

TI-B 33 (92)
Test Method
**Determination of the efficiency of concrete
curing compounds**

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1. Field of application

The method is applied to determine the efficiency of a concrete curing compound, i.e. the capability to retain evaporable water from a concrete surface. This test method replaces test method TI-B 31 "Measurement of the efficiency of concrete curing compound", dated october 1986.

2. References

ASTM C 156-80a, "Standard Test Method for Water Retention by Concrete Curing".

Basic Concrete Specifications for Building Structures, National Building Agency, March 1987.

DS 423.12: Testing of Concrete, fresh concrete, consistency, slump, 2nd. ed.

DS 423.15: Testing of Concrete, fresh concrete, air content, 1st ed.

DS 423.16: Testing of Concrete, fresh concrete, density, 1st ed.

DS 423.21: Testing of Concrete, preparation and storage of cast test samples for determination of strength, 2nd ed.

3. Definitions

Concrete curing compound: An agent applied to the free surface of a newly cast concrete in order to prevent desiccation (evaporation).

Efficiency: The difference between the weight loss of the treated and untreated concrete test samples. I.e. the efficiency is an expression of the capability of the curing compound to prevent evaporation from the concrete surface.

4. Test samples

Test samples shall be prepared of a standard concrete that complies with the following requirements:

PC(R/IS/MA/G):	295 ± 5 kg/m ³
v/c-ratio:	0,40 ± 0,03
Consistency, slump:	40 ± 30 mm
Air content:	5 - 7%
Max size of stone:	16 mm

5. Test method

5.1 Principle

In principle the present test method corresponds to ASTM C 156-80a, with the following exceptions:

The ASTM-method uses test samples prepared of mortar and during the testing the curing compound is applied to a fresh, mat dry surface of mortar. Furthermore the ASTM-method uses a curing climate where the air temperature is 38°C, the relative air humidity is 32%, and there are no requirements to the air circulation.

The present method uses test samples prepared from concrete, and during testing the curing compound is applied to a demoulded concrete surface when the curing has just started. Furthermore the present method uses a curing climate with an air temperature of 26°C, the relative air humidity is 70%, and the surface to the test samples shall be exposed to a well defined and known flow of air with a given velocity.

With a view to the subsequent evaluation of the results, at least 6 test samples are prepared, 3 with curing compound and 3 without.

3 days after the application of the curing compound the weight loss of each test sample is registered and the efficiency of the curing compound is calculated on the basis of these weight losses.

5.2 Equipment

Equipment for casting of concrete and determination of slump, air content and density of the fresh concrete.

Closed moulds of a non-absorbent material that is tight to diffusion and inactive to cement. The moulds shall hold concrete test samples with a thickness of 100 mm. The lateral surfaces of the test samples (from where the evaporation shall take place) shall have a surface area of at least 40.000 mm².

Plate for determination of the degree of evaporation from the curing compound. The plate shall be made of a non-absorbent material with a surface area of at least 120.000 mm².

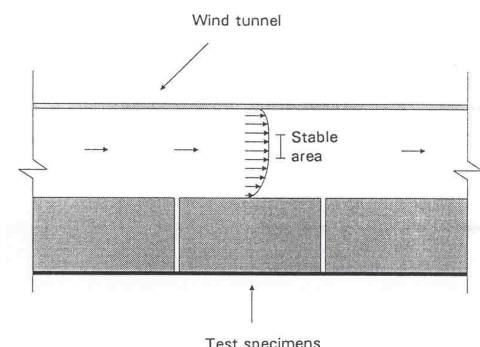
Weight capable of weighing at least 15 kg with an accuracy of 1 g.

Climate cabinet where a temperature of 26 ± 3°C and a relative air humidity of 70 ± 3% can be maintained.

Wind tunnel, where the free surface of the test samples are exposed to a well defined and known flow of air with a velocity of 3.6 ± 0,1 m/s. The velocity shall be measured 30 mm above the free surface of the test samples in the stable area of the wind profile, see figure.

Application spray or other equipment for application of the curing compound.

Cover plate to ensure that the curing compound is applied only to the surface of the test samples.



5.3 Preparation of test samples

A concrete mix that complies with the requirements described in item 4 of at least 40 litres is prepared. The slump, air content and density of the fresh concrete are determined according to DS 423.

At least 6 test samples are prepared of the mix in the moulds described in item 5.2. The casting shall be carried out in accordance with DS 423.21 for vibrated concrete, the moulds shall however not be coated with oil or similar because of the subsequent application of curing compound. The test samples are cast in a vertical position so that the demoulded concrete surface, from where the evaporation shall take place, is a lateral surface and not a top or bottom surface.

The crack, if any, between the side of the mould and the subsequently demoulded concrete surface shall be tightened so that the evaporation can take place only from the demoulded lateral side of the test sample.

After casting the moulds are closed and placed in the climate chamber in a vertical position.

5.4 Procedure

5.4.1 Curing compound on concrete

The application of the curing compound is initiated 4 hours after the mixing and shall be completed in maximum 20 minutes.

The test samples are placed in horizontal position and one side of the mould is removed from each test sample. The curing compound is applied to the free surface of half of the test samples (at least 3). The application is carried out with a quantity per area unit in accordance with the manufacturer's instructions.

Immediately after the application of the curing compound all test samples are weighed and then placed in the wind tunnel in the climate chamber. The test samples are placed at a height where the free surface is on a level with the bottom of the wind tunnel in order to reduce the wind resistance to a minimum.

The wind tunnel is started up when the test samples have been placed.

Each test sample is weighed 3 days after the application of the curing compound.

5.4.2 Weight loss of the curing compound

The weight loss from the curing compound is determined by measuring the weight loss from a plate to which the curing compound has been applied.

The plate is weighed, and the curing compound is applied in the same way and with the same quantity per area unit as for the concrete test samples.

Then the plate is placed in the wind tunnel in such a height that the surface is on a level with the bottom of the wind tunnel.

The wind tunnel is started up.

The plate is weighed 3 days after the application of the curing compound.

5.5 Calculations

5.5.1 Degree of evaporation of the curing compound

On the basis of the test of the weight loss of the curing compound the degree of evaporation p is determined, from the formula

$$p = \frac{V_f}{M_f}$$

where

- V_f is the weight loss of the curing compound after 3 days [g/m^2]
- M_f is the quantity of curing compound applied [g/m^2].

5.5.2 Efficiency of the curing compound

On basis of the registered weight losses the efficiency of the curing compound F is calculated from the formulas

$$F = \frac{\sum_{n=1}^N F_n}{N}$$

where N is the number of test samples with curing compound and

$$F_n = \frac{V_{without} - (V_{with,n} - p \cdot V_{f,n})}{V_{without}}$$

where

- $V_{without}$ is the average weight loss after 3 days of test samples without curing compound [g/m^2]
- $V_{with, n}$ is the registered weight loss after 3 days of test sample No. n with curing compound [g/m^2]
- P is the degree of evaporation of the curing compound [%]
- $V_{f, n}$ is the quantity of curing compound applied to test sample No. n [g/m^2]
- n is test sample number for the test samples with curing compound.

5.6 Accuracy

In case the coefficient of variation (standard deviation/average value) for the weight loss of similarly treated test samples exceeds 15%, the test results shall be rejected, and a new testing of the efficiency of the curing compound shall be carried out.

A coefficient of variation higher than 15% can however be accepted for test samples with curing compound, if the calculated degrees of efficiency separately are higher than the value required in the Basic Concrete Specification for Building Structures or like.

5.7 Test report

A test report shall include at least the following information:

- a) Name and address of the test laboratory.
- b) Date and identification of the report.
- c) Name and address of the client.
- d) Test method (No. and title).
- e) Deviations, if any, from the method description.
- f) Identification of curing compound (date of manufacture and receipt and way of storage and possible labelling).
- g) Prescribed quantity of curing compound per area unit and application method used.
- h) Curing climate (air temperature, relative air humidity, wind velocity).
- i) Data of the concrete (composition, air content, density and slump).
- j) Date of testing.

- k) Test result: The average degree of efficiency determined after 3 days and the average quantity of curing compound applied.
- l) Accuracy. The individual results of the quantity of curing compound applied and the appertaining standard deviations. The coefficients of variation for the weight loss of the test samples with and without curing compound applied.
- m) Other information of importance to the evaluation of the results.
- n) Signature.