

²⁹Si MAS-NMR study of hydrated cement paste and mortar with varying content of fly ash

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Abstract: This study presents ²⁹Si magic-angle-spinning nuclear magnetic resonance (MAS-NMR) measurements that trace the cement hydration process in both cement paste as well as mortar specimens made from Type I ordinary Portland cement, when the cement content was replaced by 0, 20, 40, 55 and 70% by weight of high lime fly ash. The specimens were cured by continuous immersion in potable water for 3, 7, 14, 28, 90 and 180 days at a laboratory temperature of 21°C (69.8°F). The results show that values of the degree of hydration (%) and the compressive strength generally decreased with increasing content of high lime fly ash. Beyond 28 days of curing time, a progressive increase in the degree of hydration (%), that was comparable with that of the control specimens occurred in the cement paste specimens containing 20, 40, and 55% high lime fly ash. This indicates delayed pozzolanic reactivity of the high lime fly ash that started after 28 days of curing time and reached optimal value at 90 days of curing time. Moreover, throughout the curing ages of this study, the cement paste as well as the mortar specimens containing 20% high lime fly ash indicated values of degree of hydration (%) and compressive strength that were close and comparable with those of the control specimens without high lime fly ash.