ICS 59.100.20

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 42911-2023

Carbon fibre reinforced composites - Method for accelerated moisture absorption and supersaturated conditioning by moisture using sealed pressure vessel

碳纤维增强复合材料 密封压力容器加速吸湿和过饱和调节方法

Issued on: August 6, 2023 **Implemented on: March 1, 2024**

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

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Foreword

This document was issued on 6 August 2023 by the State Administration for Market Regulation; Standardization Administration of the PRC and takes effect on 1 March 2024.

It is a GB/T standard: recommended rather than compulsory, but it is the text a Chinese reviewer applies when assessing a submission.

1 Scope

GB/T 42911-2023 covers a way of driving moisture into carbon fibre reinforced composites far faster than ambient exposure would, using a sealed pressure vessel filled with saturated water vapour above ambient temperature: heat raises the diffusion rate of water molecules in the material and pressure works with it, and the principle clause explains that mechanism before any apparatus is described. The equipment is a supersaturated moisture absorption device built around a sealed pressure vessel rated to at least 2.0 MPa, together with the parts listed alongside it. Specimens follow whatever test method is to be run afterwards, and their glass transition temperature is determined first. Conditioning and the laboratory environment are fixed before the run - at least 24 hours at (23 +/- 2) degrees Celsius and (50 +/- 10) percent relative humidity - after which the operating procedures, by far the longest part of the document, take the specimens through accelerated absorption and the supersaturated condition, with a test report clause closing it. Composite parts take up water in service and behave differently once they have, and reaching that state at room conditions is slow. Useful to composite laboratories, aerospace and rail qualification teams, and

material suppliers conditioning coupons before mechanical testing.

This document describes methods for accelerated moisture absorption and supersaturation conditioning of carbon fiber reinforced composites. This method is carried out in a saturated water vapor sealed pressure vessel at a temperature higher than 100°C but lower than the glass transition temperature (Tg) of the test material.

This document applies to thermosetting carbon fiber reinforced composite materials with a glass transition temperature greater than 150°C. For thermoplastic carbon fiber reinforced composite materials, this document can also be used as a reference.

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.

GB/T 40396, Test method for glass transition temperature of polymer matrix composites -- Dynamic mechanical analysis (DMA)

GB/T 40724, Terminology for carbon fiber and carbon fiber composites

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 40724 as well as the followings apply.

3.1 additional moisture content

The percentage of the additional moisture absorption mass of the test material to its mass before accelerating moisture absorption.

NOTE: See formula (1).

3.2 supersaturated conditioning by moisture

The process of cooling the test material from a saturated hygroscopic state at high temperature and high humidity (saturated water vapor pressure exists at high temperature) to a hygroscopic state at room temperature.

3.3 accelerated moisture absorption

The process of enabling the test material to obtain the saturated moisture content (3.4)

in a short period of time under a certain high temperature (such as 120 degrees C) and high-

water vapor pressure (such as 0.2 MPa).

3.4 saturated moisture content

The moisture content of the specimen in the supersaturated moisture state when it is cooled from a higher temperature with saturated moisture content (such as 120 degrees C) to a

lower temperature (such as room temperature).

NOTE: See formula (2).

4 Principle

The test material is placed under high temperature and high pressure saturated water vapor conditions for moisture absorption treatment. Because high temperature can accelerate the diffusion rate of water molecules in the material, and high pressure can increase the rate at which the material surface absorbs water molecules from the outside, the material can reach a saturated hygroscopic state in a short time. When the test material that has reached the saturated hygroscopic state is cooled to room temperature, due to the slow diffusion rate of water molecules inside the test material and the slow release rate on the surface at room temperature, the material will be in a supersaturated hygroscopic state. This method can quickly obtain the supersaturated moisture absorption state of carbon fiber reinforced composite materials.

5 Equipment and material

5.1 Supersaturated moisture absorption device. As shown in Figure 1, the supersaturated moisture absorption device consists of the following parts.

a) Sealed pressure vessels. The maximum pressure is not less than 2.0 MPa. It has heating function. The temperature can be controlled within +/-2°C of the set

shall be controlled at (105+/-2) degrees C under decompression conditions.

5.3 Analytical balance. The graduation value is 0.1 mg.

5.4 Desiccator. 10 L glass desiccator with built-in silica gel.

5.5 Specimen bag. It is made of high temperature resistant nylon material; sealable.

5.6 Dust-free absorbent paper.

6 Specimens

6.1 The specimens shall comply with the requirements of the relevant test method to be carried out as given in 8.7.

6.2 The glass transition temperature of the specimen shall be determined according to the provisions of GB/T 40396 before accelerated moisture absorption begins.

7 Conditioning and laboratory environment

7.1 Conditioning

Before the test, the specimen shall be placed at a temperature of (23+/-2) degrees C and a relative

humidity of (50+/-10)% for at least 24 h.

7.2 Laboratory environment

The temperature is (23+/-2) degrees C. The relative humidity is (50+/-10)%.

8 Operating procedures

8.1 Preparation before accelerated moisture absorption

8.1.1 Check the appearance of the specimen. Number each specimen.

8.1.2 Adjust the specimen condition according to the provisions of 7.1.

8.1.3 Use an analytical balance (5.3) to weigh the mass of each specimen, recorded as M0, accurate to 1 mg.

8.1.4 The specimens are not dried before moisture absorption.

8.2 Supersaturated conditioning by moisture

8.2.1 Set the sealed pressure vessel temperature to the test temperature. The test temperature shall be greater than 100 degrees C. The maximum test temperature shall not exceed the material's glass transition temperature (Tg) minus 25°C, that is, Tg-25°C.

8.2.2 Place the specimen on the specimen holder [5.1 b)]. Then put the specimen holder into the sealed pressure vessel [5.1 a)]. Try to avoid contact between specimen surfaces.