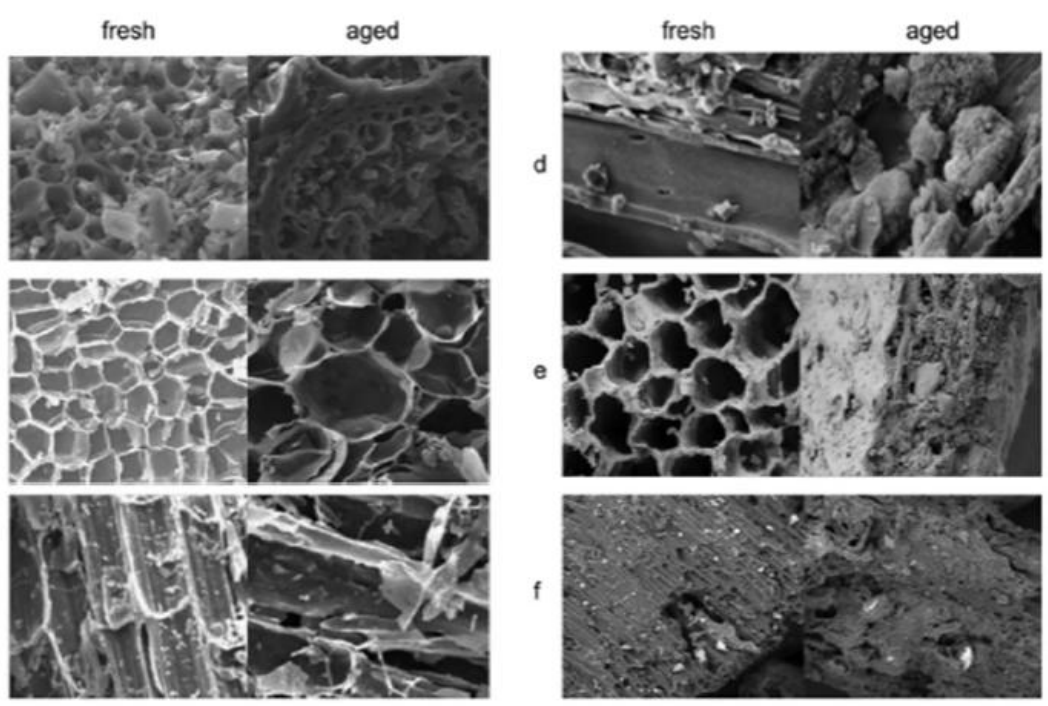
CAN BIOCHAR PROVIDE A PRACTICAL ADSORBENT FOR HEAVY METALS IN MINE WATER?

ADSORBENT MECHANICS

- HEAVY METAL ADSORPTION
- REMOVAL RATE PREDICTED
  - 70 – 95% COPPER REMOVAL
  - 80 – 90% ZINC REMOVAL
- BIOCHAR EQUALIBRIUM AND REMOVAL CAPACITY
- REMOVAL STRATEGY



BIOCHAR AS AN ADSORBENT



BIOCHAR	ACTIVATED CARBON
↓ TEMPERATURE AND OXYGEN PROCESSING	↑ TEMPERATURE WITH REACTIVE CHEMICAL PROCESSING
↓ SURFACE AREA WITH LARGE PORES	↑ SURFACE AREA WITH WITH ULTRA-FINE PORES
↓ COSTS AND SUSTAINABLE OPPORTUNITIES	↑ COSTS AND SUSTAINABLE OPPORTUNITIES
• PHYSICAL ADSORPTION PERFORMANCE – GOOD • STRONG SURFACE CHEMISTRY FOR METAL INTERACTIONS	• PHYSICAL ADSORPTION PERFORMANCE – EXCELLENT • ESTABLISHED COMMERCIAL ADSORBENT



LABORATORY-SCALE ADSORPTION REACTOR

- **REACTOR SETUP**
  - 80 L RECIRCULATING SYSTEM
  - BIOCHAR MASS – 50g
  - CONCENTRATIONS
    - 100 µg/L of copper
    - 200 µg/L of Zinc
- **REACTOR MODIFICATIONS**
  - BIOCHAR INTRODUCED THROUGH UPPER INJECTOR POINT
  - PUMPS ALLOWING FOR CONTINUOUS CIRCULATION

- **TESTING STRATEGIES**
  - COLLECT WATER SAMPLES AND ANALYSE HEAVY METAL CONCENTRATION USING ICP-MS
  - CONTINUE UNTIL ADSORPTION EQUILIBRIUM
- **PERFORMANCE + REPLACEMENT**
  - DETERMINE TIME TO REACH EQUILIBRIUM
  - REMOVE SPENT BIOCHAR AND REPLACE
  - ASSESS REPLACEMENT FREQUENCY AND TREATMENT PERFORMANCE

WIDER UNIVERSITY RESEARCH

REMOVING HEAVY METALS USING RAIN GARDENS

- USING THE SAME WATER CONCENTRATIONS
- BIOCHAR USED IN ONE RAIN GARDEN COLUMN
- COMPARING THE PERFORMANCE OF HEAVY METAL REMOVAL



GROWING WHITE ROT FUNGI ON BIOCHAR

- INVESTIGATING WHITE-ROT FUNGI TREATMENT
- POTENTIAL BIOSORPTION OF CONTAMINANTS
- EXPLORING SUSTAINABLE MANAGEMENT OF SPENT BIOCHAR



FROM LAB TO MINE – WHERE DOES THIS RESEARCH LEAD?



PROJECT RESULTS:

- PERFORMANCE
  - HOW MUCH COPPER AND ZINC CAN BE REMOVED?
  - HOW QUICKLY DOES ADSORPTION OCCUR?
- OPERATION
  - BIOCHAR ADSORPTION CAPACITY AND BEHAVIOR
  - WHEN DOES THE BIOCHAR NEED REPLACING?
  - HOW MUCH FRESH BIOCHAR IS REQUIRED?
- APPLICATION
  - CAN THE PROCESS BE SCALED TO MINE WATER?

CAN A LOW-COST SUSTAINABLE MATERIAL BECOME A PRACTICAL RESOURCE FOR TREATING MINE-IMPACTED WATER?







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THANK YOU