Efficiency of Tailings Sand Operations

Introduction

Mount Polley Mining Corporation (Mt. Polley) has requested that AMEC Earth & Environmental (AMEC) undertake a review of their tailings sand operation with the objective of providing recommendations to improve the efficiency of these operations. This work has been commissioned by Mr. Ron Martel, Environmental Superintendent.

Mt. Polley's mine is located near Likely, central British Columbia. The mine produces a copper-gold concentrate from an alkalic porphyry ore from three open pits. The concentrate is produced with a grinding and flotation circuit. The tailings are sent by gravity to a valley side U-shaped tailings facility.

The review of Mt.Polley's tailings operations included a review of information provided by the mine and a two-day site visit. The site visit started with an initial meeting to discuss the key issues encountered by Mt.Polley and a presentation by AMEC on principles and experiences in tailings operations. Most of the first day and the morning of the second day were spent in the field visiting the site, observing construction conditions and discussing the details of the operation with supervisory and operations personnel. The site supervisor for the off-shift was brought in by Mt.Polley thus there was opportunity for input from and discussion with both shift supervisors. A closure meeting was held at the end of the site visit to present and discuss a summary of the conclusions and the main recommendations of the review exercise. A briefing document was prepared and handed out at the meeting; it is included in Appendix A.

Dam Construction Requirements

The tailings dam is a zoned compacted fill dam that is being built using a modified centreline method. It is formed by three components – the Main Dam, the Perimeter Embankment and the South Embankment to a total length of approximately 4 km. The maximum dam height at the end of construction will be in the order of 53 m (El. 965 m). The dam is currently approximately at El.951 m.

The information on the dam available for review included Drawings 104, 115 and 215 (Stage 6) by Knight & Piesold. No reports were reviewed as part of this exercise.

Drawing 215 shows Zone U as a "step-over" zone upstream of the clay till core, built in stages partly on previously built Zone U and partly on a tailings beach surface placed upstream of the dam section. The cross section shows a layer of rock (CBL, "coarse bearing layer") placed over the beach to bring it to El.951 m (Stage 5) and to provide support for Zone U construction in the following stage. Stage 6 Zone U construction (current cell construction) is shown as a 3 m lift (Stage 6a from El. 951 m to El.954 m). Dashed lines also indicate Stage 6b to El.958 m.

Stage 6a Zone U is shown in Drawing 215 as being 11 m wide at the base (El.951 m) and 10 m (minimum) wide at the top (El.954 m). Note 5 on the drawing indicates that these dimensions assume sand cell construction using tailings sand against 1H:1V clay till (Zone S) core slope on the upstream side and a 1.3H:1V slope of the upstream on the beach side. It is our understanding that Zone U could cover a range of materials. The selected material was tailings sand placed by cell construction.

Drawing 104 “Material specifications” indicates that the material type for Zone U is “Select Fill” located on “the upstream toe” and states that the placement and compaction requirements are “to be determined based on material selection”. Grain size curves under the heading of Zone U show gradation limits for “Zone S contact” and for “Zone CBL contact”.

Tailings Characteristics and deposition system

Mt. Polley operates three open pits and there is wide variability in the ore characteristics. Ore blending reduces this variability but the tailings characteristics are still expected to be variable with time as a function of ore and plant operation variations.

The monthly composite gradations of the tailings were provided by Mt.Polley (see Appendix?). The variability of the monthly gradations is shown on Figure ?.

A mean gradation of the tailings solids:

Variability of the solids content of the tailings slurry
“tailings density” Ron will send

Mean specific weight of the solid particles is 2.7 g/cm^3.

The current mine throughput is 20,000 tons/day or an average of 833 tons/hour. At an average solids content in the slurry of 35%, that represents a total flow rate into the tailings facility of ????? m^3/s or ???? USgpm. The tailings is discharged by gravity through a 24” HDPE DR11 pipeline from the mill (El.1100m) to the tailings dam (currently approximately at El.951m; final crest at El.965m. The tailings line is in the order of 3 to 5km???? long from the mill to the tailings facility. The total length of the dam is in the order of 4 km.

Key Issues

The main issues with the current tailings sand deposition brought up by Mt.Polley staff are ????

- Low efficiency / high costs building cell for Zone U
- Too much wash out on cells
- Too much time preparing cells + need to place CBL (rock on beach to support cell construction)
- Lack of beach

Field observations

Cells are typically 10 m wide and approximately 150 m long. During the site visit, cell construction was occurring along the South Embankment. The cell observed was likely a little narrower than 10 m (Photo 1). The flow during the first day of the site visit (Photo 1) was described as “typical”.

The flow during the morning of the second day (Photo 2) was probably lower density. There seems to be more water flowing on the cell surface and the operator reported that it was not “building well”.

The flow into the cell is the full tailings line (24” diameter), which flows partly full (Photo 3), however the flow velocity is high due to the significant head difference between the plant and the dam site.

The cell decant facility is provided by two 22” pipes (Photo 4) that discharge onto the beach. The pipes are installed across the berm by a backhoe. The pipes are installed approximately at the same elevation.

Due to the lower solids content on the decant flow, it erodes the previously placed beach (Photo 5). When the decant pipe is at an elevation similar to the top of the beach, the flow tends to channel next to the cell, which can lead to erosion of the berm (Photo 6).

The cell is constructed by running a dozer along the length of the cell while the tailings line discharges the slurry (Photo 7). The dozer operator lowers the blade and pushes the sand deposited on the cell towards the downstream end of the cell (Photo 8) to liberate slimes and facilitate their flow towards the decant pipes (Photo 9).

The dozer then moves back towards the discharge point with the blade lowered to push some of the sand back up the cell (Photo 10).

When the sand fill reaches approximately the level of the top of the decant pipe, the tailings flow is diverted from the cell to a by-pass line. A back-hoe re-installs the decant pipes approximately half the pipe diameter above the previous location (Photo 11). The dozer uses the material placed in the cell to raise the berms (Photos 12 and 13).

The dozer smoothes the bottom of the cell (Photo 14) before deposition and cell construction re-starts.

The elevation of the pond on June 02, 2008 was 949.39m

Discussion of issues and conditions

Flows through the cell
Dozer Operation
Decant Facility
Beach operation
Impact of feed variability
Optimization of sand operations
Tailings plan
Data collection

Main recommendations:

The following main recommendations were made to improve the efficiency and reliability of tailings operations:

1. Increase the width of the cells. Tentatively increase the cell width to 20 m with the objective of decreasing flow velocity and flow depth. Cell length seems adequate for now.
2. Track pack the cell perpendicular to the flow (as opposed to working the cell up and down). Berms (dry dykes) could be raised as cell compaction proceeds – reduce downtime
3. Build and install a spillbox to reduce downtime
4. Potential for installing spigots upstream of the cell to improve feed (by reducing water and slimes) or manage feed consistency into the cell - decrease volumes/velocities.
5. Prepare a tailings plan / mass balance consistent with the water balance.
    a. Tailings plan needs to verify availability of sand to build the required cell and beach to support the cell raises.
    b. Tailings plan could include planning for focus on cell construction in the summer and beach placement in the winter.
    c. Cell construction could be optimized by having 2 cells on each side of the dam and possibly night shift; one cell could be prepared while the other one is being built; one side of the dam can be draining while the other is being built/prepared.
    d. Cell construction would likely take 2 “passes”: built 1.5m in one cell, come back over with an additional 1.5m.
6. Collect data on material parameters (gradation, cell deposit density, beach angles, etc), mill operation (gradation, slurry solids content) and cell operation (volumes, time, cost, etc). Data would be used to calibrate (and improve) tailings plan to actual performance and to develop performance improvement changes in the field.
7. Train field supervisors and operators. Bring them up to speed with the technical objectives of the cell construction and the desired outcome.

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