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Discussion

Reply to the discussion by S. Chatterji of the paper "Mercury porosimetry — an inappropriate method for the measurement of pore size distributions in cement-based materials"☆

Sidney Diamond*

School of Civil Engineering, Purdue University, West Lafayette, IN 47907-1284, USA

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I thank Dr. Chatterji for his interesting discussion.

Dr. Chatterji's remarks concerning the fact that cement paste specimens undergo drying shrinkage are of course correct. It is clear that overall shrinkage does in fact occur on drying (irrespective of the degree of rigor of the drying method used). However, part of the overall shrinkage results from an increase in the density of the internal structure of the dehydrated C–S–H gel, and not from a decrease in open porosity.

In my view, the possible effect of drying on porosity is small when compared to the total volume of pore space, and unimportant compared to the many uncertainties in the MIP measurement of it. For example, for a mature w:c 0.4 paste, as shown in Fig. 5 of the paper under discussion, the intruded porosity is ca. 23% of the total volume. This can be compared to measurements of drying shrinkage, which have been reported by various authors, most recently by Baroghel-Bouny and Goudin [1]. Their linear drying shrinkage strain for a 1-year-old paste (as measured from the progressive decrease in diameter of thin disks) is approximately 4200×10^6. Assuming isotropy, the volume shrinkage strain would be approximately three times this, or $12{,}600 \times 10^6$, i.e., about 1.3%. In my view, the various uncertainties in the MIP measurement of intruded porosity, as detailed in the accompanying reply to a discussion by Wild [2], are very much greater than this.

Alteration of the sizes of some of the pores by the effect of drying are certainly possible, but the potential magnitude of this drying effect on actual pore sizes is trivial compared to the degree of error inherent in MIP pore size distribution measurement.

The writer is very much less concerned than Dr. Chatterji appears to be about drying-induced alterations in the structure of cement paste. SEM examinations clearly indicate that the structure is that of an interconnected and well knit, albeit porous, matrix. Such a matrix may well undergo modest tensile or compressive drying strains on drying, but the notion expressed by Dr. Chatterji that "solid particles are brought nearer to each other" during the compression stage and "solid particles are separated from each other" during the tension stage would seem to have little basis in reality for cement paste. Such a description might well be appropriate for fine particulate materials, e.g., clay soils, which are composed of individual uncemented particles and whose particle arrangements undergo much greater deformations on drying.

References

[1] V. Baroghel-Bouny, J. Godin, Experimental study on drying shrinkage of ordinary and high-performance cementitious materials, Concr. Sci. Eng. 3 (9) (2001) 13–22.

[2] S. Diamond, Reply to the discussion by S. Wild of the paper "Mercury porosimetry—an inapprpriate method for the measurement of pore size distributions in cement-based materials", Cem. Concr. Res. 31 (11) (2001) 1655–1656.

☆ Cem. Concr. Res. 30 (2000) 1517–1525.

* Tel.: +1-765-494-5016; fax: +1-765-496-13645.

E-mail address: diamond@ecn.purdue.edu (S. Diamond).

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