GEOLOGY, MINING AND TAILING CHARACTERISTICS OF SELECTED GOLD MINES IN PAHANG

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The characteristics of gold mine tailings are generally dependent upon the geology and mining practices within the mine as well as the duration of the operation. In order to illustrate this, the geology and mining operations in two hardrock gold mines are briefly described, and their controls on some of the tailings characteristics discussed. In addition, the mining operations and tailings from these two hardrock gold mines are compared to that from an alluvial gold mine operation.

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The gold mines involved in this study are the Selinsing gold mine, located about 50 km north of Raub; the Bukit Koman gold mine in Raub; and an alluvial gold mine located in Tersang. The Selinsing and Bukit Koman gold mines are actually old underground operations with similar histories: having pre-independence cyanided tailings and a series of openings and closures prior to the present operation. The alluvial operation in Tersang has moved gradually downstream for about 3 to 4 km along Sungai Chenua over the past six years.

The main rock type at the Selinsing gold mine are weathered calcareous phyllite, generally striking between 340° and 350°, and dipping between 65° and 81° to the east. Limestones predominate at the base of the hill where the mine is located, and outcrops at the eastern part of the mine, away from the working area. The gold bearing quartz veins are hosted by the calcareous phyllite, and conform to the bedding planes. The Bukit Koman gold mine is composed of interbedded limestones, schists and mudstones, generally striking between 350° and 360° , with varying dip directions. The gold and sulphide bearing quartz veins are hosted within these rock types.

The gold bearing veins and adjacent bedrock at Selinsing and Bukit Koman are extracted using hydraulic excavators and hauled to the stockpile, near the processing plant, by dump trucks. The alluvial mining operation in Tersang first involves clearing the working area of vegetation, mostly consisting of logged primary forest. Ditches are excavated for drainage purposes before the overburden is stripped. Then, the gold bearing material is excavated and sent to the processing plant. When this material is exhausted, the whole process is repeated downstream. In contrast to the mining of weathered rock which proceeds downwards, leaving a large hole a few hundred meters in length at Bukit Koman and a denuded hill at Selinsing, the alluvial mining in Tersang extends laterally, leaving shallow mined out pits less than tens of meters in radius.

At Selinsing and Bukit Koman, the ore is pushed on to the hopper by a tractor and then fed into the ball mill with the aid of water. The discharge from the ball mill passes through the trommel, where the oversized are separated and sent back to the crusher. The undersized material flows on to the *palong* (sluice box) in the form of a slurry. The gold and other heavy metals are trapped at the wooden riffles while the lighter minerals flow down the inclined *palong*, which are elevated on trestles. Upon retrieval from the *palong*, the concentrates are separated on the shaking table. Further dressing involves panning and treatment with concentrated acids to eliminate the sulphides and other impurities.

At the gold mine in Tersang, the alluvium is dumped directly onto the hopper by dump trucks where they are well washed and puddled against the flow of water. All the large pebbles are discarded when clean and manually placed onto the dumpsite located nearby. The current of the water carries the fine sands along the *palong* to the point of discharge where they are discarded as tailings while the heavy minerals, sand and the gold are caught behind the riffles. The concentrates collected from the *palong* in Tersang are sent elsewhere for further dressing.

Apart from gold bearing material, the mining operations at Selinsing, Bukit Koman and Tersang have produced waste removed during the development phases, and tailings found in the settlement ponds. The term tailings refers exclusively to the solids that settles out from the water in the settlement ponds. Three tailing samples were collected from three different settlement ponds in Selinsing, and two samples each were collected from Bukit Koman and Tersang. Samples were collected using a clean plastic spade, up to an average depth of about 10-15 cm. Depending on the size of the area, each sample is a composite of no less than 10 sampling points. The tailings were analyzed for their solid content, mineralogy, particle size distribution and heavy metal content.

The solid content values show that the tailings furthest away from the point of discharge and closest to the edge of the water is more saturated, and has a relatively lower solid content. The tailings in the hardrock mines have a maximum size of 2 mm, while that from the alluvial mine contain particles up to 5 cm across. The particle size distribution bar charts show that the tailings closer to the point of discharge have relatively higher amounts of coarse and very coarse sand (in the case of hardrock mines) as well as pebbles and granules (in the case of alluvial mines). A bimodal distribution is obtained for tailings from older settlement ponds.

The composition of tailings from Selinsing and Bukit Koman are generally similar, having angular grains; the majority being vein quartz fragments, with subordinate amounts of rock fragments and small amounts of calcite and illite. The tailings from the alluvial mine have sub-angular grains; a large proportion of quartz and rock fragments of various origins, as well as small amounts of mica, kaolinite, illite and montmorillonite. The 500-62.5 um fraction and the -62.5 um fraction of the tailing samples were digested and analyzed for its Fe, Cu, Mn and Zn contents, amongst others. The results indicate that the highest concentration of metals are not necessarily restricted to the finer fractions (-62.5 um) of the gold mine tailings.