DRINKING WATER FROM MINE WATER USING THE HiPRO® PROCESS - OPTIMUM COAL MINE WATER RECLAMATION PLANT

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OUTLINE

• Background
• Mine Water Reclamation Project
  – Mine Water Collection and Transfer
  – Mine Water Treatment Plant
  – Treated Water Collection and Distribution
  – Waste Disposal
• Conclusion
  – Recovery
  – Waste Production
  – Operating Costs

BACKGROUND

• Optimum Coal Mine

BACKGROUND

• Water Management Scheme

BACKGROUND

• Selection of Water Treatment Technology
  – >98% Water Recovery
  – Minimum Brine Waste Generation
  – Potentially Useful Solid By-products
  – High Quality Drinking Water (SANS highest standard)
  – Large-scale Commercially Proven Technology

HiPRO® PROCESS

(High Recovery Precipitation Reverse Osmosis Process)
MINE WATER RECLAMATION PROJECT

• Mine Water Collection and Transfer

MINE WATER RECLAMATION PROJECT

• Mine Water Treatment Plant

MINE WATER RECLAMATION PROJECT

• Mine Water Quality

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<th>Median</th>
<th>50th Percentile</th>
<th>95th Percentile</th>
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<td>Conductivity (mS/m)</td>
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<td>TDS (mg/l)</td>
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<td>Sodium (mg/l)</td>
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<td>Strontium (mg/l)</td>
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MINE WATER RECLAMATION PROJECT

• Mine Water Treatment Plant – Pretreatment

  - Stage 1
    • Feed - Neutral pH, Low Mn & Fe
    • No Neutralisation
    • Ozone – oxidation & disinfection
    • Clarifiers – solids settling
    • Sand Filters - polishing
  - Stage 2 & 3
    • RO reject feed – supersaturated
    • Precipitation reactors – high pH with lime
    • Hydrocyclones – solids classification
    • Clarifiers – solids settling
MINE WATER RECLAMATION PROJECT

Mine Water Treatment Plant – Ultrafiltration
- Solids removal
  - Total of 11 UF Skids
    - Stage 1 – 7 Skids
    - Stage 2 – 3 Skids
    - Stage 3 – 1 Skid
- Dead-end mode operation
- Automatically and intermittently backwashed
- Backwash water collected in Plant Sump and retreated
- Antiscalant dosing

Stage 1 – 7 Skids
- Dead-end mode operation
- Automatically and intermittently backwashed
- Backwash water collected in Plant Sump and retreated
- Antiscalant dosing

Stage 2 – 3 Skids
- Dead-end mode operation
- Automatically and intermittently backwashed
- Backwash water collected in Plant Sump and retreated
- Antiscalant dosing

Stage 3 – 1 Skid
- Dead-end mode operation
- Automatically and intermittently backwashed
- Backwash water collected in Plant Sump and retreated
- Antiscalant dosing

MINE WATER RECLAMATION PROJECT

Mine Water Treatment Plant – Reverse Osmosis
- Dissolved Salts removal
- Total of 7 UF Skids
  - Stage 1 – 4 Skids 70% Recovery 13 bar
  - Stage 2 – 2 Skids 65% Recovery 18 bar
  - Stage 3 – 1 Skid 60% Recovery 30 bar
- Permeate – to potable or excess water distribution
- Reject – to next stage or brine pond

Stage 1 – 4 Skids
- Dead-end mode operation
- Automatically and intermittently backwashed
- Backwash water collected in Plant Sump and retreated
- Antiscalant dosing

Stage 2 – 2 Skids
- Dead-end mode operation
- Automatically and intermittently backwashed
- Backwash water collected in Plant Sump and retreated
- Antiscalant dosing

Stage 3 – 1 Skid
- Dead-end mode operation
- Automatically and intermittently backwashed
- Backwash water collected in Plant Sump and retreated
- Antiscalant dosing

MINE WATER RECLAMATION PROJECT

Treated Water Collection and Distribution
- Potable Water
  - Stabilised and Disinfected RO Permeate
  - Guaranteed <450mg/l TDs and SANS Class 0 compliant
  - Hendrina Municipality
  - Current capacity 5ML/day
- Excess Water
  - RO Permeate
  - Guaranteed <450mg/l TDs and SANS Class 0 compliant
  - Released to clean water canal, upstream of mine workings
  - Balance of 15ML/day not assigned to potable water

Waste Disposal
- Mixed Sludge
  - Transferred to lined Sludge Pond with large settling capacity
  - Supernatant is returned to WTP for further treatment
  - Solids content 10-15% (m/v)
  - Primarily Mg(OH)$_2$ and CaSO$_4$ phases

- Gypsum Sludge
  - Dewatered by means of a Vacuum Belt Filter
  - Filtrate is returned to WTP for further treatment
  - Dewatered Gypsum is stockpiled with prospect of sale to potential users

- Brine
  - Stage 3 RO reject ~30 000mg/l TDS
  - Brine Pond - evaporation
CONCLUSION

• Recovery
  – 98% Potable Water Recovery

• Waste Production
  – Mixed Sludge
    • 2.34 m³/h water AND 3.52 t/h solids
  – Gypsum Sludge
    • 0.55 m³/h water AND 1.28 t/h solids
  – Brine
    • 6.1 m³/h water
    • ~30 000 mg/l salinity

• Operating Costs (March 2010) – 15ML/day
  – Variable: ~R5.00/m³ (excl. Power)
  – Fixed: ~R2.50/m³

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