Modified ASR Test ASTM C 1260 Method with Weight, Volume Changes and Ultrasonic Pulse Velocity

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Abstract: In this study, Modified ASTM C1260 was used to predict the alkali silica reactivity of a locally available fine aggregate. In addition to the length change, changes in weight, volume and ultrasonic pulse velocity were determined in order to correlate the expansion of Mortar-Bars with the other changes.

1. Introduction

The reaction between alkalis in the cement and certain forms of silica present in aggregates is called alkali silica reaction (ASR). Hydroxide ions attack the Si-O bond of the silica present in aggregates, creating an alkali-silica gel that is capable of swelling by imbibing water. The resulting volumetric expansion causes cracking and can lead to strength and stiffness reduction in concrete structures. In 1940, Thomas Stanton of the California State Division of Highways published the first paper on alkali–silica reaction (ASR) [4]. The mineralogical structure of the aggregates is one of the main factors affecting ASR, amorphous silica (opal), chalcedony, cristobalite, tridymite and volcanic glass appear as the reactive components leading to a rapid or normal reaction rate, showing visible signs of reaction in concrete at ages as low as 1 year, depending on the surrounding environment. The great majority of cases of concrete structures reported as showing deterioration due to alkali-silica reaction were made using high-alkali cement. There were mainly three ASTM methods for evaluating expansion because of alkali-silica reactivity. Of the three ASTM methods, ASTM C1260, Potential Alkali Reactivity of Aggregates (Mortar-Bar Method), and is probably the most widely used test method.

2. Objective

The objective of the study is to compare the ASTM C1260 to the Modified ASTM C1260 methods in terms of length extension, weight, volume and pulse velocity.

3. Experiment

Locally available sand (source: Lagrange Pit) was used with ASTM C 150 Type I Portland cement and sodium silicate powder. The ASTM C1260 Mortar-Bar method was modified by mixing 5% of sodium silicate powder to the weight of cement. Three mortar bars were prepared for each test and placed in moist cabinet room for 24 hrs with relative humidity of 54%, after removing the molds the specimens were cured for 24 hrs in a water bath maintaining a temperature of 80^{o}C. The cured specimens were then stored in 1N NaOH solution at 80^{o}C. The subsequent measurements were taken periodically for all the specimens, in addition to the length measurements weight change, volume change and ultrasonic pulse velocity measurements were recorded to compare them with the expansion of Mortar-Bar. In this paper only the 7 day measurements were presented to see the early expansion in modified ASTM C1260 method.

4. Results and Discussion

The changes in length for the standard and modified tests are shown in Fig. 1. In 7 days, the Modified ASTM C1260 (0.08%) showed greater extension than the standard ASTM C 1260 (0.06%). The weight change was greater in the Modified method (1.87%) when compared to the standard ASTM C1260 (1.73%). The volume change (0.03%) and ultra sonic pulse velocity change (0.02%) are almost similar in both Modified ASTM C1260 and standard ASTM C1260 methods indicating that the addition of sodium silicate has less effect on volume change and ultrasonic sonic pulse velocity when compared to weight change and expansion changes.

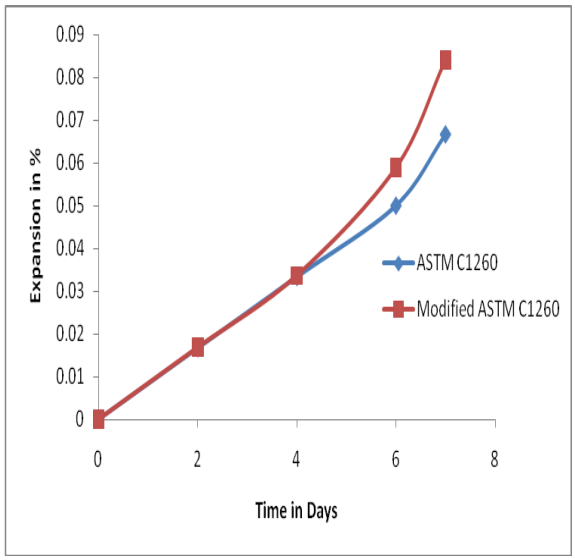

Fig.1 Expansion results of ASTM C1260 and weight, Modified ASTM C 1260

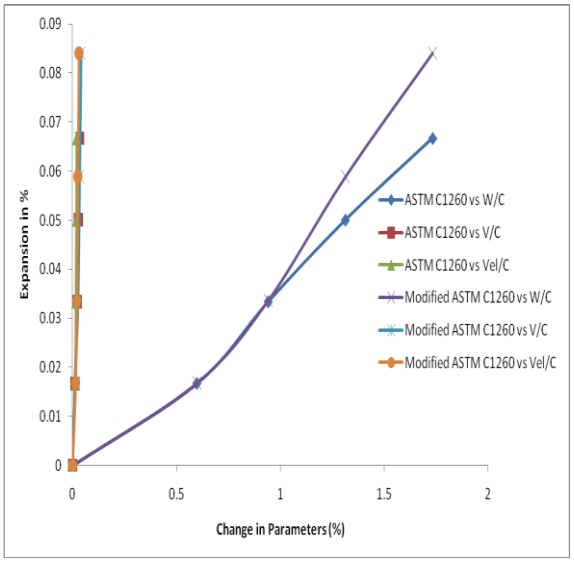

Fig.2 Expansion results vs Change in volume and velocity

4. Conclusions

Addition of sodium silicate (Modified ASTM C 1260) affected the test results in many ways. The expansion and weight changes in Modified method are greater than the standard method. The change in volume and ultrasonic pulse velocity shows similar change in both methods.

5. Acknowledgement

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6. References

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