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# Flexural strength reduction of cement pastes exposed to $CaCl_2$ solutions

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**Abstract**

Calcium chloride ($CaCl_2$) can react with calcium hydroxide ($Ca(OH)_2$) to form calcium oxychloride which can reduce flexural strength and damage concrete. This paper aims to characterize the reduction in flexural strength of cement pastes exposed to $CaCl_2$ solutions using the ball-on-three-ball test. The amounts of $Ca(OH)_2$ and calcium oxychloride in the cement paste are measured using thermogravimetric analysis and low-temperature differential scanning calorimetry, respectively. The volume change that occurs as a result of the reactions between the cement paste and $CaCl_2$ is also measured. The reduction in flexural strength increases as the concentration of the $CaCl_2$ solution increases and the exposure temperature decreases. The flexural strength reduction can be mitigated by increasing the amount of supplementary cementitious materials (fly ash) in the cement pastes. Lowering the water-cementitious materials ratio also reduces the flexural strength reduction. The flexural strength reduction is correlated with the amount of calcium oxychloride and the volume change in the cement paste exposed to the $CaCl_2$ solution. While the flexural strength reduction is believed to be primarily due to the formation of calcium oxychloride, the formation of Friedel's salt and Kuzel's salt also results in volume change which and could contribute to the flexural strength reduction.