Advancing In-Place Recovery (IPR): Innovations in Underground Leaching Operations for Sustainable Mineral Extraction

A. Hassanvand[1], P. Dare-Bryan[2], Zh. Wang[3] and D. Hunter[4]

1. Senior Research Engineer, Orica Australia, Kurri Kurri NSW 2327. Email: armineh.hassanvand@orica.com
2. Senior Research Fellow, Orica Australia, Perth WA 6007. Email: peter.dare-bryan@orica.com
3. Research Fellow, School of Chemical Engineering, The University of Adelaide, Adelaide SA 5000. Email: zhihe.wang@adelaide.edu.au
4. Senior Metallurgist, Core Resources, Albion QLD 4010. Email: dhunter@coreresources.com.au

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ABSTRACT

Underground mining operations are adopting innovative technologies to address the growing need for critical minerals while upholding sustainability goals. Among these, underground leaching operations are gaining more attention in recent years due to their capacity for low cost and low environmental footprint mineral extraction. In contrast to In-Situ Recovery operations, which dominate global uranium production and favour permeable deposits, In-Place Recovery (IPR) targets hard rock formations with limited natural permeability. IPR involves blasting a stope, using a lixiviant to dissolve metal-bearing minerals, and pumping the solution to the surface for processing. It is a form of "solution mining," distinct from milling/smelting, with benefits like safety, energy efficiency, and lower costs, enabling recovery from low-grade deposits and flexibility in reaction to volatile markets. Blasting plays a critical role in generating small rock fragments to increase contact between the ore and the lixiviant. Supported by a Cooperative Research Centres Projects (CRC-P) grant, Orica is partnering with leading industries and research institutions in this field to assess the viability of IPR as an eco-friendly solution through lab experiments, precise modelling, and field demonstrations. The primary objective is advancing the Technology Readiness Level for critical mineral extraction to enable commercial deployment. This involves foundational research on blast optimization for IPR, effective mineral leaching methods, and hydro-thermo-chemical fluid flow modelling, culminating in proof-of-concept field trials at partner mine sites to validate the selected technologies against real-world data. This initiative promotes the acceptance and adoption of IPR as a sustainable mining method, which has the potential to significantly contribute to underground operations achieving a net zero target by 2050.