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Measurement and characterization of particles by acoustic methods —

Part 2:
Linear theory

Caractérisation des particules par des méthodes acoustiques —

Partie 2: Théorie linéaire

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Foreword

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

This second edition cancels and replaces the first edition (ISO 20998-2:2013), which has been technically revised.

The main changes are as follows:

— References to relaxation mechanisms that affect attenuation

— Additional explanatory notes for Table 1

— Clarification of notation used in Formula (9)

— Minor editorial changes

A list of all parts in the ISO 20998 series can be found on the ISO website.

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Introduction

It is well known that ultrasonic spectroscopy can be used to measure particle size distribution (PSD) in colloids, dispersions, and emulsions[1],[2],[3],[4]. The basic concept is to measure the frequency-dependent attenuation or velocity of the ultrasound as it passes through the sample. The attenuation spectrum is affected by scattering or absorption of ultrasound by particles in the sample, and it is a function of the size distribution and concentration of particles[5],[6],[7]. Once this relationship is established by empirical observation or by theoretical calculations, one can estimate the PSD from the ultrasonic data. Ultrasonic techniques are useful for dynamic online measurements in concentrated slurries and emulsions.

Traditionally, such measurements have been made off-line in a quality control lab, and constraints imposed by the instrumentation have required the use of diluted samples. By making in-process ultrasonic measurements at full concentration, one does not risk altering the dispersion state of the sample. In addition, dynamic processes (such as flocculation, dispersion, and comminution) can be observed directly in real time[8]. This data can be used in process control schemes to improve both the manufacturing process and the product performance.

While it is possible to determine the particle size distribution from either the attenuation spectrum or phase velocity spectrum, the use of attenuation data alone is recommended. The relative variation in phase velocity due to changing particle size is small compared to the mean velocity, so it is often difficult to determine the phase velocity with a high degree of accuracy, particularly at ambient temperature. Likewise, the combined use of attenuation and velocity spectra to determine the particle size is not recommended. The presence of measurement errors (i.e. “noise”) in the magnitude and phase spectra can increase the ill-posed nature of the problem and reduce the stability of the inversion.

