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Particle size analysis — Dynamic light scattering (DLS)

Analyse granulométrique — Dispersion lumineuse dynamique (DLD)

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 24, *Particle characterization including sieving*, Subcommittee SC 4, *Particle characterization*.

This third edition cancels and replaces the second edition (ISO 22412:2017), which has been technically revised.

The main changes are as follows:

— inclusion of multi-angle dynamic light scattering (MADLS);

— inclusion of imaging dynamic light scattering (DLS);

— addition of Clause A.5 on polarisation-separated backscatter photon cross-correlation spectroscopy;

— extension of Annex B on online measurements;

— incorporation of the content from ISO TR 22814 into Annexes C and D.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Particle size analysis in the sub micrometre size range is performed on a routine basis using the dynamic light scattering (DLS) technique, which probes the hydrodynamic mobility of the particles. The technique is successful because it provides estimates of the average particle size and size distribution within a few minutes, and because user-friendly commercial instruments are available. Nevertheless, proper use of the instrument and interpretation of the result involve certain precautions.

The principle of DLS for a concentrated suspension is the same as for a dilute suspension. However, specific requirements for the instrument setup and specification of test sample preparation are specified for concentrated suspensions. At high concentrations, particle-particle interactions and multiple light scattering can become dominant and can result in apparent particle sizes that differ between concentrated and dilute suspensions.

DLS is also referred to as “quasi-elastic light scattering (QELS)” and “photon correlation spectroscopy (PCS),” although PCS is actually one of the measurement methods.

Several methods have been developed for DLS. These methods can be classified in several ways:

a) by the difference in raw data acquisition (autocorrelation, cross-correlation and frequency analysis, spatial correlation);

b) by the difference in optical setup (homodyne mode versus heterodyne mode);

c) by the angle of observation.

In addition, instruments show differences with respect to the type of laser source and often allow application of different data analysis algorithms, e.g. cumulants, non-negative least squares (NNLS), CONTIN, etc.

Particle size analysis — Dynamic light scattering (DLS)

1 Scope

This document specifies the application of dynamic light scattering (DLS) to the following:

— measurement of average hydrodynamic particle size;

— measurement of the size distribution of mainly sub micrometre-sized particles, emulsions or fine bubbles dispersed in liquids.

This document is applicable to the measurement of a broad range of dilute and concentrated suspensions.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
particle
minute piece of matter with defined physical boundaries

Note 1 to entry: A physical boundary can also be described as an interface.

Note 2 to entry: A particle can move as a unit.

[SOURCE: ISO 26824:2022, 1.1, modified — Note 3 to entry has been deleted.]

3.2
average hydrodynamic diameter
$\overline{x}_{\mathrm{DLS}}$
hydrodynamic diameter that reflects the central value of the underlying *particle* (3.1) size distribution

Note 1 to entry: The average particle diameter is either directly determined without calculation of the particle size distribution, or calculated from the computed intensity-, volume- or number-weighted particle size distribution or from its fitted (transformed) density function. The exact nature of the average particle diameter depends on the evaluation algorithm.

Note 2 to entry: The cumulants method yields a scattered light intensity-weighted harmonic mean particle diameter, which is sometimes also referred to as the "z-average diameter."

Note 3 to entry: Arithmetic, geometric and harmonic mean values can be calculated from the particle size distribution according to ISO 9276-2.

Note 4 to entry: Mean values calculated from density functions (linear abscissa) and transformed density functions (logarithmic abscissa) can differ significantly (see ISO 9276-1).