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Hygrothermal performance of building materials and products — Determination of water absorption coefficient by partial immersion

Performance hydrothermique des matériaux et produits pour le bâtiment — Détermination du coefficient d'absorption d'eau par immersion partielle

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15148 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 163, *Thermal performance and energy use in the built-up environment*, Subcommittee SC 1, *Test and measurement methods*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

Annex ZA forms a normative part of this International Standard. Annex A is for information only.

Contents

Foreword

This document EN ISO 15148:2002 has been prepared by Technical Committee CEN/TC 89 "Thermal performance of buildings and building components", the secretariat of which is held by SIS, in collaboration with Technical Committee ISO/TC 163 "Thermal insulation".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2003, and conflicting national standards shall be withdrawn at the latest by June 2003.

This standard is one of a series of standards which specify test methods for the thermal and moisture related properties of building materials and products.

NOTE Normative references to International Standards are listed in annex ZA (normative).

Annex A is informative, annex ZA is normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The movement of moisture within hygroscopic capillary building materials is a combination of vapour and liquid flows which have complex interactions with the temperature and humidity gradients and the properties of the materials present. Three stages can be identified.

a) At very low humidities transport is by vapour diffusion alone and the permeability can be derived from dry-cup tests, defined in ISO 12572.

b) At higher relative humidities in the hygroscopic region, up to about 95 % relative humidity, there is a mixture of gas and water filled pores with simultaneous flows of vapour and liquid. The increasing liquid flow causes the exponentially increasing permeability measured by cup tests under isothermal conditions. However, under practical, non-isothermal conditions this liquid flow could increase, or decrease, the total mass flow.

c) Above about 95 % relative humidity, depending on the material, the total mass transport is governed by transport in the liquid phase. This is the situation that arises when a material is dipped in water or severely wetted e.g. by driving rain. The water moves under the hydraulic pressure, the negative suction pressure. After the water source is removed, the hydraulic pressure ceases and the liquid is redistributed within the material at a different rate (stages b) and c) do not necessarily apply to all hygroscopic materials).

Methods are currently being developed in research laboratories to quantify capillary transport and measure the relevant coefficients. At present, however, these involve sophisticated measuring techniques such as gamma ray and neutron absorption or Nuclear Magnetic Resonance (NMR) spectroscopy together with complex mathematical methods to analyse the results: comparisons between laboratories have shown that further work is needed to develop standard techniques. It will, therefore, be a number of years before it is possible to standardise such methods - see annex A for further information.

At present it is possible to standardise the measurement of the absorption of liquid water into the surface of a material, which gives an indicator of its liquid transport performance.

1 Scope

This European Standard specifies a method for determining, by partial immersion with no temperature gradient, the short-term liquid water absorption coefficient. It is intended to assess the rate of absorption of water, by capillary action from continuous or driving rain during on site storage or construction, by insulating and other materials, which are normally protected. The method is suitable for renders or coatings tested in conjunction with the substrate on which they are normally mounted.

It is not intended to assess the absorption of water by materials used under water or in overall contact with saturated ground, where a total immersion test is more appropriate.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

ISO 9346, *Thermal insulation - Mass transfer - Physical quantities and definitions.*

3 Terms and definitions

3.1 Definitions

For the purposes of this European Standard, the terms and definitions given in ISO 9346 and the following apply.

3.1.1

water absorption coefficient
mass of water absorbed by a test specimen per face area and per square root of time

NOTE See equation (2) in clause 8.

3.1.2

homogeneous material
material the properties of which are uniform on a macroscopic scale

3.2 Symbols and units

Symbol	Quantity	Unit
A	face area	m^2
A_w	water absorption coefficient	$kg/(m^2 \cdot s^{0,5})$
A_{wt}	water absorption coefficient related to a specific time, t, in seconds	$kg/(m^2 \cdot s^{0,5})$
Δm_t	mass gain per face area after time t	kg/m^2
M_i	initial mass of specimen	kg
m_t	mass of specimen after time t	kg
t	time	s or h
W_w	water absorption coefficient	$kg/(m^2 \cdot h^{0,5})$
W_{wt}	water absorption coefficient related to a specific time, t, in hours	$kg/(m^2 \cdot h^{0,5})$

NOTE Water absorption coefficient is defined in terms of seconds in EN ISO 9346. The alternative definition in terms of hours is widely used.

4 Principle

The water absorption by partial immersion is determined by measuring the change in mass of the test specimen, the bottom surface of which is in contact with water, over a period which is usually at least 24 h.

The water adhering to the surface and not absorbed by the product is completely removed by, for example, blotting with a sponge before the specimen is weighed.

5 Apparatus

The test apparatus shall include:

a) balance, capable of weighing a test specimen to an accuracy of ± 0,1 % of the mass of the specimen;

b) water tank with a device for keeping the water level constant to ± 2 mm and a device to keep the test specimen in position. The tank shall include point supports, which do not damage the specimen, to keep the specimen at least 5 mm clear of the base;

c) timer accurate to at least one second in 24 h.

6 Test specimens

6.1 Shape of test specimens

Test specimens shall be representative of the material or product and of regular shape with constant cross section to ensure one dimensional water flow. The faces shall be free from surface irregularities.

6.2 Dimensions of test specimens

6.2.1 Area

The water contact area of each test specimen shall be at least 50 cm^2. However, in the case of materials including macroscopic particles such as aggregates, the side of a square specimen or the smallest diameter of the face shall be at least ten times the largest particle size.

NOTE Larger specimens, preferably with a face area of at least 100 cm^2, are advised as they will lead to greater accuracy.

6.2.2 Thickness

Where possible, the specimen thickness should be the full product thickness. When specimens are cut from products they shall be representative of the material to be assessed and thick enough to enable handling without damage. In the case of materials including macroscopic particles such as aggregates, the thickness should be preferably at least ten times, but shall be no less than five times, the largest particle size.

6.3 Number of test specimens

At least three specimens shall be tested.

If the water contact area of the individual specimens is less than 100 cm^2, at least six specimens shall be tested representing a total area of at least 300 cm^2.

6.4 Preparation of test specimens

Test specimens shall be representative of the whole material and shall be cut so that they do not include product edges. In the case of materials known to be non-isotropic, sets of test specimens shall be prepared in all orientations of the potential use of the material.

The test specimens shall be prepared by methods that do not change the original structure of the product; any skins, facings or coatings shall be retained. In the case of products such as coatings, thin rendering or plasterwork that are normally adhered to a substrate in use, specimens shall be made up from the product and a normal substrate combined. The total thickness then is the sum of the coating and the substrate.

The sides of a solid specimen shall be sealed with a water and vapour tight sealant that does not react chemically with it or significantly penetrate the pores of the product. It is especially important that the sides of specimens with surface coatings are sealed to prevent bypassing of the coating.

If sealing is not possible in the case of very low density fibrous or loose fill materials, they may be placed in a tightly fitting tube supported on a wire mesh placed over the mouth of the tube. The open area of the mesh shall be as large as possible while completely supporting the sample during the whole course of the test. In this case, to minimise the edge effects, the face area of the specimen shall be at least 100 cm^2.

The surface in contact with the water shall be plane, allowing for the normal surface roughness of the material.

6.5 Conditioning of test specimens

The test specimens shall be stored under the test conditions (see 7.1) until the mass of each specimen has stabilised to within 0,1 % of its total mass, when measured over 24 h.

NOTE Further details of appropriate conditioning techniques are given in ISO 12570.

7 Procedure

7.1 Test conditions

The test shall be carried out within the range of conditions shown in Table 1.

Table 1 - Allowed range of mean conditions and variability during test

	Temperature °C	Relative humidity
Allowed range of test conditions	18 to 28	0,4 to 0,6
Allowed variation during test	± 2	± 0,05

7.2 Test procedure

The following procedure shall be applied to each specimen.

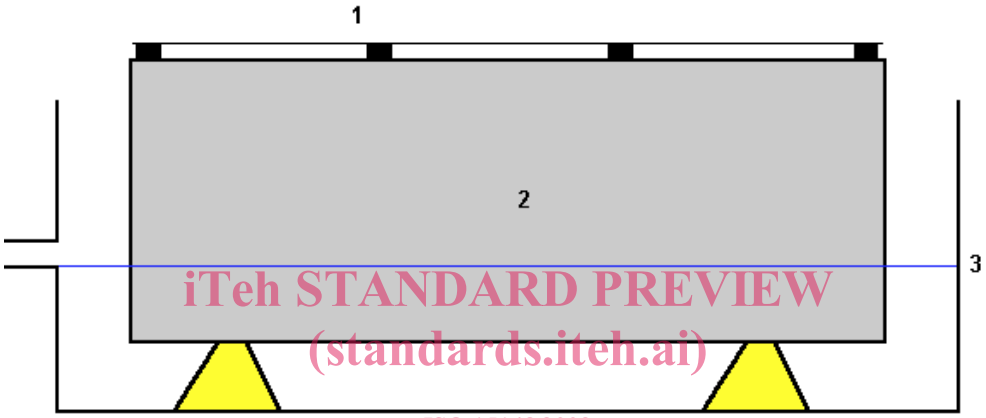
Weigh the test specimen with an accuracy of ± 0,1 % of its mass to determine the initial mass m_i after conditioning.

Fill the tank with tap water to the depth specified in the following paragraph and condition it to the test temperature.

Place the specimen in the tank so that its base is resting on point supports that keep it clear of the bottom of the tank. Care shall be taken, especially with specimens with uneven bases, to ensure that air bubbles are not trapped below the specimen. If necessary, apply sufficient load, while leaving the top surface of the specimen predominantly free, to keep the specimen in contact with the supports. The water level shall be kept constant during the test at (5 ± 2) mm above the highest point on the base of the specimen. In the case of specimens with very uneven bases, this may mean that the lowest parts are more than 5 mm below the surface; this shall be noted in the test report.

NOTE Figure 1 gives an example of a suitable testing apparatus.

Care shall be taken, especially in the case of fibrous materials, to ensure that specimens are not distorted by the supports when a load is applied.



Key

1 Grid to weigh down buoyant specimens (if required)
2 Specimen
3 Water level

Figure 1 - Example of testing apparatus

To eliminate non-isotropic effects, half the specimens of a homogeneous material, cut from the same sample, shall be placed with one major face downwards, the other half with this face upwards. Specimens of non-homogeneous materials shall be placed with the face normally exposed in use to driving rain or other water source downwards. This is especially important in the case of renders or other coatings tested on their substrate.

Start the timer as the specimen is immersed in the water.

After approximately 5 min remove the specimen from the water, blot the surfaces with a damp sponge, ensuring that the sponge is wrung out before blotting each face, and weigh the specimen with an accuracy of ± 0,1 % of its mass. Repeat the procedure of immersion, removal, surface drying and weighing at times such as 20 min, 1 h, 2 h, 4 h and 8 h after immersion and then at a minimum of two more times, including 24 h, to give a series of masses m_t at times t.

NOTE 1 The operations of blotting and weighing should be carried out as quickly as possible, preferably within a minute and the specimen returned to the water immediately afterwards.

As the method of calculating the result depends on the shape of the resulting curve (see clause 8) and the accuracy of the results depends almost entirely on the handling and drying of the specimens (see clause 9), the