Bettersize
BETTER PARTICLE SIZE SOLUTIONS
APPLICATION NOTE

Detecting Dark Brown Colloidal Suspensions Using the BeNano 180 Zeta Pro

Zhibin Guo, Hui Ning
Application Research Lab, Bettersize Instruments Ltd.

Introduction

Darker colored samples often manifest strong light absorption, leading to decreased intensity and fluctuations in scattered light during dynamic light scattering tests. Consequently, sample dilution becomes essential for obtaining more precise results.

In this application note, the BeNano 180 Zeta Pro were employed to investigate the particle size of two samples dispersed in aqueous solutions with light-absorbing effects.

Instrumentation

The BeNano 180 Zeta Pro is equipped with a solid-state laser with a wavelength of 671 nm and a power of 50 mW. The scattered light signals of the sample at 90° or 173° is collected for DLS measurement. The calculation of the intensity fluctuation provides correlation function. The diffusion coefficient could be obtained. With the Stokes-Einstein equation, the size and size distribution of the sample are determined.

Experiment

Both samples in this investigation exhibited a brown coloration, indicative of robust light absorption characteristics. Particle size analysis was conducted on the two samples under different conditions, including their stock solutions, as well as subsequent dilutions of 2x, 10x, and 100x, respectively.

All measurements were performed at 25°C ±0.1°C with the 90° and 173° optics. Each sample was measured three times to check the repeatability of the results.

Results and Discussion

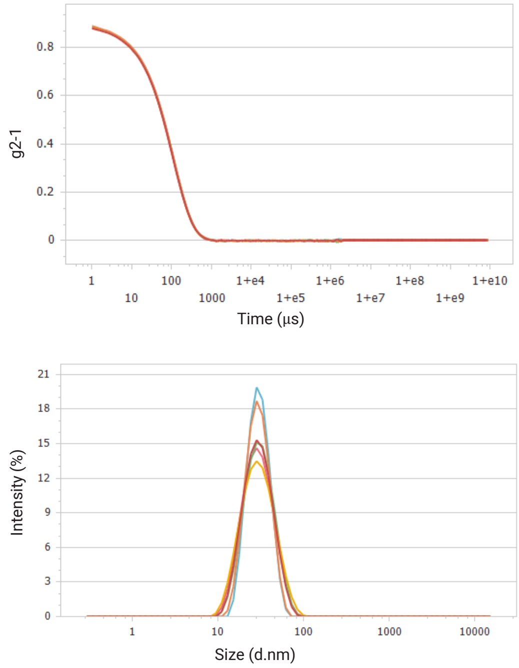

Figure 1. Correlation functions (top) and size distributions (bottom) of 2x diluted sample #1 detected at 90°

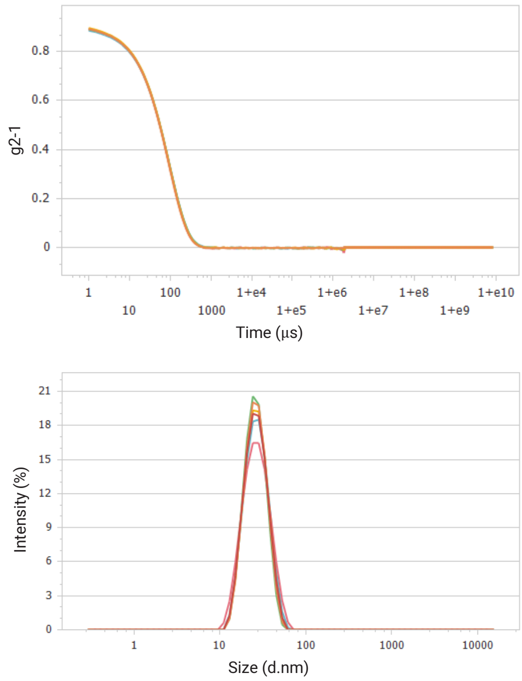

Figure 2. Correlation functions (top) and size distributions (bottom) of 2x diluted sample #2 detected at 90°

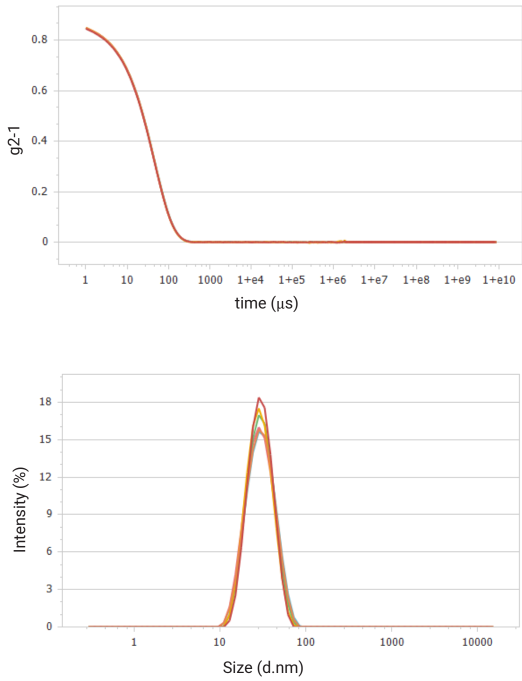

Figure 4. Correlation functions (top) and size distributions (bottom) of 2x diluted sample #2 detected at 173°

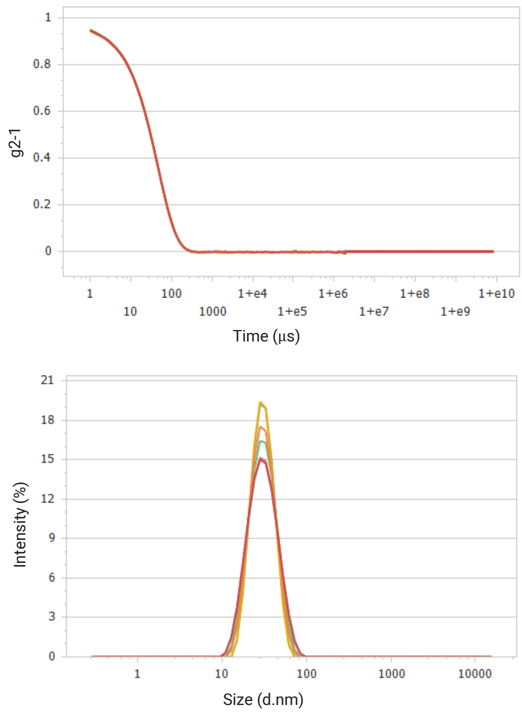

Figure 3. Correlation functions (top) and size distributions (bottom) of 2x diluted sample #1 detected at 173°

Figures 1 - Figures 4 demonstrate the excellent repeatability of test results for the two samples across different concentrations and angles. The stock solution is not detected at a 90° optics angle due to the sample's intense absorption.

Table 1. Size results of sample #1

Sample #1	90°	173°
Dilution Factor	Z-average Size	Z-average Size
0	—	45.90 ± 0.23
2	29.74 ± 0.4	28.50 ± 0.12
10	26.11 ± 0.91	25.61 ± 0.08
100	25.86 ± 0.23	25.71 ± 0.11

Table 2. Size results of sample #2

Sample #2	90°	173°
Dilution Factor	Z-average Size	Z-average Size
0	—	34.38 ± 0.1
2	24.21 ± 0.44	24.93 ± 0.24
10	22.68 ± 0.2	22.98 ± 0.26
100	23.18 ± 0.24	22.55 ± 0.16

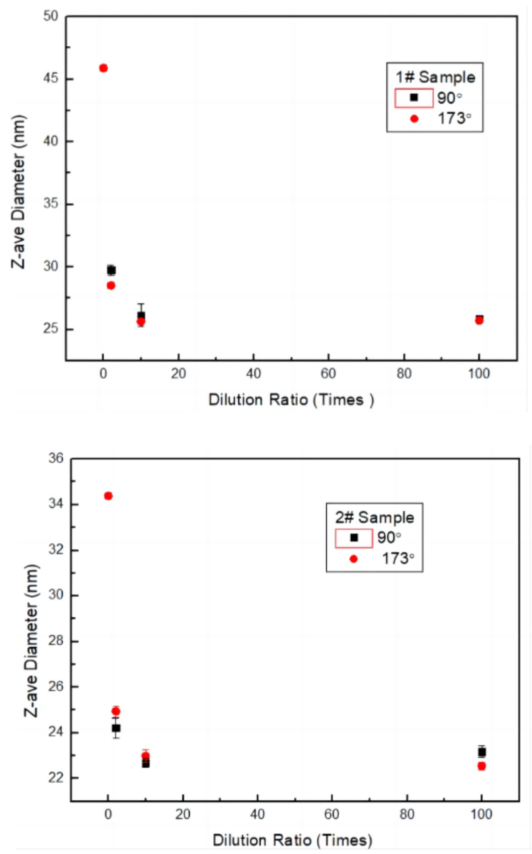

Figure 5. *Z-average sizes of sample #1 (top) and #2 (bottom) obtained at different dilution ratios and at different detection angles.*

In Figure 5, the observed size results exhibit a concentration-dependent decrease when measured at 90° and 173°. Beyond a tenfold dilution, no further changes in size are observed with concentration. The results at 90° and 173° exhibit consistent agreement under dilution conditions.

The size increases with concentration, which is attributed to the sample's strong absorption of scattered light, diminishing the intensity and fluctuations in scattered light, consequently yielding larger results. Therefore, for samples exhibiting significant absorption, dilution is essential. The particle size remains stable within the 10 to 100 times dilution range, indicating negligible absorption of scattered light and ensuring the authenticity of the size results.

Conclusion

Utilizing different detection angles, specifically 173° and 90°, revealed that the 173° results were not closer to the true value at higher concentrations. This is because the advantage of backscattering (173°) is in suppressing multiple light scattering for high-concentration samples, such as milky-white samples. However, for samples with strong absorption, backscattering is not able to enhance detection capabilities at high concentrations. Therefore, users are advised to consider their sample characteristics when selecting instrument configurations and detection angles, rather than relying solely on instrument specifications.

Bettersize

BETTER PARTICLE SIZE SOLUTIONS

Bettersize Instruments Ltd.

Further information can be found at

https://www.bettersizeinstruments.com

Email: info@bettersize.com

Address: No. 9, Ganquan Road, Lingang Industrial Park, Dandong, Liaoning, China

Postcode: 118009

Tel: +86-415-6163800

Fax: +86-415-6170645

Bettersize Inc.

Address: Suite K-2, 3188 Airway Ave, Costa Mesa, CA 92626, United States

Tel: +1 833-699-7493 (SIZE)

Download Our Application Notes:

Visit Our BeNano 180 Zeta Pro Site: