SHIMADZU

Application News

Powder Property Analysis No.Q108

Automatic Calculation of Refractive Index in Laser Diffraction Particle Size Distribution Analyzer

■ Introduction

When using a particle size distribution analyzer based on the laser diffraction and scattering principle, selecting the proper refractive index can be difficult, but it is very important. Various methods that require experience and / or theoretical knowledge have been proposed for addressing this issue.
Whichever the approach, however, some manual operation must be performed by the operator, which in turn requires that the operator have an understanding of the measurement principles as well as some degree of experience. Performing this operation has never been very easy.
The WingSALDII software, provided with the Shimadzu Laser Diffraction Particle Size Analyzer, includes a Refractive Index Automatic Calculation feature that was not available in previous versions of the software.
Utilizing this feature, the software automatically calculates refractive indices that are appropriate for the measured sample, listing the top 5 candidates. The calculation process is based on the concept of the LDR (Light Intensity Distribution Reproduction) method. In this report, we introduce the refractive index automatic calculation feature using the measurement results obtained for actual samples.

Table 1 Measurement Conditions

Measurement instrument	: SALD-2201
Dispersion solvent	: Pure water
Dispersion agent	: Sodium hexametaphosphate (0.1 wt%)
Dispersion method	: 100 W ultrasonic bath, 5 minutes irradiation

Fig. 1 Laser Diffraction Particle Size Analyzer SALD-2201

■ Test Samples and Results

White, fused alumina powder was used for the samples, which consisted of 3 different particle sizes (No. 1, No. 2, No. 3).
By applying the refractive index automatic calculation to the respective sample measurement results, top 5 candidate refractive indices were obtained for each sample, as shown in Table 2. Among the refractive indices that were calculated for the 3 samples, there were 2 refractive indices that all 3 samples had in common (1.65-0.00i and 1.70-0.00i). Fig. 2 shows the particle size distributions when the refractive index is set to 1.70-0.00i, which is closer to the documented value of α -alumina.

Table 2 Results of Application of Refractive Index Automatic Calculation

	Sample 1	Sample 2	Sample 3
1	1.75-0.01i	1.65-0.00i	1.60-0.00i
2	1.70-0.01i	1.75-0.00i	1.70-0.00i
3	1.70-0.00i	1.70-0.00i	1.65-0.00i
4	1.65-0.00i	1.90-0.00i	1.55-0.20i
5	1.85-0.05i	1.85-0.00i	1.75-0.00i

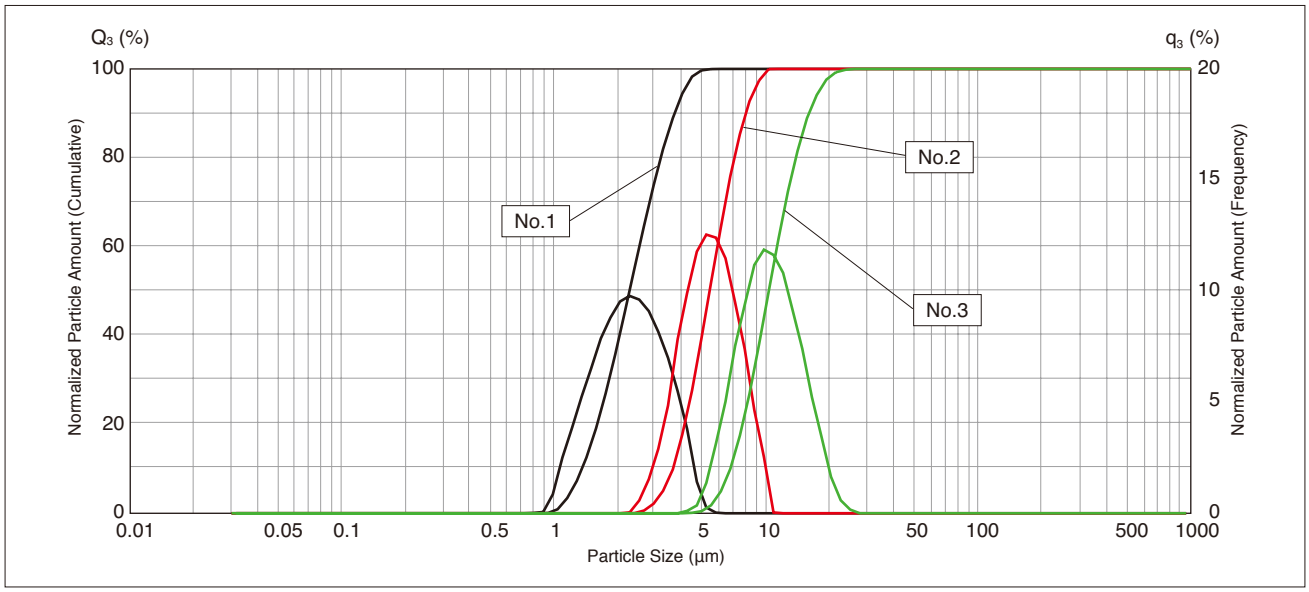

Fig. 2 Particle Size Distribution of 3 Types of Alumina Powder

■ Results Including Additional Samples

Two additional samples were prepared, consisting of equal quantities of No. 1 and No. 2, and No. 1 and No. 3, respectively. Following measurement of the newly prepared samples, the refractive index automatic calculation was applied to both samples. Once the refractive indices were entered in all 5 candidate positions for each sample, the only refractive index that all 5 samples had in common was 1.70-0.00i. Fig. 3 shows the particle size distribution measurement results after setting the refractive index to 1.70-0.00i for all 5 samples. (Cumulative distribution only)

The relationships between the single powder samples and respective mixed powder samples were appropriate taking into account the mixing ratios. This is one piece of evidence indicating that the proper refractive index was selected, and that the refractive index automatic calculation feature works effectively.

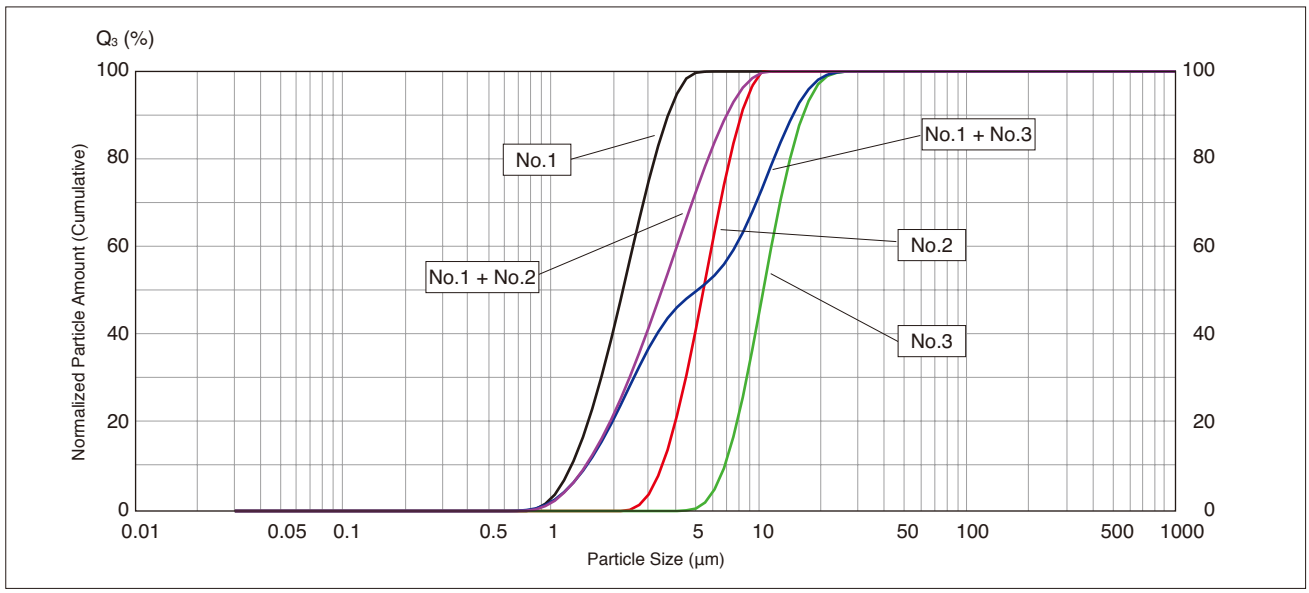

Fig. 3 Particle Size Distribution of 5 Types of Alumina Powder

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