Lithium recovery from high grade, low grade and altered spodumene ores

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ABSTRACT

The conventional process for extracting lithium from spodumene includes decrepitation, sulphuric acid baking and water leaching. Early process development has mainly relied on material from a single mine and the process is thus designed for concentrates of specific mineralogical and chemical composition. Yet, the predicted growth in lithium demand for battery manufacturing requires lithium extraction from lower grade sources. It is thus critical to understand how low grades and alteration of spodumene affect the lithium extraction process.

Here, we characterise low and high-grade spodumene ores and concentrates of different alteration stages from the Greenbushes, Bald Hill, and Mount Marion pegmatites in Western Australia and investigate their behaviour during conventional lithium extraction. Calcination at 1050 °C and 60 min. results in full conversion to *β*-spodumene for the high-grade and unaltered concentrate. Subsequent acid bake and water leach yield high lithium recovery. Spodumene in low-grade ores is effectively converted from *α*- to *β*-phase but lithium recoveries during leaching are lower than for the high-grade material. Calcines of altered ores contain *β*-spodumene particles that are partly or fully encapsuled by a glassy K, Mg, Na, and Fe-bearing aluminosilicate phase. The glassy phase remains after leaching, consistent with lower lithium recoveries from altered ores compared to the high-grade material.

High-grade, un-altered spodumene concentrates provide ideal conditions for the conventional lithium extraction process to reach maximum lithium recoveries. However, our work shows that issues, such as clinker formation during calcination, have a significant impact on lithium recoveries from low grade or altered spodumene ores and concentrates. Adaption of the conventional process or the development of a new process that can accept a wider range of source materials is thus required to meet the increasing demand for lithium.