CO_2 SEQUESTRATION IN NON-AIR ENTRAINED CONCRETE

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ABSTRACT

The objectives of this project were to sequester carbon dioxide (CO_2) in concrete and study the effects of carbonation on the properties of concrete made with or without fly ash. Class C fly ash was used for partial replacement of cement. In this research, one type of concrete was used: non-air entrained. 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. Three series of non-air entrained concrete mixtures were produced. They contained 0, 15, and 30 % cement replacement with fly ash. Each series of non-air entrained 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 on both types of concrete. Depth of carbonation and abrasion resistance tests were also performed on non-air entrained concrete.

As expected, for better strength development of concrete, sufficient initial curing was necessary. Also, as may be expected, relative humidity and CO_2 concentration in the curing environment were very important factors affecting the rate of carbonation in concrete. It was found that the rate of carbonation in concrete increased considerably at 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 achieved. Carbonation improved strength levels and abrasion resistance of non-air entrained concrete. Rate of carbonation in concrete containing fly ash was higher compared to the concrete without fly ash at lower relative humidity in the curing environment; and the rate of carbonation of fly ash concrete increased with increase in the percent of cement replacement with fly ash.