The estimation of maximum allowable rates of rise of South African Highveld gold tailings

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ABSTRACT

There is a limiting rate of rise for all tailings storage facilities that must not be exceeded to ensure that each deposited layer of tailings undergo the necessary amount of desiccation prior to the deposition of each subsequent layer. For upstream raised facilities, including gold tailings facilities on the South African Highveld, it is critical that the rate of rise is low enough to ensure that the outer zone tailings attains adequate shear strength, is sufficiently over-consolidated to reduce the risk of liquefaction, and does not recharge the phreatic surface within the facility. This paper refers to this limiting value as the maximum allowable rate of rise, with the acceptable final state of each tailings layer defined as both having reached the shrinkage limit and having become partially saturated.

With the processing capacity of metallurgical plants ever-increasing (> 1 Mtpm) and with improved thickener design and performance making the deposition of higher relative density gold tailings slurries (> 1.55 t/m³) quite feasible, rule-of-thumb or experience based estimates of the maximum allowable rate of rise for tailings storage facilities are no longer appropriate given the substantial impact inappropriate design assumption can have on the facility’s risk profile and capital cost.

This paper presents a semi-analytical method of determining the maximum allowable rate of rise using an approach originally developed by O’Kane Consultants. Results presented are based on field and laboratory testing of gold tailings for a project located on the South African Highveld and also considers the impact of the following aspects on the calculated maximum rate of rise: tailings slurry density at discharge, dissolved salt concentrations in tailings pore water, tailings grading and permeability, tailings shrinkage limit, tailings surface albedo and rainfall intensity.