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Carbonation and Mechanical Performance of Reactive Magnesia Based Formulations

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Abstract : Reactive MgO hydrates to form brucite (Mg(OH)2, magnesium hydroxide), which can then react with CO2 and additional water to form a range of strength providing hydrated magnesium carbonates (HMCs) within cement-based formulations. The presented work focuses on the use of reactive MgO in a range of concrete mixes, where it carbonates by absorbing CO2 and gains strength accordingly. The main goal involves maximizing the amount of CO2 absorbed within construction products, thereby reducing the overall environmental impact of the designed formulations. Microstructural analyses including scanning electron microscopy (SEM), X-ray diffraction (XRD) and thermogravimetry/differential thermal analysis (TG/DTA) are used in addition to porosity, permeability and unconfined compressive strength (UCS) testing to understand the performance mechanisms. XRD Reference Intensity Ratio (RIR), acid digestion and TG/DTA are utilized to quantify the amount of CO2 sequestered, with the goal of achieving 100% carbonation through careful mix design, leading to a range of carbon neutral products with high strengths. As a result, samples stronger than those containing Portland cement (PC) were produced, revealing the link between the mechanical performance and microstructural development of the developed formulations with the amount of CO2 sequestered.

Keywords : carbonation, compressive strength, reactive MgO cement, sustainability
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