Effective and responsible management of tailings dams and mine waste
Simple Monitoring, inspection and reporting techniques

Tailings facilities provide a window on the mining industry. They tell a story to the public about how the industry manages its activities. They also pose a risk that must be managed for the long term. The mining industry has the technology to safely design, build, operate and decommission tailings facilities. This technology must be consistently applied for the safe and environmentally responsible management of tailings.

Mill Tailings Characteristics
Waste throughout the mining process needs to be monitored and regulated and usually fall in to three distinct areas:

Ore and Mine Rock Characterization
Chemical properties; physical and engineering properties (e.g. strength, gradation, slaking potential); acid generating potential; leachable contaminants.

Tailings Characterization
Daily/annual throughput and total quantity; size distribution; % solids; density of solids; specific gravity; plasticity; liquid phase chemistry; acid generating potential.

Mill Operation Characteristics
Reagents used; water recirculation requirements; mill treatment processes (e.g. cyanide destruction); miscellaneous inflows to tailings basin; pipes and appurtenances; potential for pit and/or underground backfilling; % of disposal to surface facility vs. backfill.

Dam Structure Monitors and controls
The following considerations relate to dam and containment basin design. The list may not apply to all sites or all situations. It is up to the design professional to decide which aspects apply. Site-specific conditions may require the use of additional criteria.

Dam Monitoring Systems
Level controls; inclinometers; settlement gauges; seepage flow monitoring; temperature recording (permafrost, frost penetration, heating).

Dam water levels can be monitored by suspending hydrostatic sensors at intervals over the dam wall. The Endress+Hauser Waterpilot FMX167 with integrated PT100 and temperature transmitter TMT181 will monitor liquid levels and also temperatures in overflow wells and dammed waste pools. For solids or rock based waste an ultrasonic FMU90 transmitter Prosonic S and sensor will measure open pit slope wall levels and warn against significant rock slide or excessive rock build up.

The benefits of such simple level control of tailings dams are:

- Early warning against sudden rising levels due to rain, flood or ice melt
- Automatic switch on of overflow discharge pumps against high level alarms
- Overflow is automatically channelled to secondary containment wells
Seepage Analysis and Management:
Assess the requirement for seepage control, including into groundwater, consideration of water chemistry and acid generating potential. Plan for implementation of appropriate measures, as warranted, such as filter design; cut-off walls; grout curtains; ditching; low permeability core; interception wells.

Endress+Hauser offer a full range of seepage effluent monitoring and water analysis sensors including:

- Self cleaning and auto calibrating pH sensors
- Turbidity and dissolved oxygen sensors
- BOD, COD and water conductivity sensors
- Analysers for aluminium, copper, iron, lead, phosphate, sulphide and more…
- Secure paperless data loggers and recorders such as the Memograph S
- Remote data retrieval over the Internet and telephone line using Fieldgate

Open Channel or closed pipe waste flow measurement
Effluent will flow from most mining processes through pipes or open channels into the dammed holding basins. It is not only important to measure the waste characteristics e.g. pH, conductivity, turbidity but to measure the actual daily volumes of waste produced. To this end Endress+Hauser has the largest range of flow devices designed for effluent waste flow measurement. Flanged closed pipe electronic flow meters from Endress+Hauser include:

- Promag 35S magnetic flow meters with rubber liners for extremely abrasive media
- Promass 83 coriolis mass flow meter with integral slurry density and temperature measurement
- Recycled steam and compressed air flow measurement using a vortex Prowirl 72 meter
- Compressed air flow control using Endress+Hauser orifice plates and pitot tubes plus Deltabar S differential pressure sensors

More often than not though effluent will flow through open channels. The easiest way to measure the flow and record the daily flow through is to install an Endress+Hauser ready made Venturi flume and Prosonic S FMU90 flow controller.

Figures shows a typical open channel flow schematic. The FMU electronics comes with flow curves for most typical weirs and funnels.

**Pulses for volume counter + time pulses (e.g. for sampler)**

**Flow measurement with backwater alarm or sludge detection**
If the ratio “downstream level:upstream level” rises above or falls below a critical value, an alarm will be generated.