Chemeca2026
Innovate. Integrate. Impact.
28 – 30 September 2026
Melbourne, Australia

Hazards Australasia 2026

Chemeca 2026 and Hazards Australasia
28 – 30 September, Melbourne, Australia

Enhanced Kinetics of CO_2 Mineralisation in Iron-based Cement

Chichi Zhang, Johann Land, Matthew Watson, Ben Yin, Matthew Cowan

Chemical and Process Engineering, University of Canterbury

chichi.zhang@canterbury.ac.nz

ABSTRACT

Global warming, driven by excessive greenhouse gas emissions, has intensified efforts to develop technologies for carbon sequestration, utilisation and storage. The cement industry is a major contributor to global CO_2 emissions, primarily due to limestone calcination ($CaCO_3 \rightarrow CaO + CO_2$) and the fossil fuel consumption required for clinker production. Recently, carbonatable building materials, such as Fe-based cement, have emerged as promising alternatives to conventional Portland cement. Unlike Portland cement, which gains strength through hydration reactions, iron-based cement relies on a carbonation process in which dissolved Fe^{2+} reacts with carbonate ions to form $FeCO_3$ precipitates ($Fe^{2+} + CO_3^{2-} \rightarrow FeCO_3(s)$). Previous studies have demonstrated that the distribution and precipitation of $FeCO_3$ were associated with hardness development in the iron-based cement system. In this study, the carbonation-driven curing process was further investigated using two representative iron sources with significantly different dissolution behaviours. In-situ X-ray diffraction (XRD) was employed to track the evolution of carbonate phases, revealing CO_2 uptake kinetics. To elucidate the key factors governing carbonation performance, the physicochemical properties of the iron sources were subsequently compared using a range of experimental methods, including particle size analysis, electrochemical measurements and X-ray photoelectron spectroscopy (XPS). The results showed that the variation in carbonation performance was independent of particle size and surface area but was primarily influenced by electrochemical properties and surface reactivity. This work provides insights into iron source selection for effective CO_2 capture, utilisation and storage in carbon-storing construction materials.

KEY WORDS

Iron-based cement, iron carbonate, iron corrosion, carbon sequestration and utilisation

BIOGRAPHY

Dr Chichi Zhang is a postdoctoral research fellow in the Department of Chemical and Process

Engineering (CAPE) at the University of Canterbury, New Zealand, where she conducts research on CO_2-storing iron-based cement. She received her PhD from CAPE, University of Canterbury and Bachelor's degree in Materials Science and Engineering from Tongji University, China. She specialises in advanced materials characterisation and engineering with publications in prestigious scientific journals such as *Energy* and *International Journal of Hydrogen Energy*.

CONFERENCE PROGRAM

Please indicate which conference program your abstract relates to:

☐ Hazards Australasia

☒ Chemeca