Wetlands Treatment of Mine Drainage at Antamina Mine

Howard Plewes and Harvey Mcleod
Klohn Crippen Berger Ltd.

Margaret McBrien
Louis Berger Group Inc.

Henri Letient
Compañía Minera Antamina S.A.
Introduction

• 500 Mt Tucush Waste Dump started in 2004
• Wetlands selected for passive treatment of expected neutral mine drainage
• Construction completed in early 2006
• This presentation will:
  • Overview design and construction aspects
  • Present early performance data
Site Location

Map of South America showing the site location of Antamina Mine in Peru.
Antamina Mine

- Copper-Zinc-Molydenum Mine
- El. 4200 m in Peruvian Andes
Tucush Wetlands Treatment System

- Wet season design flow = 115 L/s
- Dry season flows supplemented with seepage waters from tailings facility
Tucush Waste Dump – Ultimate Configuration
Expected Dump Water Quality

Key Parameters

• Zn – 0.8 mg/l
• Mo – 0.3 mg/l
• Ammonia – 7.5 mg/l
Wetlands Treatment

Wetlands treatment selected for:

- Expected neutral pH dump drainage
- Low operational costs
- Long-term sustainability

Tucush wetlands are unique because:

- It may be the highest wetland ever built
- Few treatment wetlands in South America
- *Built pro-actively in advance of potential problem loadings from the dump*
Basic Elements of Treatment System

**Sediment Control**
- Pre-sedimentation pond
- Serpentine sedimentation channel

**Wetlands**
- 4.2 Ha divided into two treatment sections
- Aerobic cells promoting ammonia removal
- Anaerobic cells for removal of metals and sulphate
- Retention time = 2 – 5 days
Aerobic Cells

- 0.4 m water depth
- 0.5 – 1.0 % bed slope
- 15 cm of topsoil substrate in the base
- Cascading spillways between cells for aeration of water
Anaerobic Cells

- 0.75 m water depth
- < 0.5% bed slope
- 15 cm topsoil growth substrate
- 15 cm of organic matter and planted vegetation
Wetland Vegetation

- Provides substrate for microbial attachment
- Aids in filtration and adsorption
- Uptakes nutrients and metals
Wetlands Planting

- 10,500 plants harvested from Lake Pajoscochas

- Primarily bullrushes, *Scirpus californicus* & *Juncus Arcticus*

- Adapted to climate and seasonal hydrological conditions
Project Area Prior to Construction
Construction of Wetland Cells
Local Contractors Planting Wetlands
Operating Pre-Sedimentation Pond
Operating Serpentine Channel
Vegetation – June 2007
Fully Operational Wetlands System
Operational Performance

• Early treatment data available for 2006 and 2007

• Inflows from Tucush Waste Dump only

• Loads from waste dump are well below design allowances

• Treated water quality easily meets discharge criteria at compliance points
### Initial Operational Performance in 2006

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DESIGN TARGET AT 40 L/s</th>
<th>INITIAL PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical flow rates</td>
<td>40 L/s</td>
<td>16 – 24 L/s</td>
</tr>
<tr>
<td>Suspended solids in outflow</td>
<td>&lt; 25 mg/L</td>
<td>7 mg/L</td>
</tr>
<tr>
<td>Dissolved Zinc removal</td>
<td>48%</td>
<td>81%</td>
</tr>
<tr>
<td>Dissolved Molybdenum removal</td>
<td>39%</td>
<td>49%</td>
</tr>
<tr>
<td>Ammonia</td>
<td>31%</td>
<td>87%</td>
</tr>
</tbody>
</table>
Future Work

- Ramp up flows to design of 115 L/s by addition of tailings seepage water
- Tracer test to evaluate residence time and flow path
- Continued monitoring and optimization
Gracias por su atención