

# Selective separation of cobalt versus nickel by split-phosphinate complexation using a phosphonium-based ionic liquid

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### Abstract:

The rising demand of metals for batteries is calling for advanced methods to separate metallic mixtures in mineral ores and electronic waste. In particular, the extraction in separate form of nickel and cobalt are focusing attention because these metals are used in cathodes of lithium-ion batteries. Here we developed the selective separation of cobalt versus nickel using a green ionic liquid, trihexyl(tetradecyl)phosphonium bis-2,4,4-(trimethylpentyl)phosphinate, from an HCl leached solution of spent lithium-ion batteries. More than 99% of cobalt was selectively extracted versus nickel at ionic liquid concentration of 0.8 mol/L, chloride ion concentration of 3.0 mol/L, equilibrium pH of 5.0, temperature of 333 K, and organic-to-aqueous phase ratio of 2/3. The corresponding separation factor of cobalt-to-nickel is 1097. Recovery of cobalt back in the aqueous phase was achieved by stripping with 2.0 mol/L H<sub>2</sub>SO<sub>4</sub>.

### Keywords

**Author Keywords:** Liquid; Liquid extraction; Critical metals; Cobalt-nickel separation; Ionic liquid

**Keywords Plus:** SOLVENT-EXTRACTION; RECOVERY; CHLORIDE; NI(II)

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