Pergamon

Cement and Concrete Research 32 (2002) 1993

CEMENT AND CONCRETE RESEARCH

Discussion

A discussion of the paper "Modeling the effects of solution temperature and concentration during sulfate attack on cement mortars" by M. Santhanam, M.D. Cohen and J. Olek [Cem Concr Res 32 (2002) 585–592]

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Received 16 April 2002

I was astonished that the authors did not provide the chemistry of the Type I cement used for their study. Surely, the C_3A content is a most important factor, and the equations might not apply at all to a Portland cement having a high $\bar{S}/C_3A$ ratio. At ratios above 2, which many cements now have, most of the ettringite production may have already occurred before exposure to sulfate solutions. Further, C_2S and C_3S amounts and ratios may greatly affect gypsum production.

About 65 years ago, Thorvaldson and Wolochow [1] placed pure cement compounds in sodium and magnesium sulfate solutions of about 10,0090 ppm sulfate concentration. There were enormous differences in expansions of the specimens depending on the presence or absence of C_3A. They, incidentally, also studied stem-cured specimens; those studies may have significant application to today's precast products.

Even earlier, Tuthill [2] investigated cements having various proportions of C_3S, C_2S C_3A and C_4AF. Great differences in performance were found, not only for C_3A concentration, but also for various ratios of C_3S to C_2S.

I note also that the authors use the term "sulfate attack" as is now, unfortunately, customary: meaning any effects caused by any sulfate salt. But, for example, gypsum (calcium sulfate) would not cause most of the effects that the authors model.

Certainly, the findings of Santhanam et al. are very interesting. But, any attempt to use their equations must rest on further work showing their limits.

References

[1] T. Thorvaldson, D. Wolochow, The action of sulfate solutions on steam-cured composite cement mortars, Proc. Am. Conc. Inst. 34 (1938) 241–265.

[2] L. Tuthill, Resistance of cement to the corrosive action of sodium sulfate solution, Proc. Am. Conc. Inst. 33 (1936) 83–106.

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PII: S0008-8846(02)00899-2