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Reply to Discussion by W.G. Hime on "A state-of-the-art review of delayed ettringite attack on concrete" [Cement & Concrete Composites 25 (2003) 401–407] ☆

I completely agree with the conclusions of Dr. Hime and his colleagues: "*We must advance the State-of-the-Art*". The following comments to their four specific questions confirm this statement. Indeed, my comments are all based on my further research studies on this subject (pre-announced through Ref. [15] of my paper) which will be published within few months [1].

(1) Higher temperatures (>70 °C) cause dissociation of already formed ettrigite. The lower temperatures reported to cause DEF related to internal sulphate attack (ISA) are not confirmed by these studies [1]: presently ISA-related DEF expansion does not occur, after about 2 years of permanent exposure to water, in concrete specimens cured at room temperature (25 °C), independently of the sulphate content in cement (SO_3: 2.60–4.20%) or clinker (SO_3: 1.02–2.15). The exposure at longer times than 2 years will be published later.

(2) The SO_3 content is a very important parameter and when it is more than 4% it can cause ISA-related DEF expansion provided that the curing temperature is higher than 70 °C and concrete is exposed to wet conditions [1].

(3) At a given total SO_3 content in cement (for instance: 4%), the use of sulphur-rich clinker (SO_3: 2%) causes ISA-related DEF expansion more quickly with respect to clinker with lower sulphur content (SO_3: 1%).

(4) Pre-existing microcracks accelerate the ISA-related DEF expansion. However, in the absence of pre-existing cracks, this expansion can start but at longer ages of permanent wet exposure [1]. Therefore, I agree with the statement by Dr. Hime and his colleagues: "*ASR and microcraking may promote DEF, but neither are necessary*". On the other hand, I do not agree with their conclusion that for DEF "*nor may high temperature be required*", if it refers to ISA-related DEF expansion. This statement by Dr. Hime could be acceptable only for ESA-related DEF expansion.

Reference

[1] Collepardi M, Ogoumah Olagot JJ, Salvioni D, Sorrentino D. DEF-related expansions of concrete as a function of sulfate content in the clinker phase or cement and curing temperature. Accepted paper for the Proceedings of the CANMET-ACI Conference "Recent Advances in Concrete Technology", Las Vegas, USA, 26–29 May 2004.

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