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Influence of CO_2 on the Curing of Permeable Concrete

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Abstract : Since the mid-19th century, the boom in the economy and industry has grown exponentially. This has led to an increase in pollution due to rising Greenhouse Gas (GHG) emissions and the accumulation of waste, leading to an increasingly imminent future scarcity of raw materials and natural resources. Carbon dioxide (CO_2) is one of the primary greenhouse gases, accounting for up to 55% of Greenhouse Gas (GHG) emissions. The manufacturing of construction materials generates approximately 73% of CO_2 emissions, with Portland cement production contributing to 41% of this figure. Hence, there is scientific and social alarm regarding the carbon footprint of construction materials and their influence on climate change. Carbonation of concrete is a natural process whereby CO_2 from the environment penetrates the material, primarily through pores and microcracks. Once inside, carbon dioxide reacts with calcium hydroxide (Ca(OH)2) and/or CSH, yielding calcium carbonates (CaCO3) and silica gel. Consequently, construction materials act as carbon sinks. This research investigated the effect of accelerated carbonation on the physical, mechanical, and chemical properties of two types of non-structural vibrated concrete pavers (conventional and draining) made from natural aggregates and two types of recycled aggregates from construction and demolition waste (CDW). Natural aggregates were replaced by recycled aggregates using a volumetric substitution method, and the CO_2 capture capacity was calculated. Two curing environments were utilized: a carbonation chamber with 5% CO_2 and a standard climatic chamber with atmospheric CO_2 concentration. Additionally, the effect of curing times of 1, 3, 7, 14, and 28 days on concrete properties was analyzed. Accelerated carbonation in-creased the apparent dry density, reduced water-accessible porosity, improved compressive strength, and decreased setting time to achieve greater mechanical strength. The maximum CO_2 capture ratio was achieved with the use of recycled concrete aggregate (52.52 kg/t) in the draining paver. Accelerated carbonation conditions led to a 525% increase in carbon capture compared to curing under atmospheric conditions. Accelerated carbonation of cement-based products containing recycled aggregates from construction and demolition waste is a promising technology for CO_2 capture and utilization, offering a means to mitigate the effects of climate change and promote the new paradigm of circular economy.

Keywords : accelerated carbonation, CO_2 curing, CO_2 uptake and construction and demolition waste., circular economy
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