

Tailings – From Concept to Closure

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It is frustrating that, despite modern engineering, tailings storages continue to wreak havoc through failures or spillages. Very few of these incidents were due to poor design or highly complex technical difficulties. The majority were due to simple causes, were preventable and should never have happened.

In a study of 221 such incidents, the International Congress of Large Dams (ICOLD) found that the majority were due to slope or foundation stability (33%) or poor water management (14%).

Many stability problems were in turn influenced by lack of seepage control which, together with other seepage issues, would make seepage one of the main issues in tailings storages. Earthquake damage occurred in 14% of cases but the statistics are influenced by multiple failures from a single earthquake in one country (ICOLD Bulletin 121, 2001).

What is being done to correct the mistakes and poor management?

Commonly, mine management regard tailings as an unwanted nuisance. Tailings operations are relegated to available staff who may not have been trained in the skills necessary to deal with the many engineering facets of tailings disposal. They confuse risk with consequence. They feel the risk is low, which it generally is, but the consequences are enormous. Failures or spillages in recent years have led to loss of life, stopping of production, multi-million dollar clean-ups and major impact on company credibility and share value.



The Australian Centre of Geomechanics (ACG) has made a very significant contribution by preparing a DVD: *Tailings - From Concept to Closure*. This is a timely tool for lifting the standards and training associated with tailings disposal. Scripted by Dr Andy Fourie of ACG, the DVD was reviewed by seven leading exponents of tailings systems representing the major international and Australian mining companies. This DVD represents not only the latest safe practices but is also pragmatic in its approach, showing real life situations. While most examples are Australian and many are in dry climates, there are a number of examples of tailings disposal in wet climates. The principles described and the variety of situations makes this DVD suitable for many countries.

The DVD is an essential training tool for all mines or processing plants that have tailings storage facilities (TSF). Before describing the features of the DVD, it is worthwhile to define what it is not. It is not a substitute for a design manual, nor is it an operations manual. It is not a training tool for the designer, but it is very useful for new design staff or those staff working on one aspect of a design so that they can get an appreciation of the interaction between the different aspects of tailings disposal.

The DVD is easily operated and is based on five “titles” or sections as follows:

- TSF overview,
- TSF operations,
- Water management,
- Monitoring and response, and
- Closure and rehabilitation.

Each “title” is broken into a series of chapters covering different topics. The DVD can be operated to play continuously (not recommended as it is one hour long and the comprehensive information would cause mental overload), on each title or individual chapter can be selected when wanting to focus on one particular aspect.

The TSF overview section is regarded as essential viewing for all staff involved in mine or plant operations. It should follow soon after the initial site and safety inductions. It is imperative that everyone on site has a feeling for the major damage that can be caused by tailings incidents and that as many pairs of eyes as possible be alert to signs that can give early warning that action is required. This 11-minute section shows the consequence of some failures and emphasises that there were always some tell-tale signs before the failures. The broad concepts of tailings disposal are described and due emphasis is given to the importance of operations manuals, water management and monitoring. Closure and rehabilitation is described as being an essential part of the original concept and design, rather than an afterthought at a time when funds are in short supply.

The second section on TSF operations is 12 minutes long and gives a comprehensive outline on the nature of tailings, their transport and deposition techniques. Due emphasis is given to potential environmental impacts of the tailings themselves and the water associated with tailings disposal. Potential problems are outlined and factors influencing choice of deposition method and its impact on the behaviour of tailings after deposition are described. Diagrams are used to illustrate the various points, with footage of a variety of tailings systems giving the viewer a clear understanding of how the principles are put into practice. The factors influencing the behaviour of tailings on the beach and their impact on the strength and other tailings properties are clearly covered with sufficient detail to allow the viewer to see the impact of various decisions. A number of examples of good practice shows where improvements may be possible at their own facility.

The section on water management is the longest at 20 minutes, but this is appropriate given the significance of this topic and the fact that most tailings incidents have arisen from poor practice in this area. Vivid illustrations are given of relatively recent major failures at Stava, Merriespruit and Baia Mare, with pointers as to why they occurred and what measures might be taken to prevent future incidents. These dramatic pictures are mixed with views of very practical and well operated decant systems. This section is the most detailed and shows with diagrams the principles involved in water balance, the importance of controlling the decant pond position and the control of freeboard. Seepage behaviour and its potential to cause piping failure, stability failure or liquefaction is well illustrated. It is demonstrated that pond control is one of the factors in determining wall-raising methods. The various wall construction methods are described, along with schematics that cover the relevant issues.

The important topic of monitoring is given due emphasis, an important factor that is not given adequate attention at many mines. This 11-minute long section describes routine inspections, the annual auditing process and provides checklists. Appropriate guidelines are described to help establish the inspection regime. This section highlights the critical relevance of an operations manual that is mentioned several times earlier in the DVD. The value of monitoring is diminished if

observers do not know how to identify critical situations and the appropriate response. These topics are well covered, with an exhortation to have clear trigger levels for initiating a response and to have clear written instructions on what that response should be. Again, there is a graphic warning of what can go wrong and why it is important to have clear and rapid responses.

The final section on closure and rehabilitation appears to carry less emphasis, being only four minutes long. It is not appropriate to outline all the possible end land uses and methods of achieving the desired outcomes for different climates. The DVD wisely stays with broad principles only, but nevertheless hammers home the key messages that closure must be considered in the concept stage for the TSF. It stresses the need to plan ahead and the benefits of progressive closure. Warnings are given about the significant cost implications and the effect these have on cash flow. It is fitting that the DVD closes with views of how a well managed TSF can be returned to aesthetic and stable land forms.

Overall, the video ranks as one of the most useful training tools in this field. Again, it is stressed that TSFs have such potential for damage that all staff should at least see the overview section as part of their basic site induction.

Please contact the ACG via acg@acg.uwa.edu.au to order your copy of *Tailings – From Concept to Closure: Best Practices for Tailings Disposal* – a training DVD for owners and operators of tailings storage facilities.