Stoping Under Paste - The Dilution versus Binder Tradeoff

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ABSTRACT

Historically the limit equilibrium solutions by Mitchell and Roettger (1991) have been used when specifying backfill strengths for horizontal exposures. In larger underhand stoping applications, with cemented pastefill, these solutions tend to result in formation of a stable 'arch' geometry, but only after some dilution. When considered in the context of complete unravelling, the observed dilution is small, but the implications on the Life of Mine economics can be significant.

The reason for the observed dilution is a result of persistent, cohesionless, horizontal "cold/flow" joints, which form during the hydraulic deposition process. This jointing is not accounted for in the analytical solutions by Mitchell and Roettger (1991) but is expected to be controlling the mechanics of the dilution. After incorporating the influence of these joints into dis-continuum numerical analysis, this model is shown to provide a more reasonable representation of the relationship between dilution and strength observed across several sites.

Interrogation of the numerical output reveals two new analytical models for representing the horizontal exposure behaviour. The first is based on Voussoir beam theory and relates depth of overbreak (or dilution) to backfill strength, while the second provides a model for estimating the strength below which catastrophic, uncontrolled caving would occur.

Using the proposed solutions mine designers can develop useful relationships that allow the cost of dilution to be traded off against the cost of binder.