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Title: Early-stage dissolution behavior of MgO-clay-based cement

Abstract: Magnesia-based cement emerges as a promising alternative to traditional OPC due to its lower carbon emissions in manufacturing and its potential for application in nuclear waste disposal, owing to its compatibility with low-pH environments. The dissolution behavior of magnesia-clay-based cement is significantly influenced by pH levels. In this study, acidic citric acid and alkaline sodium carbonate admixtures were employed to investigate the early-stage (first 48 hours) dissolution characteristics of MgO-clay-based cement. The phase assemblage of MgO-clay-based cement during hydration was examined by utilizing semi-in-situ quantitative X-ray diffraction and solid-state ^{27}Al, ^{29}Si Nuclear Magnetic Resonance spectroscopy. Moreover, time-dependent analyses of suspension samples (comprising Mg, Si, Al, and Ca ions) were conducted to elucidate the mechanism underlying the early-stage dissolution of MgO-clay-based cement with citric acid or sodium carbonate addition. The findings indicate that metakaolin dissolution necessitates dissolved Mg^{2+} species, while citric acid/sodium carbonate addition can disrupt the nucleation/staking process of brucite (Mg(OH)2) nanosheets through distinct mechanisms.

Keywords: Magnesia, Clay, Dissolution; Citric acid; Sodium carbonate.