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Development of Mineral Carbonation Process from Ultramafic Tailings, Enhancing the Reactivity of Feedstocks

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Abstract : The mineral carbonation approach for reducing global warming has garnered interest on a worldwide scale. Due to the benefits of permanent storage and abundant mineral resources, mineral carbonation (MC) is one of the most effective strategies for sequestering CO_2. The combination of mineral processing for primary metal recovery and mineral carbonation for carbon sequestration is an emerging field of study with the potential to minimize capital costs. A detailed study of low-pressures–solid carbonation of ultramafic tailings in a dry environment has been accomplished. In order to track the changing structure of serpentine minerals and their reactivity as a function of temperature (300-900 ^oC), CO_2 partial pressure (25-90 mol %), and thermal preconditioning, thermogravimetry has been utilized. The incongruent CO_2 van der Waals molecular diameters with the octahedral-tetrahedral lattice constants of serpentine were used to explain the mild carbonation reactivity. Serpentine requires additional thermal-treatment to remove hydroxyl groups, resulting in the chemical transformation to pseudo-forsterite, which is a mineral composed of isolated SiO_4 tetrahedra linked by octahedrally coordinated magnesium ions. The heating treatment above 850 ^oC is adequate to remove chemically bound water from the lattice. Particles with a diameter < 34 (μm) are desirable, and thermally treated serpentine at 850 ^oC for 2.30 hours reached 65% CO_2 storage capacity. The decrease in particle size, increase in temperature, and magnetic separation can dramatically enhance carbonation.

Keywords : particle size, thermogravimetry, thermal-treatment, serpentine
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