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Autoclave Method for Soundness of Portland Cement

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Autoclave Method for Soundness of Portland Cement

1 Subject Contents and Applicable Scope

This Standard specifies the instrument, operating method and result assessment, etc. of autoclave method for soundness of Portland cement.

This Standard is applicable to determine the uneven volume changes of the following cements due to periclase hydration like Portland cement, ordinary Portland cement, slag Portland cement, pozzolanic Portland cement, flyash Portland cement, etc.; it is also applicable to other cement products designated use of this Standard.

2 Normative References

GB 177 Test Method for Strength of Hydraulic Cement Mortar

GB 751 Test Method for Drying Shrinkage of Cement Mortar

GB 1346 Standard Test Method for Water Requirement for Normal Consistency Setting Time and Soundness of the Portland Cement

GB 3350.2 Apparatus for Physical Test of Cement – Vibrator for Compacting Mortar Specimen

GB 3350.8 Apparatus for Physical Test of Cement – Mixer for Cement Paste

3 Method Principle

Under the condition of saturated water vapor, improve the temperature and pressure to cause most of the periclase in the cement to hydrate in short period; use the test piece deformation to judge the volume soundness of cement slurry.

4 Terminologies

Autoclave method: it indicates the treatment process under the condition of saturated vapor with temperature greater than 100°C. In order to make the periclase in the cement hydrate in short period, use 215.7°C saturated vapor to treat 3h; its corresponding pressure is of 2.0MPa.

5 Apparatus

5.1 25mm×25mm×280mm test mode, nail head, tamper and length comparator

It shall meet the requirements of GB 751.

5.2 Mixer for cement paste

It shall meet the requirements of GB 3350.8.

5.3 Boiling box

It shall meet the requirements of 3.3 in GB 1346.

5.4 Autoclave

It is Installed automatic pressure controller, pressure gauge, safety valve, drain vale and electric heater for high-pressure steam container. The electric heater shall be able to make the steam pressure in the pot up to the gauge pressure of 2.0MPa within 45~75min under the maximum test load; try not to discharge the steam under the constant pressure. The automatic pressure controller shall be able to control the pressure in the pot at 2.0±0.05MPa (equivalent to 215.7±1.3°C) range; and maintain for 3h above. The autoclave can reduce the pressure from 2.0MPa to 0.1MPa or less within 90min after the heating is stopped. The drain valve is used to remove the air from the pot during the initial heating phase and to release the remaining water vapor from the pot at the end of the cooling period. The maximum range of pressure gauge is 4.0MPa; the minimum scale value shall be no greater than 0.05MPa. The autoclave cover shall also be equipped with temperature measuring hole, after inserting the thermometer into it, it can measure the temperature into the autoclave.

6 Specimen

6.1 The specimen shall pass through the 0.9mm square-mesh screen.

6.2 The specimen's boiling soundness must be qualified. To reduce the impact of f-

9 Boiling of Test Piece

9.1 Measurement of initial length: after the test piece is demolded, measure its initial length. Use the adjustable stem to calibrate the zero reading of dial-gauge of length comparator before measurement; the zero reading shall also be checked after the measurement; if there is any change, the test piece shall be re-measured.

Clean the nail head before measure the length of the test piece; in order to minimize the error, the upper and lower position of the test piece in the length comparator shall be consistent in each measurement; rotate left and right before reading; when the dial-gauge indicator needle indicates to a stable reading (L_0), the result shall be recorded to 0.001mm.

9.2 Boiling test: horizontally place the test piece that have been measured length onto the test frame of boiling box; boil as per the system of boiling soundness test stipulated in GB 1346. If necessary, the length of test piece after boiling can be measured.

10 Autoclaving of Test Piece

10.1 After boiling, the test piece shall be finished autoclaving within 4 days. The test piece before autoclaving and after boiling shall be placed into 20±2°C water for curing.

Place the test piece onto the test frame at the room temperature before autoclaving. Gaps shall be maintained between test pieces. In order to ensure the vapor pressure in the autoclave is always saturated during the autoclaving period, sufficient distilled water shall be added; the adding quantity is generally about 7%~10% of pot capacity; however, the test piece shall not touch the surface.

10.2 Open the drain valve in the initial heating period; discharge the air from the autoclave, and close till the vapor is seen release; improve the temperature in autoclave; so that the gauge pressure can reach 2.0±0.05MPa from heating to after 45~75min; maintain for 3h under such pressure, then cut off the power; cool off the autoclave, so that the pressure in the autoclave can reduce to 0.1MPa below within 90min. Then slightly open the drain valve to discharge the remained vapor from the autoclave.

The operating procedures of autoclave shall be performed in strict accordance with the relevant regulations and Appendix B (supplement) in this Standard.

10.3 Open the autoclave; take out of the test piece, immediately place into 90°C above hot water; then evenly inject cold water into the hot water; reduce the water temperature to room temperature within 15min; when injecting water, don’t wash the

Appendix B

Safety Precautions

(Supplement)

B.1 Use the thermometer and pressure gauge at the same time during the autoclaving test; because the temperature and the saturated vapor pressure have a certain relationship; using them at the same time can find out the failure of the pressure gauge, and the abnormal situation due to the moisture loss from the autoclave during the test period.

B.2 The safety valve shall be adjusted to 10% higher than the working pressure of autoclaving test; namely, about 2.2MPa; the safety value shall be checked at least twice per year; the pressure gauge can be used to inspect the device during the inspecting period; the automatic pressure controller can also be adjusted, so that the autoclave can reach 2.2MPa; at this time, the safety valve shall be immediately opened. Pay attention that the air-release direction of safety valve shall be opposite to the operator.

B.3 In practical operation, the following failures may occur at the same time: failure of automatic controller, safety valve is not sensitive; pressure indicator needle indicates to zero suddenly, which reversely return to zero due to exceeding the maximum scale; if these conditions are found, regardless the pressure in the autoclave, cut off the power immediately, and take appropriate safety measures.

B.4 When releasing air after the autoclaving test, the operator shall stand in the opposite direction of the air-releasing; when opening the autoclave, wear the asbestos gloves to avoid scalding.

B.5 For the autoclave in use, the pressure gauge needle may return to the initial position of the test or starting point; at this time, it may not indicate the pressure is zero; there must be some pressure in the autoclave, so find out the cause and take measures.

Additional Information:

This Standard was proposed by State Bureau of Building Materials Industry.

This Standard shall be under the jurisdiction of China Building Materials Academy.

This Standard was responsibly drafted by Cement Research Institute of China Building Materials Academy.

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