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Evaluation of pore size distribution and porosity of solid materials by mercury porosimetry and gas adsorption —

Part 1: Mercury porosimetry

Distribution des dimensions des pores et porosimétrie des matériaux solides par porosimétrie au mercure et par adsorption de gaz —

Partie 1: Porosimétrie au mercure



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15901-1 was prepared by Technical Committee ISO/TC 24, *Sieves, sieving and other sizing methods*, Subcommittee SC 4, *Sizing by methods other than sieving*.

ISO 15901 consists of the following parts, under the general title *Evaluation of pore size distribution and porosimetry of solid materials by mercury porosimetry and gas adsorption*:

- *Part 1: Mercury porosimetry*
- *Part 2: Analysis of mesopores and macropores by gas adsorption*
- *Part 3: Analysis of micropores by gas adsorption*

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Introduction

In general, different pores (micro-, meso-, and macropores) can be pictured as either apertures, channels or cavities within a solid body or as space (i.e. interstices or voids) between solid particles in a bed, compact or aggregate. Porosity is a term which is often used to indicate the porous nature of solid material and is more precisely defined as the ratio of the volume of the accessible pores and voids to the total volume occupied by a given amount of the solid. In addition to the accessible pores, a solid can contain closed pores which are isolated from the external surface and into which fluids are not able to penetrate. The characterization of closed pores is not covered in this International Standard.

Porous materials can take the form of fine or coarse powders, compacts, extrudates, sheets or monoliths. Their characterization usually involves the determination of the pore size distribution as well as the total pore volume or porosity. For some purposes, it is also necessary to study the pore shape and interconnectivity and to determine the internal and external specific surface area.

Porous materials have great technological importance, for example in the context of the following:

- controlled drug release;
- catalysis;
- gas separation;
- filtration including sterilization;
- materials technology;
- environmental protection and pollution control;
- natural reservoir rocks;
- building materials properties;
- polymers and ceramic.

It is well established that the performance of a porous solid (e.g. its strength, reactivity, permeability or adsorbent power) is dependent on its pore structure. Many different methods have been developed for the characterization of pore structure. In view of the complexity of most porous solids, it is not surprising that the results obtained are not always in agreement and that no single technique can be relied upon to provide a complete picture of the pore structure. The choice of the most appropriate method depends on the application of the porous solid, its chemical and physical nature and the range of pore size.

The most commonly used methods are as follows:

- a) mercury porosimetry, where the pores are filled with mercury under pressure; this method is suitable for many materials with pores in the appropriate diameter of 0,003 μm to 400 μm ;
- b) meso- and macropore analysis by gas adsorption, where the pores are characterized by adsorbing a gas, such as nitrogen, at liquid nitrogen temperature; the method is used for pores in the approximate diameter range of 0,002 μm to 0,1 μm (2,0 nm to 100 nm), and is an extension of the surface area estimation technique;
- c) micropore analysis by gas adsorption, where the pores are characterized by adsorbing a gas, such as nitrogen, at liquid nitrogen temperature; the method is used for pores in the approximate diameter range of 0,4 nm to 2,0 nm, and is an extension of the surface area estimation technique.