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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 21650.1-2026

Replacing GB/T 21650.1-2008

**Evaluation of pore size distribution and porosity of solid
materials by mercury porosimetry and gas adsorption - Part 1:
Mercury porosimetry**

压汞法和气体吸附法测定固体材料孔径分布和孔隙度 第1部分：压汞法
(English Translation)

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents".

Drafting.

This document is Part 1 of GB/T 21650 "Determination of Pore Size Distribution and Porosity of Solid Materials by Mercury Intrusion Porosimetry and Gas Adsorption Method".

GB/T 21650 has published the following parts.

---Part 1: Mercury Porosimetry;

---Part 2: Gas Adsorption Method for Mesoporous and Macroporous Structures;

---Part 3: Gas adsorption method for microporous analysis.

This document replaces GB/T 21650.1-2008 "Determination of Pore Size Distribution and Porosity of Solid Materials by Mercury Intrusion Porosimetry and Gas Adsorption Methods - Part 1" the main technical changes in "Metal Intrusion Porosimetry" compared to GB/T 21650.1-2008, aside from structural adjustments and editorial modifications, are as follows.

a) The minimum equivalent aperture has been changed (see Chapter 1, Chapter 1 of the 2008 edition);

b) Added porosity measuring instrument, porosity measurement method, blind pore, powder, pore, pore diameter, median pore diameter, peak pore diameter, hydraulic pore diameter, and accumulated body.

Terms and definitions for volume, skeletal volume, and inclusion density (see Chapter 3);

c) Terms and definitions such as "loose packing density" and "blind hole" have been removed (see Chapter 3 of the 2008 edition);

d) Symbols for packed volume, skeleton volume, packed density, skeleton density, porosity, and dilatometer have been added (see Chapter 4);

- e) The principle of mercury porosimetry has been added (see Chapter 5);
- f) The requirements for mercury purity have been changed (see 6.3, 2008 edition of 6.3);
- g) Added performance testing requirements for the borehole measuring instrument (see 7.5);
- h) Added methods for calculating bulk density, skeleton density, and porosity (see 9.4 and 9.5).

This document is equivalent to ISO 15901-1:2016 "Determination of pore size distribution and porosity of solid materials by mercury porosimetry and gas adsorption method" Part. Mercury Porosimetry.

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed and is under the jurisdiction of the National Technical Committee on Standardization of Particle Characterization, Sorting and Screening (SAC/TC168).

Introduction

Typically, pores include micropores, mesopores, and macropores, used to describe openings, channels, or cavities within solids, and also to describe beds formed by particles.

Porosity refers to the gaps (such as cracks or voids) within layers, compacted bodies, or aggregates. It is a commonly used term to characterize the porous properties of materials; in this document, pores...

The precise definition of porosity is. the ratio of the total volume of interconnected pores and voids to the volume of the particle aggregate. Besides interconnected pores, solids may also contain other...

Closed pores are isolated from the outer surface, preventing fluid from penetrating them. This document does not address the characterization of closed pores.

Porous materials can be fine powders, coarse powders, compressed materials, extrusions, flakes, or monomeric structures. Characterizing porous materials typically involves measuring pore size.

The calculation of pore volume or porosity is required, and in certain cases, it is also necessary to study the pore shape and connectivity and measure the internal and external specific surface areas.

Porous materials have significant technological value in many fields, such as controlled drug release, chemical catalysis, gas separation and filtration (sterilization), and materials technology.

Environmental protection and pollution control, natural reservoir rocks, building materials, polymers and ceramics, etc.

The properties of porous solids (such as strength, reactivity, and permeability) depend on their pore structure. To address the complex characteristics of most materials, numerous...

There are various methods for characterizing pore structure, and the results obtained by different methods may differ. Usually, a single method cannot fully characterize the pore structure.

Therefore, it is necessary to select the most suitable characterization scheme based on the application scenario, physicochemical properties, and pore size range of the material.

GB/T 21650 describes the testing principles and methods for materials with different pore sizes, and is proposed to consist of three parts.

---Part 1: Mercury Intrusion Porosimetry. The purpose is to describe the mercury intrusion porosimetry method for evaluating the pore size distribution and specific surface area within solids.

---Part 2: Gas Adsorption Method for the Analysis of Mesopores and Macropores. The aim is to describe the method for determining porosity and pore size distribution using gas adsorption.

The method of cloth.

---Part 3: Gas Adsorption Analysis of Micropores. The aim is to describe the determination of micropore volume in microporous materials using low-temperature gas adsorption.

And specific surface area method.

Mercury porosimetry and gas adsorption Determination of pore size distribution and porosity of solid materials Part 1: Mercury Porosimetry Warning---The use of this document may involve hazardous materials, operations, and equipment. This document is not intended to describe all safety precautions associated with its application.

Regarding all issues, it is the user's responsibility to establish appropriate safety and hygiene measures and determine the applicability of regulatory restrictions before use.

1 Scope

This document describes a method for evaluating the pore size distribution and specific surface area of solids using the Ritter-Drake mercury intrusion porosimetry method.

A comparative method. Mercury is polluting, and this method is generally destructive. The volume of mercury penetrating into pores or voids varies with the applied static pressure.

The pressure can be correlated with the orifice size.

In actual operation, the maximum external pressure is limited to approximately 400 MPa (60,000 psi), which corresponds to a minimum equivalent orifice diameter of approximately 4nm. The maximum measurable pore size is mainly affected by the sample depth because there is a difference in the hydrostatic pressure of mercury from the top to the bottom of the sample.

The maximum pore size measured was 400 μm (the maximum pore size of some samples can reach 900 μm or even larger under specific conditions). Mercury porosimetry.

The method of measuring porosity includes both intraparticle and interparticle porosimetry. Typically, without additional information from other methods, mercury porosimetry is difficult to determine.

This document distinguishes between these two types of coexisting pores. This document is applicable to the study of most non-wetting porous materials. This document is not suitable for amalgamated materials.

Materials, such as certain metals like gold, aluminum, copper, nickel, and silver. If this method must be used, the sample needs to be pre-passivated. Under external pressure Under stress, some materials will deform, be compressed, or break, resulting in open-pore collapse and closed-pore opening. In some cases, it may be necessary to...

A sample compression correction factor is introduced to obtain useful and comparable data. Therefore, mercury porosimetry is comparable.

2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included.

For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies.

This document.

Safety insampling

Note: GB/T 3723-1999 General Safety Guidelines for Sampling of Industrial Chemical Products (ISO 3165:1976, IDT) Note. GB/T 47100-2026 Sampling and sample reduction in the determination of particle properties of particulate materials (ISO 14488:2007, IDT)

3 Terms and Definitions

The following terms and definitions apply to this document.

Porosimeter

An instrument used to measure pore volume and pore distribution.