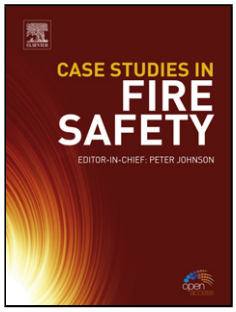

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Degradation of concrete with addition of mineral admixture due to free chloride ion penetration under the effect of carbonation

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Highlights

- Free Cl^- content in concrete was determined by embedded Cl^- selective electrodes.
- Penetration of free Cl^- in carbonated or uncarbonated concrete follows Fick's second law.
- The ability of carbonation to resist penetration of Cl^- is stronger than that to promote Cl^-.
- Concrete after carbonation has a higher risk of inducing steel corrosion.

Abstract

The free Cl^- diffusion law, binding Cl^- capacity and long-term reliability of electrodes in concrete were investigated under the effects of carbonation. Results reveal that the diffusion of free Cl^- in concrete with and without carbonation adheres to Fick's second law. Reducing ratio of water to binder and adding mineral admixture can decrease the free Cl^- diffusion coefficient. Although the ability of carbonation to resist the penetration of Cl^- is stronger than that to promote Cl^- erosion, concrete after carbonation has a higher risk of initiating steel corrosion. Improving the reliability and decreasing the cost of electrodes requires more research.

Keywords: Steel reinforced concrete; Reinforcement corrosion; Mineral admixtures; Chlorides; Carbonation.

1. Introduction

The durability of concrete structures has received considerable attention from both scientists and engineers, and steel corrosion has been regarded as the main cause leading to the degradation of durability in reinforced concrete [1]. Corrosion of steel in concrete can be initiated once chloride ion (Cl^-) in the vicinity of steel accumulates to a certain threshold value [2]. Therefore, effective ways of preventing and slowing down corrosion-induced damage in concrete structures include monitoring the ingress of deleterious species from the external environment, selecting appropriate concrete mix designs, managing the concrete surface, and using corrosion inhibitors [3-8]. Among these methods, monitoring the invasion of Cl^- content in concrete has been highlighted for reinforced concrete subject