

# Corrosion Behaviour of Reinforced Steel in LC3 and OPC Simulated Pore Solutions

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## Abstract

Carbonation, a process in which atmospheric CO<sub>2</sub> reacts with the alkaline components of concrete, reduces the pH of the pore solution from values above 12 to around 9. This reduction in pH can compromise the passive layer on the embedded steel surface and significantly increase the risk of corrosion, especially in combination with chlorides. <sup>1</sup> A promising alternative to ordinary Portland cement (OPC) is limestone calcined clay (LC3) cement, which significantly reduces environmental impact, primarily through lower CO<sub>2</sub> emissions. However, OPC and LC3 differ in cement composition, microstructure and pore solution chemistry, which affects their carbonation behavior. LC3-based systems tend to carbonate more readily, potentially resulting in lower pH values. Simulated concrete pore solutions provide a controlled environment to study the corrosion characteristics of steel under conditions relevant to both OPC and LC3 systems before and after carbonation. <sup>2</sup>

In this study, we investigated the corrosion behavior of carbon steel immersed in simulated non-carbonated and carbonated OPC and LC3 pore solutions. The corrosion behavior was evaluated using classical electrochemical techniques, including open-circuit potential (OCP), linear polarization (LPR), Tafel extrapolation, and potentiodynamic polarization. These results were complemented by measurements of temporal and spatial corrosion current distributions obtained using coupled multi-electrode arrays (CMEA), which provide additional insight into corrosion activity. All electrochemical measurements were performed in triplicate to ensure reproducibility and allow for statistical comparison. After electrochemical testing, the exposed steel surfaces were examined using optical microscopy to assess the extent and morphology of corrosion damage.

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2. R. Hay, K. Celik, *Construction and Building Materials* **2024**, 429, 136428.