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Comparison of Water Curing and Carbonation Curing on Mortar Mix Incorporating Cement Kiln Dust

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Abstract : Sustainable development is a key to protect the environment for a secure future. Accelerated carbonation curing is a comparatively new technique for curing of concrete which involves sequestration of carbon dioxide gas into the precast concrete, resulting in improvement of the properties of concrete. This paper presents the results of a study to evaluate the effect of carbonation curing on cement mortars incorporating cement kiln dust (CKD) as partial replacement of cement. The mortar specimens were prepared by replacing cement with CKD in varying percentages of 0-50% by the weight of cement. The specimens were subjected to 12 hour carbonation curing, followed by sealed packing till testing age. The results were compared with the normal curing procedure, in which the specimens were water cured till the testing age. Compressive strength and microstructure of the mix were studied. It was noted that on increasing the percentage of CKD up to 10% by the weight of the cement, no considerable change was observed in the compressive strength. But as the percentage of CKD was further increased, there was a decrease in compressive strength, with strength decreasing up to 40% when 50% of the cement was replaced with CKD. The decrease in strength is due to the lesser lime content in CKD as compared to cement. High ettringite formation was observed in mixes with high percentages of CKD, thus indicating a decrease in the compressive strength. With carbonation curing, an early age strength gain was observed in mortars, even with higher percentages of CKD. The early strength of the carbonation cured mixes was found to be greater than water cured mixes irrespective of the percentage of CKD. 7 days and 28 days compressive strength of the mix was comparable for both the carbonation cured and water cured specimen. The increase in compressive strength can be attributed to the conversion of unstable Ca(OH)2 into stable CaCO3, which causes densification of the mix. CaCO3 precipitation and greater CSH gel formation was clearly observed in the SEM images of carbonation cured specimen, indicating higher compressive strength. Thus, carbonation curing can be used as an efficient method to enhance the properties of concrete.

Keywords : carbonation, cement kiln dust, compressive strength, microstructure
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