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HEAP LEACHING SCALE UP PHENOMENA QUANTIFIED

By

Petrus J. van Staden

MINTEK, South Africa

Presenter and Corresponding Author

Petrus J. van Staden

ABSTRACT

The analysis provided in this paper is based on the premise that column and heap leaching kinetics are generically governed by a combination of chemical reaction rate and diffusional mass transfer, which may include competing reactions. It transpires that the hypothetical parameters of diffusional distance, tortuosity, and constrictivity, together with diffusivity and moisture content, can be grouped into a single constant termed Transfer Time, $\boldsymbol{\theta}$, which characterises column or heap leaching kinetics.

Data from case studies for which comparable column and heap leaching results were available was analysed. In some cases, the ratio between $\boldsymbol{\theta}$ for the heaps and $\boldsymbol{\theta_{ref}}$ for the corresponding columns followed a theoretically derived relationship for the predicted effect of heap densification. In the balance of cases, the ratio between $\boldsymbol{\theta}$ and $\boldsymbol{\theta_{ref}}$ followed the theoretically predicted effect of having a wider dripper spacing on the heaps compared to the effective dripper spacing in the column(s). Furthermore, the asymptotic extent of extraction (i.e. extrapolated towards time infinity), could be correlated to dripper spacing.

Leaching in laboratory apparatus in which segregation and stratification were simulated indicated no statistically verifiable effect on leaching kinetics, although segregation did seem to have a slight effect on bulk density and hydraulic conductivity. The quantified correlations thus derived suggest a fundamentally-based procedure for extrapolating column leaching kinetics to heap scale. For the immediate future, it is suggested as a means to corroborate heap leaching kinetics predicted by the traditional experience-based methods. Furthermore, it can provide quantitative indications of the likely sensitivity of kinetics on dripper spacing and heap density, amongst other parameters. The confidence in the statistical accuracy of the method can be further improved by the incorporation of further case studies into the database.

Keywords: heap(s); column(s); heap leach(ing); column leaching; scale up; kinetic(s); mass transfer; dripper spacing; bulk density; segregation; stratification; extent of extraction.