- Environmental issues with tailings management

Seminar: Methods for treatment of mine tailings
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Disposition

• Basic approach
• Environmental issues with tailings management
• Why decommission?
• Techniques used
• Demands and challenges
• Examples on decommission projects.
Basic approach:

Mining operations are limited in time
Decommissioning - a part of mining
Self maintaining - a long time solution
- Sustainable reclamation measures
- Risk assessment
- Site specific criteria
- Alternative land uses

Best available technique (BAT)
Boliden takes an active interest in the development of new techniques:
- unique experiences
- reuse of waste material
Environmental issues with tailings management

- **Dust** (water cover, saturation, water spray, lignin, sewage sludge, bark mm)
- **Dam safety** (GruvRidas- design criteria, supervision and control)
- **Weathering** (deposition method, characterize, oxygen levels)
- **Water quality** (weathering, Nitrogen, process in the concentrator)
- **Drainage water** (supervision)
- **Groundwater quality** (location, supervision)
- **Impact on the landscape**
Why decommission?

- Minimise long-term environmental impact
- Removal of safety risks
- ARD control
- Removal of structures
- Hazardous materials
- Contaminated soil remediation
- Re-vegetation
- Enhance public acceptance
- Cost effective
- Legal requirement
Techniques used

- Dry cover
- Flooding
- Wet land construction
Demands

• Site specific demands depending on the site, the waste and the recipient
• Reduced risk with time
• Long resistant Long-term stability
• Minimized oxygen supply (compaction, hydraulic conductivity)
• Protective layer (erosion, root penetration, frost)
• Proven long-term stable methods (the next ice age)
  – Homogeneous
  – Long-term Stable
  – The material must be durable and not leach, till a proven geologically stable material
Challenges

• Large areas
• Access to materials
• Transport costs – long distances
• Economically viable
• Legislation and requirements for financial surety
Examples on decommission projects
Dry cover on Saxberget tailings pond

Protecting cover, unclassified till

Sealing cover, clayey till

Tailings
Saxberget, conclusions

- The cover reduces the oxygen inflow and water infiltration as predicted
- Significant reduction in mass transport from the area
- Cover sensitive to erosion
- Sewage sludge as sealing layer (test plot) well functioning
- Compaction during "wet" conditions effective

Reclaimed upper tailings pond
Kristineberg

Aerial view of Kristineberg mine site
Kristineberg, decommissioning project completed
Integration of reclamation methods

Systems approach

- Composite cover
- Groundwater saturation
- Flooding
Kristineberg, monitoring programme, results

- Sampling frequency: Four to six times a year for surface water
- Assay programme: metals, SO$_2$, pH, cond
- Oxygen content and ground water level under sealing layer

- Systems approach taken, a condition for success
- Groundwater quality is steadily improving
- Groundwater saturation is a powerful method, reduces need for composite cover
- 1m protective cover is sufficient for frost protection
Aitik waste rock cover project

- Permit for cover using 1 + 0.3 m till
- Modelling indicates 99% reduction of oxygen transport
- In total 3500 ha waste rock dumps
- Sludge from Stockholm is used - reduces oxygen concentrations
Laisvall

- Lead-zinc mine, closed 2001
- Sewage sludge and other organic material used
- Mechanical stability – wind, surface water and frost/snowmelt effects a challenge.
Reclamation Laisvall before and after

Tailing pond before and after reclamation
Bark and sewage sludge is used for cover
Laisvall

Tailing area-fertilizer
Flooding

Water

Tailings
Objective of flooding in Stekenjokk

• Prevent the pond from becoming a major source of ARD
• Adapt the area to the surrounding environment
• Positive water balance needed
Stekenjokk

Evolution of zinc concentration (μg/l) in effluent 1992-2003
Stekenjokk

Evolution of zinc concentration (μg/l) in effluent 1994-2009
Gillervattnet – planned reclamation
Gillervattnet

Amount of material for reclamation (calculated):

- Till (unclassified) 1,095,000 m³
- Till (clayey) 201,000 m³
- Waste rock 532,500 m³
- Sewage sludge 180,000 m³