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Selective recovery of nickel, cobalt and copper from ammonia glycine pregnant leach solution

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ABSTRACT

Driven by the explosive demand of lithium-ion batteries for energy storage and electric vehicles in last a few decades, the selective recovery of the core metals such as nickel, cobalt and lithium from primary ores, concentrates, tailings and wastes has become a focus of much research. While sulphuric acid system or hydrochloride system is more commonly used for nickel and cobalt leaching, The ammonia glycine system has been selected for efficient leaching of nickel, cobalt and copper while a considerable number of impurities are also co-leached. Solvent extraction is one of the most attractive, approachable and reliable technologies due to the high reliability, easy operation, small footprint, and low capital and operating costs, this study aimed to recover nickel, cobalt and copper from the co-leached metals from the ammonia glycine system using solvent extraction. Among several available extractants, hydroxy-oximes such as LIX84-IC was selected for its strong extractability and good selectivity in the relevant pH range.

This study investigated the extraction kinetics and isotherms of nickel, cobalt and copper in ammonia glycine solution using LIX84-IC and developed a feasible method to separate valuable metals. The kinetic and isotherm models have been developed in understanding the extraction mechanisms of nickel, cobalt and copper and assisting the predictions of the reaction time, extraction efficiency and loading capacities of different amounts of extractant. The experimental results showed that LIX84-IC performed well as strong extractability for copper and nickel, with copper preferential to nickel and cobalt. The separation of copper and nickel can be achieved by stagewise extraction at two different pH, and the separation of three target metals from impurity metals is feasible with pH control.

This work provides a feasible and efficient pathway to purify and concentrate the critical target metals from ammonia glycine pregnant leach solutions. The kinetic and isotherm models developed enable to predict the required extraction time, the distribution ratios, the concentrations in two immiscible phases, the maximum metal loading capacity determined by the volume ratio of the extractant. These are of significance in developing a customized process for specify feed pregnant leach solution and in upscaling the whole process.

KEY WORDS

critical metals, solvent extraction, kinetics, thermodynamics, ammonic glycine leaching

BIOGRAPHY

Dr Wen Li is a Research Fellow in the Advanced Separations Group at University of Melbourne. Her research focuses on the recovery and purification of critical metals and bioactive compounds using advanced separation technologies, particularly solvent extraction. She received her Master's degree in Materials Engineering from the University of British Columbia and completed her PhD at University of Melbourne, where she worked on pulse solvent extraction column design and modelling. Dr Li collaborates extensively with industry partners and worked on several ARC hubs and projects for developing industrial processes, process models and techno economic analysis and designing large scale reactors.

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