

ELECTROCHEMICAL CHARACTERISATION OF CEMENT HYDRATION AND PROPERTIES BY ALTERNATING CURRENT IMPEDANCE SPECTROSCOPY

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The complexity of the chemical and microstructural evolution of cement during the hydration process can be evaluated using many different characterisation techniques. One of these techniques which has been demonstrated to be useful, but not yet fully accepted by the cement research community, is Alternating Current Impedance Spectroscopy (ACIS). However, although ACIS is a non-destructive, rapid, and easily implemented technique, it has been found in the past that it has several limitations such as electrode contact, electrode area dependence, ground coupling effects, complications due to inductance at high frequencies, and a lack of mathematical and physical rigour in much of the data interpretation.

This study assesses ACIS as a characterisation technique to evaluate the early hydration process of white Portland cement (WPC) pastes blended with ground-granulated blast-furnace slag (GGBS), by comparison with data obtained from isothermal calorimetry and other analytical techniques. Points addressed include the electrochemical cell setup, the inductance behaviour and the resistivity changes observed during the impedance measurements, and the impact of the addition of GGBS throughout the WPC hydration process, from the fresh to the hardened state. The results show a correlation between the heat of hydration observed in the calorimetric curves and the impedance measurements, which could be used as a new approach to evaluate the early cement hydration process. Inductance behaviour observed in the impedance measurement during the early cement hydration process needs further investigation.

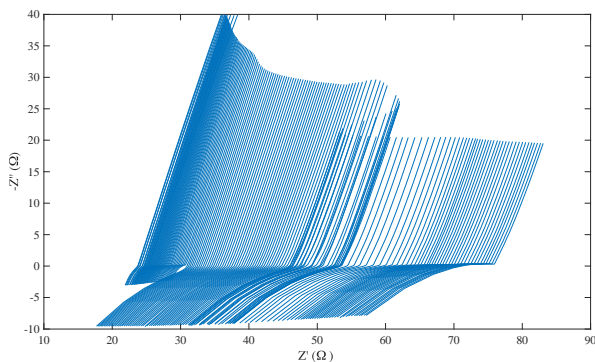


Fig 1. Impedance response for WPC over 24

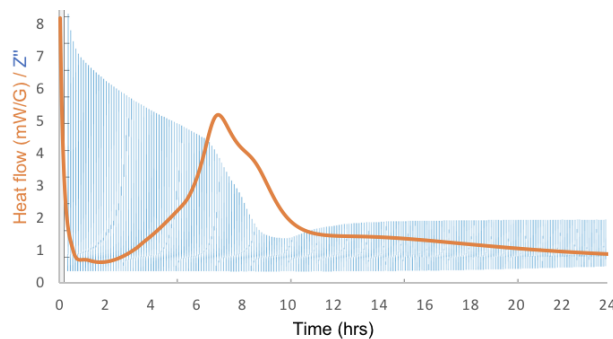


Fig 2. Impedance response (decreasing curve) against hydration curve (increasing curve) for WPC over 24 hours.