Nano-Silica based mineral flotation frother: Synthesis and flotation of Platinum Group Metals (PGMs)

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Abstract

We report the synthesis and application of nanomaterials in the field of mineral processing. Nanotechnology is a potentially disruptive technology with a huge potential to open up new avenues of enhancing mineral recovery and grades in the domain of mineral froth flotation. In this investigation a solid, nano-silica (NS) based frother was synthesized using the sol–gel method for test works involving Platinum Group Metals (PGMs) and associated base metals. The nano flotation reagent was characterized using Fourier Transform Infrared Spectroscopy for chemical structure analysis (FTIR), Powder X-Ray Diffraction (P'XRD) for structural analysis and Field Emission Scanning Electron Microscopy (FESEM) for surface morphology and particle size distribution, Energy Dispersive Spectroscopy (EDS) for elemental analysis. X-ray fluorescence (XRF) was used for mineral assaying after flotation. The generated nano-silica had an average particle size distribution of 35–41 nm. The flotation performance of the nano-frother was benchmarked with a commercial conventional frother (SasFrother). At an optimum nano-frother dosage of 20 g/t a recovery of 73.8%, 77.0%, 84.0% and 78.2% platinum, palladium, nickel and copper respectively was realized. However, the associated grades were lower when compared with the conventional frother. On the other hand, increasing nano-silica dosage above the optimal dosage resulted in a reduction of the actual recovery for all the metals. Interestingly, the dosage requirement for the nano-frother required for optimal mineral recover was much lower than that of the conventional frother. Based on these findings, opportunities at nano scale can proffer numerous novel materials with exceptional properties for application in mineral froth flotation.