Acid Mine Water Reclamation using the ABC Process
(Alkali Barium Calcium Process)

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Outline of presentation
Background
AMD treatment
CSIR's ABC desalination process
Results – water stage
Sludge processing stage
Conclusions
Acknowledgements

Background
Mining activities in SA
• Important sector of the SA economy
Abandoned mines
• Threatening the environment
  • Water not pumped from closed mines
  • Converted to AMD
Effectively treat AMD
• Reduce the impact on the environment

AMD Treatment Options
Physical processes
• Reverse Osmosis, Ion exchange
Biological processes
• Sulphate reduction
Chemical processes
• Precipitation reaction
Disadvantage of chemical processes
• High operating costs
• Disposal of bulky sludge

AMD Treatment
AMD characterized by one or more or the following:
• Low pH
• High heavy metals
• High TDS and sulphate
Treatment unit operations
• Neutralization
• Metal removal
• Desalination and or sulphate removal

ABC Desalination Process
Chemical precipitation process
• Neutralize acidic water
• Remove metals
• Remove sulphate
Water treatment section is integrated with a sludge processing section to recover:
• Alkali as CaCO₃ and MgCO₃
• Barium as BaCO₃
• Calcium as Ca(OH)₂
Technology Demonstration

Project initiated to treat 360 ML/day AMD
- Reclamation of excess mine water

Ultimate goal
- Create a zero-effluent discharge plant
- Treat contaminated mine drainage to potable water quality

Pilot scale demonstration unit (1 m³/day)
- Treat water to drinking water quality standards
- Design and costing of a full-scale plant (75 ML/day)

Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Feed</th>
<th>Treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>3.3</td>
<td>7.9</td>
</tr>
<tr>
<td>Total Acidity</td>
<td>mg/L as CaCO₃</td>
<td>714</td>
</tr>
<tr>
<td>Sulphate</td>
<td>mg/L as SO₄</td>
<td>1910</td>
</tr>
<tr>
<td>Magnesium</td>
<td>mg/L as Mg</td>
<td>124.6</td>
</tr>
<tr>
<td>Calcium</td>
<td>mg/L as Ca</td>
<td>205</td>
</tr>
<tr>
<td>Iron (II)</td>
<td>mg/L as Fe</td>
<td>180</td>
</tr>
<tr>
<td>Aluminium</td>
<td>mg/L as Al</td>
<td>2.97</td>
</tr>
<tr>
<td>Manganese</td>
<td>mg/L as Mn</td>
<td>63.69</td>
</tr>
</tbody>
</table>

Barium Recovery Stage

Sulphate removal
- \( \text{SO}_4^{2-} + \text{Ca}^{2+} + \text{BaCO}_3 \rightarrow \text{BaSO}_4 + \text{CaCO}_3 \)

Barium sludge processing
- \( \text{BaSO}_4 + 2\text{C} \rightarrow \text{BaS} + 2\text{CO}_2 \)
- \( \text{BaS} + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{BaCO}_3 + \text{H}_2\text{S} \)

Barium recovery stage
- Eliminate the high cost of barium salts
- Eliminate environmental toxicity of barium
Conclusions

AMD is the most critical environmental problem created by mining

Treatment of mining waste should be conducted in a sustainable manner

Sustainable solution is:
- Economical viable
- Generates little or no waste
- Energy efficient
- Not a source of pollution

Conclusion

CSIR’s ABC Process
- Provide SA and the rest of the world with an effective, affordable and therefore sustainable solution to the hazard of polluted water caused by mining activities

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Thank You