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Determination of density by volumetric displacement — Skeleton density by gas pycnometry

Détermination de la masse volumique par déplacement volumétrique — Masse volumique du squelette mesurée par pycnométrie à gaz

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 24, *Particle characterization including sieving*, Subcommittee SC 4, *Particle characterization*.

Introduction

The true solid state density of a material is defined as the ratio of the mass to the volume occupied by that mass. Therefore, the contribution to the volume made by pores or internal voids and also interparticle voids (in the case of granulated or highly dispersed samples) shall be subtracted when calculating the true density.

If the material has no porosity, the true density can be measured by displacement of any fluid in which the solid remains inert. The accuracy of the method is limited by the accuracy with which the fluid volume can be determined. Usually, however, the pores, cracks, or crevices of the material will not easily be completely penetrated by a displaced liquid. In these instances, the true density can be measured by using a gas as the displaced fluid if the material does not contain closed pores, which cannot be penetrated by the analysis gas. Therefore, the density experimentally determined by gas pycnometry generally is the so called skeleton density of the material which equals the true solid state density only for samples without closed pores.

Apparatus used to measure solid volumes are often referred to as pyknometers or pycnometers after the Greek “pyknos”, meaning thick or dense. With gas pycnometry, materials of irregular shape can be analysed.

Once the volume of solid skeleton of the sample and the sample mass have been determined, the skeleton density is readily calculated.

Determination of density by volumetric displacement — Skeleton density by gas pycnometry

1 Scope

This International Standard specifies a method for rapid and efficient determination of the skeleton density of solid material samples of regular or irregular shape, whether powdered or in one piece, by means of a gas displacement pycnometer.

2 Normative references

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

ISO 14488, *Particulate materials — Sampling and sample splitting for the determination of particulate properties*

ISO 9277, *Determination of the specific surface area of solids by gas adsorption — BET method*

ISO 15901-3, *Pore size distribution and porosity of solid materials by mercury porosimetry and gas adsorption — Part 3: Analysis of micropores by gas adsorption*

3 Terms and definitions

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

3.1
density
ratio of the mass of a certain amount of a sample to the volume occupied by that mass

3.2
true solid state density
ratio of the sample mass to the volume of the compact solid skeleton of the sample which excludes the volume of open and closed pores or internal voids and also interparticle voids as in the case of granulated or highly dispersed samples

3.3
skeleton density
ratio between sample mass and the volume of the sample including the volume of closed pores (if present) but excluding the volumes of open pores as well as that of void spaces between particles within the bulk sample

3.4
closed pore
pore totally enclosed by its walls and hence not interconnecting with other pores and not accessible to fluids

3.5
open pore
pore not totally enclosed by its walls and open to the surface either directly or by interconnecting with other pores and therefore accessible to fluids