IMIA Short Paper

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A word on tailing dams

Due to spectacular damage to environment and near-by housing areas tailing storage has received some attention in the media again recently which may justify a few words on tailing dams.

Tailings are a waste product and may consist of various ground, rock and process effluents congaing often environmentally hazardous substances.

This material is no longer allowed in most countries as a waste discharge to rivers and the sea, so the number of tailing storage facilities has drastically increased. They are found nowadays in various industries such as mining, coal power (ashes), petrochemical industry (hydro carbons, oil sand tailings)

Generally, mechanical and chemical processes are used to extract the desired product from a mine ore and also produce a waste stream. This process of product extraction is never 100% efficient, nor is it possible to reclaim all reusable and expended processing reagents and chemicals. The unrecoverable and uneconomic metals, minerals, chemicals, organics and process water are discharged, normally as slurry, to a final storage area commonly known as a Tailings Management Facility (TMF) or Tailings Storage Facility (TSF).

Unsurprisingly waste is stored in the most cost effective way possible to meet regulations and site specific factors. Dams, embankments and other types of surface impoundments are the most common storage methods used today and remain of primary importance in tailings disposal planning. Naturally the particular design of these retaining structures is unique to a particular environment and mining operation, but it should be noted that such dams in the past (in the absence of official codes and criteria) were usually constructed using the cheapest materials available.

As a consequence, early tailings structures were very often subject to failure which went unnoticed if they were located in a remote area and no human lives were affected**.** In fact, failures were frequent which subsequently created more attention, with resultant national and international conferences being held which finally led to new design codes, to best practice papers both for construction and for operation.

The main reasons for failures were, and continue to be, the local conditions, soil properties, design and materials used, but a contributory factor is also the maintenance and controls.

Tailing Facilities are frequently only a part of an industrial plant, their values are not always given in the cost breakdown. Moreover, with years going by, extensions become necessary – both to surface area and in height – these may make construction an ongoing process, which again means individual values and sublimits have to be regularly adjusted. . .

Material damage appears to be spectacular but is limited assuming the tailings facilities are not located upstream of the insured assets. However in certain cases they may trigger important Business Interruption losses. This may be the case particularly when large third party damage – material and/or casualties - has occurred and authorities close down an operation for investigation and/or impose changes in design. The life span of TSF may exceed generations of owners, operators, employees and consequently all changes, extensions and controls should be properly documented.

Cross valley tailings impoundment at Highland Valley Copper, BC, Canada
(Courtesy TeckCominco)

Underwriters consider it useful to check design, local conditions, construction methods and materials both in the construction and the operations. They also will consider whether extensions in surface and height have already been completed previously. Moreover, underwriters will appreciate satisfactory information on operational guidelines, regulations in force, risk management, maintenance, controls and monitoring.

Although the Third Party Liability exposure and the Environmental Liability exposure (these are considered separately by experienced liability underwriters) may in most cases exceed the material damage exposure, there are some essential differences from conventional large dams which deserve special attention, such as low cost of construction, construction as an ongoing process under operational cover and an ongoing process of best practice standards development. Whilst such development is certainly an improvement, it may mean that after a loss and given the new-for-old cover much higher repair resp. reconstruction costs may apply, compared with original costs and actual values.

All said, underwriting tailing dams may serve as a good example for the need and certainly for the usefulness of an engineering approach in operational covers such as IAR (Industrial All Risks).

June 14th, 2011
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Supplementary notes:

For underwriting purposes it is useful and must be recommended to check

1. **Design**
    - by whom and based on which standards
    - the environment, geology, topography

- the site selection, foundations, seismic risk, flood, wind storm
- the permeability of the underground and also the permeability of the dam
- the construction (usually goes on during operation and often is a continuous extension)
- the material used for dam construction,
- drainage/dewatering provisions and installations

2. Construction

- material used
- contractor's experience
- resident engineers involved

If construction was done before:

- has the original height been increased since original construction ? how often ?
- are there operational guidelines in force - by government's or non-governmental organisation's application/governance of ISO codes, national regulations, commitment to best practice rules
- is there a specialised and well trained team permanently in place ?

3. Controls and monitoring

- Risk management of insured, checklists applied ?
- Are controls done by insured (trained team in force ?) or are they outsourced to external experts – check reputation/experience
- which control program is in force, which parameters checked and documented ? (ingress of oxygen, permeability, hydrogeology, groundwater movements, pore pressures, properties/behaviour of decanted particles, solids density, consolidation, porosity, subsidence, erosion of embankments, movement of slopes etc.)
- Incident Control Program and documentation of incidents
- Independent Peer review
- documentation of history, changes etc.

4. Some examples for Codes and Guidelines:

ISO - International Organisation for Standardisation
ISO 14000, 14001 and 19001 (does not mean more than that tailings management strategies exist)
ICOLD International Commission on Large Dams :
Publications on tailings storage:

44 Bibliography: Mine and Industrial Tailings Dams and Dumps. (1982)
44a Bibliography: Mine and Industrial Tailings Dams and Dumps. (1989)
45 Manual on Tailings Dams and Dumps. (1982)
74 Tailings Dam Safety – Guidelines. (1989)
97 Tailings Dams – Design of Drainage. (1994)
98 Tailings Dams and Seismicity – Review and recommendations. (1995)
101 Tailings Dams – Transport, Placement and Decantation (1995)
103 Tailings Dams and the Environment – Review and recommendations (1996)
104 Monitoring of Tailings Dams – Review and recommendations. (1996)
106 A Guide to Tailings Dams and Impoundments – Design, construction, use and rehabilitation. (1996)
121 Tailings Dams: Risk