



Measuring the Sizes and Zeta Potentials of Copolymer Latex Samples

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



Through emulsion polymerization, polystyrene and butadiene can form nano copolymer latex sphere, which are widely used in paper, cement, and other industry areas. Depending on the composition, the latex surface may take positive or negative charges that maintain the stability of the latex system. Therefore, it is important to measure the zeta potential to evaluate charges and, eventually, the stability of the sample.

In this application note, the BeNano 90 Zeta (Bettersize Instruments Ltd.) was utilized to measure the sizes and zeta potentials of polystyrene-butadiene copolymers dispersed in aqueous environments that are from the same source but vary in manufacturing processes.

Instrumentation

In the BeNano 90 Zeta, a solid state laser beam with a wavelength of 671 nm and a power of 50 mW illuminates the sample. An avalanche photodiode (APD) detector coupled with fiber is used to collect scattered light signals from 12° for zeta potential measurement and from 90° for size measurement.

Experiment

Two copolymer latexes were diluted in pure water by 1000 times for size and zeta potential measurements.

Each sample was measured at least three times to investigate the repeatability of the results and obtain the standard deviation of the results.

Results and Discussion

The sizes and zeta potentials of two latex samples were obtained. Figure 1 shows the size distribution curves of both samples. It turns out that both samples are nano-scaled, without large aggregates but only narrow peaks. Figure 2 and Figure 3 display the phase plots and zeta potential trend plots of ELS measurement. The slopes of phase plots represent the frequency shifts of scattered light due to electrophoresis. As can be seen in the figures, the very clear slopes of the phase plots demonstrate good signal-to-noise ratios of measurements.

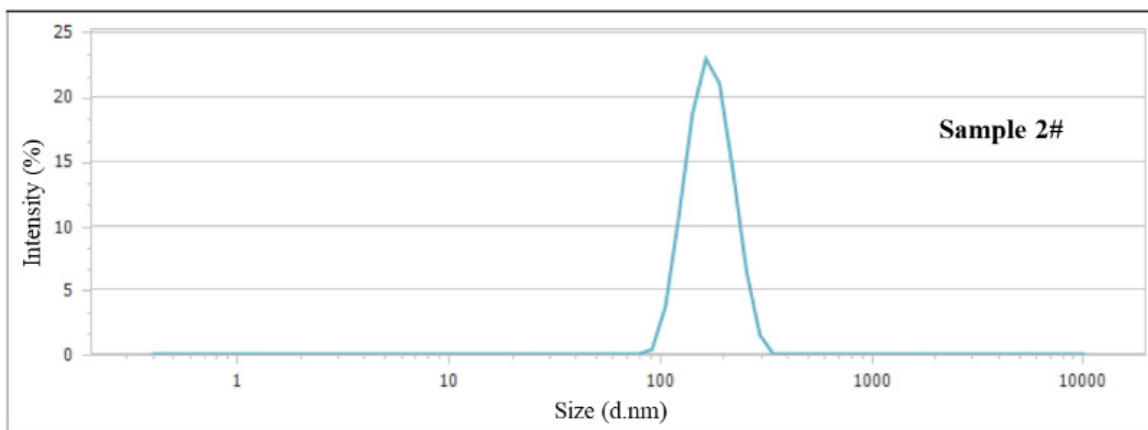
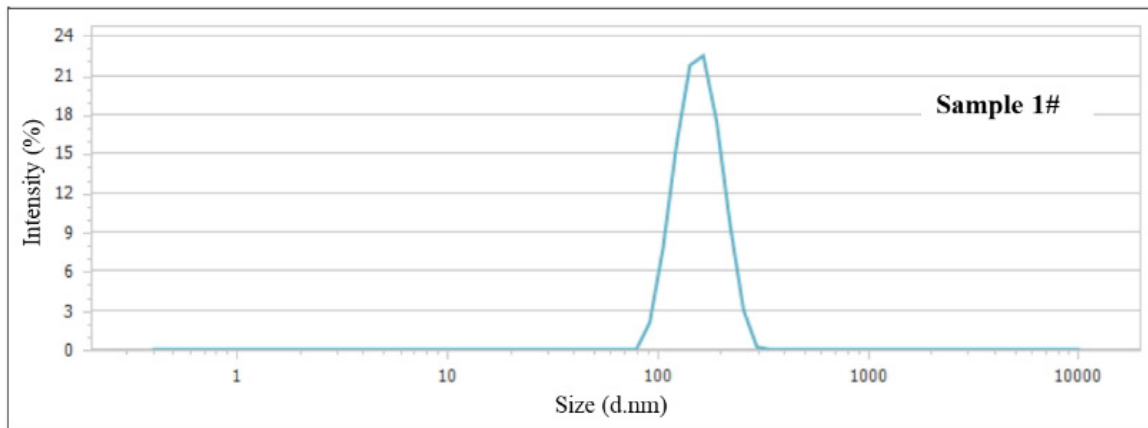


Figure 1. Size distribution curves of Sample 1# and Sample 2# copolymers

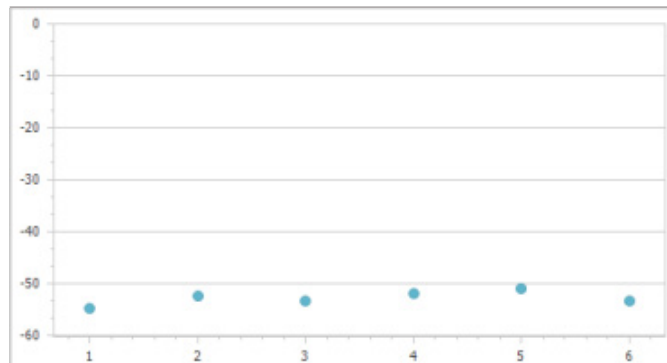
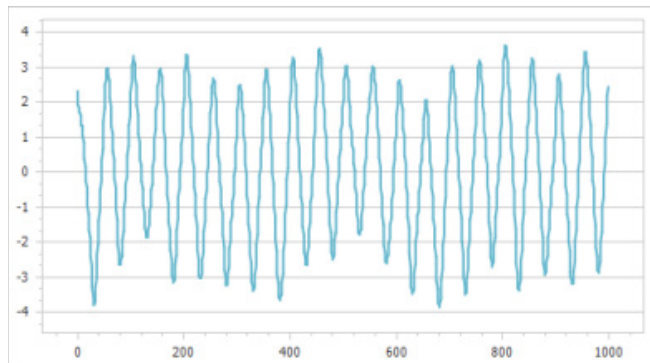


Figure 2. The phase plot and zeta potential trend plot of sample 1#

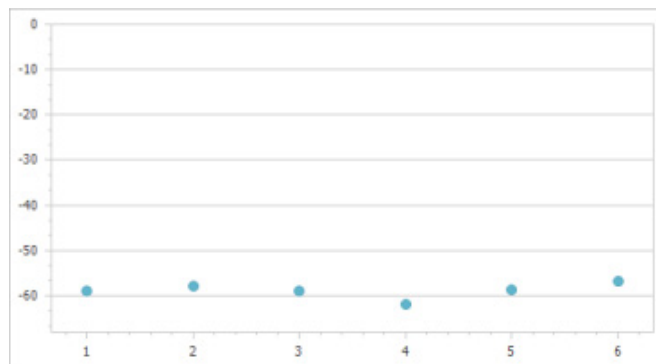
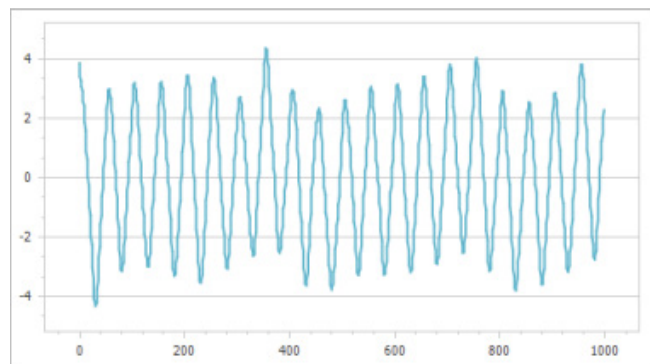


Figure 3. The phase plot and zeta potential trend plot of sample 2#

The sizes and zeta potentials of two latex samples were obtained. Figure 1 shows the size distribution curves of both samples. It turns out that both samples are nano-scaled, without large aggregates but only narrow peaks. Figure 2 and Figure 3 display the phase plots and zeta potential trend plots of ELS measurement. The slopes of phase plots represent the frequency shifts of scattered light due to electrophoresis. As can be seen in the figures, the very clear slopes of the phase plots demonstrate good signal-to-noise ratios of measurements.

The multiple measurement results of two samples are shown in Table 1, indicating that the size difference is small. PDI of both samples are far less than 0.05, which means that the samples are narrowly distributed in size. With respect to zeta potentials, the signs are negative and absolute values are larger than 30 mV, suggesting that a large number of negative charges are carried by the particle surfaces to generate strong electrostatic repulsion to keep the latex system stable.

Table 1. Measurement results of two latex samples

Sample	Z-average (nm)	PDI	Zeta potential (mV)
1#	155.76	0.010	-52.76±1.31
2#	170.31	0.002	-58.90±1.68

Conclusions

With the BeNano 90 Zeta, the size and zeta potential of the two polystyrene-butadiene copolymer latexes were successfully characterized. The results show that both copolymers are monodisperse in terms of size and are less likely to form aggregates due to high zeta potentials.

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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

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