SLOVENSKI STANDARD
SIST ISO 13323-1:2002

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Določ evanje granulacije - Metode z interakcijo svetlobe in posameznih delcev - 1. del: Ocenitve na osnovi interakcije svetlobe

Determination of particle size distribution -- Single-particle light interaction methods -- Part 1: Light interaction considerations

Détermination de la distribution granulométrique -- Méthodes d'interaction lumineuse de particules uniques -- Partie 1: Considérations relatives à l'interaction lumineuse

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Determination of particle size distribution — Single-particle light interaction methods —

Part 1: Light interaction considerations

Détermination de la distribution granulométrique — Méthodes d'interaction lumineuse de particules uniques —

Partie 1: Considérations relatives à l'interaction lumineuse

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 part of ISO 13323 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 13323-1 was prepared by Technical Committee ISO/TC 24, *Sieves, sieving and other sizing methods*, Subcommittee SC 4, *Sizing by methods other than sieving*.

ISO 13323 consists of the following parts, under the general title *Determination of particle size distribution — Single-particle light interaction methods*:

— *Part 1: Light interaction considerations*

— *Part 2: Light-scattering single-particle light interaction device design, performance specifications and operation requirements*

— *Part 3: Single-particle light-extinction device design, performance specifications and operation requirements*

Annexes A, B and C of this part of ISO 13323-1 are for information only.

Introduction

Measurement of individual particles by interaction with light has been carried out for many years using a variety of instruments. These instruments vary in optical design, light-source types, and means of particle presentation to the light. For these reasons, data from nearly identical particle sources frequently differ when different instruments are used for measurement. In addition, the extent of light interaction produced by a particle is affected by several physical parameters in addition to the particle size. The purpose of this part of ISO 13323 is to define the basis for, and to reduce the variability of, data produced by light interaction methods of particle size measurement.

Particle size measurement by single-particle light interaction devices normally involves either determination of the light scattered as a result of the light interaction with a single-particle or the amount of light extinction caused by the presence of the particle in the light beam. This part of ISO 13323 will discuss the principle of the light interaction phenomena that are measured. The general performance and operational parameters that are pertinent to the instruments and to the particle/fluid environment in which the instruments operate will be summarized. Specific instrument types, operation, and performance are not discussed in this part of ISO 13323.

Determination of particle size distribution — Single-particle light interaction methods —

Part 1: Light interaction considerations

1 Scope

This part of ISO 13323 provides guidance on the selection and operation of devices that determine the size and number of particles by measuring the phenomena resulting from light interaction with individual particles present in a gas or liquid. The reported particle size is defined as an equivalent optical size based upon the response of the measurement system to calibration particles. This definition requires that the instrument be calibrated with well-defined materials.

This part of ISO 13323 applies to particles ranging in size from approximately 0,05 µm in diameter to the millimetre size range. Gas-borne particles in sizes from approximately 0,05 µm to 20 µm or so are measured primarily by light-scattering. Larger particles can be measured using light extinction sensors. Liquid-borne particles in the size range from approximately 0,05 µm to a few micrometres are measured by light-scattering. Light extinction is used to measure liquid-borne particles in sizes from approximately 1 µm to the millimetre size range. The size range capability of any single instrument is usually approximately 100:1. Particles larger than approximately 100 times the size of the smallest particle that can be measured with good sizing resolution are reported as “greater than or equal to the threshold size” of the largest size channel of the instrument.

The response that is considered in this part of ISO 13323 is the change in collected light flux resulting from the presence of a single-particle within the optical sensing zone of the measuring instrument. For this reason, instruments, which rely upon optical interaction to produce data only indicating the extent of particle motion, are not discussed here.

NOTE Instruments not discussed here include devices such as aerodynamic particle sizers or phase Doppler particle analysers, which produce data primarily dependent upon the aerodynamic size of the particles. Those instrument types do not use the extent of light interaction to measure the particle size. The particle size is defined by residence time during motion through a defined distance or by particle velocity. These instruments report a particle size that is related to fluid-dynamic measurements.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 13323. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 13323 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3165, *Sampling of chemical products for industrial use — Safety in sampling*.

ISO 6206, *Chemical products for industrial use — Sampling — Vocabulary*.

ISO 14887[1)], *Sample preparation — Dispersing procedures for powders in liquid*.

3 Terms and definitions

For the purposes of this part of ISO 13323, the following terms, definitions and symbols apply.

3.1 Definitions

3.1.1
absorption
reduction of intensity of a light beam traversing a medium (fluid or particle) by energy conversion in the medium

3.1.2
coincidence
presence of more than one particle within the sensing zone of an instrument at any time

NOTE The effects include decreased indication of particle population and increased indication of particle size, since several particles can be reported as a single larger one.

3.1.3
relative complex refractive index
refractive index of a particle relative to that of the fluid medium (n_m) in which it is suspended, consisting of a real part (n_p) and an imaginary (absorption) part (ik_p)

$$m = \frac{n_p - ik_p}{n_m} \quad (1)$$

3.1.4
counting accuracy
ratio of the reported population to the true population in the measured sample

NOTE The counting accuracy may be expressed as counting efficiency by multiplying the ratio by 100.

3.1.5
equivalent optical diameter
diameter reported by a single-particle light interaction device, based upon the light interaction signal from that single-particle being equivalent to that from a calibration particle of known dimensions and optical properties

NOTE This diameter will vary with the optical system of the device and particle/fluid optical properties and some physical properties.

3.1.6
extinction
attenuation of light through absorption and scattering when passing through or otherwise interacting with a medium

3.1.7
multiple scattering
three-dimensional spatial pattern of light intensity emitted from a particle from scattering of light from the primary light source and light scattered from other particles in the sensing volume which is directed to the particle of concern in the sensing zone

3.1.8
reflection
return of radiation by a surface without change in wavelength

1) To be published.

3.1.9
refractive index
ratio of the velocity of light in a medium to the velocity in a vacuum which is expressed as the combination of a real and an imaginary term

NOTE The real term expresses the light velocity ratio and the imaginary term expresses the fraction of incident light absorbed by the medium through which the light passes.

3.1.10
refraction
change in the direction of light propagation as a result of change in the velocity of propagation in passing from one medium to another

3.1.11
reported size range
size channel
size range defined by a particle sizing instrument

NOTE When several size ranges are reported, the lower and upper range limits are shown. The upper limit of all but the largest size range is equal to the lower limit of the next larger range. The size limits of the largest range is typically defined as "equal to or greater than x", where x is the lowest size limit of that range.

3.1.12
scattering
general term describing the change in light propagation at the interface of two media

3.1.13
scattering pattern
three-dimensional spatial pattern of light intensity emitted from a particle as a result of scattering of light transmitted from the primary light source to the particle being measured in the optical sensing zone

3.1.14
sensing zone
sensing volume
volume within the instrument that is optically and physically defined where particle interaction with light is observed and used to develop data on particle size and quantity

3.1.5
Stoke's number
St
product of particle relaxation time (t), time for a particle to accommodate to a fluid velocity change and actual particle velocity (v), divided by the sample probe inlet size (d_i)

$$St = \frac{tv}{d_i} \tag{2}$$

3.1.6
extinction coefficient
E
ratio of total light flux scattered and/or absorbed by a particle to the light flux incident upon the particle

3.2 Symbols

a Particle radius

A Projected area of particle(s) illuminated by incident light

c_n Numerical particle concentration