Scheelite Flotation Modelling and Preconcentration for improved Grade-Recovery

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Scheelite ($CaWO_4$) is one of the prolific economic mineral sources of tungsten – a critical mineral, and an essential component of high-strength materials. As with every other valuable mineral, scheelite is associated with gangue minerals such as: calcite ($CaCO_3$), and fluorite (CaF_2) which possess similar surface chemistry as scheelite, hindering the flotation selectivity. This limitation motivated the research on the application of a novel depressant – colloidal silica – to selectively separate scheelite from the non-valuable minerals. In a precursor to this work, standard flotation reagents in combination with novel set of depressant variants were considered in microflotation, batch, and pilot scale testing to understand the selectivity potential of these depressant variants. This work was aimed at developing an optimized mini-pilot plant flowsheet for the froth flotation of scheelite. To minimise test work and optimize the pilot scale test, our objective was to model, simulate, and optimize the flotation test work that was implemented on a pilot scale to the end of obtaining improved selectivity and recovery in favour of scheelite. It was found from the modelling and optimisation campaign that the aluminate-modified colloidal silica were the best variants considering costs, and selectivity in favour of scheelite producing a final concentrate with grade of 8.11% and recovery of 75.95% recovery. However, the aluminate-modified colloidal silica seemed to have a depressing action on not only calcite, but also scheelite reducing the recovery significantly compared to the other colloidal silica variants. To combat this drawback, we are currently considering the intrinsic properties that distinguishes scheelite from its associated gangue minerals to predominantly apply it in a preconcentration attempt aimed at substantially reducing the quantity of gangue minerals. The gravity concentration bears strong potential for preconcentration, repeatability of which is being studied at bench scale.

Keywords: colloidal silica, depressant, selectivity, modelling, gravity concentration, preconcentration.