Award of Merit

Johnny Mountain Gold Mine — The high art of winter construction

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Winter construction in Canada is a tricky business at best, but when it is at an elevation of 1070 metres, on the toe of a glacier, just above the tree line in northwestern British Columbia, at a gold mine supplied by air, the challenge is enormous.

In the case of Johnny Mountain Mine, owned by Skyline Gold Corporation, the mine and mill was developed in a single year. Before milling could begin in early 1988, a tailings pond had to be built and approved by government agencies. The pond and dykes for the cyanide-bearing tailings had to be of high quality as the site is in the Iskut-Stikine watershed, a valuable fisheries resource for BC and Alaska.

Innovative methods developed by geotechnical consultant Robert C Dick PEng, permitted construction of the embankment dykes for the tailings pond to proceed through the winter. Because of the altitude, much of the heavy, coastal precipitation is in the form of snow, with 18.8m (62ft) recorded during the winter of 1987-88. Construction of the pond began at the end of September 1987. The average temperature during the season was about -4°C with brief periods reaching an extreme -21°C.

The pond is located in a natural depression at the site's plateau, underlain by a dense, impervious basal till. This till was utilized for embankment construction, with as much as possible being taken from within the pond to increase storage capacity. A nearby deposit of gravel provided material for an underdrain.

Embankment dykes constructed in winter without negative effect.

No new equipment could be flown in because mill machinery had priority. Construction of the pond coincided with the first significant snowfall of the year.

Since normal methods could not be used, special procedures were developed to maintain quality while placing fill at a slow rate during snow and to protect the works during delays caused by weather. The normal method of embankment construction, ie, creating a large borrow area and placing fill in horizontal lifts, was unsuitable. It was essential to prevent snow or rain from mixing with the till while it was being excavated, transported, placed and compacted.

This posed some difficulties as the only equipment available was one backhoe, one articulated dump truck and one bulldozer, which were used to build access roads, strip the construction and borrow areas, plow snow from the airstrip, dig drainage ditches, remove damaged material from the dykes and borrow areas, and to excavate, haul, place and compact both the impervious till and the drain gravel.

The till borrow areas were protected by excavating on a vertical face with drainage ditches at the top and bottom. A small area could be worked, which minimized the risk of wetting or freezing during construction and facilitated removal of material after a delay.

To protect the dykes from freezing, the snow was left undisturbed until fill was to be placed. A sub-horizontal method of placement was devised, whereby the fill was spread on a slop of about 1V:10H so that only a small area was being worked at any time. This produced a completed embankment several metres high in one pass, although lifts remained less than 0.3m thick. Snow and frozen or wet material was removed just ahead of the toe of the advancing lift and the surface of the completed pass was allowed to freeze. Work continued on a twenty-four hour basis to keep the fill surface "alive".

It was determined by trial that fill quality could be maintained down to a temperature of -10°C. After delays caused by weather or breakdown, construction could be resumed only if the temperature was above -5°C.

The first-phase dykes were completed in early April 1988, by which time almost 19m of snow had fallen. The second phase of construction began in July, with three to six metres of dense snow remaining on low areas. In October, a subcontractor was able to fly another dump truck and two scrapers to the site, which significantly contributed to a November completion.

Mean embankment density was 104.5 percent standard Proctor density, with a standard deviation of 6.2 percent well above the specified 98 percent. Moisture content remained dry of optimum. The completed dykes have a maximum height of 10m, are one kilometre long and contain 60,000m^3 of fill, surrounding a 9.65 hectare pond.

The winter construction methods produced no laminations, wet zones or inclusions of snow, according to test excavations of the dykes conducted by consultants retained by the inspector of mines. ○