Recovery of nickel-cobalt mixed hydroxide from laterites through HCl leaching route

*Goutam Das1, Li Zeng2, Chamika Yapa Appuhamilage Don3, Sean Paton4, Yoko Pranolo5, Keith Barnard6 and Joanne Loh7*

1. Principal Research Scientist, CSIRO Mineral Resources, Waterford, WA 6152, Australia. Email: [goutam.das@csiro.au](mailto:goutam.das@csiro.au)
2. Research Scientist, CSIRO Mineral Resources, Waterford, WA 6152, Australia. Email: [li.zeng@csiro.au](mailto:li.zeng@csiro.au)
3. Senior Experimental Scientist, CSIRO Mineral Resources, Waterford, WA 6152, Australia. Email: [chamika.yapaappuhamilagedon@csiro.au](mailto:chamika.yapaappuhamilagedon@csiro.au)
4. Research Technician, CSIRO Mineral Resources, Waterford, WA 6152, Australia. Email: [sean.paton@csiro.au](mailto:sean.paton@csiro.au)
5. Research Technician, CSIRO Mineral Resources, Waterford, WA 6152, Australia. Email: [yoko.pranolo@csiro.au](mailto:yoko.pranolo@csiro.au)
6. Group Leader, CSIRO Mineral Resources, Waterford, WA 6152, Australia. Email: [keith.barnard@csiro.au](mailto:keith.barnard@csiro.au)
7. Group Leader, CSIRO Mineral Resources, Waterford, WA 6152, Australia. Email: [joanne.loh@csiro.au](mailto:joanne.loh@csiro.au)

Keywords: Nickel laterites, hydrochloric acid leaching, nickel-cobalt recovery, mixed hydroxide precipitate.

# ABSTRACT

The exploitation of laterite resources for the recovery of nickel and cobalt (Ni/Co) has increased significantly over the last two to three decades due to the depletion of nickel sulphide deposits. Laterite processing has been explored through different mineral acids (sulphuric, nitric, hydrochloric) using different techniques such as heap leaching, atmospheric leaching and high-pressure acid leaching (HPAL). HPAL with sulphuric acid has been successfully established for commercial operations. The nitric and hydrochloric acid routes are mainly explored through atmospheric leaching, due to the more corrosive nature of these acids that obviates the need for pressure. These routes are yet to be established as commercially viable options for reasons that include materials of construction requirements and/or acid cost.

Recently, CSIRO has developed a novel process for nickel laterite processing using hydrochloric acid (HCl) leaching to produce high purity Ni/Co mixed hydroxide. The process has been shown to be applicable to a variety of lateritic ores such limonite, smectite and saprolite, with the leaching stage occurring at atmospheric conditions below 100 °C using <25% w/w HCl. The Fe(III) in the pregnant leach liquor is reduced to Fe(II) enabling removal of aluminium/chromium/copper by precipitation (through pH increase). Nickel and cobalt are then precipitated by further increases in pH, along with the majority of Fe(II) to generate a Fe/Ni/Co solid. The presence of ferrous hydroxide in this solid enables partial removal of iron via selective redissolution, after which the residual solid is further treated through selective pH dissolution steps, followed by Fe removal to generate a Ni/Co rich solution for enabling precipitation of high purity mixed hydroxide by lime addition. The Fe/Ni/Co-free process liquor is treated for removal of manganese and magnesium, realising a calcium chloride-rich liquor that, through the addition of sulphuric acid, regenerates HCl for reuse in the leaching stage, along with generation of a high-quality calcium sulphate (anhydrite) precipitate.