Performance of Conventional Portland Cement and Calcium Silicate Based Carbonated Cementitious Systems During Freezing and Thawing in the Presence of Calcium Chloride Deicing Salts

This paper examines the behavior of two different cementitious materials during thermal changes associated with freezing and thawing in the presence of calcium chloride (CaCl₂) deicing salts. The two systems consist of a conventional portland cement based material and an alternative economically friendly cement that forms a solid by carbonating a Calcium Silicate based Cement (CSC). Low Temperature Differential Scanning Calorimetry (LT-DCS) is used to quantify the phase changes associated with ice formation, eutectic solution transformation and calcium oxycarbonate formation. Longitudinal guarded comparative calorimetry (LGCC) was used to detect the damage that develops due to the expansive pressures created by these phases when they form. In both systems exposed to low salt concentration the damage is primarily due to hydraulic and osmotic pressure. This type of damage is moderate at low degrees of saturation (e.g., < 90%), however, as the degree of saturation increases so does the damage. In conventional cementitious systems at higher salt concentrations the damage that develops is mainly due to the formation of calcium oxycarbonates. However, in the cementitious materials made by carbonating CSC, calcium hydroxide is not present, therefore at higher salt concentrations calcium oxycarbonate does not form and as a result no damage develops.

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