Abstract

The growing demand for low-carbon construction materials has driven significant changes in the composition of Portland cements, including increased incorporation of supplementary cementitious materials (SCMs) and reduced clinker content. While these strategies contribute to lowering CO_2 emissions, their effects on fiber-cement manufacturing through the Hatschek process remain poorly understood, particularly when combined with the use of recirculated process water. This study investigates the influence of different Portland cements used in fiber-cement production on hydration kinetics in systems containing process water collected from an industrial fiber-cement plant. Cements with distinct chemical compositions and physical characteristics, representative of products currently available in the Brazilian market, were selected. The process water was chemically characterized and compared with deionized water used as a reference. Hydration was monitored using isothermal calorimetry, in situ X-ray diffraction, and thermogravimetric analysis, allowing the assessment of hydration reaction development and hydrated phase formation. The results showed that the chemical composition of the process water significantly affects the early hydration of cementitious systems, influencing the induction period, heat release rate, and development of hydration products. The magnitude of these effects varied according to the characteristics of the cement, indicating a strong interaction between binder composition and the chemistry of the water recirculation circuit. The findings highlight the need for specific criteria for selecting Portland cements for the Hatschek process, considering not only conventional properties but also their compatibility with process water and low-carbon manufacturing strategies.