12. Tailings Water Management

All tailings disposal systems require management of the water component in the tailings. Management strategies are closely linked with the method of disposal, design of containment facilities and the potential for impacts both on and off the site.

12.1 *Disposal Methods*

Tailings disposal methods can be separated into four major categories:

- saturated tailings management, where the tailings are transported and discharged as a slurry. The saturated tailings are held in a dedicated containment area where gravity separation isolates a percentage of the water from the tailings solids. As deposition of the tailings is in a wet slurry, tailings beach slopes are flat and, consequently, large containment areas required. To minimise storage requirements, the separated water should always be recycled as much as possible;
- semi dry or thickened tailings management, which involves discharging the tailings to a containment area at higher solids content than the saturated tailings management. Depending upon the stacking characteristics of the particles in the tailings, higher beaching slopes are possible, with resulting smaller containment areas for tailings and decant water;
- dry stacking, which permits the extraction of most of the water before deposition. This allows the solids to be transported into a solids rejects dump from where they can be taken to waste dump areas for contouring, topsoiling and revegetating; and
- co-disposal of tailings which is the combined disposal of coarse rejects material and fine tailings usually by combined slurry pumping. The mixture produces a stable landform at the point of disposal with major advantages for rehabilitation. Significantly larger volumes of water are required than for conventional tailings disposal. The advantages of co-disposal are the stable ongoing and end landform, the reduction in area for waste disposal, the potential for recycling most of the discharge water and fewer environmental impacts. The technique does require large volumes of water, and there are greater potential seepage losses and large recycling pumps are required to return the water for the ongoing co-disposal process. Co-disposal techniques are being used at coal mines but are also applicable to metalliferous mines where there is a rejects component that, when combined with tailings will produce a well graded stable in-situ landform.

In all these processes, the effectiveness of the dewatering processes is a function of local conditions, the type of waste solids, size distribution, statutory requirements and economics.

It is critical for the rehabilitation of tailings facilities that the disposal and decommissioning methods are compatible and decided upon in the planning stage. For example, if a tailings storage facility is planned to be decommissioned by drying out the surface and covering it with waste rock or other material to encourage revegetation, disposal of the tailings under water (sub-aqueous disposal) could lead to poor settlement and ineffective drying of the surface. Conversely, a facility which will be decommissioned using a wet cover, typically used to inhibit acid drainage, should not be operated with dry beaches where oxidation of the sulphides can take place.

12.2 *Characteristics and Management of Tailings Water*

12.2.1 NATURE OF THE WATER

The water used to transport tailings and co-disposal tailings or extracted during thickening of the waste becomes contaminated during the process. In some cases, such as in the goldfields of Western Australia, the water itself is a risk to the environment because of its hypersaline nature. Tailings water can be acid or alkaline, have elevated concentrations of heavy metals or contain concentrations of cyanide which can have considerable environmental impacts if it is released to the environment. It is important to characterise the tailings water through a monitoring program and manage the water accordingly.

In some cases, it may be necessary to treat the water before disposal to the tailings storage facility. Denaturing or recovery of cyanide from gold process liquors is frequently practiced in order to reduce costs and also to reduce the potential environmental impacts.

12.2.2 MANAGEMENT

The following are the key elements that need to be considered in tailings water management:

- the sensitivity of the containment area to infiltration and hence the requirements for lining the storage area need to be evaluated;
- the ability of the storage area to contain stormwater inflows should be assessed. The potential impact of discharges from the tailings storage during storm events must be assessed. This will necessitate a risk assessment (see Fact Sheet Nos 2 and 3) with a resulting design storm event for containment;
- diversion of drainage from surrounding catchment areas in order to reduce inflow as much as possible;
- the need for separate reservoirs for water to be recycled eg. in co-disposal;
- recycling of tailings decant water should be encouraged as much as possible;
- tailings pipelines should be bunded and have collection sumps to contain spills from leaking or ruptured pipes;
- infiltration monitoring systems are required around the containment site to detect contaminants escaping from the impoundment; and
- discharge monitoring for disposal systems with continuous discharge of tailings liquor and/or solids.

12.3 *Seepage Management*

Seepage can occur through the walls and through the floor of a tailings storage facility (Figure 12.1).

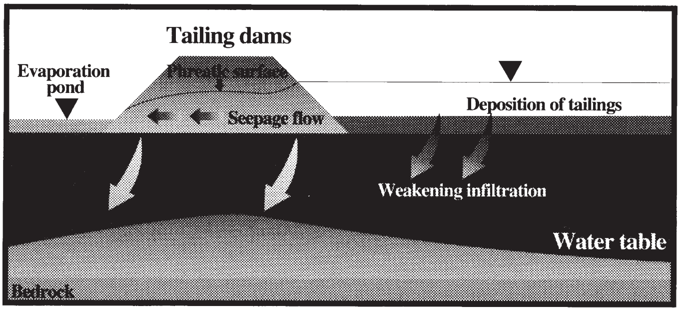
Infiltration through the floor of the tailings storage facility usually decreases with time as tailings are deposited in successive layers and form a retardant to vertical flow. In the long-term, the majority of tailings water seepage occurs through the dam wall and via infiltration through the ground surface on which the wall is built.

12.3.1 SEEPAGE CONTROL

Seepage may be controlled to some extent by constructing the tailings facility using permeable (for filter dam segments) and impermeable soils where applicable. In addition, geofabric liners may be used to increase the insulation against seepage flow.

Under-drains may be installed in the floor of the facility before deposition of tailings in order to collect and channel water to a collection system. Similarly, interception drains and trenches may be

FIGURE 12.1: **Seepage Paths from a Tailings Storage Facility**



installed around the facility to collect seepage before it can escape into the environment. In extreme cases, impervious slurry walls and interception systems have been installed in the preferred seepage paths to prevent escape of potentially contaminated water into sensitive environments downstream of the facility.

12.3.2 MONITORING

Monitoring of seepage flow through the wall of a tailings storage facility (TSF) is readily accomplished using piezometers to determine the geometry of the phreatic surface (Figure 12.1). This may be translated to seepage flow rates using standard groundwater flow theory.

It is also common practice to install piezometers around the base of the impoundment wall in order to detect seepage escape into shallow aquifers under the facility. Such piezometers should be installed in appropriate locations so as to be able to detect a contamination front moving from the impoundment early enough to take remedial action. Indicator elements should be determined from a knowledge of the chemical composition of the tailings water.

Water balance monitoring of TSFs enhances the overall understanding of the site water circuit. Monitoring should be carried out within the tailings pond, in the dam wall and in any downstream evaporation ponds. Adequate knowledge of tailings settlement and water retention in voids, as well as evaporation rates, are critical to forming a water balance management scheme.

12.3.3 WATER CONTROL

Tailings water control may be implemented using containment measures such as:

- sizing the TSF sufficiently to hold large volumes;
- constructing filter dams to allow selective seepage of water into retention ponds or evaporation ponds. Water extracted in this way may be more acceptable for recycling in processing plants;
- staging of containment wall construction to facilitate drainage from the co-disposal area;
- sizing and locating outlet structures to hydraulically control discharges from the storage; and
- sizing evaporation ponds to reduce water levels at sufficiently high rates.

The re-use of tailings water is often limited because of specific water quality requirements of the process. In general, the characteristics of tailings water is process-specific, as is the acceptability of tailings water for re-use.