

36 MASONRY: COMPONENTS TO ASSEMBLAGES

DISCUSSION

"ASTM C90 Lightweight and Medium Weight Masonry Units Using Aardelite Aggregate" - E. R. Dunstan, Jr., R. Keck, P. Hay.

Discussion (T. A. Holm, Solite Corporation, Richmond, VA)

According to the definitions presented in the INTRON Institute report, "PROPERTIES OF CONCRETE MADE WITH THREE TYPES OF ARTIFICIAL PFA COARSE AGGREGATES", by G.J.L. van der Wegen and J.M.J.M. Bijen, Netherlands, August 1985, the Aardelite aggregate presently produced in Florida is a "cold bonded" fly ash particle type. The INTRON report divides fly ash aggregates into three types based upon process temperatures reached during formation of the particle microstructure.

- 1) sintering (temperature $T > 900$ deg. C)
- 2) hydrothermal treatment (100 deg. C $< T < 250$ deg. C)
- 3) cold bonding (10 deg. C $< T < 100$ deg. C)

Whereas sintered lightweight aggregates have a ceramic microstructure, both hydrothermal and cold bonding aggregates are composed of cementitious bound fly ash particles that bear a closer resemblance to the paste matrix than the aggregate fraction. The Aardelite aggregates used in the INTRON report were autoclaved (hydrothermal) prior to use in the concretes tested. Concretes composed of autoclaved coarse Aardelite and natural sand fine aggregates developed the highest shrinkage of the three fly ash concrete types tested with a strain of .07% reported at 100 days.

Commenting upon the higher shrinkage the authors stated, "Apart from the smaller restraining effect of the Aardelite particles (because of the lower modulus) the higher shrinkage of Aardelite concrete is probably due to the shrinkage of the Aardelite aggregate itself. It is known that autoclaved lime-silica materials show drying shrinkage whereas sintered ceramic materials such as Lytag and dense natural aggregates do not."

The data presented at the symposium suggested that the cold bonded fly ash Aardelite concrete (presumably entirely Aardelite aggregate) developed drying shrinkage strains of .07% when measured in accordance with ASTM C331. The same drying shrinkage strain (.07%) was reported in the INTRON paper, despite fundamental differences between the Aardelite aggregate type used in the INTRON investigation when compared with that produced in Florida. In addition to being autoclaved the Aardelite aggregate tested by INTRON incorporated 45% quartz sand within the pellet in addition to the fly ash. Furthermore, the INTRON Aardelite concretes contained natural river sand as a fine aggregate. Equal drying shrinkage strains

reported on the autoclaved, sanded Aardelite concrete and the Florida Aardelite (presumably all lightweight aggregate concrete incorporating only cold bonded fly ash particles) contradicts usual experience when drying strains of autoclaved and non-autoclaved concrete products are compared.

Qualifications of a lightweight aggregate, according to ASTM C331, require lightweight aggregate concretes (composed entirely of lightweight aggregates) to develop drying shrinkage less than .1% (ASTM C331 paragraph 5.2.3). It is essential that aggregates used in masonry units meet ASTM C33, or C331 specifications to insure dimensional stability of concrete products in keeping with the expectations of design professionals.

The influence of shrinking aggregates with dimensional stability characteristics closer to the cementitious matrix than the inert aggregate fraction may be analyzed by the Hansen-Nielsen report "Influence of Aggregate Properties on Concrete Shrinkage" ACI Journal, July 1965.

Answer Your question has addressed the shrinkage properties of Aardelite aggregate. You have referenced work by INTRON Institute on studies of Aardelite manufactured in Holland. As you pointed out, the Aardelite from Holland is "different" than Florida Aardelite.

First, our formula uses much less lime; about 1 part lime to 20 parts fly ash whereas the Holland material is 1 to 10. They use autoclave; we steam at 175°F for 16 plus hours. The Holland material is a coarse aggregate whereas our material is a fine aggregate. It is difficult to make direct comparisons.

The shrinkage test procedures in the INTRON report are different than that of ASTM C157. The aggregate in the INTRON report is soaked for 30 minutes before the specimens are cast. We do not soak any lightweight used in our block plants and we thus make our specimens from Aardelite at the shipping weight and moisture content. The INTRON Aardelite shrinkage tests requires soaking the bars in water for 7 days before drying whereas ASTM C157 is storage in a fog room. The INTRON concrete slump was almost 5-inches, whereas ASTM C331 specifies 2-3 inch slump. The shrinkage bars are different in the INTRON test and ASTM C157.

The differences and how they effect shrinkage could be discussed in depth. Where would it lead? The Florida experience is that Aardelite was tested by ASTM C157 procedures and found to have a shrinkage of 0.07%.