

Title

Resistance of cementitious materials to sulfate attack: quantifying performance with a reliable unidirectional approach

Abstract

Concrete degradation due to sulfate attack from external sulfate sources has been investigated for decades, but the focus remained mainly on fully-immersed exposure in which the chemical sulfate attack is dominant. Therefore, the deterioration mechanisms of chemical sulfate attack were relatively clearly determined in previous research. However, the physical sulfate attack (which takes place predominantly in practical engineering contexts), is not well understood and even confused with the chemical attack. Thus, the causes and mechanisms of the physical sulfate attack are still debated. To mimic field conditions, a rigorous semi-immersion approach has to be established. Therefore, a new setup was designed to study both types of sulfate attack under unidirectional sulfate diffusion with controlled conditions: solution concentration, relative humidity, temperature conditions, etc.

Different types of cement systems are considered in this study, e.g., ordinary Portland cement, high sulfate resistant cement and limestone calcined clay cement. The aim is to investigate the attack mechanisms in a variety of mineralogical composition and porous networks, as these parameters are involved in the physiochemical reactions of sulfate attack. Because chemical and sulfate attack can happen simultaneously but on different regions of the same sample, mutual influences may occur between the two mechanisms, which has not yet been discussed. The work will focus on two main objectives: (1) understand the causes and mechanisms of physical sulfate attack under unidirectional ionic penetration; (2) find a reliable way to comprehensively characterize sulfate attacks on cementitious materials.