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Determining coprecipitation mechanisms for the loss of nickel and cobalt during partial neutralisation of nickel laterite leach liquors

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ABSTRACT

With the rising global demand for critical battery minerals, there is an urgent need for more efficient and sustainable technologies to process nickel laterite ores into battery-grade chemicals. Promising yet uncommercialised technology, such as nitric acid leaching, which uses an atmospheric pressure leaching circuit offer significantly lower environmental impact compared to existing commercial processes for production of nickel and cobalt from laterite ore.

Development of nitric acid leaching processes for industrial application requires a deeper understanding of the complex nitrate-based leaching system and subsequent refining stages. This study examines the behaviour of nickel and cobalt during the partial neutralisation of leach liquors. Understanding the potential pathways for nickel and cobalt loss will assist in identifying strategies to minimise valuable metal losses and optimise the partial neutralisation process.

Bench-scale partial neutralisation experiments were performed using a synthetic leach liquor and $CaCO_3$ *as the neutralising agent at 50°C, across a pH range of 2.5 to 4.0. The resulting precipitation products were analysed using an array of techniques, including powder X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FTIR), electron probe microanalysis (EPMA), scanning electron microscopy - energy dispersive spectroscopy (SEM-EDS) and thermogravimetric analysis (TGA).*

Detailed characterisation of the precipitates, containing 0.00-1.17wt% Ni and 0.00-0.07wt% Co, suggests that the loss of nickel and cobalt through precipitation of their hydroxides is unlikely during partial neutralisation. Similarly, adsorption onto freshly precipitated aluminium products was also identified to be an unlikely mechanism for metal losses. Instead, nickel was found to be uniformly enriched within a hydrated aluminium sulfate-hydroxide phase closely resembling Felsőbányaite (formerly basaluminite), $Al_4(SO_4)(OH)_{10}{\cdot}4H_2O$, *suggesting that nickel (and likely cobalt) is incorporated into this phase, making it the likely primary mechanism for metal losses during partial neutralisation. Occlusion of aqueous* *solution (leach liquor) containing nickel and cobalt was determined to likely be a minor mechanism for metal deportment during partial neutralisation.*

KEYWORDS

Partial neutralisation, precipitation, nickel laterite, nickel, cobalt

BIOGRAPHY

Udari is a PhD candidate at RMIT University working, in collaboration with Queensland Pacific Metals Ltd., on establishing the fundamental chemistry and engineering principals of the TECH Project. Her research focuses on the precipitation of key metals (Al, Ni and Co) during partial neutralisation of nickel laterite ore leach liquors.

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