Pergamon

Cement and Concrete Research, Vol. 26, No. 11, p. 1745, 1996

0008-8846/96 $15.00 + .00

PII S0008-8846(96)00165-2

LETTER TO THE EDITOR

ETTRINGITE TECHNOLOGY

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The letter from Fu and Beaudoin* dealt with part of this subject. I would like to carry the discussion to cover a slightly wider area. I suggest that one can usefully classify the ettringite that is found in products made using hydraulic cements into four classes: primary, secondary, early, and late. I further suggest that only late primry ettringite is associated with deterioration, and such deterioration is what has long been known as sulfate.

Early ettringite is ettringite that is formed intentionally early in the life of cementitious systems during that part of the history of the system when the issue of whether or not the process is expansive ("nonaccommodative") is irrelevant since the matrix is not brittle enough to crack. The ingredients that combine to form the ettringite were not previously assembled as ettringite so the product is primary as well as early.

Early primary ettringite is the only ettringite in most concrete. If concrete is damaged due to any process that induces significant cracking and thereafter is left out in the rain, or otherwise gets wetted and dried, the early primary ettringite will partially dissolve and precipitate as tufts of acicular crystals in cracks and voids. Most optical photomicrographs labelled "ettringite" are of such secondary ettringites. Its precipitation causes no damage to concrete.

Late primary ettringite has been known for a long time, in early days as the "cement bacillus." It is the culprit in sulfate attack. It forms when sulfate ions in solution react topochemicaly, in situ, with unsulfated or undersulfated calcium aluminates or aluminoferrites or chemically active alumina-bearing constituents of some fly ashes. If the sulfate ions in solution come from outside the concrete, the process is classic, traditional sulfate attack. If the sulfate ions in solution are from sulfate that was in the concrete as batched, mixed, and placed, the process may be called "delayed ettringite formation."

Since ettringite, strickly speaking, is a mineral, i.e., a naturally formed substance, I do not believe it is desirable to use terms such as "primary" and "secondary" with meanings other than those that are used in mineralogy; i.e., "Primary—characteristic of or existing in a rock at the time of its formation. Secondary—applied to rocks and minerals formed as a consequence of the alteration of pre-existing minerals." (Glossary of Geology, American Geological Institute, 1957.)

*Vol. 26, No. 6, p. 979, 1996.