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Discussion

Reply to the discussion by H. Vaupel and I. Odler of the paper "Microstructural investigations on aerated concrete"☆

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The main objective of the investigation of phase composition presented in this paper was to substantiate the extensive microstructural observations and establish correlation with observed mechanical behavior.

In the XRD pattern of moist-cured aerated concrete with sand, the presence of a few weakly crystalline phases of C-S-H were observed and as pointed out in the discussion the presence of portlandite has also been indicated. It has been mentioned in the paper that all mixtures contained lime to augment aeration (lime/cement ratio = 0.25) and obviously high lime–silicates (C/S of the order of 1.5 to 2) have been formed contrary to the C-S-H systems formed from cement alone as starting lime-bearing material.

As brought out in the discussion, quartz phase will be present in non-autoclaved siliceous systems. The non-reference of quartz in the XRD diagrams was because it was not considered pertinent to the issues discussed in this paper.

The weakly crystalline C-S-H phases present in mixtures of fly ash also can be attributed to the additional amount of lime that was added to facilitate aeration.

The hydrogarnet and ettringite phases observed are in mixtures with fly ash (the term "ettringite" inadvertently got included in the XRD of AAC with sand. Instead, this reference should have been included in the XRD of AAC with fly ash. This aspect, however, has been referred correctly in the text in paragraph 1 of page 461).

With a view of presenting only the data pertaining to the main objective of the investigation, several details including the mineralogical composition of fly ash, formation of hydroxyl-ellestadite and anhydrite were not included. The XRD investigations were carried out at a 2θ interval of 5°, as is required to establish the presence of tobermorite phase. However, since the charts had to be compressed, the axes needed editing and thus only intervals of 10° appear in the charts. Emphasis has been given to the identification of strength imparting phases in aerated concrete rather than the determination of all the phases present in the component materials. The authors regret that the whole discussion on the paper revolves around the two XRD diagrams leaving the microstructure–property relationship, which is the focal issue of the paper.

As to the doubt expressed in the discussion on the existence of any other high lime–silicates other than tobermorite, it is reiterated that the additional lime added to the mixture aids the formation of C-S-H phases with C/S ratio >1.0. This is the reason why the laboratory studies of the authors of discussion revealed the existence of tobermorite only.

Generally, an increase in strength would be observed when sand is replaced by fly ash, provided the comparison is made at the same density. This is especially true for moist-cured material. An exhaustive discussion on this aspect has been published by the authors (Ref. [1]). However, when autoclaved, the strength increase depends on the type of fly ash and sand. A high calcium fly ash when autoclaved may give a lower strength because of the increased C/S ratio and more unstable reaction product provided it is low in silica content also. But when sand with relatively less reactive silica is replaced with Class-F fly ash, strength increase can be observed. Thus, strength enhancement of an autoclaved product when siliceous sand is replaced by fly ash depends on the amount of reactive silica in both sand and fly ash.

Reference

[1] K. Ramamurthy, N. Narayanan, Factors influencing the density and compressive strength of aerated concrete, Mag Concr Res 52 (3) (2000) 163–168.

☆ Cem Concr Res 31 (2001) 153.

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