Drying Shrinkage and Weight Change of Smart Ultrafine Cement

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Abstract:

In this study, drying shrinkage and weight change of smart cement were investigated during 28 days. Ultrafine cement was used with two water-to-binder ratios (w/b) of 0.4 and 0.8 and a carbon fiber content of 0.02%. Results showed that drying shrinkage and weight change of cement paste increase with the increase in the water to binder ratio from 0.4 to 0.8.

1.Introduction

Drying shrinkage can be known as the moisture loss during curing by evaporation, resulting in reducing cement paste volume (Bal et al., 2013). One of the problems of drying shrinkage is that tensile and bending strengths decrease considerably during drying (Fujiwara, 2008). In addition, drying shrinkage in concrete specimens can cause (micro) cracks on the samples (Idiart, et al., 2011). However, Ultrafine cement can be used for structural repairing, which requires more water for flowability (Sarkar et al., 2001). As a result, curing needs to be carried out in an enclosed environment to prevent water evaporation (Chen et al., 1996). To reduce this problem, highly conductive smart cement containing carbon fiber is a better solution for drying shrinkage (Vipulanandan, 2021). In this study, the effect of the water to binder ratio of smart cement on drying shrinkage and weight change was investigated.

2.Objective

The overall objective was to compare the drying shrinkage and weight change of smart cement. The specific objectives of this study are the following:

(a).Provide a low drying shrinkage and weight change by using 0.02% carbon fibers.

(b).Investigate the effect of 0.4 and 0.8 water to binder ratios on drying shrinkage and weight change.

3. Methodology

Ultrafine cement with water to binder ratios of 0.4 and 0.8 was used in this study. Short carbon fibers of 0.02% content by cement weight were dispersed in water. The cement was then hand mixed with water and fiber for 10 minutes. A cylindrical mold of height 4 inches and 2 inches in diameter was used, as shown in Figure 1. Ohmmeter was used to measure the resistivity of the specimen during casting. After casting, all specimens were cured in the molds for 28 days. Vernier caliper was then used to measure the linear change in length from all sides. Weight change was also measured using a weighing scale balance, as shown in Figure 2. Measurements were taken after 0, 1, 3, 7, and 28 days.

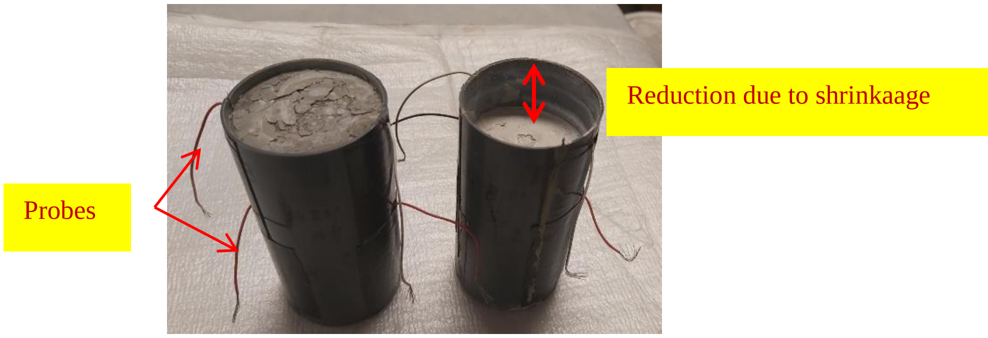

Figure 1: Probe configuration for cylindrical mold and effect of drying shrinkage

(a)

(b)

Figure 2: instruments Used for Measurements (a) Vernier Caliper and (b) Weighing scale Balance

4. Results:

(c) Drying shrinkage

The experimental results showed that after 28 days of curing, the average drying shrinkage of specimens containing a 0.8 w/b ratio was 5.67%. This value was reduced by about 88% when the water to binder ratio was reduced to 0.4 as shown in Figure 3.

(d) Weight change

The weight change of the specimens with a w/b ratio of 0.8 was 6.7% after 28 days of curing. This weight is more than that for 0.4 w/b ratio by about 75%, as illustrated in Figure 4. In addition, the rate of degradation in 0.8 ratio is more than that for 0.4 w/b ratio.

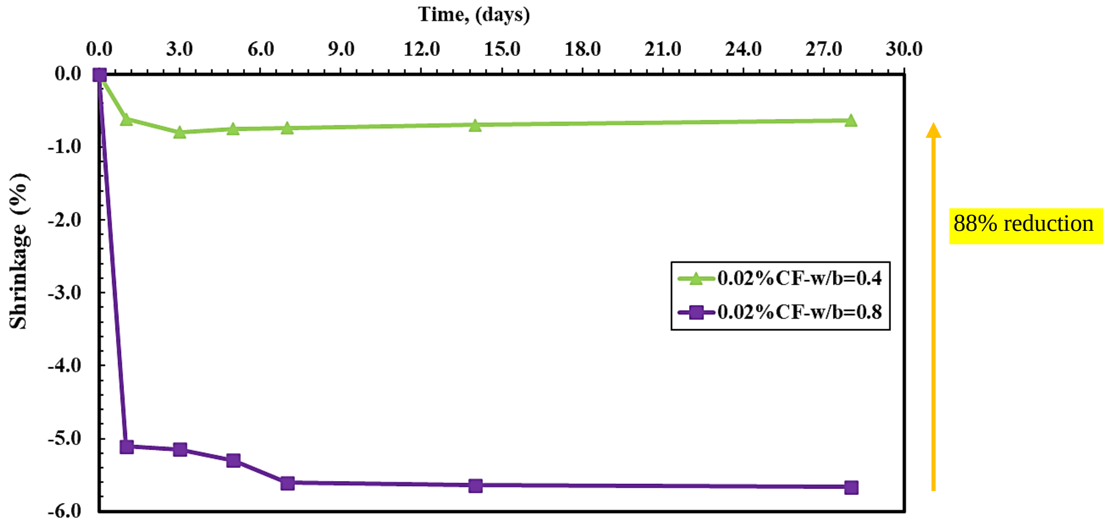

Figure 3: The effect of water to binder ratio on drying shrinkage after 28 days

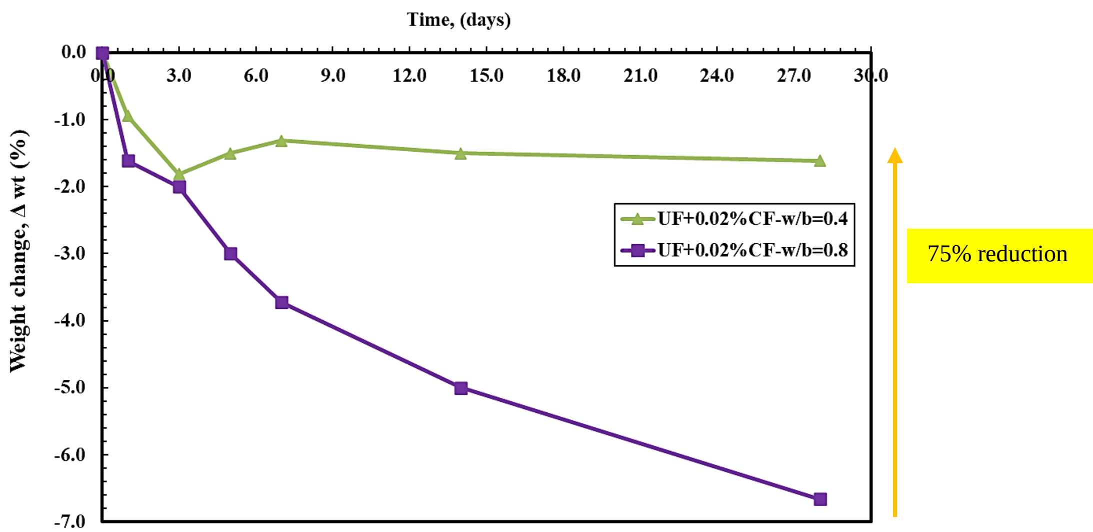

Figure 4: The effect of water to binder ratio on weight change after 28 days

5. Conclusions

From this study, the following conclusions are advanced:

(i). Drying shrinkage and weight change of cement paste increased with the increase in the water to binder ratio from 0.4 to 0.8.

(ii). Carbon fiber addition effectively decreased the drying shrinkage of smart cement paste.

6.Acknowledgments

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7.References

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