Center for By-Products Utilization

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ABSTRACT

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This paper presents a detailed experimental study on the sequestration of carbon dioxide (CO_2) in concrete. Effects of carbonation on the properties of concrete made with or without fly ash was studied. Class C fly ash was used for partial replacement of cement. No-fines concrete was used. Three types of curing environments were used with varying relative humidity and CO_2 concentration: 100 % relative humidity and 0.15 % CO_2 concentration, 50 % relative humidity and 0.15 % concentration, and 50 % relative humidity and about 5 % CO_2 concentration. Two series of no-fines concrete mixtures were produced. They contained 0 and 16 % cement replacement with fly ash. Each of these two series of no-fines concrete included three mixtures with identical mixture proportions. Each of these three identical mixtures was cured in a different curing environment. Compressive strength, splitting tensile strength, and flexural strength tests were performed. A method to study the degree of carbonation of no-fines concrete by visual analysis was developed for this research. It was found that the rate of carbonation in concrete increased considerably at the relative humidity of about 50 % and high-CO_2 concentration of about 5 %. Using such accelerated carbonation conditions, a much higher rate of carbonation in concrete could be studied. Up to seven-day age, carbonation did not show significant effects on the physical properties of the no-fines concrete with or without fly ash but showed slight improvement in strength levels at the 28-day age. Curing of no-fines concrete in 50 % relative humidity resulted in lower rate of strength development. Sufficient initial curing was necessary for no-fines concrete for better rate of strength development. Replacement of cement with Class C fly ash by 16 % resulted in increased strength levels of no-fines concrete. Detailed results are presented for no-fines concrete with or without fly ash and its ability to sequester CO_2 from air.

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