

THE INFLUENCE OF SHEAR STRENGTH PROPERTIES ON THE STABILITY OF ROCK PILES

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The stability of mine rock piles is controlled principally by the shear strength of the material. Rock piles constructed by end-dumping generally form angle of repose slopes in the range of 36° to 38°. Rocks weather with time in the presence of oxygen, water, and bacteria, and are subjected to wetting/drying and freeze thaw cycles. In most cases, fresh coarse-grain rock weathers to finer grained material. The evolution of particle sizes and the production of clay may result in a change in the shear strength properties of the mine rock and alter the physical stability of the mine rock structures. The primary objective of the rock pile slope model presented here is the evaluation of the effect of shear strength properties on the factor of safety.

In most conventional analyses, the overall stability of the mine rock is determined using an internal angle of friction with zero cohesion. The internal angle of friction for non-weathered rock pile materials at the time of placement is routinely greater than 41°, which exceeds the constructed slope angles of repose at 38° thus producing stable slopes. Weathering of waste rock tends to decrease particle size, friction angle, and the factor of Safety. Alternatively, additional shear strength may be developed by cohesion when the waste rock has a higher fraction of sand, silt and clay. Cohesion may occur as effective cohesion and/or apparent cohesion. Effective cohesion describes cohesive strength derived from inter-particle cohesion due to the presence of clay minerals and the precipitation of secondary mineral products such as grain to grain cements. Apparent cohesion describes cohesive strength associated with matric suction.

A sensitivity analyses for the rock pile model demonstrated that a reduction in the internal angle of friction decreases the factor of safety. Conversely, the reduction in factor of safety can be significantly improved with the development of relatively small values of cohesion/cementation and matric suction. In conclusion, the sensitivity study shows the relative importance of cohesion in the stability of weathered rock pile materials.