Study of the Cement Hydration Processes in Coal Metakaolin and Cement Blends by Electrochemical Impedance Spectroscopy

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The hydration process of cement materials with coal metakaolin (CMK) was investigated by electrochemical impedance spectroscopy (EIS) using a new equivalent circuit model in this study. The results suggested that the electrochemical impedance characteristics of blended cement materials vary significantly with the content of CMK. The impedance parameters R_s and R_{ct1} associated with the changes in the cement microstructure increased with increasing hydration time and CMK content across the entire hydration process. Additionally, the fractal dimension d , which characterizes the complexity and density of the pore structure, showed a trend similar to those of the above impedance parameters, but the fractal dimension d_s , which characterizes the surface properties of the pore structure, showed the opposite trend. In addition, there was a significant correlation between the impedance parameter R_{ct1} and the compressive strength of the blended cements with different CMK contents and hydration times.

Keywords: hydration process; electrochemical impedance spectroscopy; coal metakaolin; compressive strength

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