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Lesne ploġ e - Ugotavljanje sproġ anja formaldehida - 1. del: Sproġ anje formaldehida po komorni metodi

Wood-based panels - Determination of formaldehyde release - Part 1: Formaldehyde emission by the chamber method

Holzwerkstoffe - Bestimmung der Formaldehydabgabe - Teil 1: Formaldehydabgabe nach der Prüfkammer-Methode

Panneaux a base de bois - Détermination du dégagement de formaldéhyde - Partie 1 : Emission de for-maldéhyde par la méthode a la chambre

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This European Standard was approved by CEN on 16 August 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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Contents

Foreword

This document (EN 717-1:2004) has been prepared by Technical Committee CEN/TC 112 “Wood-based panels”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by April 2005, and conflicting national standards shall be withdrawn at the latest by April 2005.

This document supersedes ENV 717-1:1998.

Compared to ENV 717-1:1998 the following modifications have been made.

a) Conditions for a reduced test period have been specified in Clause 10.

b) The requirements for the air-tightness of the test chamber in 8.2.2 have been changed.

This European Standard is one of a series, which specifies methods for determining formaldehyde potential in or formaldehyde release from wood-based panels. The other standards of this series are:

EN 120, *Wood based panels — Determination of formaldehyde content — Extraction method called the perforator method.*

EN 717-2, *Wood-based panels — Determination of formaldehyde release — Part 2: Formaldehyde release by the gas analysis method*.

EN 717-3, *Wood-based panels — Determination of formaldehyde release — Part 3: Formaldehyde release by the flask method*.

This European Standard is based on CEN report CR 213 “Particleboards — Determination of Formaldehyde Emission under Specified Conditions” and COST Project 613: Indoor Air Quality and its Impact on Man, Report No. 2: “Formaldehyde emission from wood-based materials: Guideline for the determination of steady state concentrations in test chambers”.

This document includes a Bibliography.

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

Introduction

Each testing institute is responsible for the quality of the test procedure. To ensure the reproducibility of the test results, it is recommended to participate in a round-robin test for calibration at least once a year.

1 Scope

This European Standard specifies a chamber method with three options of test chambers for the determination of the formaldehyde emission from wood-based panels in terms of the steady-state concentration in a climate chamber under defined conditions, which relate to typical conditions in real-life. This chamber method can also be applied to the estimation of formaldehyde concentrations under various conditions in practice, by the use of mathematical models.

This standard can also be used for the testing of formaldehyde emissions of products other than wood-based panels.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 326-1, *Wood-based panels — Sampling, cutting and inspection — Part 1: Sampling and cutting of test pieces and expression of test results.*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1
volume of the chamber
total air volume of the unloaded chamber, including recirculating ventilation ducts, expressed in cubic metres (m^3)

3.2
loading factor
ratio of the total surface area of the test piece, excluding the area of the edges, to the volume of the chamber, expressed in square metres per cubic metre (m^2/m^3)

3.3
air exchange rate
quotient of air volume passing through the chamber per hour (m^3/h) and the chamber volume (m^3)

3.4
air velocity
velocity of the air near the surface of test pieces in the chamber in metres per second (m/s)

3.5
steady-state
state when the formaldehyde emission of the wood-based panels is quasi constant under the test conditions, this means that the formaldehyde concentration in the chamber remains constant

NOTE In practice, a true steady-state is not achievable because formaldehyde is emitted irreversibly. This standard defines a steady-state condition for the purpose of the test (see Clause 10).

3.6
emission value
the steady-state formaldehyde concentration in the chamber, obtained under constant temperature, relative humidity, loading factor and air exchange rate, expressed by mass to volume in milligrams formaldehyde per cubic metre air (mg/m^3)

NOTE At 23 °C and 1 013 hPa, the following relationship exists for formaldehyde:
1 ppm (parts per million) = 1,24 mg/m^3
1 mg/m^3 = 0,81 ppm (parts per million)

4 Principle

Test pieces of known surface area, are placed in a chamber, in which the temperature, relative humidity, air velocity and exchange rate are controlled at defined values. Formaldehyde emitted from the test pieces mixes with the air in the chamber. The air in the chamber is sampled periodically. The formaldehyde concentration is determined by drawing air from the chamber through gas washing bottles containing water, which absorbs the formaldehyde. The formaldehyde concentration in the water is determined. The concentration of formaldehyde in the chamber atmosphere is calculated from the concentration in the water in the gas washing bottles and the volume of the sampled air. It is expressed in milligrams per cubic metre (mg/m^3). Sampling is periodically continued until the formaldehyde concentration in the chamber has reached a steady-state.

NOTE The influences of temperature, relative humidity, loading factor and air exchange rate on the formaldehyde concentration in the chamber atmosphere can be described by formulas (e.g. Andersen formula). An interrelation between the structure of the test pieces, especially of their surfaces and the air velocity is also apparent but cannot be exactly described by a formula.

5 Reagents

5.1 General

Reagents and water of recognised analytical purity shall be used for the analysis.

5.2 Acetylacetone solution

4 ml acetylacetone are added to a 1 000 ml volumetric flask and made up to the mark with water.

5.3 Ammonium acetate solution

200 g ammonium acetate are dissolved in water in a 1 000 ml volumetric flask and made up to the mark.

NOTE Commercially prepared solutions may be used.

5.4 Formaldehyde standard solution

Standard iodine solution $c(I_2)$ = 0,05 mol/l

Standard sodium thiosulphate solution $c(Na_2S_2O_3)$ = 0,1 mol/l

Standard sodium hydroxide solution $c(NaOH)$ = 1 mol/l

Standard sulphuric acid solution $c(H_2SO_4)$ = 1 mol/l

6 Apparatus

6.1 Test chamber

6.1.1 General

This standard applies to different test chambers for formaldehyde emission testing which are described in Annex A.

General specifications and requirements which apply to all types of test chambers included in this standard are given in 6.1.2 to 6.1.8.

6.1.2 Test chamber materials

Materials used for the inner walls and ducts of test chambers shall have a smooth surface, which, prior to testing, can be effectively cleaned with water. The surface shall be as inert and non-absorptive as possible to formaldehyde.

NOTE Proven materials are stainless steel or aluminium (sandblasted or polished), glass and some types of plastics (PVC, PMMA).

6.1.3 Air-tightness of the chamber

The test chamber shall be air-tight in order to avoid uncontrolled air exchange.

The criteria of air-tightness are given in 8.2.2.

6.1.4 Air circulation in the test chamber

The test chamber shall contain facilities (such as fan systems) capable of maintaining:

— intensive air mixing in the chamber;

— an air velocity of 0,1 m/s to 0,3 m/s at the surface of the test pieces (see 8.2.5).

6.1.5 Air exchange facilities

The test chamber shall contain air inlet and/or outlet facilities capable of regulating the air flow and thus the rate of air exchange (replacement of chamber air by clean, conditioned air) with an error limit of 5 % at an air exchange rate of 1/h.

Precautions shall be taken to ensure that the clean air inlet and the air circulation system are adequately placed to ensure sufficient mixing and that ambient air cannot enter into the air outlet, even during sampling.

6.1.6 Clean air supply of the test chamber

Equipment capable of providing clean air with a maximum formaldehyde content of 0,006 mg/m^3 (0,005 ppm).

6.1.7 Temperature and relative humidity regulating systems

Equipment capable of maintaining the temperature and the relative humidity in the test chamber within the following limits:

— Temperature: (23 ± 0,5) °C

— Relative humidity: (45 ± 3) %

6.1.8 Equipment for monitoring of test conditions

Measuring equipment and recording facilities capable of continuous or frequent monitoring of the specified test conditions with an error limit as follows:

— Temperature: 0,1 °C

— Relative humidity: 1 %

— Air exchange rate: 0,03/h

— Air velocity: 0,05 m/s

6.2 Air sampling system

6.2.1 General

Figure 1 shows the principle of a sampling system for the determination of the formaldehyde concentration in the chamber air. The sampling tube shall be placed either in the air outlet, or inside the chamber, close to the air outlet.

NOTE Other sampling systems may be used, provided it can be shown that they give equivalent results.

6.2.2 Equipment

6.2.2.1 General

The air sampling system consists of the following components which are given in Figure 1. The numbers in brackets refer to the numbers in Figure 1:

6.2.2.2 Sampling tube (1)

6.2.2.3 Two 100 ml gas washing bottles, containing water, for absorption and subsequent determination of formaldehyde (2)

6.2.2.4 Silica absorber for drying the air (3)

6.2.2.5 Gas flow valve (4)

6.2.2.6 Gas sampling pump (5)

6.2.2.7 Gas flow meter (6)

6.2.2.8 Gas meter (including a thermometer) for measuring the volume of air (7)

6.2.2.9 Air pressure meter (8)

6.3 Equipment for chemical analysis

6.3.1 Spectrophotometer, suitable for use with cells with a path-length of at least 50 mm and capable of measuring absorbance at 412 nm

6.3.2 Water bath, capable of maintaining a temperature of (40 ± 1) °C

6.3.3 Six volumetric flasks, 100 ml (calibrated at 20 °C)

6.3.4 Two volumetric flasks, 1 000 ml (calibrated at 20 °C)

6.3.5 Bulb pipettes, 5 ml, 10 ml, 15 ml, 20 ml, 25 ml, 50 ml, and 100 ml (calibrated at 20 °C)

6.3.6 Microburette

6.3.7 At least three flasks, 50 ml, with stoppers

6.3.8 Balance, scale interval 0,001 g

6.4 Equipment for verification of air exchange rate

6.4.1 Compressed-gas cylinder with tracer-gas

6.4.2 Detector for continuous monitoring of tracer-gas

6.4.3 Recorder

NOTE Dinitrogen monoxide (N_2O) with infrared (IR) detection has proved to be suitable.

7 Test pieces

Sample the test pieces according to the general principles of EN 326-1 and cut them to a size which corresponds to a total loading rate of 1 m²/m³ (see Annex A). Wrap the test pieces hermetically immediately after cutting and leave them wrapped until the start of the test.

8 Procedure

8.1 Test conditions

The following conditions shall be maintained in the chamber throughout the test:

— Temperature (23 ± 0,5) °C;

— Relative humidity (45 ± 3) %;

— Loading factor (1,0 ± 0,02) m²/m³;

— Air exchange rate (1,0 ± 0,05)/h;

— Air velocity at the surface of the test pieces (see 8.2.5) (0,1 to 0,3) m/s.

8.2 Verification of test conditions

8.2.1 Clean air supply of the test chamber

When determined in accordance with Clause 9, the formaldehyde content of the air supplied to the chamber shall not exceed 0,006 mg/m^3 (0,005 ppm).

8.2.2 Air-tightness of the test chamber

In order to avoid uncontrolled air exchange by intrusion of ambient air, the test chamber shall be operated at a slight over-pressure.

Air-tightness shall be checked regularly, either by pressure drop measurements or by comparison of simultaneous measurement of flow rates at the inlet and the outlet ports, or by measuring tracer gas dilution.

The test chamber is considered sufficiently air-tight if at least one of the following requirements is fulfilled:

— the air leakage is less than $10^{-2} \times$ chamber volume per minute at an overpressure of 1 000 Pa;

— the inlet and outlet air flow differ by less than 2 %;

— the tracer gas dilution is less than 0,05/h.

8.2.3 Temperature and relative humidity control system

The temperature shall be controlled either by placing the test chamber within a location controlled to the appropriate temperature, or by controlling the temperature within the chamber.

In the latter case, the chamber walls shall be insulated effectively to avoid condensation of moisture on their inner surface.

Control of relative humidity shall be made either by external humidity control of the clean air supply, or internal humidity control of the air within the chamber. In the latter case, precautions shall be taken to avoid condensation, or spray of water, inside the chamber.

Temperature and relative humidity shall be monitored either continuously, or frequently, and independently of the air conditioning system. Sensors shall be placed in a representative position inside the chamber.

After loading the chamber, any initial deviations of temperature and relative humidity due to ambient air and unconditioned test pieces shall be recorded.

8.2.4 Air exchange

The clean and conditioned air supply to the chamber shall either be monitored continuously, or frequently. Suitable methods are specified in Annex A.

The air exchange rate shall not vary by more than 0,05 exchanges of air per hour.

The effective air exchange rate shall be regularly checked, by using either a calibrated gas meter, or the tracer gas procedure described in Annex B.

8.2.5 Air velocity in the chamber

Prior to testing, the air velocity in the test chamber loaded with test pieces shall be set to a value between 0,1 m/s and 0,3 m/s, measured at representative positions not more than 20 mm from the surface of the test pieces.

NOTE Hot wire or film anemometers calibrated in the range of 0 m/s to 0,5 m/s are suitable for air velocity measurement.

The positions of the measuring points depend upon the volume of chamber and the type of air flow.

Air velocity shall be measured at a minimum of 4 positions in large chambers ($\geq 12\ m^3$) and at a minimum of 2 positions in small chambers (1 m^3 or 0,225 m^3).

8.2.6 Performance of the chamber

The performance of the test chamber can be tested by a procedure described by [7].

8.3 Chamber preparation

Set the chamber to the conditions given in 8.1. The determination (see 8.6) of the formaldehyde concentration in the empty chamber (“background-level”) shall be carried out not less than 1 h after establishing the test conditions according to 8.1.