ICS 79.060
CCS B 70

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 45245-2025

Determination method of total organic carbon in wood-based panels and finishing products

人造板及其制品中总有机碳的测定方法

Issued on: February 28, 2025 **Implemented on: June 1, 2025**

Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC

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1 Scope

This document describes a method for the determination of total organic carbon in wood-based panels and their products by non-dispersive infrared absorption spectrometry, covering the reagents, the instruments and equipment, the preparation of test samples, the measuring procedure, the treatment of data and expression of results, and the report.

This document applies to the determination of total organic carbon in wood-based panels and their products.

This document does not apply to the determination of total organic carbon in wood-based panels and their products in which a carbonate mineral is the main added auxiliary material.

3 Terms and definitions

The terms and definitions given in GB/T 18259-2018 and the following apply to this document.

3.1 wood-based panel: a board or moulded product made from wood or non-wood plant fibre material as the main raw material, processed into various material units, with or without the addition of adhesives and other additives. Note: it covers mainly plywood, particleboard and fibreboard. Source: GB/T 18259-2018, 2.1.

3.2 total carbon: the total quantity of the element carbon in a wood-based panel or its product. Note: it includes the quantity of carbon in the organic state and the quantity of

carbon in the inorganic state.

3.3 total organic carbon: the total quantity of the element carbon present in the organic state in a wood-based panel or its product.

3.4 total inorganic carbon: the total quantity of the element carbon present in the inorganic state in a wood-based panel or its product. Note: it includes carbon present in forms such as carbonates or hydrogen carbonates.

4 Description of the method

A suitable quantity of a test sample of a wood-based panel or its product is oxidized to carbon dioxide gas at high temperature in an oxygen-rich atmosphere; the gas is led into a non-dispersive infrared detector, the intensity of its infrared absorption spectrum is measured and the total carbon is determined quantitatively by the external standard method. The total inorganic carbon of wood-based panels and their products is below the permitted error of the total carbon determination, and the total organic carbon is therefore expressed as the total carbon.

5 Reagents

5.1 Water: distilled water or deionized water of at least the purity of grade two water as specified in GB/T 6682.

5.2 Hydrochloric acid: analytical grade, with a mass fraction of 36 percent to 38 percent.

5.3 Hydrochloric acid solution, 1 plus 4: mix 1 volume of hydrochloric acid (5.2) with 4 volumes of water (5.1).

5.4 Glucose: primary standard reagent or guaranteed reagent.

5.5 Carbon dioxide free water: prepared before use from water (5.1) in accordance with GB/T 603.

5.6 Oxygen: of purity greater than 99.99 percent.

6 Instruments and equipment

6.1 Total organic carbon analyser: fitted with a non-dispersive infrared absorption detector, the temperature control accuracy of the decomposition furnace being 1 050 °C plus or minus 10 °C.

6.2 Sample boat: usually of ceramic, quartz, silver or tin foil.

6.3 Electronic balance: readable to 0.01 g.

6.4 Electronic balance: readable to 0.02 mg.

6.5 Oven: with a temperature control accuracy of 105 °C plus or minus 2 °C.

6.6 Muffle furnace: with a temperature control accuracy of 1 050 °C plus or minus 10 °C.

6.7 Crusher: able to crush the sample to at least 40 mesh, an aperture of 0.425 mm.

6.8 Standard sieve: 40 mesh, an aperture of 0.425 mm, of stainless steel.

6.9 Desiccator.

6.10 Wide-mouthed bottle.

6.11 Weighing bottle.

7 Preparation of test samples

7.1 For ordinary wood-based panels and their products, 9 sampling points, A1 to A9, are chosen on the sample as shown in Figure 1. Where a defect is met at a sampling point, the sampling position is moved slightly so as to avoid the defect. At each sampling point a test piece of the full thickness weighing about 25 g is taken, weighed on the electronic balance (6.3), and the pieces are mixed. In Figure 1 the symbol l is the length of the sample in millimetres and w is the width of the sample in millimetres.

7.2 For flooring and similar products, 3 boards are taken and, along the direction of the long axis, a test piece of the full thickness weighing about 25 g is taken at one third, one half and two thirds of the length of each board; the pieces are weighed on the electronic balance (6.3) and mixed. Where a defect is met at a sampling point, the sampling position is moved slightly so as to avoid the defect.

7.3 The test sample is put into a clean crusher (6.7) and ground until it passes completely through the 40 mesh standard sieve (6.8), an aperture of 0.425 mm; after thorough mixing it is reduced by quartering into portions of about 25 g each. Two diagonally opposite portions are taken and sealed separately in wide-mouthed bottles (6.10), 1 for the determination of total carbon and 1 for the determination of moisture content.

8 Measuring procedure

8.1 Determination of the moisture content of the test sample. The wet basis moisture content of the test sample is determined as set out in GB/T 36055-2018.

8.2 Preparation of the sample boat. Where a ceramic boat or a quartz boat is used, the boat shall be immersed in the hydrochloric acid solution (5.3) for 10 min, taken out and rinsed clean with carbon dioxide free water (5.5), ignited for 20 min in the muffle furnace (6.6) at 1 050 °C and cooled to room temperature in the desiccator (6.9) ready for use. Silver boats and tin foil shall not be washed and are used as they are.

8.3.1 Standard test samples. A suitable quantity of glucose (5.4) is placed in a weighing

bottle (6.11) and dried in the oven (6.5) at 105 °C for at least 3 h; the weighing bottle (6.11) is taken out, covered, and cooled to room temperature in the desiccator (6.9). Using the electronic balance (6.4), 5.0 mg, 10.0 mg, 15.0 mg, 20.0 mg, 25.0 mg and 30.0 mg of the dried glucose, corresponding to carbon masses of 2.0 mg, 4.0 mg, 6.0 mg, 8.0 mg, 10.0 mg and 12.0 mg respectively, are weighed accurately into sample boats (8.2) ready for measurement.

8.3.2 Test samples. Using the electronic balance (6.4), 3 portions of 10.0 mg to 20.0 mg of the test sample of Clause 7, to the nearest 0.02 mg, are weighed into sample boats (8.2) and placed in the desiccator (6.9) ready for measurement.

8.4 Measuring conditions. Since the result of the determination depends on the instrument used, no general parameters for the analytical conditions can be given. The following working parameters have proved suitable for the determination: a) decomposition furnace temperature of the total organic carbon analyser, 1 050 °C; b) oxygen partial pressure of the total organic carbon analyser, 0.1 MPa.

8.5 Measurement of the test samples. The temperature and oxygen (5.6) partial pressure working parameters of the total organic carbon analyser (6.1) are set as in 8.4 and, once the instrument is in a normal state, the blank sample boat, the standard test sample boats and the test sample boats are introduced in turn and the total carbon is determined.

9 Treatment of data and expression of results

9.1 Equation of the calibration curve. From the mass of the element carbon in the standard test samples and the corresponding infrared absorption peak area of the carbon dioxide, the equation of the calibration curve, Formula (1), is obtained by least squares fitting, and its linear correlation coefficient shall be greater than 0.995. Where necessary, the calibration curve is checked or corrected as set out in 8.4 and 8.5, using glucose in an amount corresponding to the mass of carbon in the test sample. The symbols in Formula (1) have the following meanings: the peak area term for the standard test sample is the infrared absorption peak area of the carbon dioxide from the standard test sample; the blank peak area term is the infrared absorption peak area of the carbon dioxide from the blank sample boat; k is the slope of the calibration curve; the mass term is the mass of the element carbon in the standard test sample, in milligrams; and b is the intercept of the calibration curve.

9.2 Calculation of the total carbon of the test sample. From the mass of the test sample and the infrared absorption peak area of the carbon dioxide, the total carbon of the test sample is calculated by Formula (2). The symbols in Formula (2) have the following meanings: the total carbon term is the total carbon in the test sample, reckoned as the element carbon, in grams per kilogram; the peak area term is the infrared absorption peak area of the carbon dioxide from the test sample; the blank peak area term is the infrared absorption peak area of the carbon dioxide from the blank sample boat; b is the intercept of the calibration curve;