



EXPERTS IN SIZE AND CRYSTALS

Copenhagen Nanosystems ApS

TESTING AND VALIDATION OF NANOCUVETTE™ S, SPECTROWORKS™ TOGETHER WITH UV-VIS SPECTROPHOTOMETER

30-Jul-2021



Written by: Wenbo Wang

Wenbo Wang, QC

Date: 30 JULI 2021

Approved by: Søren Lund Kristensen

Søren Lund Kristensen, QA

Date: 30 JULI 2021

Sponsor: _____

Name: _____

Date: _____

Sponsor: _____

Name: _____

Date: _____

Sponsor: _____

Name: _____

Date: _____



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Appendix 1. Results from NanoCuvette™ S and SpectroWork™ together with UV-Vis spectrophotometer
(24 Pages)

Appendix 2. Results from dynamic light scattering (60 Pages)



Abstract

The present report evaluates the particle size distribution and concentration of different polystyrene latex beads using NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer. The report includes:

- Evaluate mean particle size and concentration of polystyrene latex beads analyzed in SpectroWorks™ by using UV-Vis measurements with NanoCuvette™ S.
- Compare the result of concentration of polystyrene from NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer and diluted sample from stock provided by suppliers. Samples were prepared by diluting the stock provided by supplier (Sigma Aldrich).
- Compare the result of mean particle size of polystyrene latex beads from NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer and dynamic light scattering (DLS).

The performance of NanoCuvette™ S and SpectroWorks™ is assessed by comparing the results of particle size and concentration of polystyrene latex beads done with DLS. Optical filter inserted cuvette, NanoCuvette™ S and software together with spectrophotometer provided reliable results where the concentrations of all samples (except for polystyrene latex beads 1100 nm) have deviation less than 30% compared to the concentration of sample dilutions. Furthermore, the particle size results obtained from analysis of the UV-Vis measurements with NanoCuvette™ S by SpectroWorks™ have less than 22% deviation (except for run 2 of 100 nm sample) from the standard for all the size range.

1 Aim

The present report documents the results of mean particle size and concentration of polystyrene latex beads analyzed by SpectroWorks™ using UV-Vis measurements with NanoCuvette™ S. To evaluate the reliability of the results obtained from the cphnano products, the results will be compared with DLS results and product specification obtained from sample dilutions and product specification sheets provided by suppliers (Sigma).

2 Materials

The material used for measurement with NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer are listed in Table 1.

Table 1: Sample received for UV-Vis measurement with NanoCuvette™ S and SpectroWorks™ modeling

Sample name	Concentration (Vol.) (diluted samples)
Polystyrene Latex beads 100 nm	0.01%
Polystyrene Latex beads 460 nm	0.003%
Polystyrene Latex beads 600 nm	0.003%
Polystyrene Latex beads 800 nm	0.003%
Polystyrene Latex beads 1100nm	0.001%
Polystyrene Latex beads 3000 nm	0.001%



The material used for DLS measurement are listed in Table 2.

Table 2: Samples received for testing and validation of NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer

Sample name	Batch number	Internal number
Polystyrene Latex beads 100 nm	2021/07/23	32027
Polystyrene Latex beads 460 nm	2021/07/23	32028
Polystyrene Latex beads 600 nm	2021/07/23	32029
Polystyrene Latex beads 800 nm	2021/07/23	32030
Polystyrene Latex beads 1100nm	2021/07/23	32031
Polystyrene Latex beads 3000 nm	2021/07/23	32032

3 Analytical equipment

Analytical equipment is listed in 3.

Table 3. Analytical equipment included in the project

UV-Vis spectrophotometer	VWR UV-6300 Double beam spectrophotometer
DLS unit	Malvern Zetasizer Nano ZS

4 Method background

4.1 UV-Vis measurements with NanoCuvette™ S and SpectroWorks™ modeling

UV-Vis measurements using NanoCuvette™ S was done from 200nm-1100nm. Firstly, reference measurement was done by pipetting 100 µL of reference solution, DI water in the NanoCuvette™ S. B, A and D side measurements (see figure 1) were done respectively, and the spectra were saved. Secondly, the reference sample was removed and 100 µL of diluted samples were added in the NanoCuvette™ S and B, A and D side spectra are recorded and saved for further analysis. Each measurement was replicated. Reference spectra A, B, D sides and sample spectra A, B and D sides were respectively dragged and dropped in the SpectroWorks™ to obtain the results.



4.2 DLS measurement

The measurement conditions for dynamic light scattering are described in Table 4.

Table 4. Measurement conditions of samples

Sample cell	Disposable standard 1 cm cuvette, volume 3 ml
Sample preparation	The sample is diluted Ca. 50 times: 20 uL of sample is added to 1 mL of water.
Dispersant refractive index	1.330
Viscosity	0.8872 cP
Material refractive index	1.590
Material Absorption	0.010
Temperature	25.0 °C
Equilibration time	180 seconds
Evaluation model	General purpose
Display range	0.600 to 6000 nm
Multimodal – analysis resolution	Normal
Lower threshold	0.05
Upper threshold	0.01
Measurement position	Automatic
Attenuator	Automatic
Run duration	Automatic
Number of runs per measurement	Automatic
Measurements per sampling	3
Delay between measurements	0 seconds
Number of samplings	2

5 Analysis

5.1 Comparison of the diluted polystyrene latex beads concentration from stock provided by distributor with the concentration obtained from NanoCuvette™ S and SpectroWorks™

The results obtained from analyzed data using SpectroWorks™ are listed in table 5



Table 5. Concentration of the diluted polystyrene latex beads obtained using NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer.

Sample name	Concentration (Vol.) Diluted from the stock	Concentration (Vol.) From NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer. Result (% deviation)	
		Run 1	Run 2
		Polystyrene Latex beads 100 nm	0.01%
Polystyrene Latex beads 460 nm	0.003%	0.0038% (26.7%)	0.0038% (26.7%)
Polystyrene Latex beads 600 nm	0.003%	0.0026% (13.3%)	0.0026% (13.3%)
Polystyrene Latex beads 800 nm	0.003%	0.0030% (0.0%)	0.0031% (3.3%)
Polystyrene Latex beads 1100nm	0.001%	0.0016% (60.0%)	0.0016% (60.0%)
Polystyrene Latex beads 3000 nm	0.001%	0.0008% (20.0%)	0.0007% (30.0%)

The results of concentration obtained using NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer are considered reliable. The concentrations of all samples (except for polystyrene latex beads 1100 nm) from SpectroWorks™ have deviation less than 30%, when compared to the concentration of the dilution made from stock. However, due to the low concentration of polystyrene latex beads 1100 nm, the deviation of 60% might be also acceptable.

5.2 Comparison of the mean particle size of polystyrene latex beads from DLS and NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer.

The results of the mean particle size of polystyrene latex beads from DLS and NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer are listed in table 6.

Table 6. Mean particle size (Vol.) of polystyrene latex beads measured by DLS and NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer

Size of Polystyrene latex beads	PDI DLS		Mean particle size (D50, nm) from DLS (% deviation from standard)		Mean particle size (nm) NanoCuvette™ S and SpectroWorks™ together with UV-vis spectrophotometer (% deviation from standard)	
	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2
	100 nm	0.026	0.058	109 (9.0%)	107 (7.0%)	115.00 (15.0%)
460 nm	0.025	0.048	442 (3.9%)	431 (6.3%)	414.10 (10.0%)	413.04 (10.2%)
600 nm	0.040	0.086	662 (10.3%)	633 (5.5%)	546.26 (9.0%)	549.85 (8.4%)
800 nm	0.070	0.102	704 (12.0%)	730 (8.8%)	633.44 (20.8%)	637.50 (20.3%)
1100nm	0.147	0.040	873 (20.6%)	953 (13.4%)	1097.66 (0.2%)	1083.85 (1.5%)
3000 nm	0.365	0.334	1690 (43.7%)	1480 (50.7%)	3637.24 (21.4%)	3050.95 (1.9%)

For the results from DLS measurements, the deviation from the standard increases with the increase of the particle size of the sample. This phenomenon is also in line with the increase of PDI with the increase in the particle size of the sample and might be due to more sedimentation of particles when



the particle size became larger. The results from replicate measurements done using NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer are consistent except for 100 nm (Table 6). Furthermore, particle size measurements done using NanoCuvette™ S with SpectroWorks™ gives the deviation less than 22% for all measurements except for replicate 100 nm measurements, whereas the deviation range from 3.9% to 50.7% for DLS measurements from the theoretical concentration. It should also be noted that the polystyrene latex beads provided by sigma has the standard deviation ranging from 5%-15%.

6 Conclusion

NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer is considered reliable to evaluate the concentration and particle size of the sample. The concentrations of all samples (except for polystyrene latex beads 1100 nm) from SpectroWorks™ have deviation less than 30% compared to the diluted samples from the stock provided by supplier. Furthermore, the particle size results obtained from SpectroWorks™ using measurements in UV-Vis spectrophotometer and NanoCuvette™ S have less than 22% deviation (except for run 2 of 100 nm sample) from the standard for all the size range.



Change list

Issue	Change	Effective date
1	New document.	30-Jul-2021



Appendix 1:






Results from NanoCuvette™ S and SpectroWork™ together with UV-
Vis spectrophotometer (24 pages)

Summary

Experiment setup

Item ID: f5d7d373
 Box code: NCONES
 Cuvette no.: 01
 Model: NanoCuvette™ S
 Created: 2021-07-26 11:11:42
 Reference: Water (n = 1.333215 nD)

Results

 Refractive Index: 1.33612794 nD
 Reference fit quality: 39.4927 %
 Sample fit quality: 31.7062 %
 Mean Particle Diameter: 115.00 nm
 Particle Concentration: 0.0099 % (Vol.)

Sample attributes

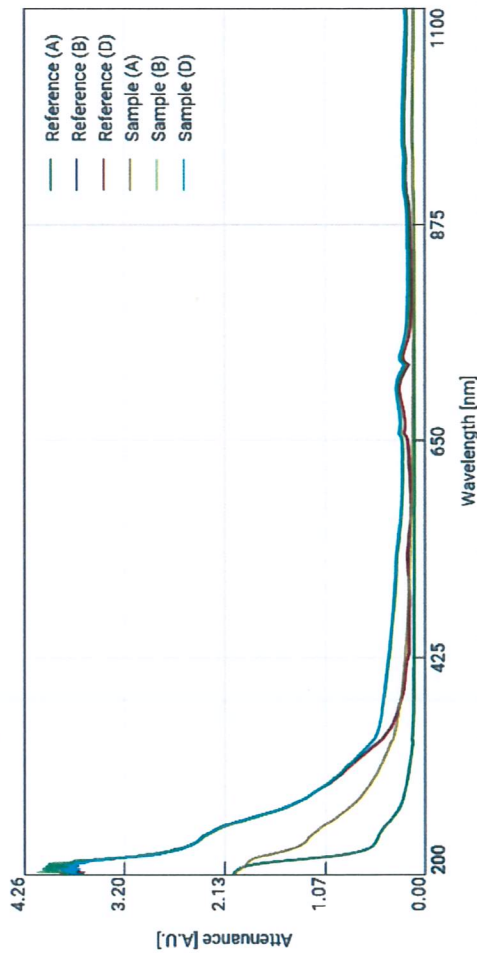
Sample name	Larex Beads 100nm 0.01%
Protocol name	
Analyte	
Solvent	DI

Notes

Here you can add notes about your sample.

Plots

Spectra 



Summary

Experiment setup

Item ID: cb18820b
 Box code: NCONES
 Cuvette no.: 01
 Model: NanoCuvette™ S
 Created: 2021-07-26 11:26:48
 Reference: Water (n = 1.333215 nD)






Sample attributes

Sample name	Latex beads 100nm 0.01% DI
Protocol name	
Analyte	
Solvent	

Notes

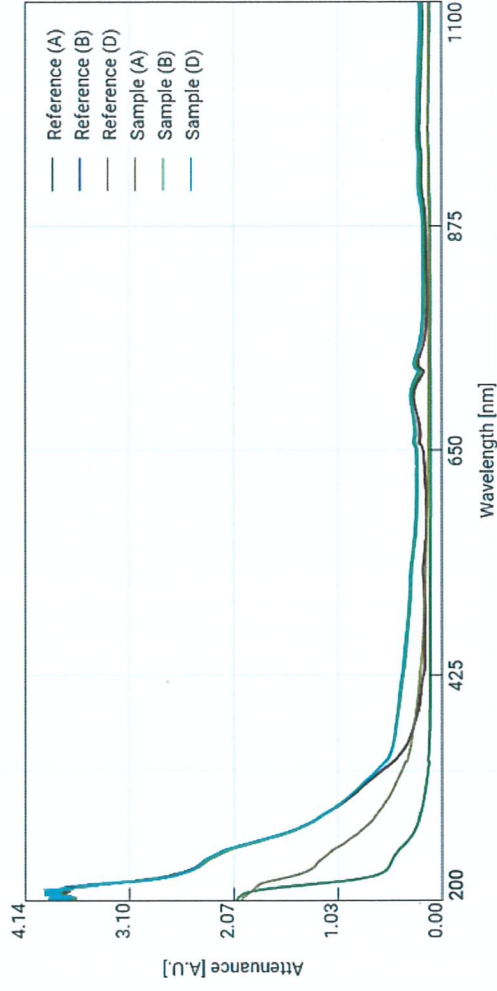
Here you can add notes about your sample.

Results

 Refractive Index: 1.33321537 nD
 Reference fit quality: 39.4927 %
 Sample fit quality: 25.9088 %
 Mean Particle Diameter: 148.90 nm
 Particle Concentration: 0.0081 % (Vol.)

Plots

Spectra Size distribution



Experiment setup

Item ID: f5d7d373
 Box code: NCONES
 Cuvette no.: 01
 Model: NanoCuvette™ S
 Created: 2021-07-26 11:11:42
 Reference: Water (n = 1.333215 nD)

Results

● Refractive Index: 1.33612794 nD
 ● Reference fit quality: 39.4927 %
 ● Sample fit quality: 31.7062 %
 ● Mean Particle Diameter: 115.00 nm
 ● Particle Concentration: 0.0099 % (Vol.)

Sample attributes

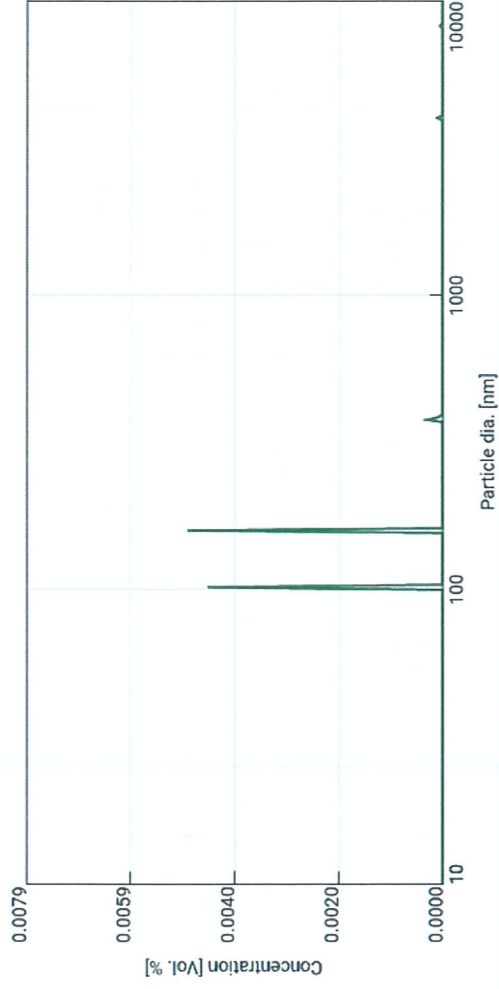
Sample name	Larex Beads 100nm 0.01%
Protocol name	
Analyte	
Solvent	DI

Notes

Here you can add notes about your sample.

Plots

Spectra **Size distribution**



Experiment setup

Item ID: cb18820b
 Box code: NCONES
 Cuvette no.: 01
 Model: NanoCuvette™ S
 Created: 2021-07-26 11:26:48
 Reference: Water (n = 1.333215 nD)

● Refractive Index: 1.33321537 nD
 ● Reference fit quality: 39.4927 %
 ● Sample fit quality: 25.9088 %
 ● Mean Particle Diameter: 148.90 nm
 ● Particle Concentration: 0.0081 % (Vol.)

Sample attributes

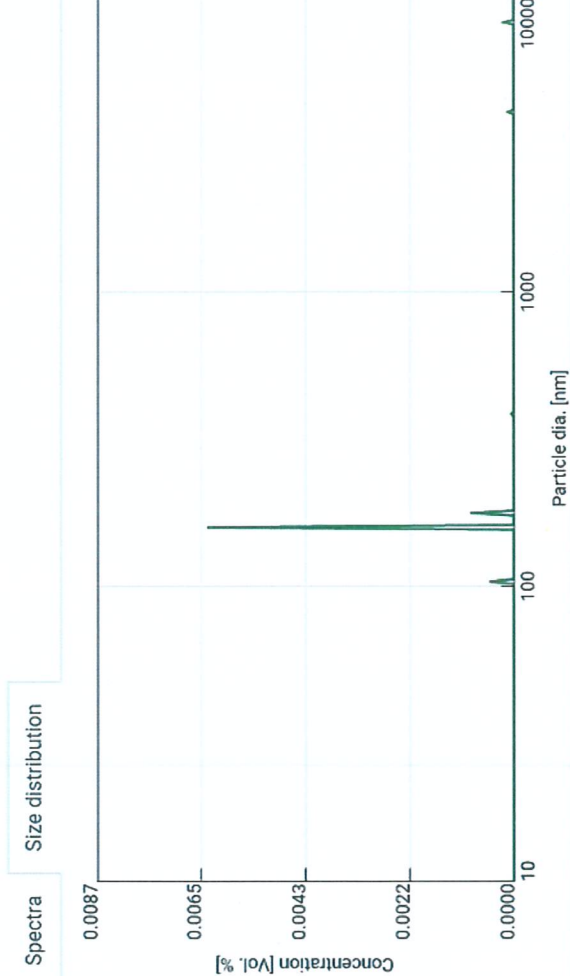
Sample name	Latex beads 100nm 0.01% DI
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Results

Plots



Experiment setup

Item ID: 79e0f0b8
 Box code: NCONES
 Cuvette no.: 02
 Model: NanoCuvette™ S
 Created: 2021-07-26 12:17:42
 Reference: Water (n = 1.333215 nD)

Results

● Refractive Index: 1.36491180 nD
 ● Reference fit quality: 35.5789 %
 ● Sample fit quality: 18.5744 %
 ● Mean Particle Diameter: 275.73 nm
 ● Particle Concentration: 0.0038 % (Vol.)

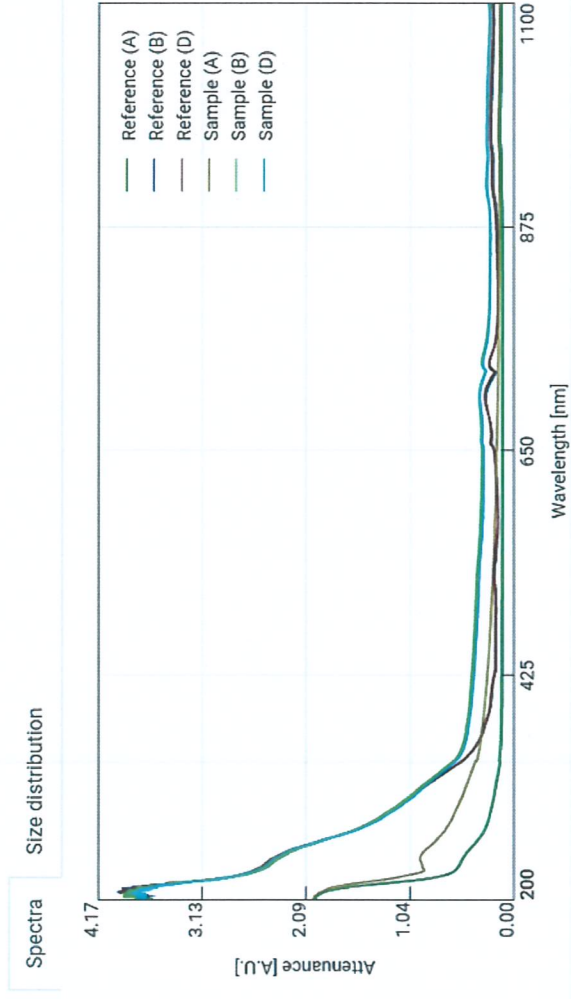
Sample attributes

Sample name	Latex Beads 460 nm 0.003% l
Protocol name	
Analyte	
Solvent	

Notes

not used discontinuity factor so concentration precise not size

Plots



Experiment setup

Item ID: f23d4cb2
 Box code: NCONES
 Cuvette no.: 02
 Model: NanoCuvette™ S
 Created: 2021-07-26 12:45:42
 Reference: Water (n = 1.333215 nD)

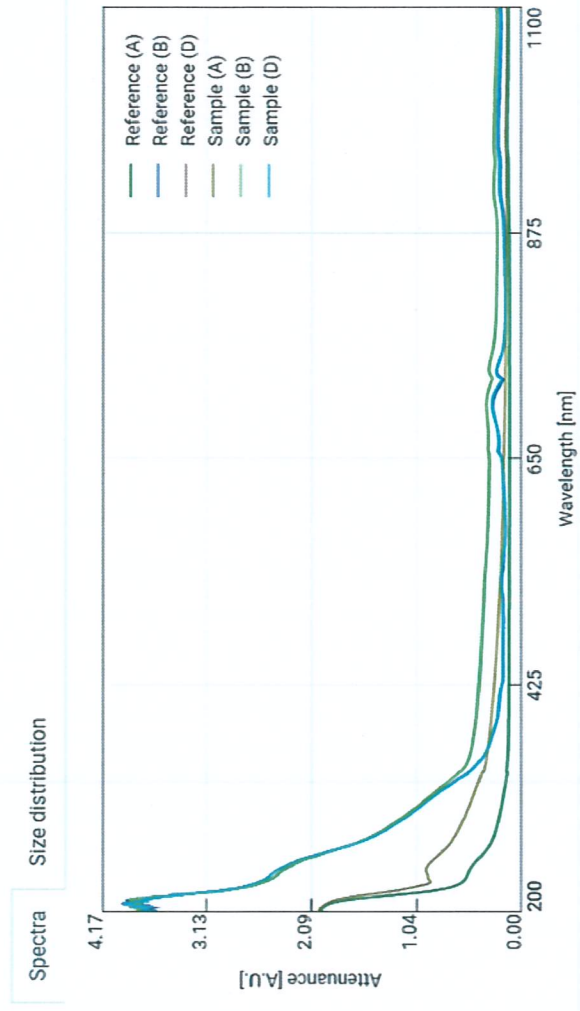
Results

- Refractive Index: 1.36487618 nD
- Reference fit quality: 35.5789 %
- Sample fit quality: 17.1269 %
- Mean Particle Diameter: 284.26 nm
- Particle Concentration: 0.0038 % (Vol.)

Sample attributes

Sample name	Latex Beads 460nm 0.003% D
Protocol name	
Analyte	
Solvent	

Plots



Notes

Not used discontinuity factor so precise concentration

Summary

Experiment setup

Item ID: e6bd2474
 Box code: NCONES
 Cuvette no.: 02
 Model: NanoCuvette™ S
 Created: 2021-07-26 12:30:26
 Reference: Water (n = 1.333215 nD)

Results

● Refractive Index: 1.36491180 nD
 ● Reference fit quality: 35.5789 %
 ● Sample fit quality: 18.6321 %
 ● Mean Particle Diameter: 414.10 nm
 ● Particle Concentration: 0.0082 % (Vol.)

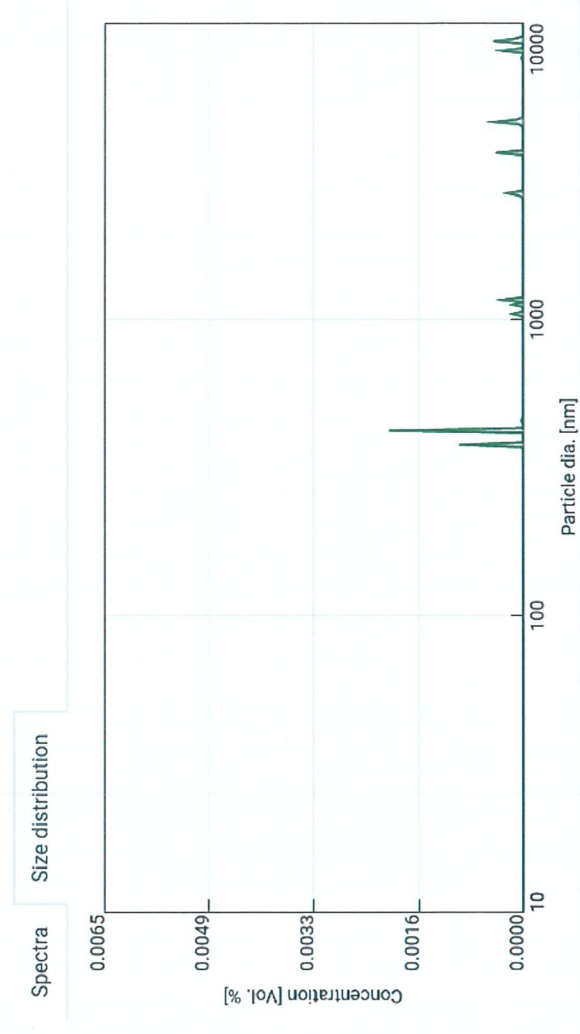
Sample attributes

Sample name	Latex Beads 460 nm 0.003% [
Protocol name	
Analyte	
Solvent	

Notes

Size precise Discontinuity used

Plots



Summary

Experiment setup

Item ID: b6121334
 Box code: NCONES
 Cuvette no.: 02
 Model: NanoCuvette™ S
 Created: 2021-07-26 12:41:19
 Reference: Water (n = 1.333215 nD)

Sample attributes

Sample name	Latex Beads 460nm 0.003%
Protocol name	
Analyte	
Solvent	

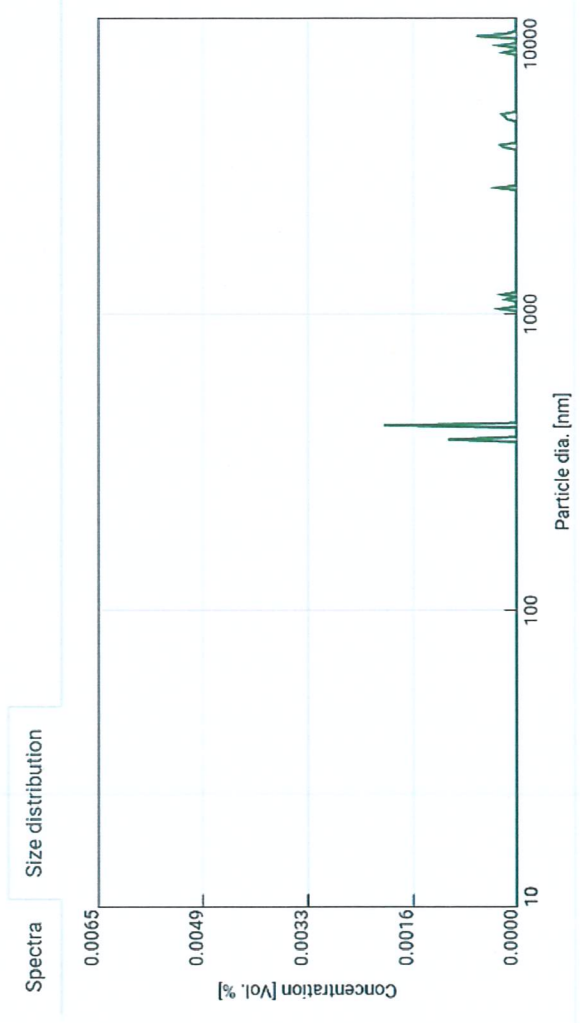
Notes

Size Precise
 Discontinuity factor used

Results

- Refractive Index: 1.36491179 nD
- Reference fit quality: 35.5789 %
- Sample fit quality: 17.1495 %
- Mean Particle Diameter: 413.04 nm
- Particle Concentration: 0.0085 % (Vol.)

Plots



Experiment setup

Item ID: 2aaece06
 Box code: NCONES
 Cuvette no.: 03
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:04:19
 Reference: Water (n = 1.333215 nD)

Results

● Refractive Index: 1.35779775 nD
 ● Reference fit quality: 54.7016 %
 ● Sample fit quality: 28.0487 %
 ● Mean Particle Diameter: 549.26 nm
 ● Particle Concentration: 0.0026 % (Vol.)

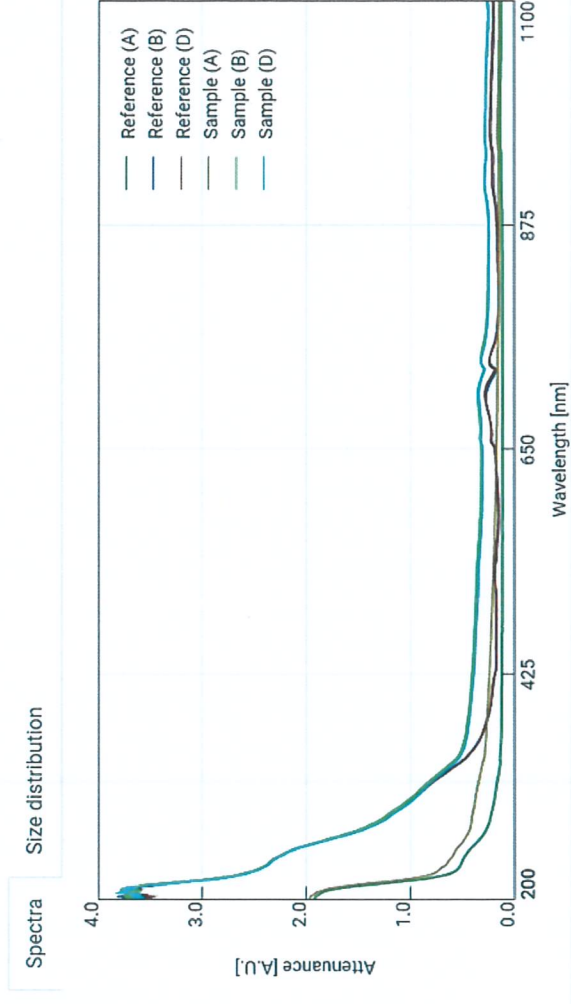
Sample attributes

Sample name	Latex Beads 600nm 0.003%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots



Summary

Experiment setup

Item ID: 29f68541
 Box code: NCONES
 Cuvette no.: 03
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:08:53
 Reference: Water (n = 1.333215 nD)

Sample attributes

Sample name: Latex Beads 600nm 0.003% D
 Protocol name:
 Analyte:
 Solvent:

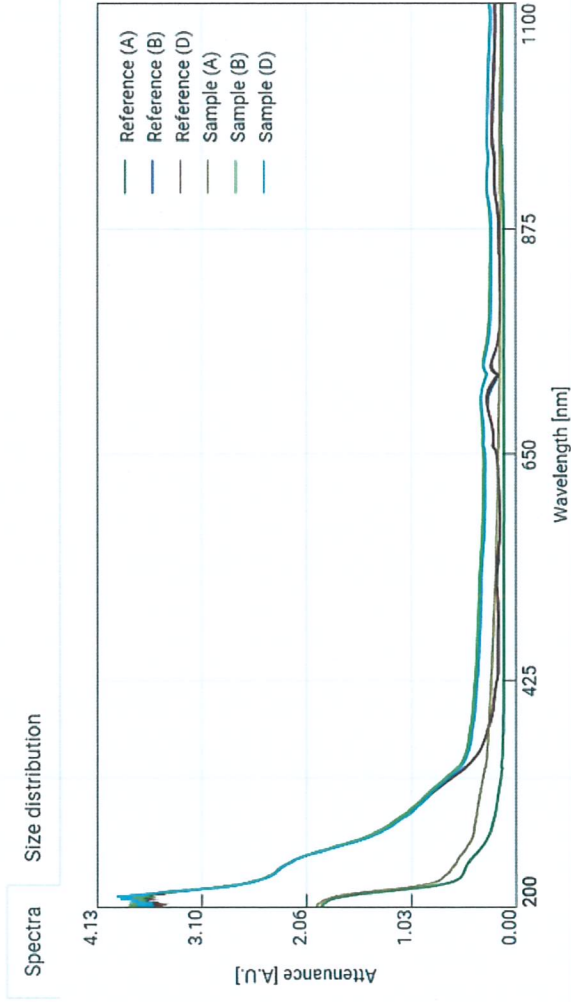
Notes

Here you can add notes about your sample.

Results

Refractive Index: 1.35936624 nD
 Reference fit quality: 54.7016 %
 Sample fit quality: 28.8134 %
 Mean Particle Diameter: 549.85 nm
 Particle Concentration: 0.0026 % (Vol.)

Plots



Summary

Experiment setup

Item ID: 2aaece06
 Box code: NCONES
 Cuvette no.: 03
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:04:19
 Reference: Water (n = 1.333215 nD)

Results

- Refractive Index: 1.35779775 nD
- Reference fit quality: 54.7016 %
- Sample fit quality: 28.0487 %
- Mean Particle Diameter: 549.26 nm
- Particle Concentration: 0.0026 % (Vol.)

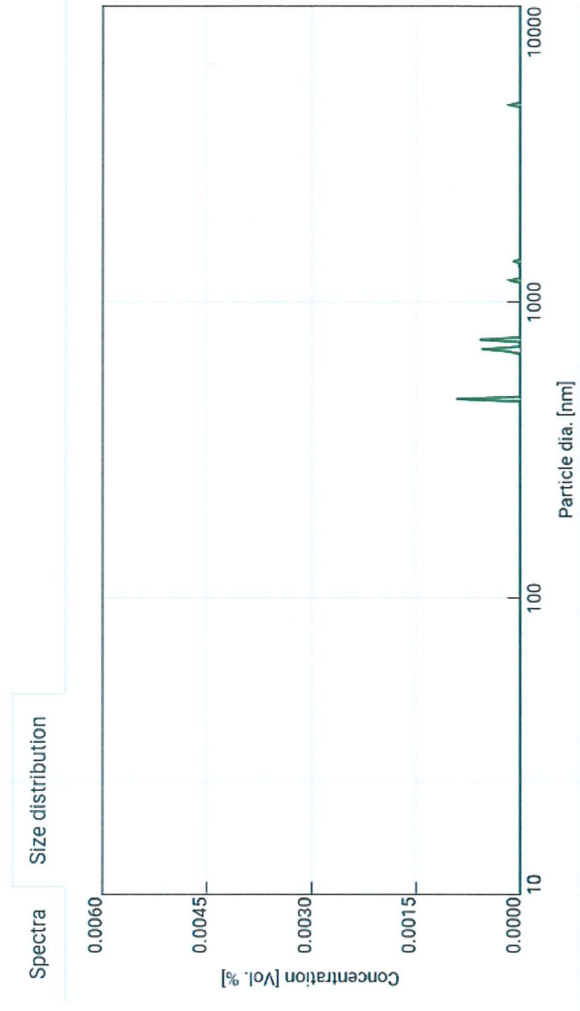
Sample attributes

Sample name	Latex Beads 600nm 0.003%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots



Experiment setup

Item ID: 29f68541
 Box code: NCONES
 Cuvette no.: 03
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:08:53
 Reference: Water (n = 1.333215 nD)

Results

● Refractive Index: 1.35936624 nD
 ● Reference fit quality: 54.7016 %
 ● Sample fit quality: 28.8134 %
 ● Mean Particle Diameter: 549.85 nm
 ● Particle Concentration: 0.0026 % (Vol.)

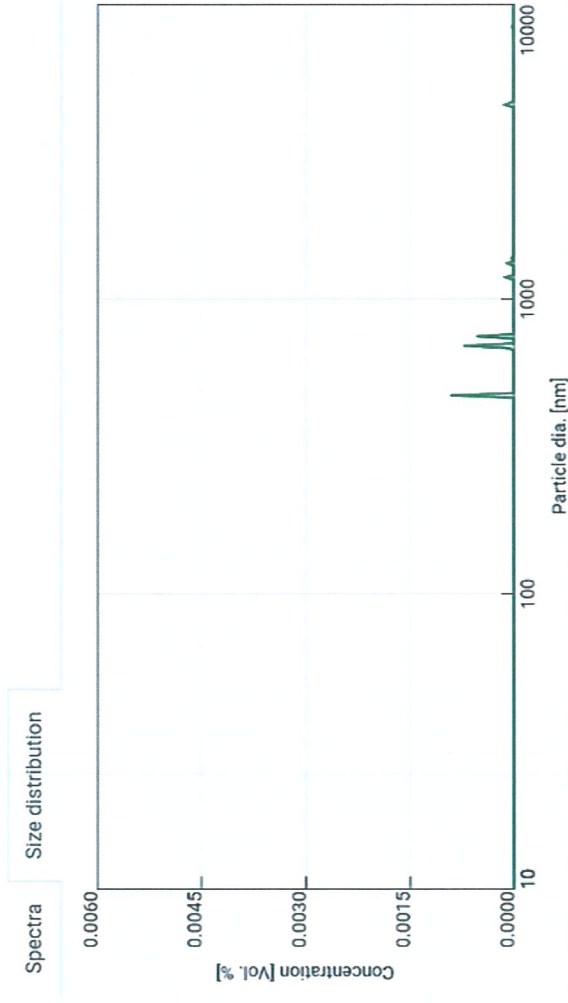
Sample attributes

Sample name	Latex Beads 600nm 0.003% D
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots



Summary

Experiment setup

Item ID: 1d43d47f
 Box code: NCONES
 Cuvette no.: 04
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:33:07
 Reference: Water (n = 1.333215 nD)

Results

- Refractive Index: 1.34305982 nD
- Reference fit quality: 55.9293 %
- Sample fit quality: 24.9135 %
- Mean Particle Diameter: 633.44 nm
- Particle Concentration: 0.0030 % (Vol.)

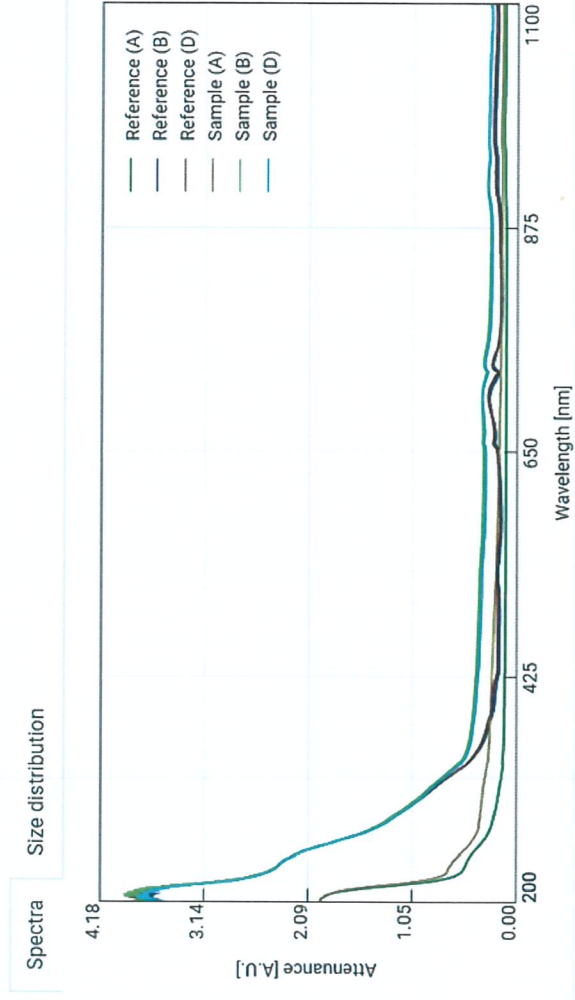
Sample attributes

Sample name	Latex Beads 800nm 0.003%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots



Summary saved

Experiment setup

Item ID: 2b515f9e
 Box code: NICONES
 Cuvette no.: 04
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:36:32
 Reference: Water (n = 1.333215 nD)

Results

● Refractive Index: 1.34309282 nD
 ● Reference fit quality: 55.9293 %
 ● Sample fit quality: 24.7994 %
 ● Mean Particle Diameter: 637.50 nm
 ● Particle Concentration: 0.0031 % (Vol.)

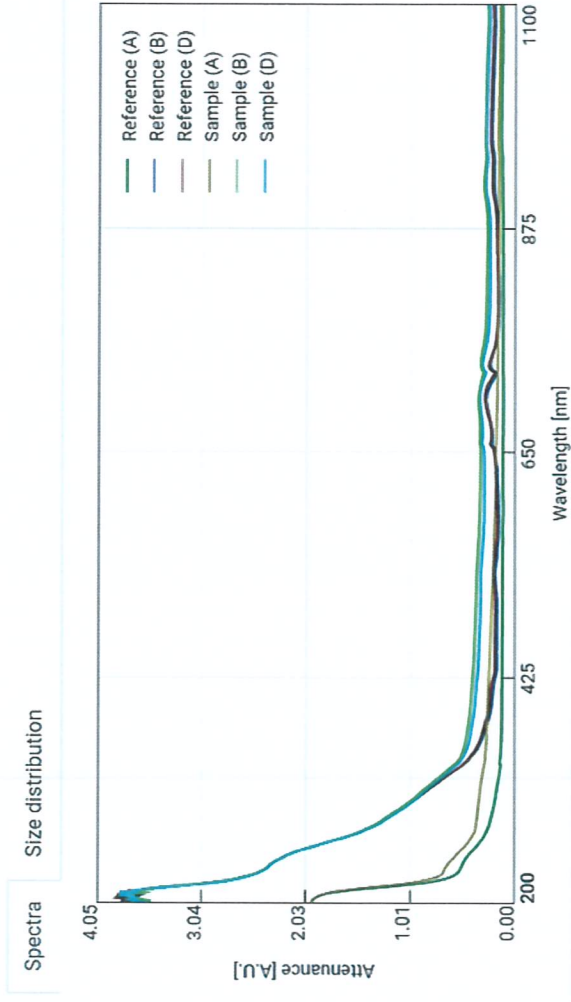
Sample attributes

Sample name	Latex Beads 800nm 0.003% D
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots



Experiment setup

Item ID: 1d43d47f
 Box code: NCONES
 Cuvette no.: 04
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:33:07
 Reference: Water (n = 1.333215 nD)

Results

- Refractive Index: 1.34305982 nD
- Reference fit quality: 55.9293 %
- Sample fit quality: 24.9135 %
- Mean Particle Diameter: 633.44 nm
- Particle Concentration: 0.0030 % (Vol.)

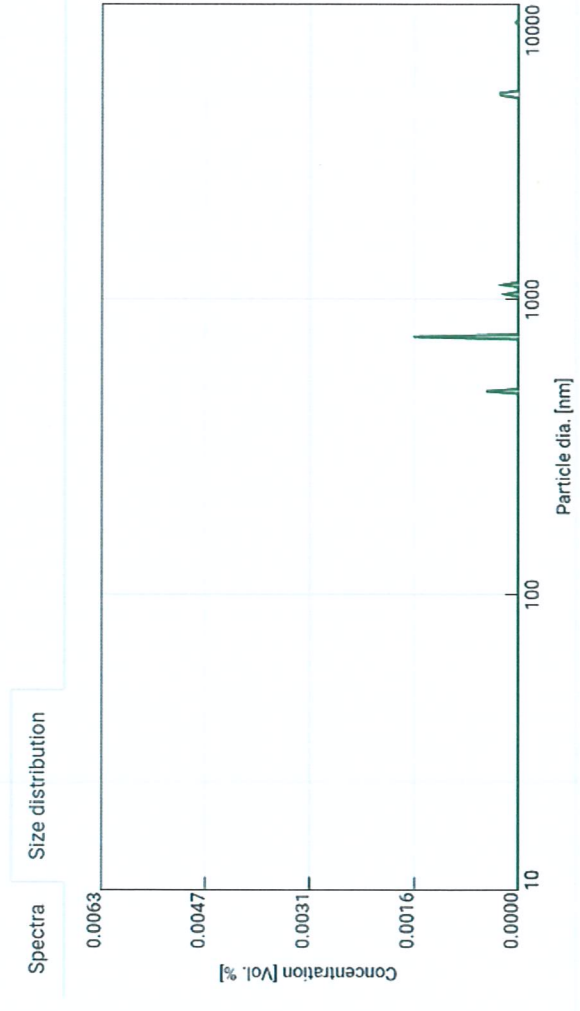
Sample attributes

Sample name	Latex Beads 800nm 0.003%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots



Experiment setup

Item ID: 2b515f9e
 Box code: NCONES
 Cuvette no.: 04
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:36:32
 Reference: Water (n = 1.333215 nD)

Sample attributes

Sample name	Latex Beads 800nm 0.003% D
Protocol name	
Analyte	
Solvent	

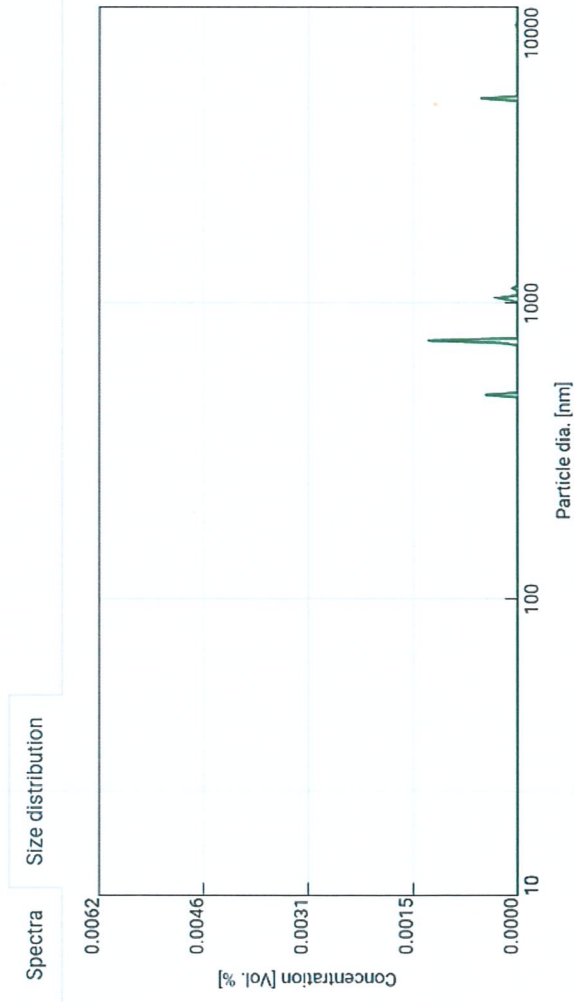
Notes

Here you can add notes about your sample.

Results

- Refractive Index: 1.34309282 nD
- Reference fit quality: 55.9293 %
- Sample fit quality: 24.7994 %
- Mean Particle Diameter: 637.50 nm
- Particle Concentration: 0.0031 % (Vol.)

Plots



Experiment setup

Item ID: 3ece3e8d
 Box code: NCONES
 Cuvette no.: 05
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:54:00
 Reference: Water (n = 1.333215 nD)

Results

- Refractive Index: N/A
- Reference fit quality: N/A
- Sample fit quality: N/A
- Mean Particle Diameter: 1097.66 nm
- Particle Concentration: 0.0016 % (Vol.)

Sample attributes

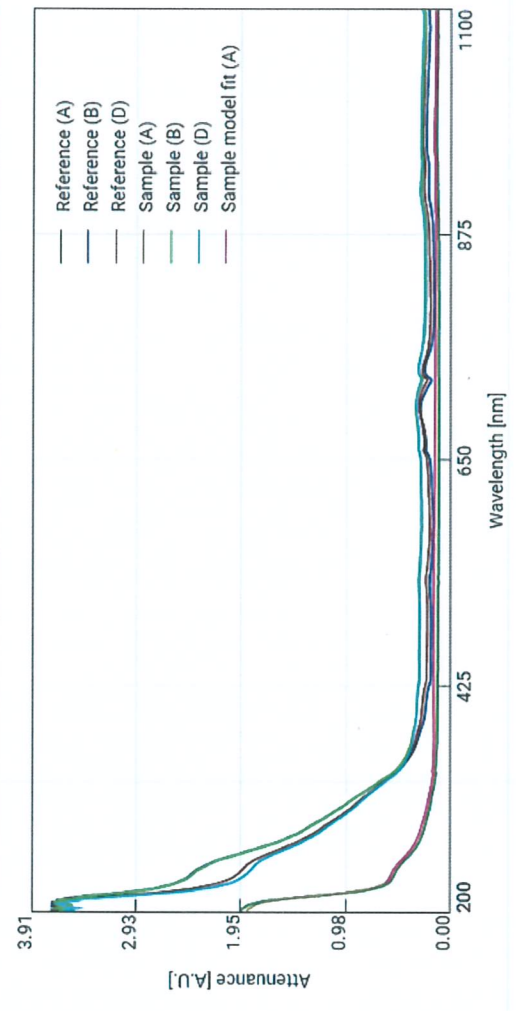
Sample name	Latex Beads 1100nm 0.001%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots

Spectra Size distribution



Experiment setup

Item ID: 0f5caa60
 Box code: NCONES
 Cuvette no.: 05
 Model: NanoCuvette™ S
 Created: 2021-07-26 14:00:18
 Reference: Water (n = 1.333215 nD)

Results

● Refractive Index: N/A
 ● Reference fit quality: N/A
 ● Sample fit quality: N/A
 ● Mean Particle Diameter: 1083.85 nm
 ● Particle Concentration: 0.0016 % (Vol.)

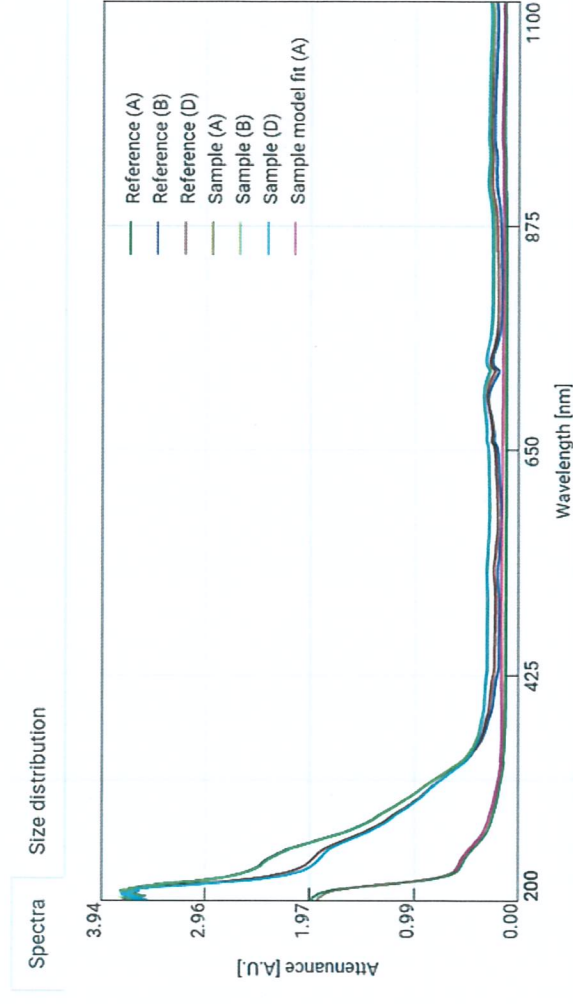
Sample attributes

Sample name	Latex Beads 1100nm 0.001%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots



Experiment setup

Item ID: 3ece3e8d
 Box code: NCONES
 Cuvette no.: 05
 Model: NanoCuvette™ S
 Created: 2021-07-26 13:54:00
 Reference: Water (n = 1.333215 nD)

Results

● Refractive Index: N/A
 ● Reference fit quality: N/A
 ● Sample fit quality: N/A
 ● Mean Particle Diameter: 1097.66 nm
 ● Particle Concentration: 0.0016 % (Vol.)

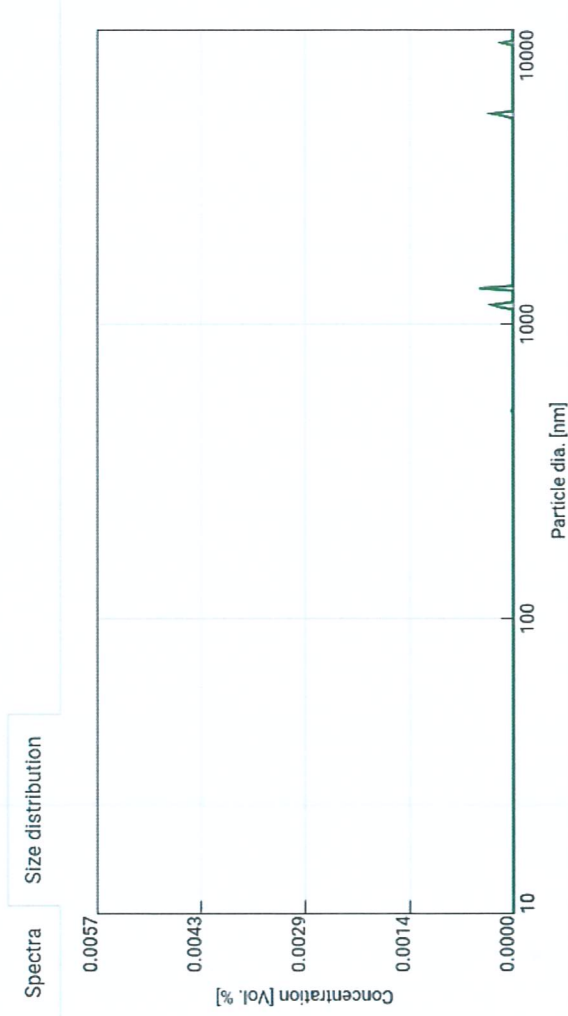
Sample attributes

Sample name	Latex Beads 1100nm 0.001%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots



Experiment setup

Item ID: 0f5caa60
 Box code: NCONES
 Cuvette no.: 05
 Model: NanoCuvette™ S
 Created: 2021-07-26 14:00:18
 Reference: Water (n = 1.333215 nD)

Results

- Refractive Index: N/A
- Reference fit quality: N/A
- Sample fit quality: N/A
- Mean Particle Diameter: 1083.85 nm
- Particle Concentration: 0.0016 % (Vol.)

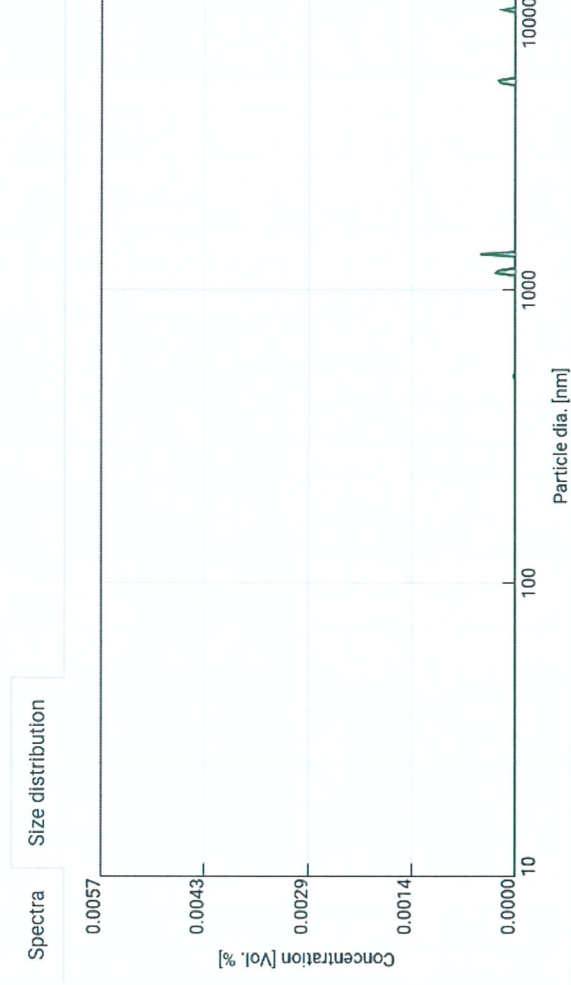
Sample attributes

Sample name	Latex Beads 1100nm 0.001%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots



Experiment setup

Item ID: 805ae0d2
 Box code: NCONES
 Cuvette no.: 06
 Model: NanoCuvette™ S
 Created: 2021-07-26 14:18:16
 Reference: Water (n = 1.333215 nD)

Results

● Refractive Index: 1.88416545 nD
 ● Reference fit quality: 35.7368 %
 ● Sample fit quality: 23.5322 %
 ● Mean Particle Diameter: 3637.24 nm
 ● Particle Concentration: 0.0008 % (Vol.)

Sample attributes

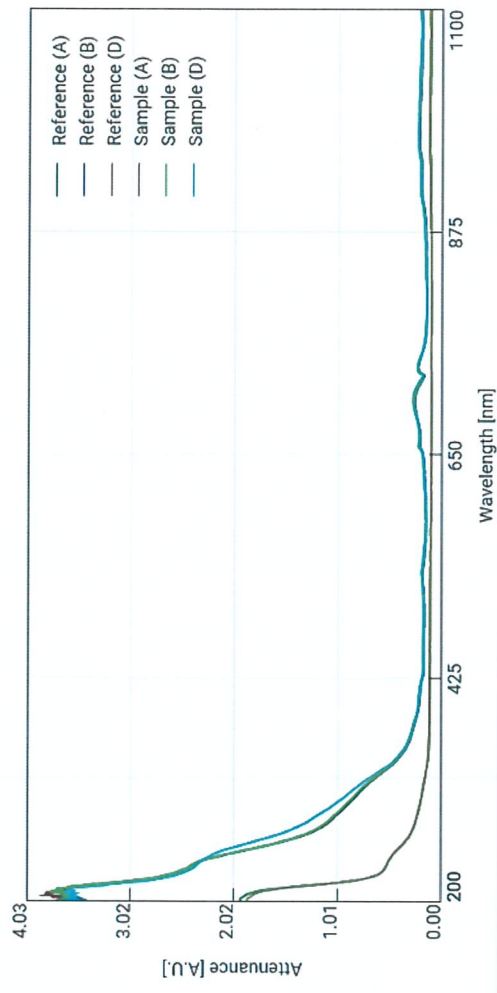
Sample name	Latex Beads 3000nm 0.001%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots

Spectra Size distribution



Experiment setup

Item ID: 551fa119
 Box code: NCONES
 Cuvette no.: 06
 Model: NanoCuvette™ S
 Created: 2021-07-26 14:22:39
 Reference: Water (n = 1.333215 nD)

Sample attributes

Sample name	Latex Beads 3000nm 0.001%
Protocol name	
Analyte	
Solvent	

Notes

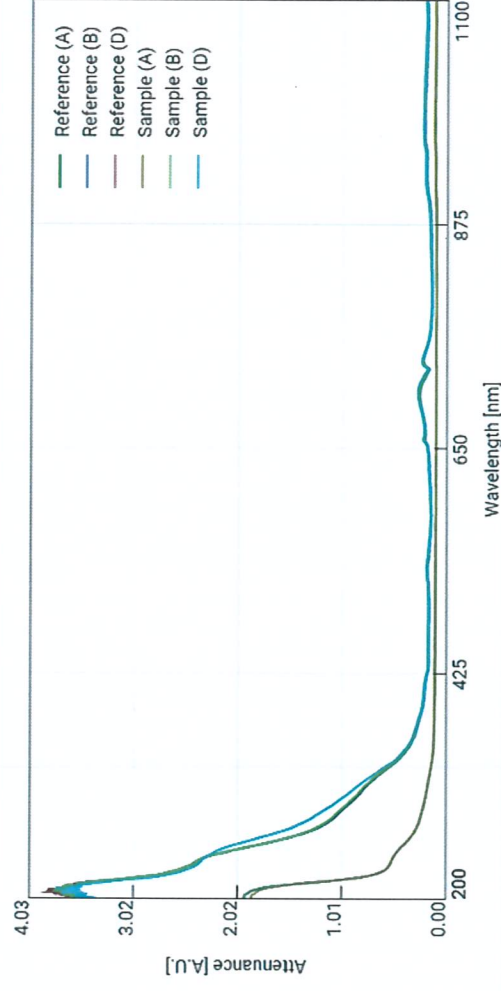
Here you can add notes about your sample.

Results

- Refractive Index: 1.57637491 nD
- Reference fit quality: 35.7368 %
- Sample fit quality: 59.9385 %
- Mean Particle Diameter: 3050.95 nm
- Particle Concentration: 0.0007 % (Vol.)

Plots

Spectra Size distribution



Experiment setup

Item ID: 805ae0d2
Box code: NCONES
Cuvette no.: 06
Model: NanoCuvette™ S
Created: 2021-07-26 14:18:16
Reference: Water (n = 1.333215 nD)

Sample attributes

Sample name	Latex Beads 3000nm 0.001%
Protocol name	
Analyte	
Solvent	

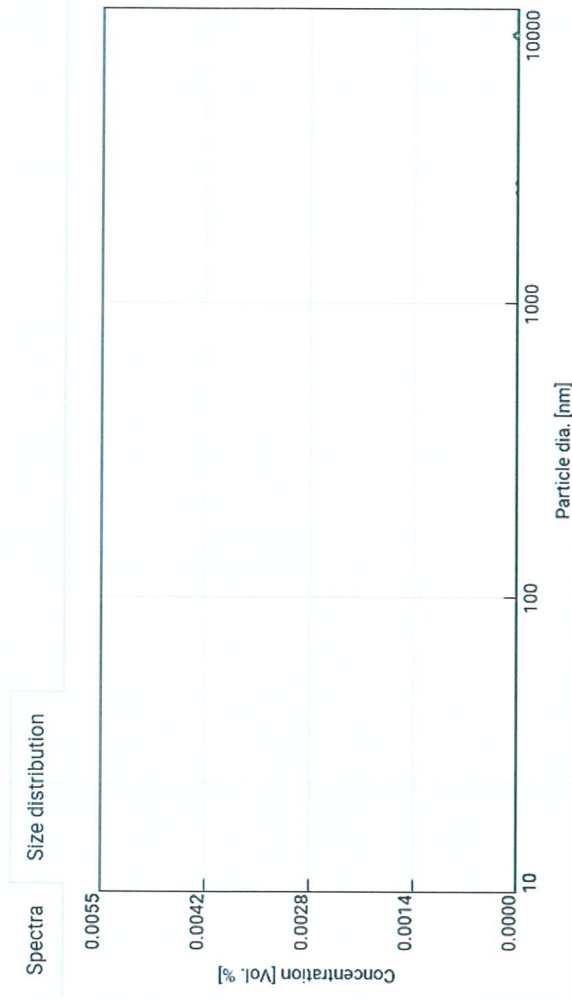
Notes

Here you can add notes about your sample.

Results

- Refractive Index: 1.88416545 nD
- Reference fit quality: 35.7368 %
- Sample fit quality: 23.5322 %
- Mean Particle Diameter: 3637.24 nm
- Particle Concentration: 0.0008 % (Vol.)

Plots



Experiment setup

Item ID: 551fa119
 Box code: NCONES
 Cuvette no.: 06
 Model: NanoCuvette™ S
 Created: 2021-07-26 14:22:39
 Reference: Water (n = 1.333215 nD)

Results

- Refractive Index: 1.57637491 nD
- Reference fit quality: 35.7368 %
- Sample fit quality: 59.9385 %
- Mean Particle Diameter: 3050.95 nm
- Particle Concentration: 0.0007 % (Vol.)

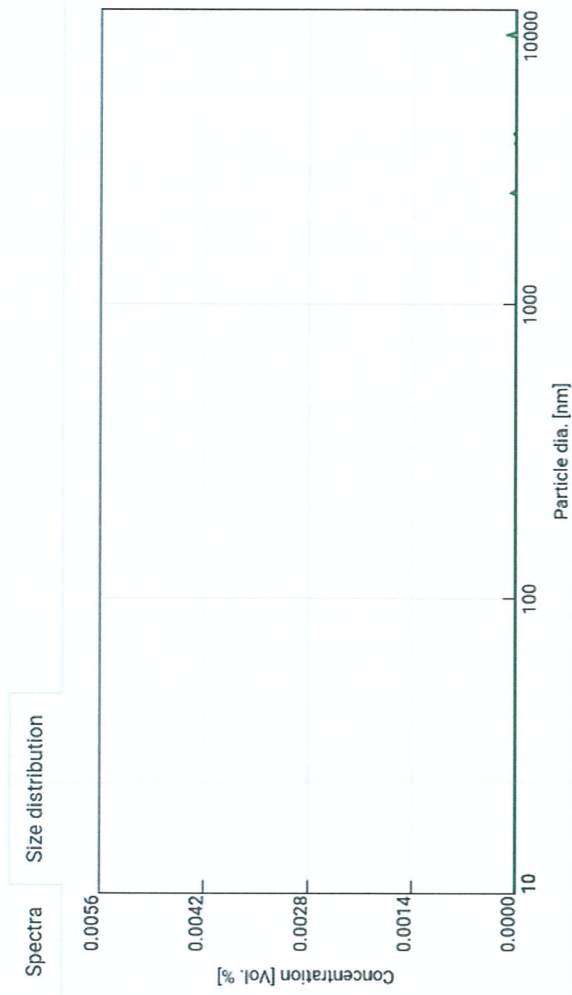
Sample attributes

Sample name	Latex Beads 3000nm 0.001%
Protocol name	
Analyte	
Solvent	

Notes

Here you can add notes about your sample.

Plots





Appendix 2:

Results from dynamic light scattering (60 pages)



CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 100nm
Batch: 2021/07/23
Internal number: 32027

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	D _{10%} (nm)**		D _{50%} (nm)**		D _{90%} (nm)**		Z-average*		PDI*	
Run 1	79.4		109		159		118		0.026	
Run 2	74.7		107		163		118.1		0.058	
Average	76.9		108		161		118.1		0.042	
Specification	-	-	-	-	-	-	-	-	-	-
Evaluation	-		-		-		-		-	

*The parameter is based on the intensity size distribution

**The parameter is based on the volume size distribution

Written by: *Autu Kudva*

Date: 28 JULI 2021

Reviewed by: ~~28 JULI 2021~~^① *Wenbo Way*

Date: 28 JULI 2021

Approved by: ~~28 JULI 2021~~^① *Wenbo Way*
QC

Date: 28 JULI 2021

The validity of the method is the responsibility of the sponsor
 Quality agreement not in place

① wrong stamp up 28-Jul-2021

**Size Distribution Report by Volume**

Sample Name: 32027 batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 08:48:19

Userid: brj

D10%(V): 78.9 nm

D50%(V): 109 nm

D90%(V): 160 nm

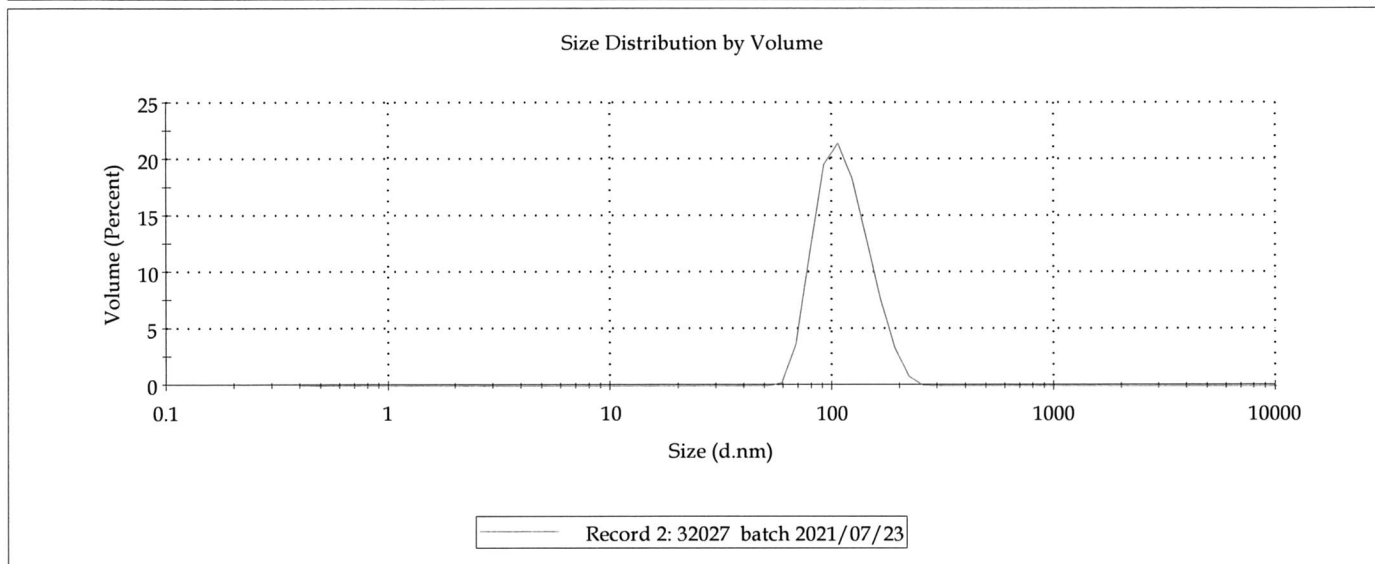
	Diam. (nm)	% Volume	Width (nm)
Peak 1:	114.3	100.0	30.95
Peak 2:	0.000	0.0	0.000
Peak 3:	0.000	0.0	0.000

Z-Average (d.nm): 118.5

Pdl: 0.022

Note: Z-average and Pdl are based on the intensity distribution

Count Rate (kcps): 259.1



General Notes: 32027 Run 1

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 6

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Size Distribution Report by Volume

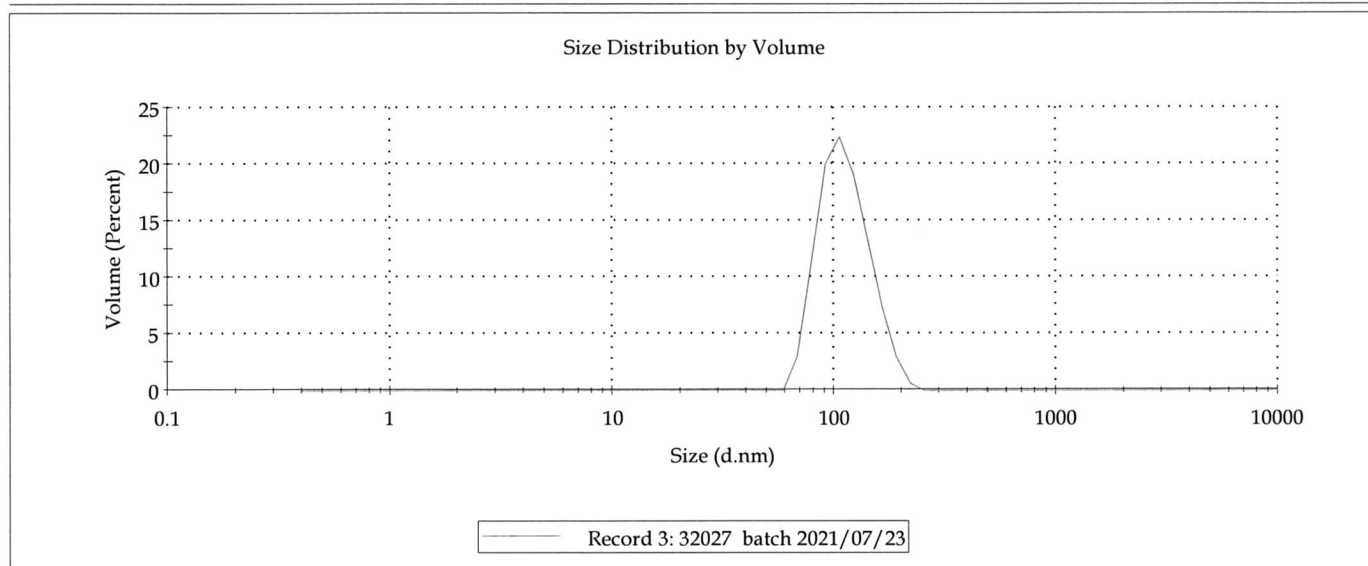


PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32027 batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 08:50:33
 Userid: brj

D10%(V): 79.8 nm		D50%(V): 109 nm		D90%(V): 158 nm	
Peak 1:	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	118.1
Peak 2:	114.1	100.0	29.46	PdI:	0.014
Peak 3:	0.000	0.0	0.000	Count Rate (kcps): 260.6	
Peak 3:	0.000	0.0	0.000		

Note: Z-average and PdI are based on the intensity distribution



General Notes: 32027 Run 1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	13

Operator:

27 JULI 2021 BRJ

Approved:

28 JULI 2021

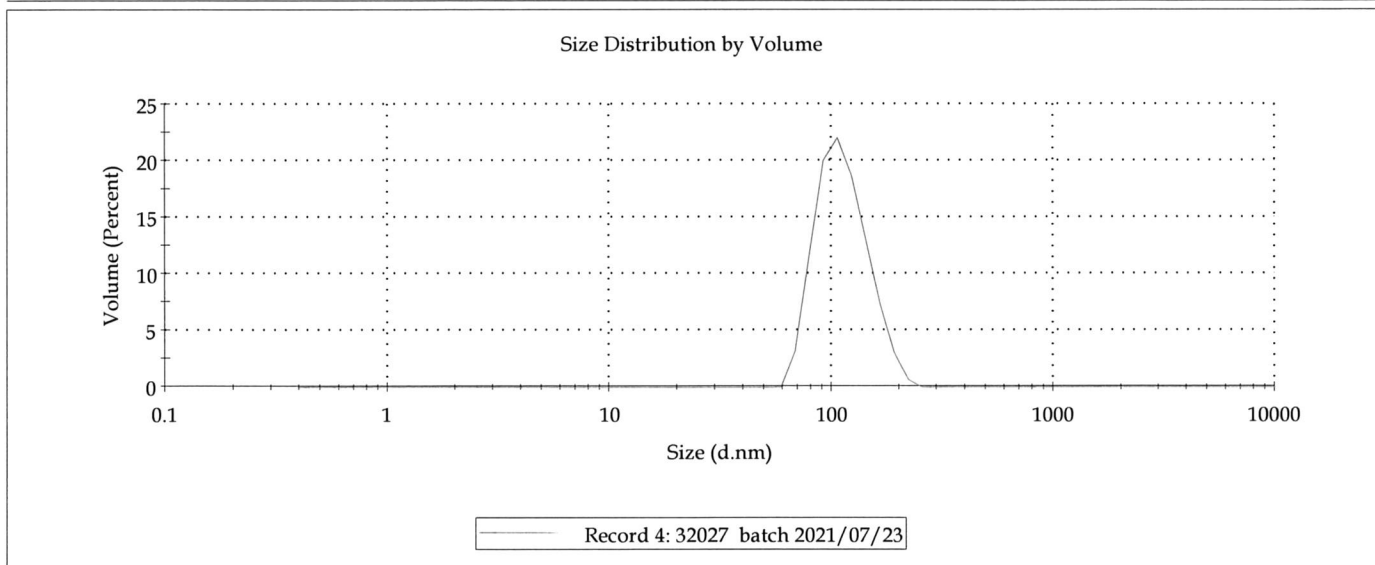
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32027 batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 08:52:46
 Userid: brj

D10%(V): 79.5	nm	D50%(V): 109	nm	D90%(V): 159	nm
Peak 1:	Diam. (nm) 114.0	% Volume 100.0	Width (nm) 29.84	Z-Average (d.nm): 117.4	Note: Z-average and Pdl are based on the intensity distribution
Peak 2:	0.000	0.0	0.000	PdI: 0.041	
Peak 3:	0.000	0.0	0.000	Count Rate (kcps): 258.6	



General Notes: 32027 Run 1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	13

Operator: 27 JULI 2021 *BRJ*

Approved: 28 JULI 2021 *WJD*

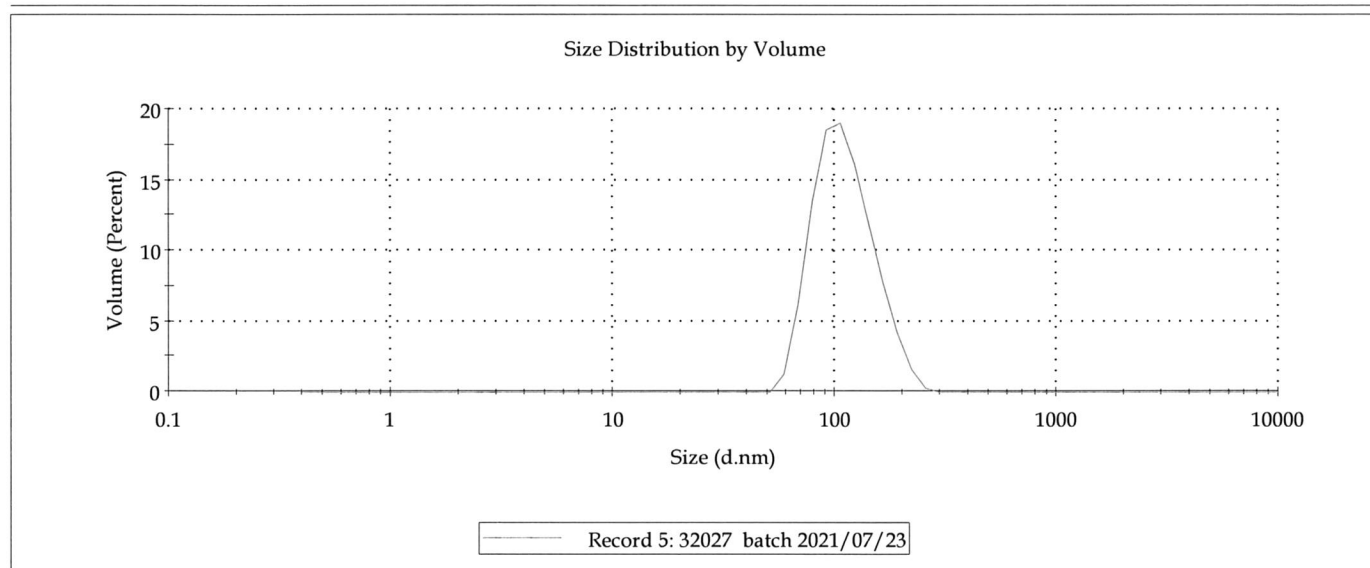
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32027 batch 2021/07/23
SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
Measurement Date and Time: 27. juli 2021 08:59:41
Userid: brj

D10%(V): 74.3 nm		D50%(V): 107 nm		D90%(V): 164 nm	
Peak 1:	Diam. (nm): 113.8	% Volume: 100.0	Width (nm): 34.99	Z-Average (d.nm): 118.3	<i>Note: Z-average and Pdl are based on the intensity distribution</i>
Peak 2:	0.000	0.0	0.000	PdI: 0.058	
Peak 3:	0.000	0.0	0.000	Count Rate (kcps): 242.7	



General Notes: 32027 Run 2

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	14

Operator:

27 JULI 2021

BRJ

Approved:

28 JULI 2021

WJ

Size Distribution Report by Volume



**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

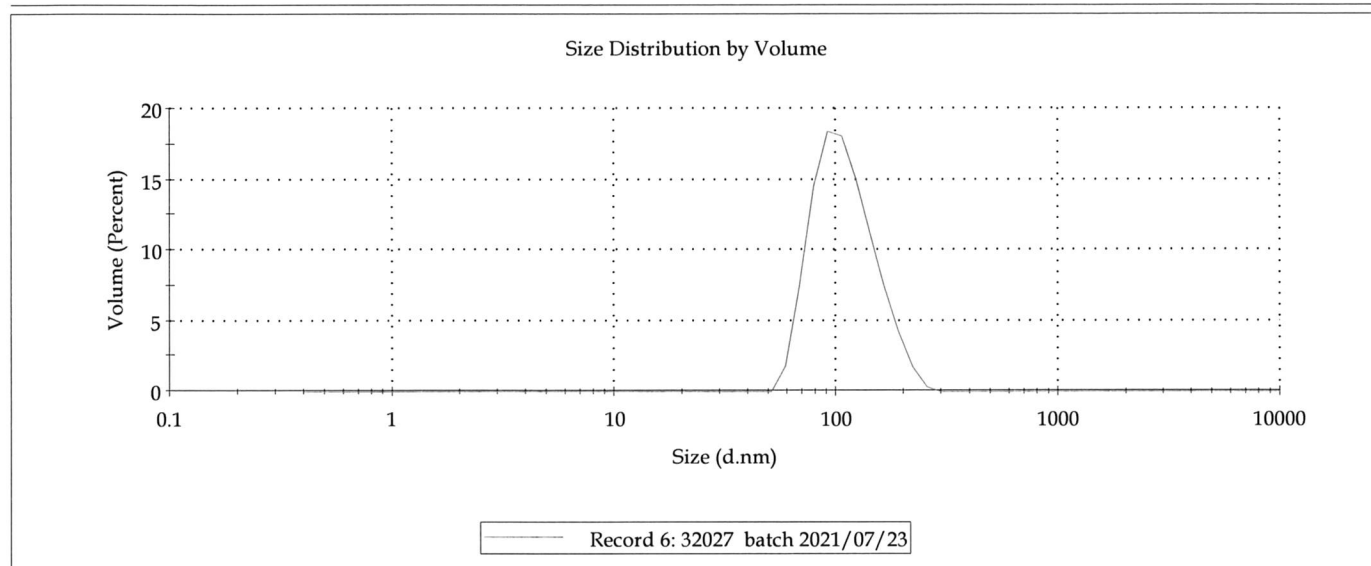
Sample Name: 32027 batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 09:02:05

Userid: brj

D10%(V): 72.4 nm	D50%(V): 105 nm	D90%(V): 164 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	117.2
Peak 1:	112.3	100.0	35.93	Note: Z-average and Pdl are based on the intensity distribution
Peak 2:	0.000	0.0	0.000	PdI: 0.068
Peak 3:	0.000	0.0	0.000	Count Rate (kcps): 243.9



General Notes: 32027 Run 2

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Dispersant Name: Water

Material Absorbtion: 0.010

Dispersant RI: 1.330

Analysis Model: General Purpose

Viscosity (cP): 0.8872

Lower Size Threshold: 0.050

Temperature (°C): 25.0

Upper Size Threshold: 0.010

Equilibration Time Set (min): 180

Size range: 0.6000 to 6000 nm

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Measurement Position (mm): 4.65

Auto Attenuate Enabled: True

Attenuator: 6

Auto Size Measurement Time: True

Duration (s): 10 Extend duration for large particles: False

Size Runs: 14

Operator: _____

27 JULI 2021 BRJ

Approved: _____

28 JULI 2021

myo

Size Distribution Report by Volume

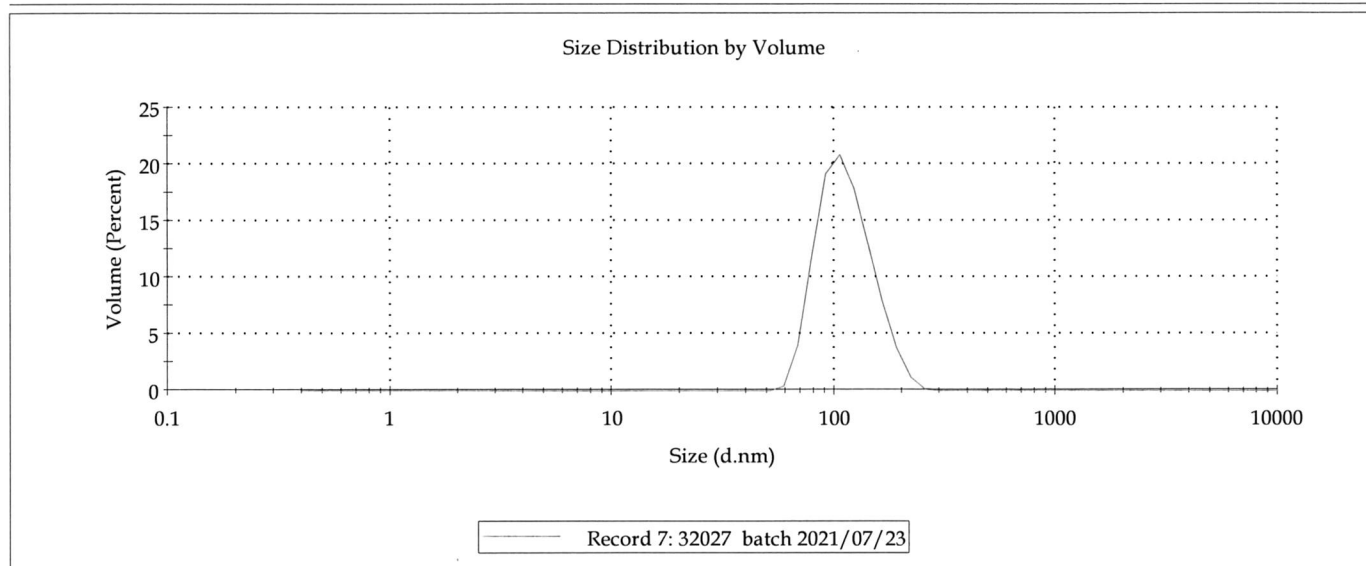


PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32027 batch 2021/07/23
SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
Measurement Date and Time: 27. juli 2021 09:04:29
Userid: brj

D10%(V): 78.3 nm **D50%(V): 109 nm** **D90%(V): 162 nm**

	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	118.7	Note: Z-average and Pdl are based on the intensity distribution
Peak 1:	115.1	100.0	32.42	PdI:	0.048	
Peak 2:	0.000	0.0	0.000			
Peak 3:	0.000	0.0	0.000	Count Rate (kcps):	243.2	



General Notes: 32027 Run 2

Cell Description:	Disposable sizing cuvette	Dispersant Name:	Water
Material RI:	1.59	Dispersant RI:	1.330
Material Absorbtion:	0.010	Viscosity (cP):	0.8872
Analysis Model:	General Purpose	Temperature (°C):	25.0
Lower Size Threshold:	0.050	Equilibration Time Set (min):	180
Upper Size Threshold:	0.010	Number of measurements:	3
Size range: 0.6000 to 6000 nm		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s): 10	Extend duration for large particles: False
		Size Runs: 14	

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 *WFD*

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32027 batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 09:39:35

Userid: brj

D10%(V): 79.4 nm D50%(V): 109 nm D90%(V): 159 nm

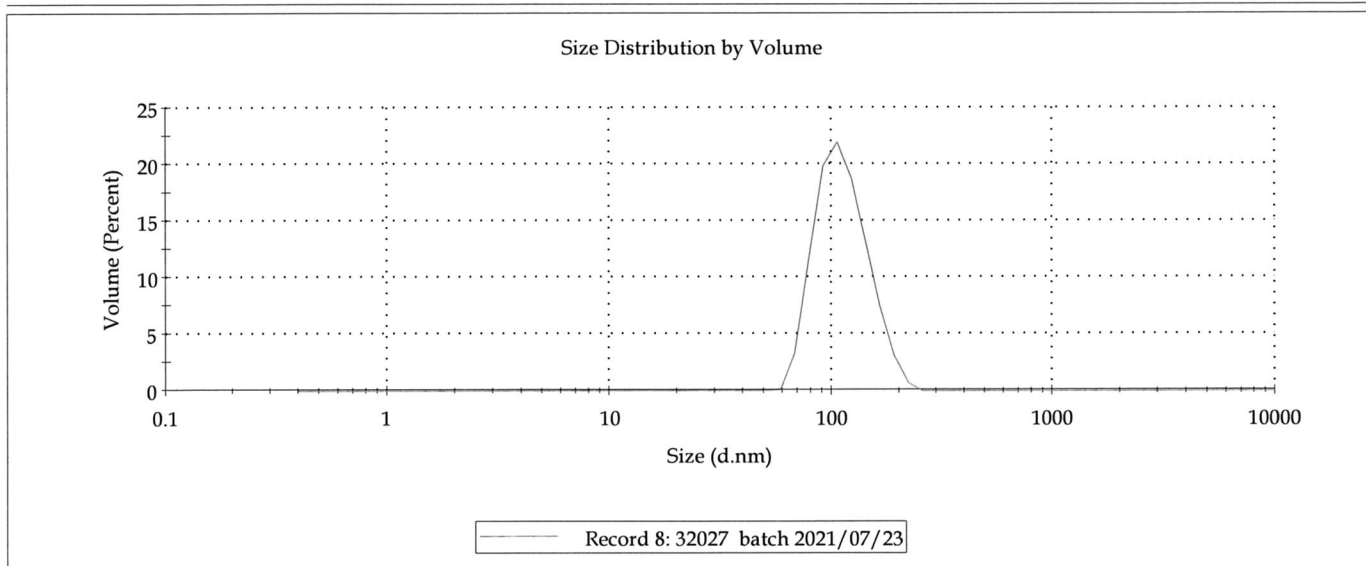
	Diam. (nm)	% Volume	Width (nm)
Peak 1:	114.1	100.0	30.09
Peak 2:	0.000	0.0	0.000
Peak 3:	0.000	0.0	0.000

Z-Average (d.nm): 118.0

PdI: 0.026

Note: Z-average and PdI are based on the intensity distribution

Count Rate (kcps): 259.1



General Notes: Average result created from record number(s): 2 3 4

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 6

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: _____

27 JULI 2021

Approved: _____

28 JULI 2021



CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 460nm
Batch: 2021/07/23
Internal number: 32028

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	D _{10%} (nm)**		D _{50%} (nm)**		D _{90%} (nm)**		Z-average*		PDI*	
Run 1	320		442		605		422.2		0.025	
Run 2	316		431		587		413.6		0.048	
Average	318		436		597		417.9		0.037	
Specification	-	-	-	-	-	-	-	-	-	-
Evaluation	-		-		-		-		-	

*The parameter is based on the intensity size distribution

**The parameter is based on the volume size distribution

Written by: *[Signature]*

Date: 28 JULI 2021

Reviewed by: *Wenbo Wang*

Date: 28 JULI 2021

Approved by: *Wenbo Wang*
QC

Date: 28 JULI 2021

*The validity of the method is the responsibility of the sponsor
Quality agreement not in place*

Size Distribution Report by Volume



**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

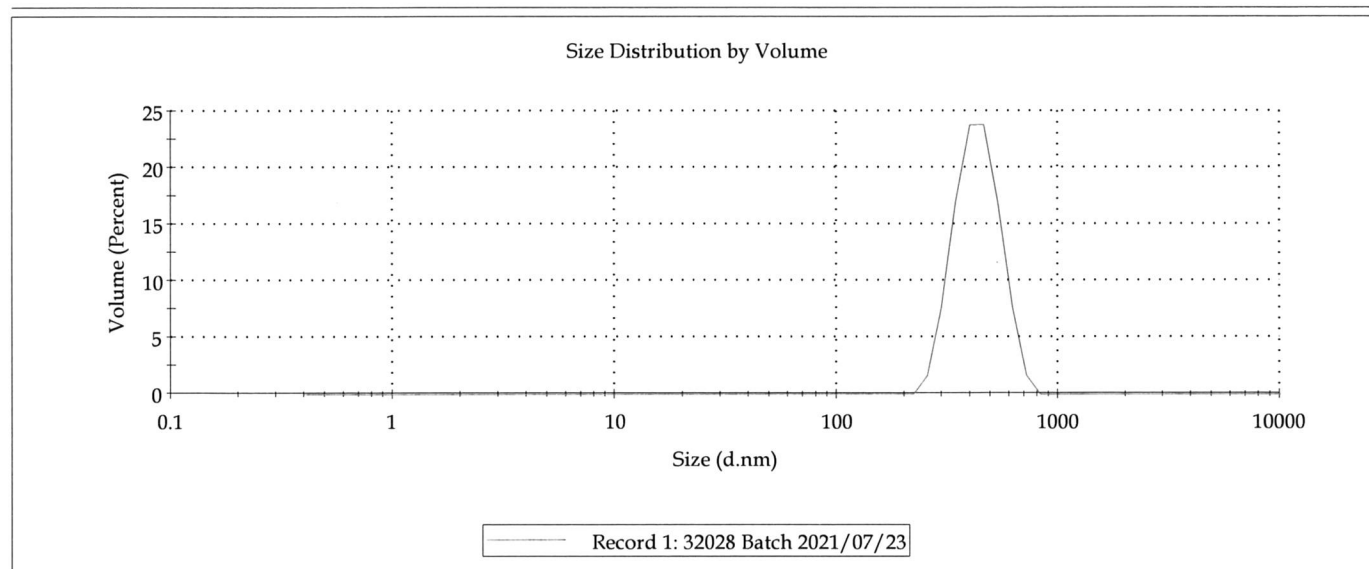
Sample Name: 32028 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:03:54

Userid: brj

D10%(V): 313 nm	D50%(V): 428 nm	D90%(V): 585 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	411.4
Peak 1: 437.0	100.0	96.69	PdI: 0.035	Note: Z-average and PdI are based on the intensity distribution
Peak 2: 0.000	0.0	0.000		
Peak 3: 0.000	0.0	0.000	Count Rate (kcps):	423.7



General Notes: 32028 Run 1

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 7

Duration (s): 10 Extend duration for large particles: False

Size Runs: 12

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

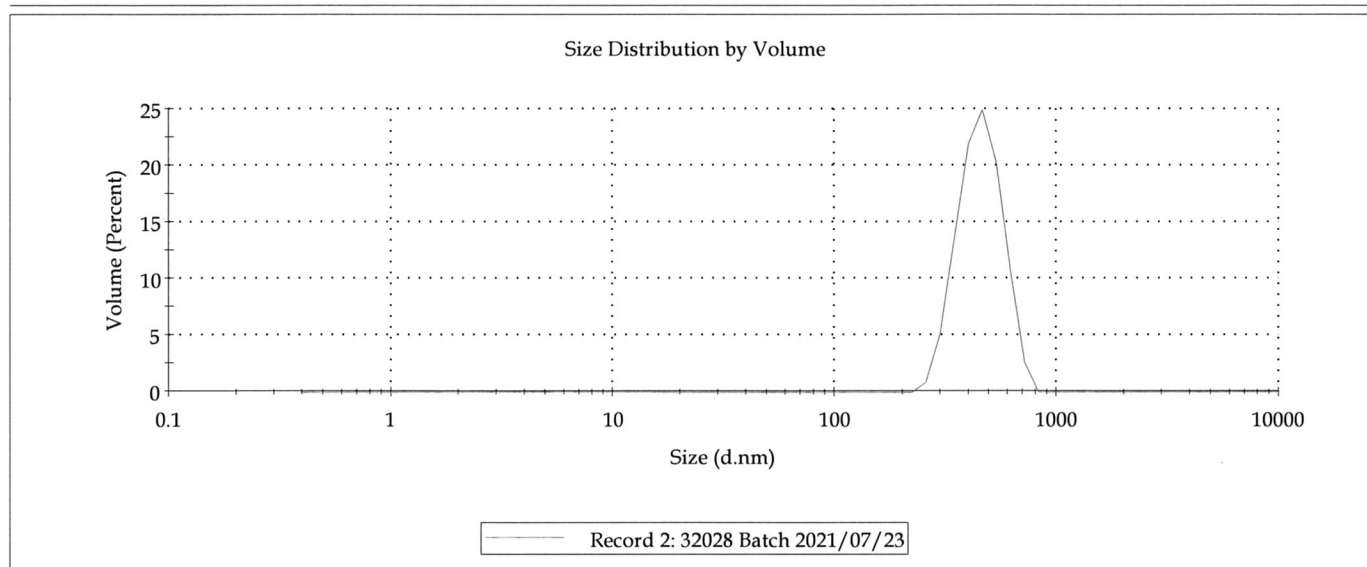
Sample Name: 32028 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:05:57

Userid: brj

D10%(V): 328 nm	D50%(V): 448 nm	D90%(V): 604 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	430.2
Peak 1:	457.1	100.0	99.23	Note: Z-average and Pdl are based on the intensity distribution
Peak 2:	0.000	0.0	0.000	
Peak 3:	0.000	0.0	0.000	
			PdI:	0.036
			Count Rate (kcps):	427.0



General Notes: 32028 Run 1

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 7

Duration (s): 10 Extend duration for large particles: False

Size Runs: 12

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

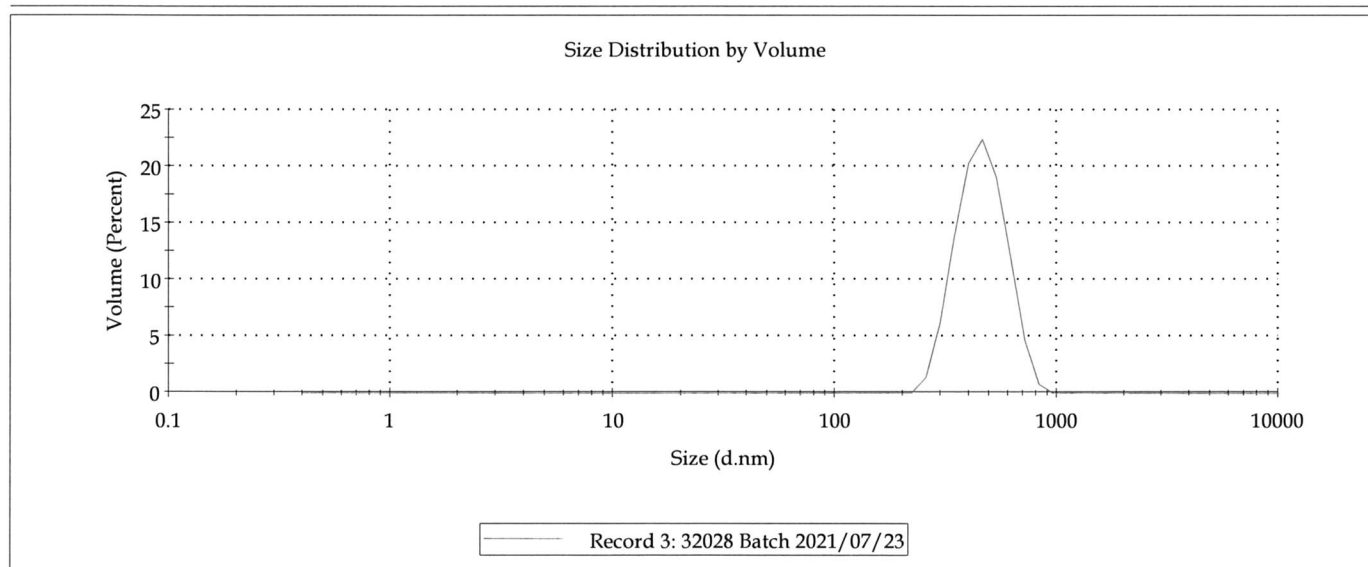
Sample Name: 32028 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:08:00

Userid: brj

D10%(V): 321 nm	D50%(V): 451 nm	D90%(V): 630 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	425.0
Peak 1: 463.8	100.0	113.0	PdI: 0.004	Note: Z-average and PdI are based on the intensity distribution
Peak 2: 0.000	0.0	0.000		
Peak 3: 0.000	0.0	0.000	Count Rate (kcps):	428.7



General Notes: 32028 Run 1

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 7

Duration (s): 10 Extend duration for large particles: False

Size Runs: 12

Operator: 27 JULI 2021 BRJ

Approved:

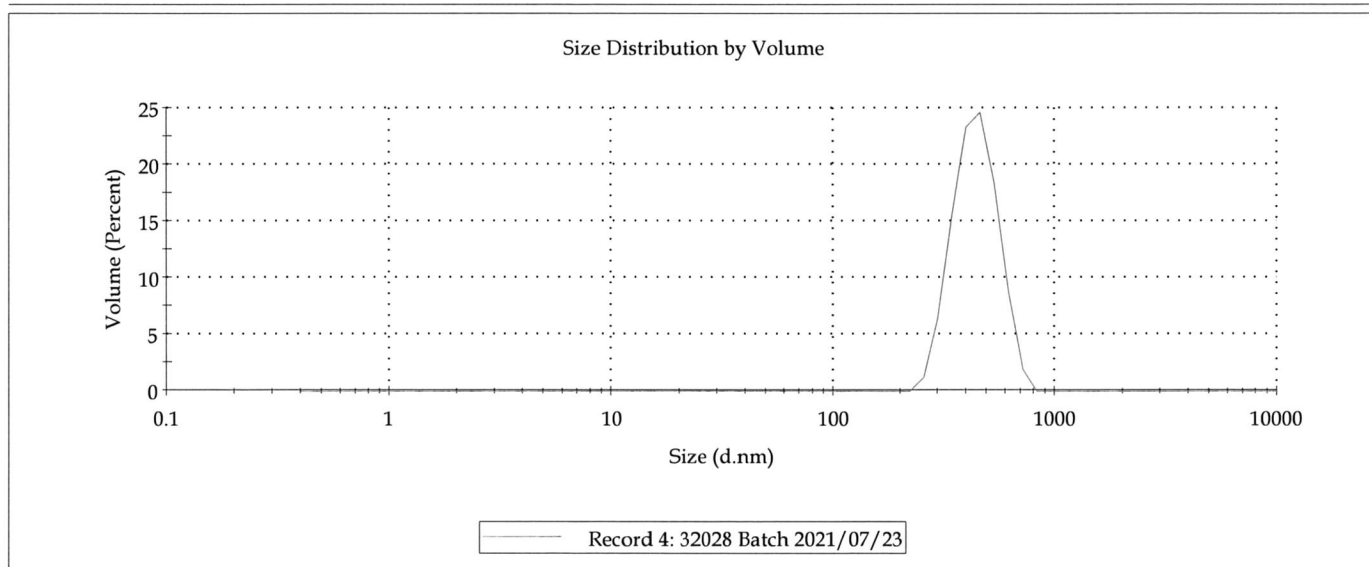
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32028 Batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 10:15:25
 Userid: brj

D10%(V): 319 nm		D50%(V): 436 nm		D90%(V): 592 nm	
	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	420.0
Peak 1:	445.0	100.0	97.11	PdI:	0.047
Peak 2:	0.000	0.0	0.000	Note: Z-average and PdI are based on the intensity distribution	
Peak 3:	0.000	0.0	0.000		
				Count Rate (kcps):	420.3



General Notes: 32028 Run 2

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	7
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	12

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

wfp

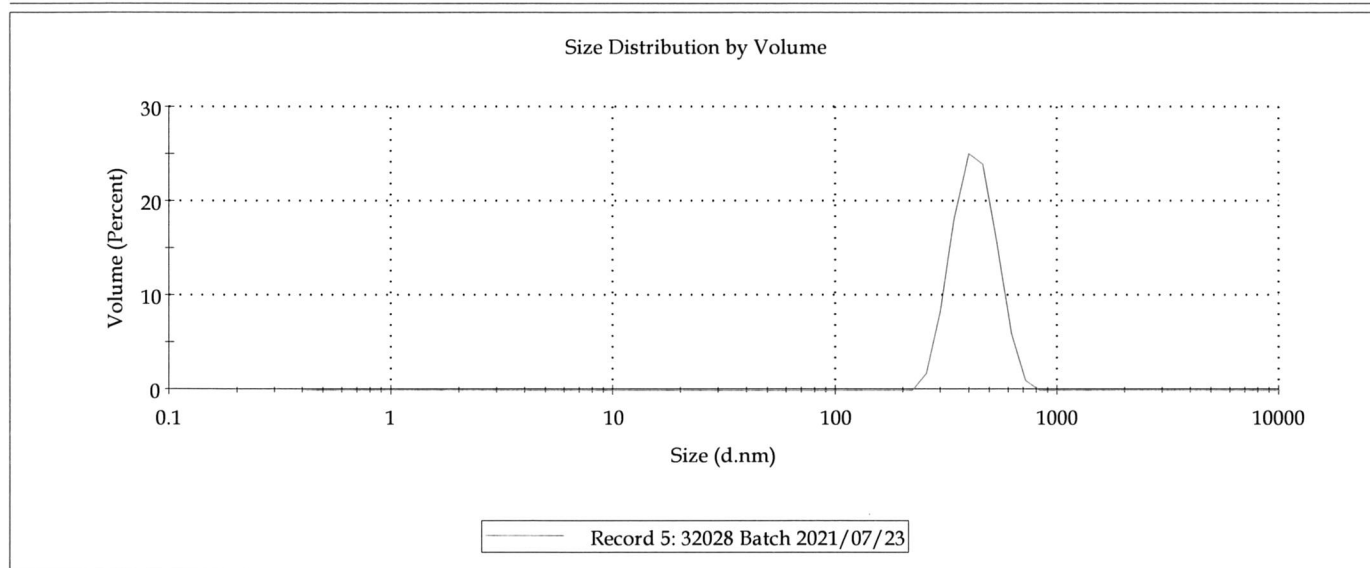
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32028 Batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 10:17:28
 Userid: brj

D10%(V): 310 nm	D50%(V): 419 nm	D90%(V): 570 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	397.4
Peak 1: 428.0	100.0	92.11	PdI: 0.036	Note: Z-average and PdI are based on the intensity distribution
Peak 2: 0.000	0.0	0.000		
Peak 3: 0.000	0.0	0.000	Count Rate (kcps):	418.5



General Notes: 32028 Run 2

Cell Description:	Disposable sizing cuvette	Dispersant Name:	Water
Material RI:	1.59	Dispersant RI:	1.330
Material Absorbtion:	0.010	Viscosity (cP):	0.8872
Analysis Model:	General Purpose	Temperature (°C):	25.0
Lower Size Threshold:	0.050	Equilibration Time Set (min):	180
Upper Size Threshold:	0.010	Number of measurements:	3
Size range:	0.6000 to 6000 nm	Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	7
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	12

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

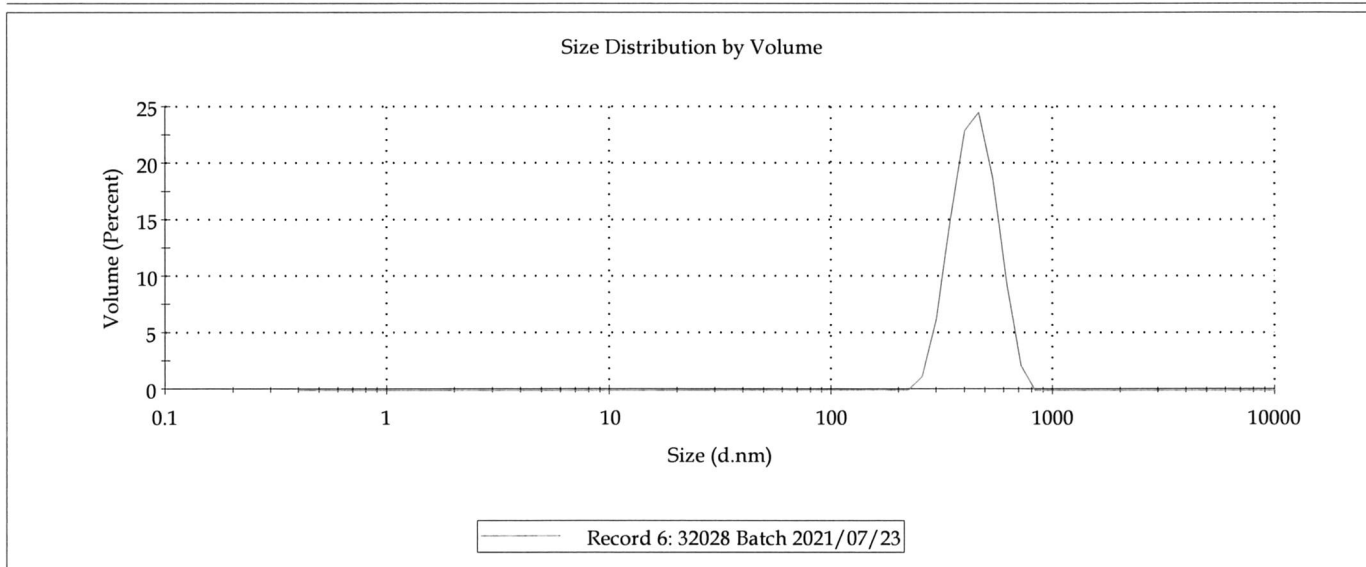
Sample Name: 32028 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:19:31

Userid: brj

D10%(V): 320 nm	D50%(V): 438 nm	D90%(V): 596 nm
Peak 1: 447.5	Peak 2: 0.000	Peak 3: 0.000
% Volume	Width (nm)	Z-Average (d.nm): 423.5
100.0	98.21	PdI: 0.061
0.0	0.000	<i>Note: Z-average and PdI are based on the intensity distribution</i>
0.0	0.000	Count Rate (kcps): 419.4



General Notes: 32028 Run 2

Cell Description: Disposable sizing cuvette	Dispersant Name: Water
Material RI: 1.59	Dispersant RI: 1.330
Material Absorbtion: 0.010	Viscosity (cP): 0.8872
Analysis Model: General Purpose	Temperature (°C): 25.0
Lower Size Threshold: 0.050	Equilibration Time Set (min): 180
Upper Size Threshold: 0.010	Number of measurements: 3
Size range: 0.6000 to 6000 nm	Size Measure Delay (s): 0
Auto Position Enabled: False	Measurement Position (mm): 4.65
Auto Attenuate Enabled: True	Attenuator: 7
Auto Size Measurement Time: True	Duration (s): 10 Extend duration for large particles: False
	Size Runs: 12

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 [Signature]

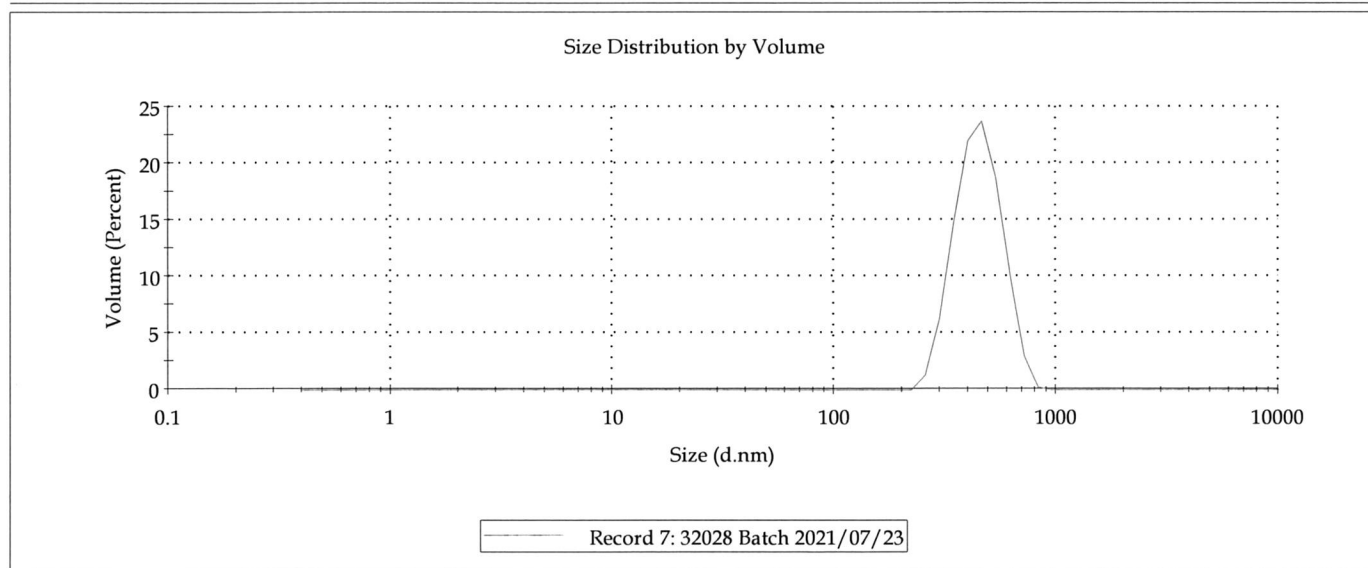
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32028 Batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 10:20:04
 Userid: brj

D10%(V): 320 nm	D50%(V): 442 nm	D90%(V): 605 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 452.6	100.0	103.8
Peak 2: 0.000	0.0	0.000
Peak 3: 0.000	0.0	0.000
Z-Average (d.nm): 422.2		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.025		
Count Rate (kcps): 423.7		



General Notes: Average result created from record number(s): 1 2 3

Cell Description:	Disposable sizing cuvette	Dispersant Name:	Water
Material RI:	1.59	Dispersant RI:	1.330
Material Absorbtion:	0.010	Viscosity (cP):	0.8872
Analysis Model:	General Purpose	Temperature (°C):	25.0
Lower Size Threshold:	0.050	Equilibration Time Set (min):	180
Upper Size Threshold:	0.010	Number of measurements:	3
Size range:	0.6000 to 6000 nm	Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	7
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	12

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

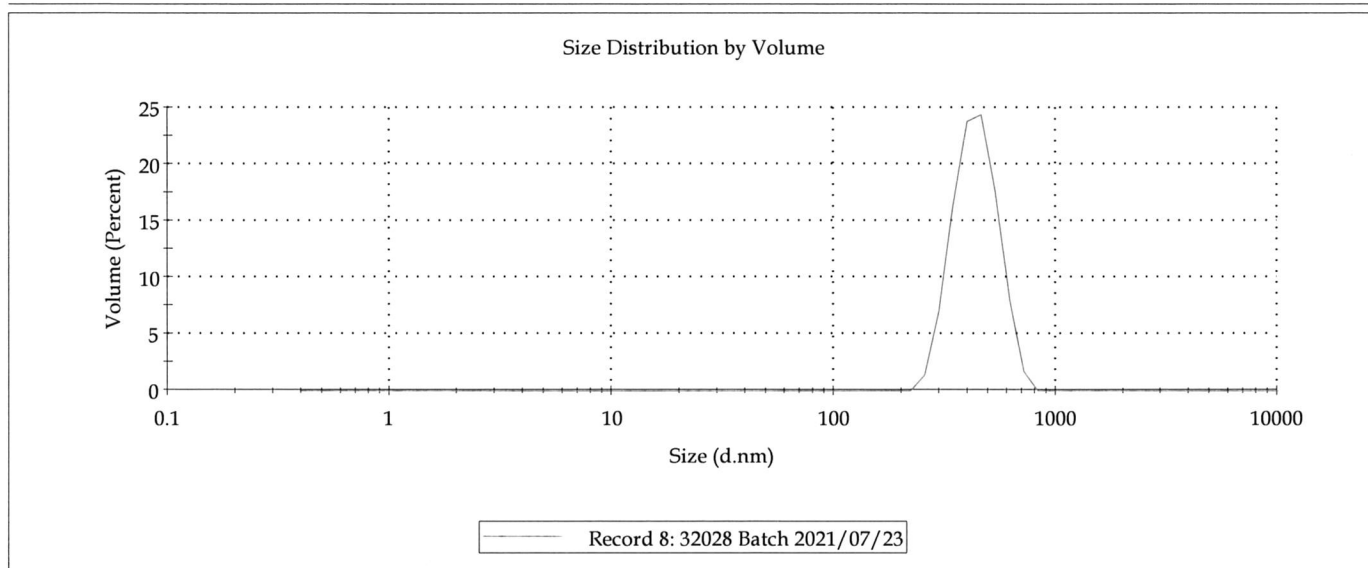
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32028 Batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 10:20:16
 Userid: brj

D10%(V): 316 nm		D50%(V): 431 nm		D90%(V): 587 nm	
	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	Note: Z-average and Pdl are based on the intensity distribution
Peak 1:	440.2	100.0	96.24	PdI: 0.048	
Peak 2:	0.000	0.0	0.000		
Peak 3:	0.000	0.0	0.000	Count Rate (kcps):	420.3



General Notes: Average result created from record number(s): 4 5 6

<p>Cell Description: Disposable sizing cuvette</p> <p>Material RI: 1.59</p> <p>Material Absorbtion: 0.010</p> <p>Analysis Model: General Purpose</p> <p>Lower Size Threshold: 0.050</p> <p>Upper Size Threshold: 0.010</p> <p>Size range: 0.6000 to 6000 nm</p> <p>Auto Position Enabled: False</p> <p>Auto Attenuate Enabled: True</p> <p>Auto Size Measurement Time: True</p>	<p>Dispersant Name: Water</p> <p>Dispersant RI: 1.330</p> <p>Viscosity (cP): 0.8872</p> <p>Temperature (°C): 25.0</p> <p>Equilibration Time Set (min): 180</p> <p>Number of measurements: 3</p> <p>Size Measure Delay (s): 0</p> <p>Measurement Position (mm): 4.65</p> <p>Attenuator: 7</p> <p>Duration (s): 10</p> <p>Size Runs: 12</p> <p>Extend duration for large particles: False</p>
---	---

Operator: 27 JULI 2021 *brj*

Approved: 28 JULI 2021 *mp*

Zetasizer Ver. 7.13
Serial Number : MAL500686

File name: 32028
Record Number: 1
27 jul 2021 14:11:

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

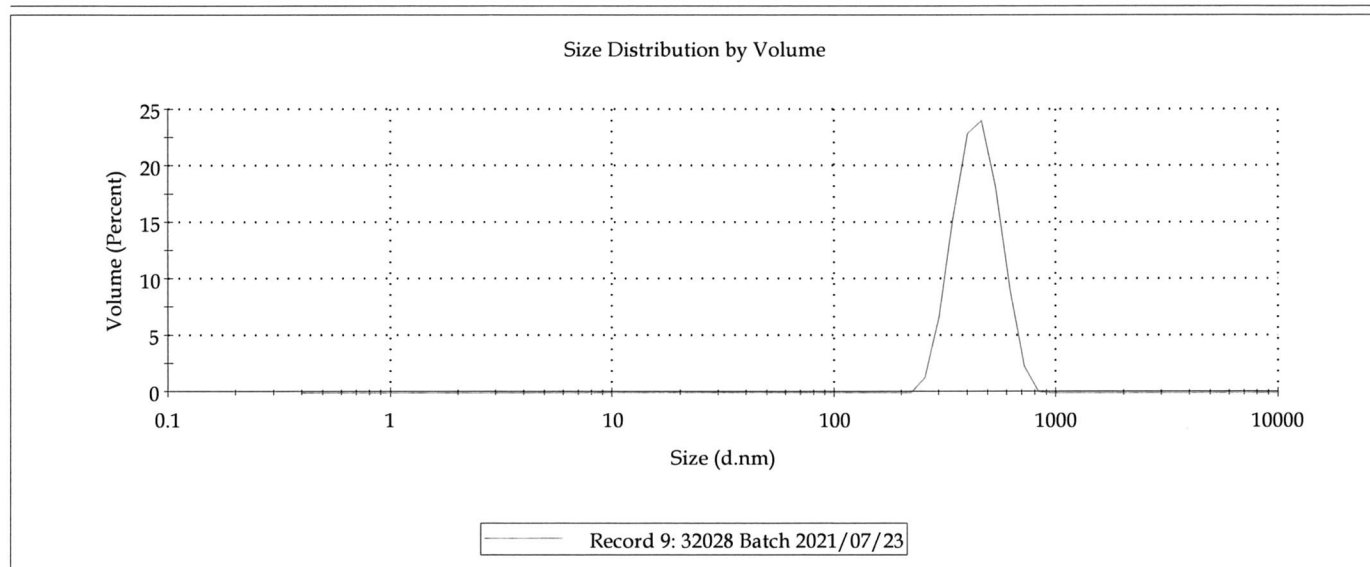
Sample Name: 32028 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:20:28

Userid: brj

D10%(V): 318 nm	D50%(V): 436 nm	D90%(V): 597 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	417.9
Peak 1: 446.4	100.0	100.3	PdI: 0.037	Note: Z-average and PdI are based on the intensity distribution
Peak 2: 0.000	0.0	0.000		
Peak 3: 0.000	0.0	0.000	Count Rate (kcps):	423.7



General Notes: Average result created from record number(s): 1 2 3 4 5 6

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 7

Duration (s): 10 Extend duration for large particles: False

Size Runs: 12

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021



CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 600nm
Batch: 2021/07/23
Internal number: 32029

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	D _{10%} (nm)**		D _{50%} (nm)**		D _{90%} (nm)**		Z-average*		PDI*	
Run 1	449		662		948		569.5		0.04	
Run 2	470		633		831		596.4		0.086	
Average	462		646		899		582.9		0.063	
Specification	-	-	-	-	-	-	-	-	-	-
Evaluation	-		-		-		-		-	

*The parameter is based on the intensity size distribution

**The parameter is based on the volume size distribution

Written by: Bente Ansgaard

Date: 28 JULI 2021

Reviewed by: Wenbo Wang

Date: 28 JULI 2021

Approved by: Wenbo Wang
QC

Date: 28 JULI 2021

*The validity of the method is the responsibility of the sponsor
 Quality agreement not in place*

Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

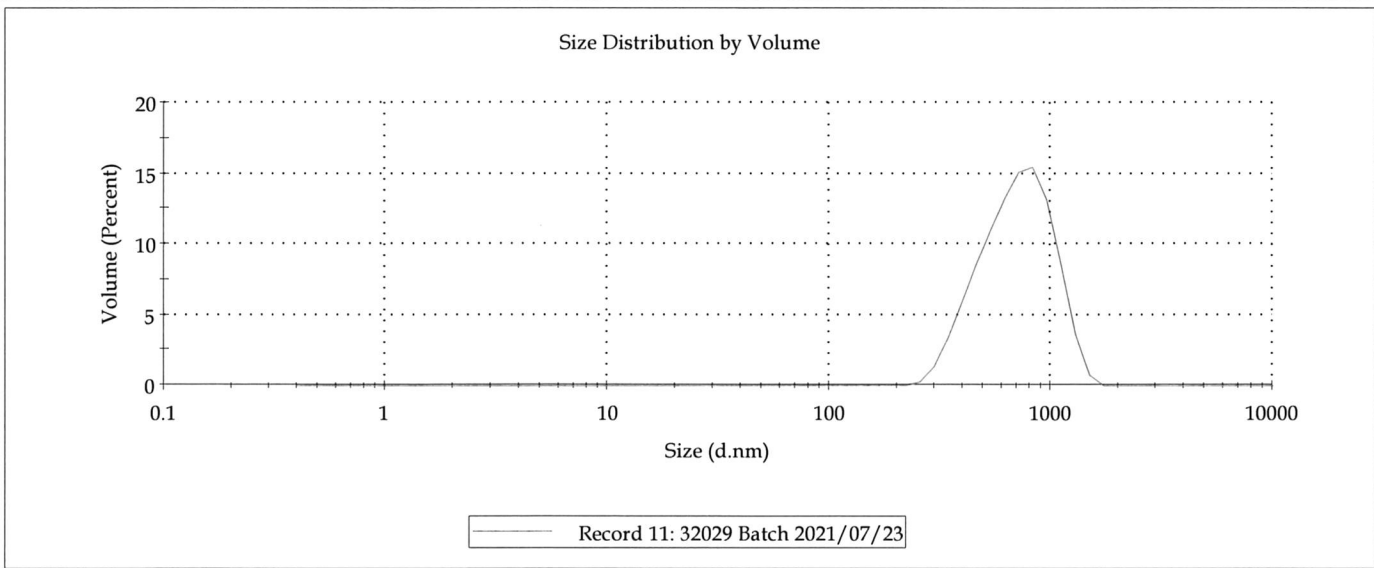
Sample Name: 32029 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:32:39

Userid: brj

D10%(V): 414 nm	D50%(V): 705 nm	D90%(V): 1090 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 729.3	100.0	250.1
Peak 2: 0.000	0.0	0.000
Peak 3: 0.000	0.0	0.000
Z-Average (d.nm): 538.3		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.090		
Count Rate (kcps): 188.5		



General Notes: 32029 Run 1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	7
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	15

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 WJN

Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

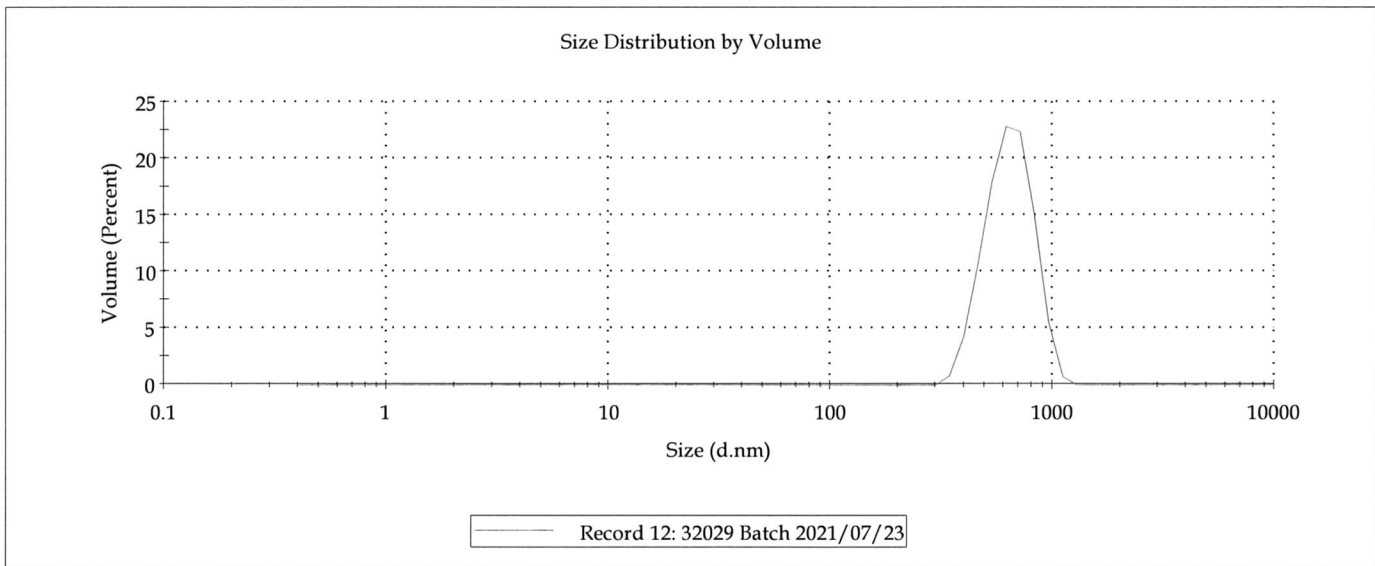
Sample Name: 32029 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:35:13

Userid: brj

D10%(V): 455 nm	D50%(V): 637 nm	D90%(V): 873 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 647.4	100.0	149.7
Peak 2: 0.000	0.0	0.000
Peak 3: 0.000	0.0	0.000
Z-Average (d.nm): 573.1		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.024		
Count Rate (kcps): 188.1		



General Notes: 32029 Run 1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	7
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	15

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 *mf*

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32029 Batch 2021/07/23

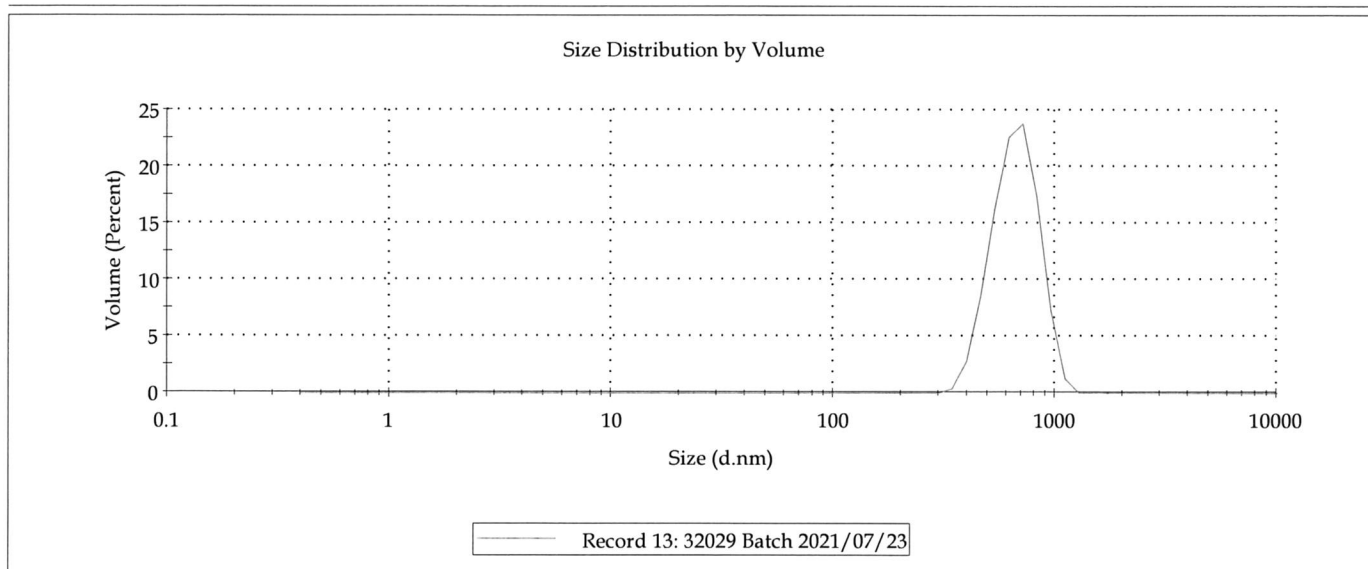
SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:37:46

Userid: brj

D10%(V): 474 nm D50%(V): 661 nm D90%(V): 902 nm

	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	597.1	Note: Z-average and Pdl are based on the intensity distribution
Peak 1:	671.4	100.0	151.9	PdI:	0.005	
Peak 2:	0.000	0.0	0.000			
Peak 3:	0.000	0.0	0.000	Count Rate (kcps):	188.9	



General Notes: 32029 Run 1

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 7

Duration (s): 10 Extend duration for large particles: False

Size Runs: 15

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

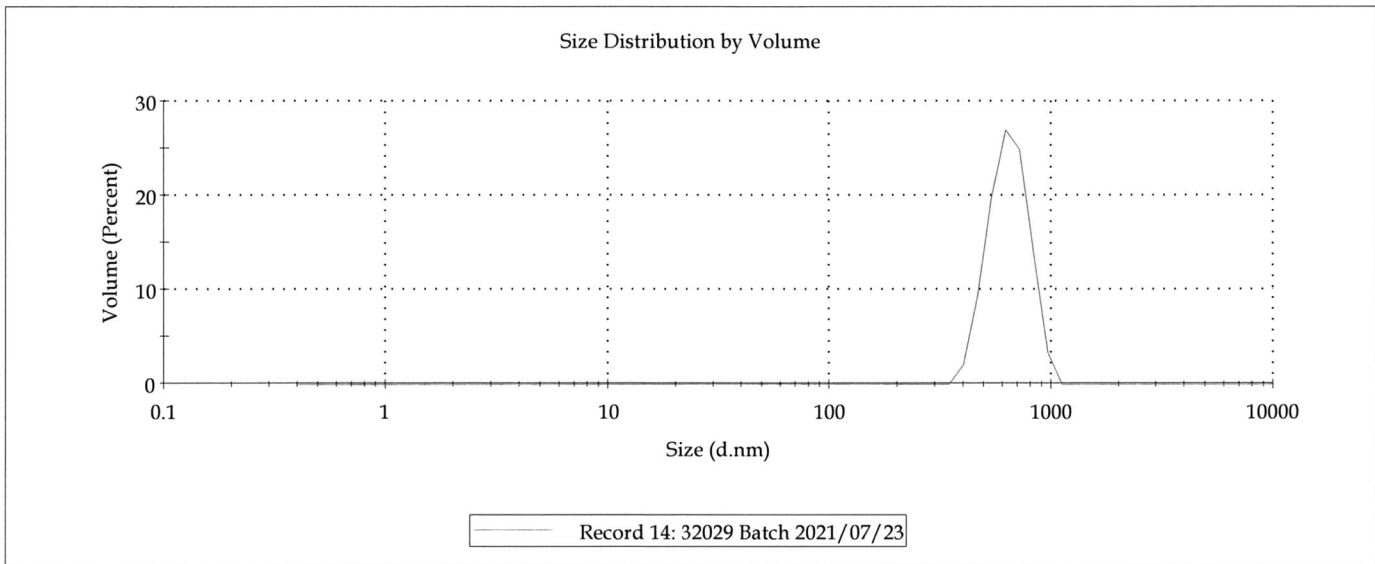
Sample Name: 32029 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:44:42

Userid: brj

D10%(V): 475 nm	D50%(V): 636 nm	D90%(V): 829 nm
Peak 1: 644.1	Peak 2: 0.000	Peak 3: 0.000
Diam. (nm)	% Volume	Width (nm)
644.1	100.0	127.2
0.000	0.0	0.000
0.000	0.0	0.000
Z-Average (d.nm): 607.3		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.134		
Count Rate (kcps): 175.4		



General Notes: 32029 Run 2

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	7
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	15

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 [Signature]

Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

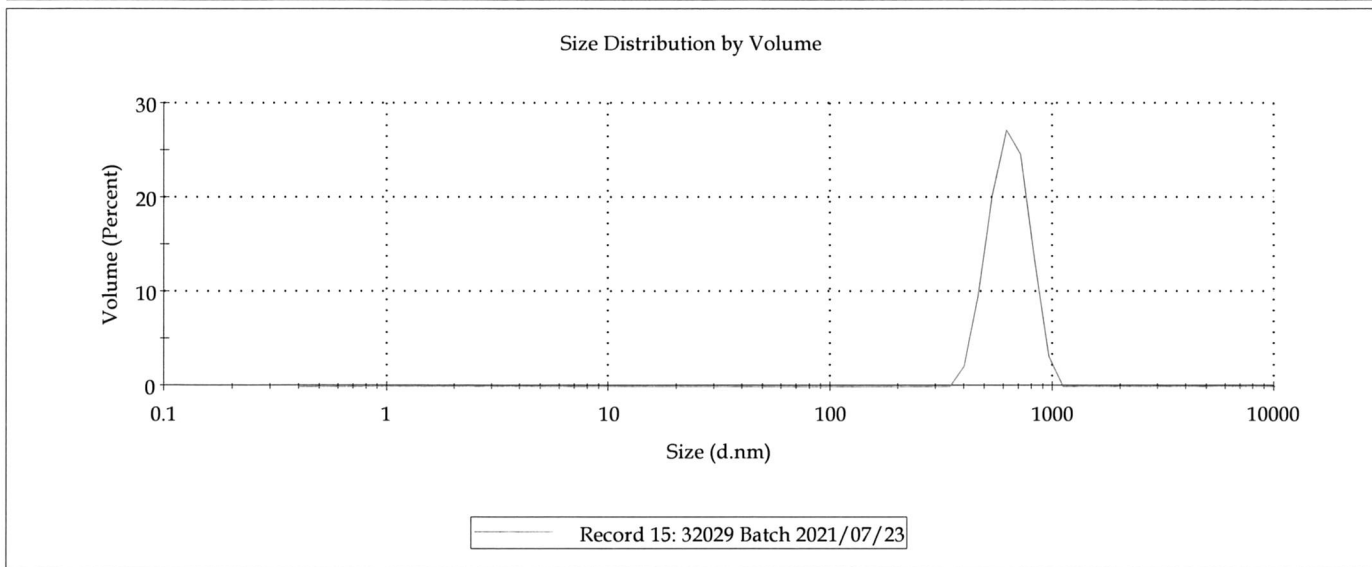
Sample Name: 32029 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:47:15

Userid: brj

D10%(V): 474 nm	D50%(V): 633 nm	D90%(V): 824 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 641.4	100.0	126.4
Peak 2: 0.000	0.0	0.000
Peak 3: 0.000	0.0	0.000
Z-Average (d.nm): 600.4		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.096		
Count Rate (kcps): 175.8		



General Notes: 32029 Run 2

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Dispersant Name: Water

Material Absorbtion: 0.010

Dispersant RI: 1.330

Analysis Model: General Purpose

Viscosity (cP): 0.8872

Lower Size Threshold: 0.050

Temperature (°C): 25.0

Upper Size Threshold: 0.010

Equilibration Time Set (min): 180

Size range: 0.6000 to 6000 nm

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Measurement Position (mm): 4.65

Auto Attenuate Enabled: True

Attenuator: 7

Auto Size Measurement Time: True

Duration (s): 10 Extend duration for large particles: False

Size Runs: 15

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

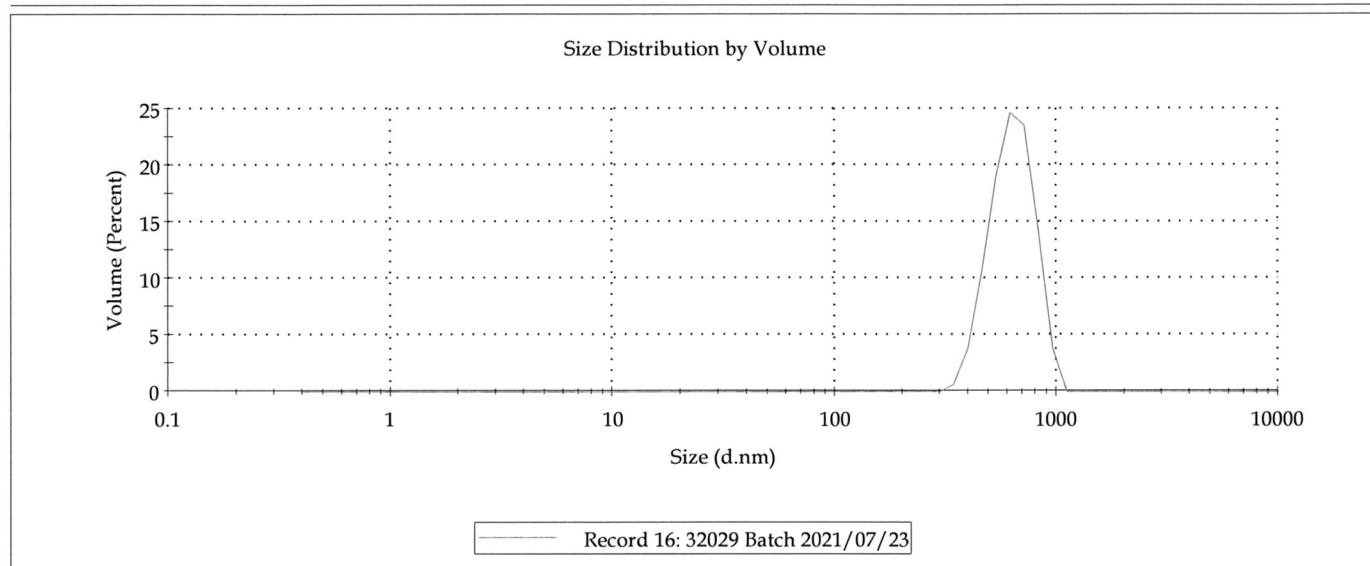
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32029 Batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 10:49:49
 Userid: brj

D10%(V): 460	nm	D50%(V): 631	nm	D90%(V): 839	nm
Peak 1:	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	581.5
Peak 2:	638.3	100.0	136.4	PdI:	0.027
Peak 3:	0.000	0.0	0.000	Note: Z-average and PdI are based on the intensity distribution	
				Count Rate (kcps):	173.2



General Notes: 32029 Run 2

Cell Description:	Disposable sizing cuvette	Dispersant Name:	Water
Material RI:	1.59	Dispersant RI:	1.330
Material Absorbtion:	0.010	Viscosity (cP):	0.8872
Analysis Model:	General Purpose	Temperature (°C):	25.0
Lower Size Threshold:	0.050	Equilibration Time Set (min):	180
Upper Size Threshold:	0.010	Number of measurements:	3
Size range:	0.6000 to 6000 nm	Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	7
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	15

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 WJD

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

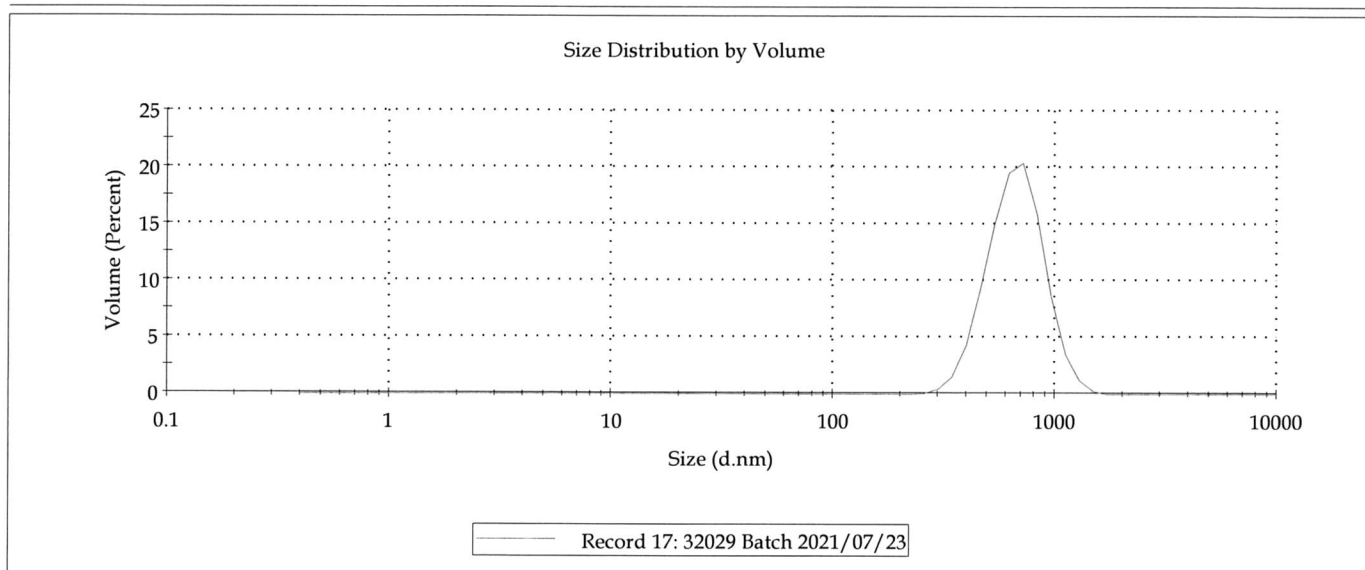
Sample Name: 32029 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:51:35

Userid: brj

D10%(V): 449 nm	D50%(V): 662 nm	D90%(V): 948 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	569.5
Peak 1: 682.7	100.0	192.8	PdI: 0.040	Note: Z-average and PdI are based on the intensity distribution
Peak 2: 0.000	0.0	0.000		
Peak 3: 0.000	0.0	0.000	Count Rate (kcps):	188.5



General Notes: Average result created from record number(s): 11 12 13

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 7

Duration (s): 10 Extend duration for large particles: False

Size Runs: 15

Operator: 27 JULI 2021 BRJApproved: 28 JULI 2021 mm

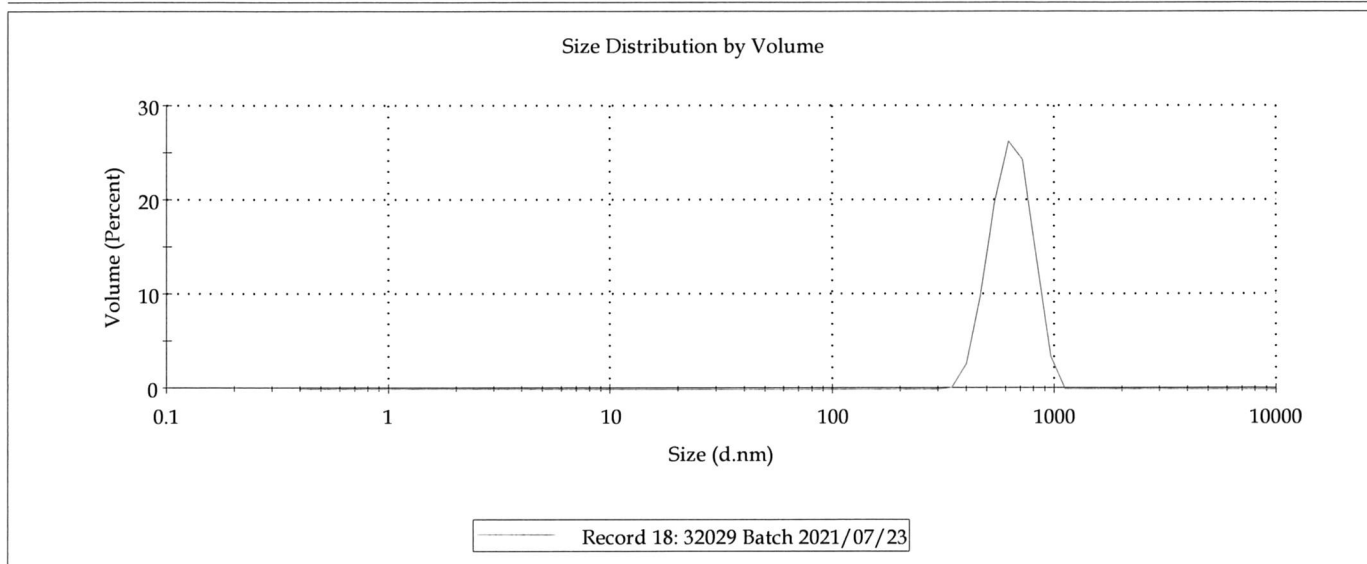
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32029 Batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 10:51:46
 Userid: brj

D10%(V): 470 nm	D50%(V): 633 nm	D90%(V): 831 nm	
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm): 596.4
Peak 1: 641.3	100.0	130.1	<i>Note: Z-average and Pdl are based on the intensity distribution</i>
Peak 2: 0.000	0.0	0.000	PdI: 0.086
Peak 3: 0.000	0.0	0.000	Count Rate (kcps): 175.4



General Notes: Average result created from record number(s): 14 15 16

Cell Description:	Disposable sizing cuvette	Dispersant Name:	Water
Material RI:	1.59	Dispersant RI:	1.330
Material Absorbtion:	0.010	Viscosity (cP):	0.8872
Analysis Model:	General Purpose	Temperature (°C):	25.0
Lower Size Threshold:	0.050	Equilibration Time Set (min):	180
Upper Size Threshold:	0.010	Number of measurements:	3
Size range:	0.6000 to 6000 nm	Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	7
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	15

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 [Signature]

Size Distribution Report by Volume


PARTICLE
ANALYTICAL
 EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32029 Batch 2021/07/23

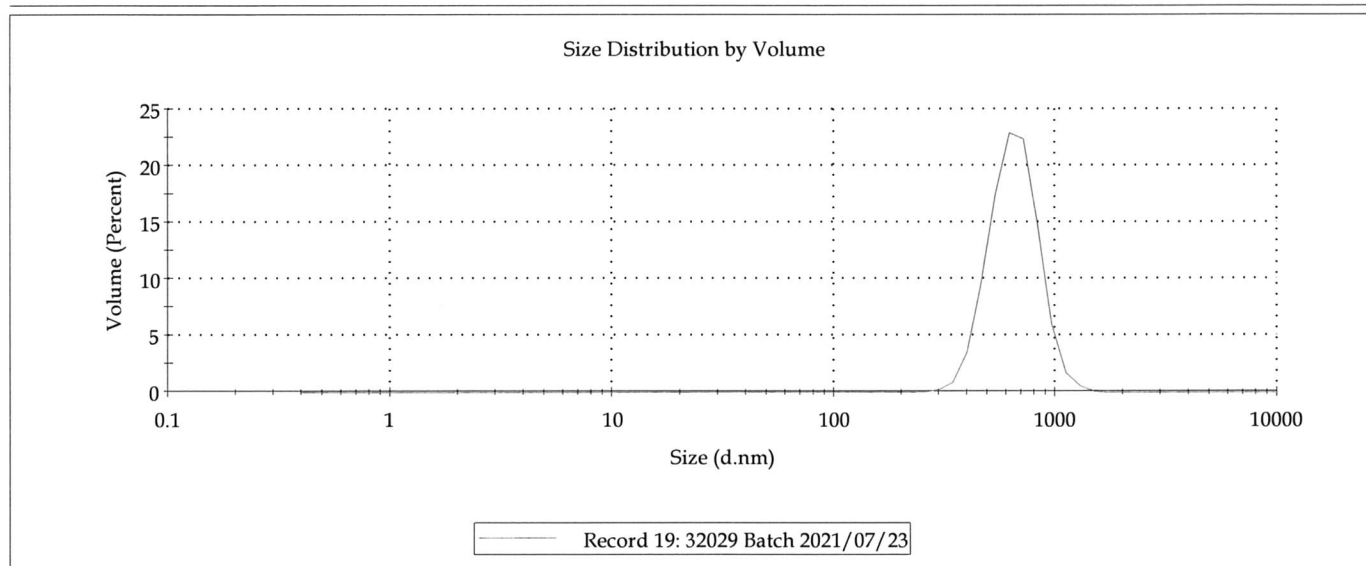
SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 10:52:50

Userid: brj

D10%(V): 462 nm D50%(V): 646 nm D90%(V): 899 nm

	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):		Note: Z-average and Pdl are based on the intensity distribution
Peak 1:	662.0	100.0	165.8	582.9		
Peak 2:	0.000	0.0	0.000	PdI: 0.063		
Peak 3:	0.000	0.0	0.000	Count Rate (kcps):	188.5	



General Notes: Average result created from record number(s): 11 12 13 14 15 16

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Dispersant Name: Water

Material Absorbtion: 0.010

Dispersant RI: 1.330

Analysis Model: General Purpose

Viscosity (cP): 0.8872

Lower Size Threshold: 0.050

Temperature (°C): 25.0

Upper Size Threshold: 0.010

Equilibration Time Set (min): 180

Size range: 0.6000 to 6000 nm

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Measurement Position (mm): 4.65

Auto Attenuate Enabled: True

Attenuator: 7

Auto Size Measurement Time: True

Duration (s): 10 Extend duration for large particles: False

Size Runs: 15

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021



CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 800nm
Batch: 2021/07/23
Internal number: 32030

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	D _{10%} (nm)**		D _{50%} (nm)**		D _{90%} (nm)**		Z-average*		PDI*	
Run 1	496		704		948		621.9		0.07	
Run 2	552		730		944		684.9		0.102	
Average	529		718		946		653.4		0.086	
Specification	-	-	-	-	-	-	-	-	-	-
Evaluation	-		-		-		-		-	

*The parameter is based on the intensity size distribution

**The parameter is based on the volume size distribution

Written by: *Brent Rupp*

Date: 28 JULI 2021

Reviewed by: *Wenbo Wang*

Date: 28 JULI 2021

Approved by: *Wenbo Wang*
QC

Date: 28 JULI 2021

*The validity of the method is the responsibility of the sponsor
 Quality agreement not in place*

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

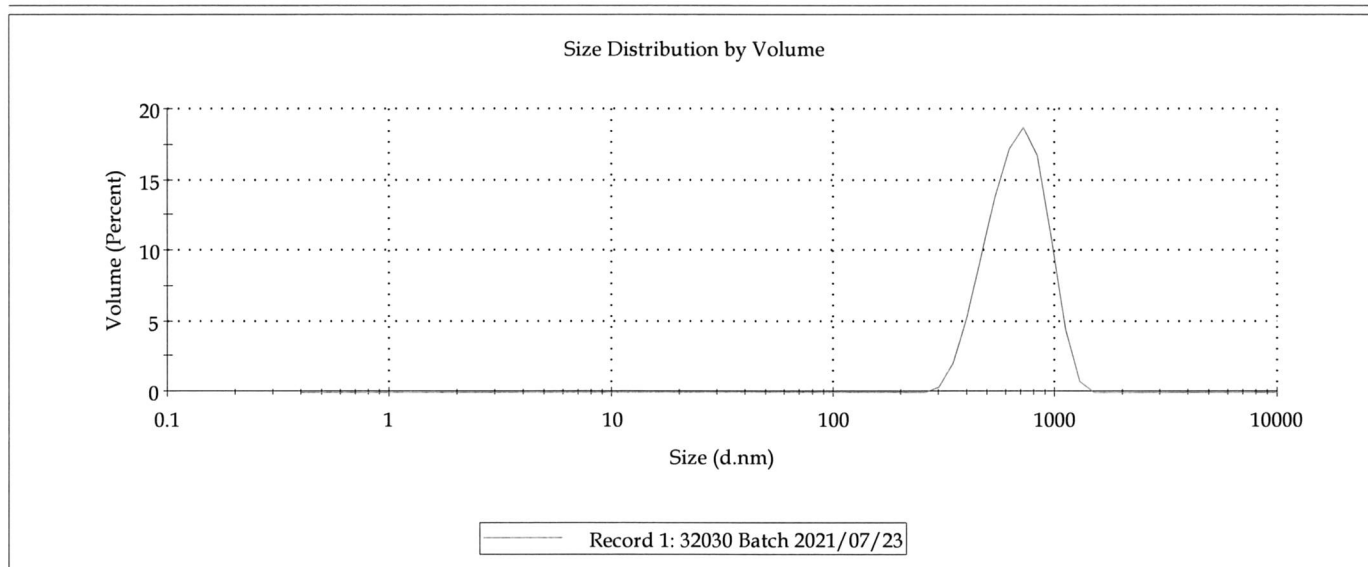
Sample Name: 32030 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:04:35

Userid: brj

D10%(V): 436 nm	D50%(V): 670 nm	D90%(V): 968 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	547.7
Peak 1: 686.9	100.0	196.5	PdI: 0.164	Note: Z-average and PdI are based on the intensity distribution
Peak 2: 0.000	0.0	0.000		
Peak 3: 0.000	0.0	0.000	Count Rate (kcps):	290.7



General Notes: 32030 Run1

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 8

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Size Distribution Report by Volume


PARTICLE
ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

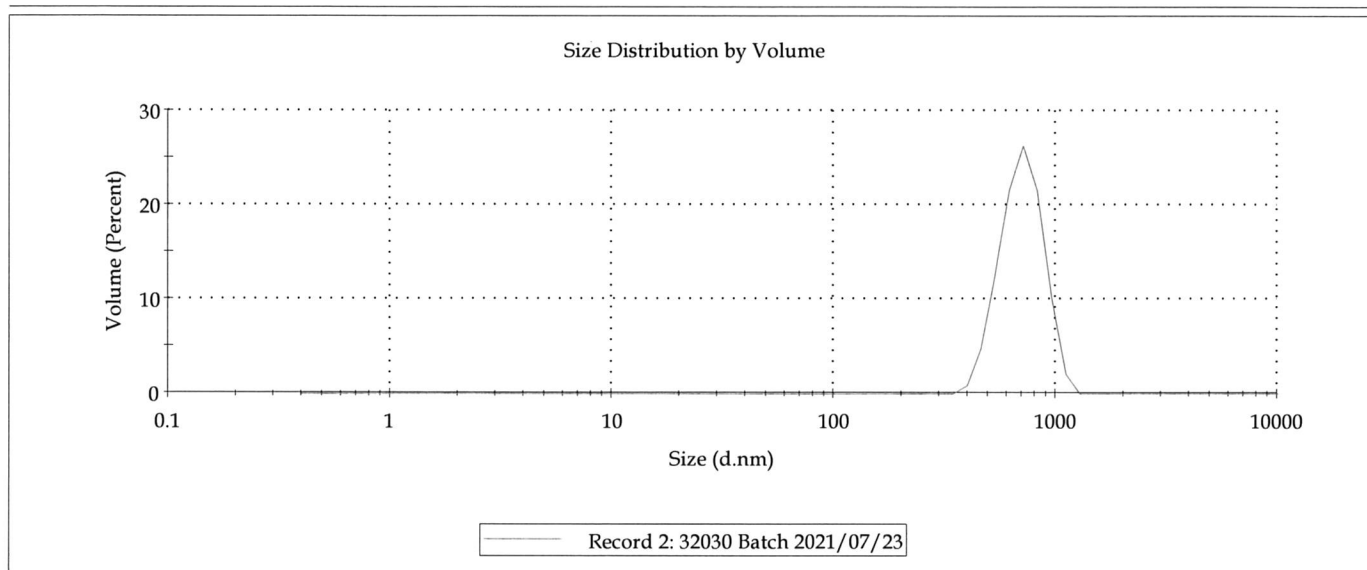
Sample Name: 32030 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:06:48

Userid: brj

D10%(V): 515 nm	D50%(V): 700 nm	D90%(V): 933 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 711.2	100.0	149.1
Peak 2: 0.000	0.0	0.000
Peak 3: 0.000	0.0	0.000
Z-Average (d.nm): 643.0		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.038		
Count Rate (kcps): 285.5		



General Notes: 32030 Run1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	8
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	13

Operator:

27 JULI 2021 BRJ

Approved:

28 JULI 2021

Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

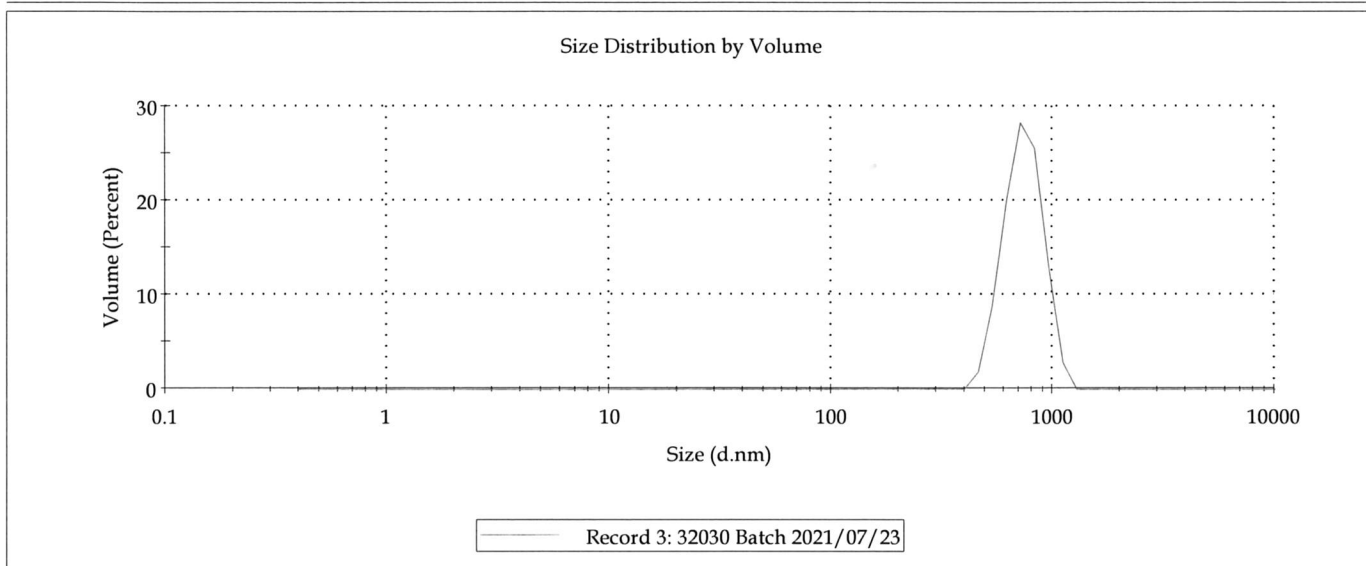
Sample Name: 32030 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:09:01

Userid: brj

D10%(V): 553 nm		D50%(V): 735 nm		D90%(V): 951 nm	
	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	Note: Z-average and Pdl are based on the intensity distribution
Peak 1:	744.2	100.0	142.4	PdI: 0.008	
Peak 2:	0.000	0.0	0.000		
Peak 3:	0.000	0.0	0.000	Count Rate (kcps):	288.2



General Notes: 32030 Run1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	8
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 *WJA*

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

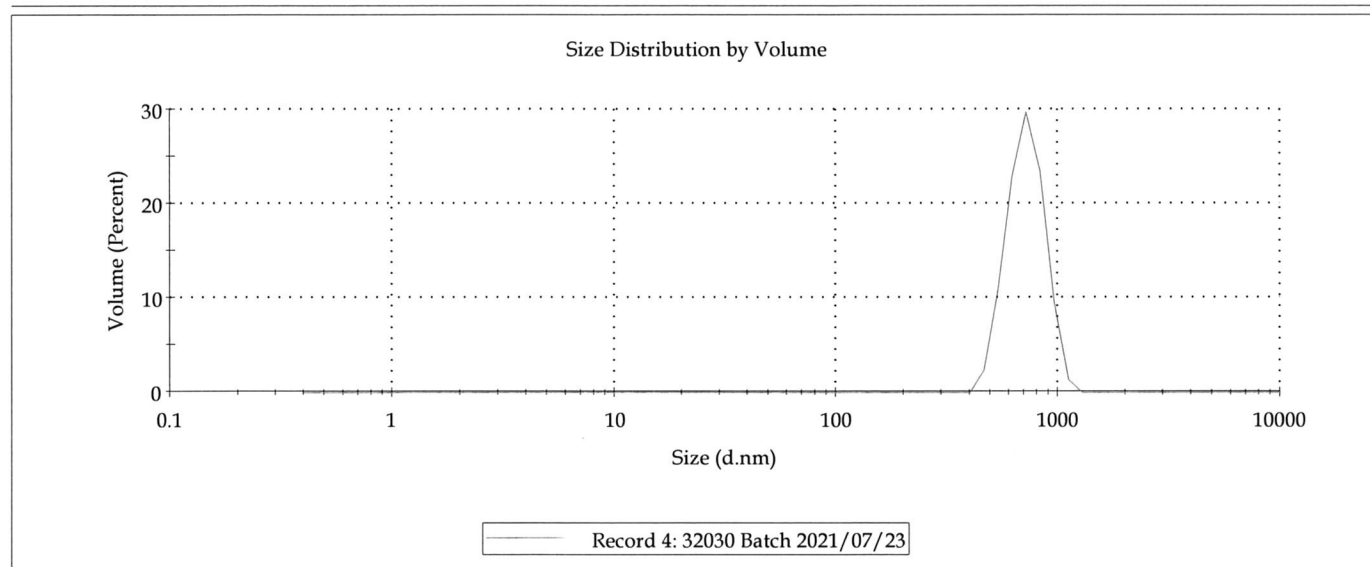
Sample Name: 32030 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:16:03

Userid: brj

D10%(V): 543 nm	D50%(V): 710 nm	D90%(V): 925 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	669.6
Peak 1: 720.1	100.0	134.0	PdI:	0.089
Peak 2: 0.000	0.0	0.000	Note: Z-average and PdI are based on the intensity distribution	
Peak 3: 0.000	0.0	0.000		
			Count Rate (kcps):	275.1



General Notes: 32030 Run 2

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 8

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32030 Batch 2021/07/23

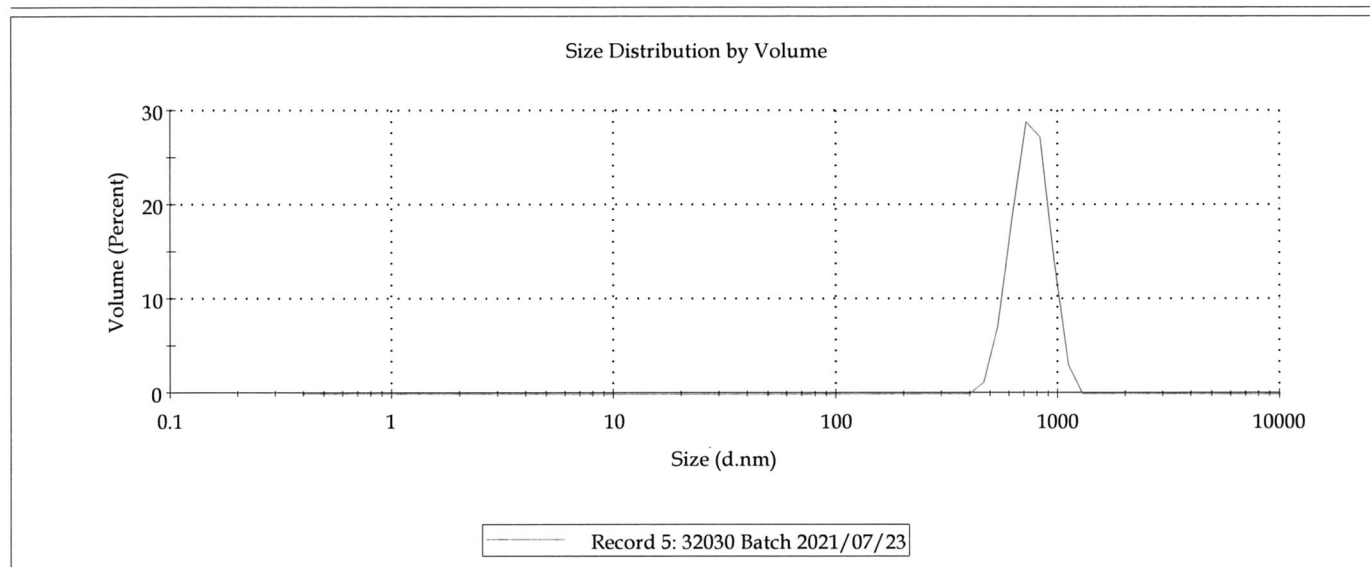
SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:18:16

Userid: brj

D10%(V): 565 nm	D50%(V): 748 nm	D90%(V): 958 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	697.1
Peak 1: 755.4	100.0	139.9	PdI:	0.097
Peak 2: 0.000	0.0	0.000		
Peak 3: 0.000	0.0	0.000	Count Rate (kcps):	274.4

Note: Z-average and PdI are based on the intensity distribution



General Notes: 32030 Run 2

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 8

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 WJO

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32030 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:20:29

Userid: brj

D10%(V): 552 nm D50%(V): 731 nm D90%(V): 946 nm

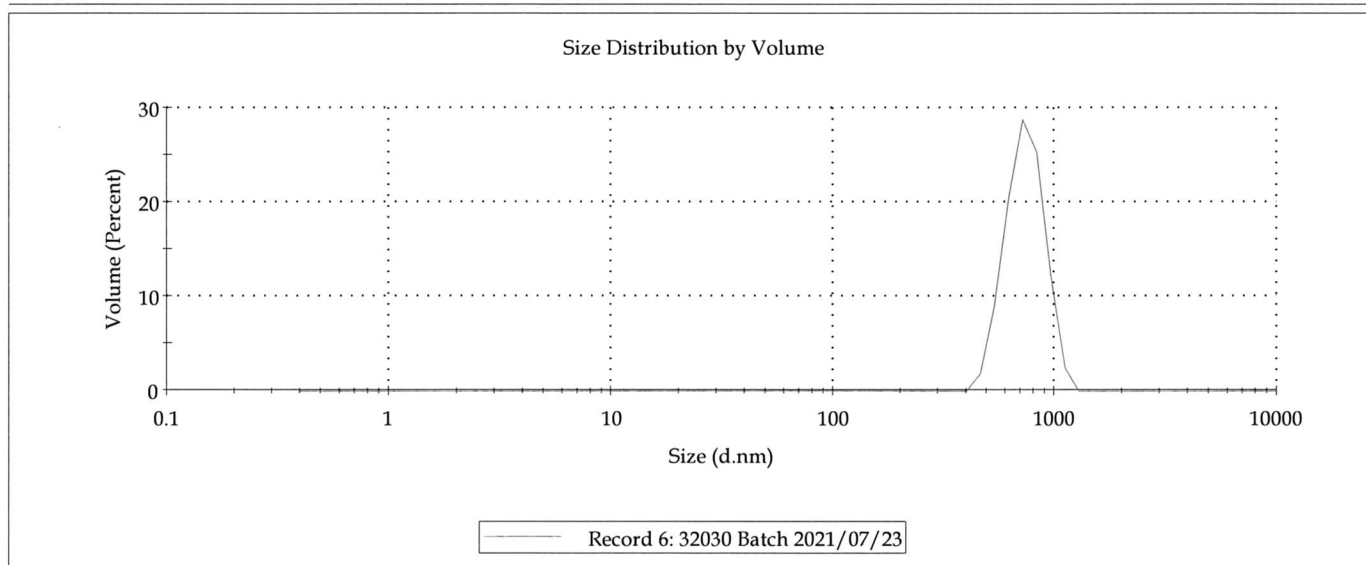
	Diam. (nm)	% Volume	Width (nm)
Peak 1:	739.8	100.0	140.2
Peak 2:	0.000	0.0	0.000
Peak 3:	0.000	0.0	0.000

Z-Average (d.nm): 688.0

Note: Z-average and Pdl are based on the intensity distribution

PdI: 0.118

Count Rate (kcps): 274.4



General Notes: 32030 Run 2

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Dispersant Name: Water

Material Absorbtion: 0.010

Dispersant RI: 1.330

Analysis Model: General Purpose

Viscosity (cP): 0.8872

Lower Size Threshold: 0.050

Temperature (°C): 25.0

Upper Size Threshold: 0.010

Equilibration Time Set (min): 180

Size range: 0.6000 to 6000 nm

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Measurement Position (mm): 4.65

Auto Attenuate Enabled: True

Attenuator: 8

Auto Size Measurement Time: True

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: 27 JULI 2021 BRJApproved: 28 JULI 2021

Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

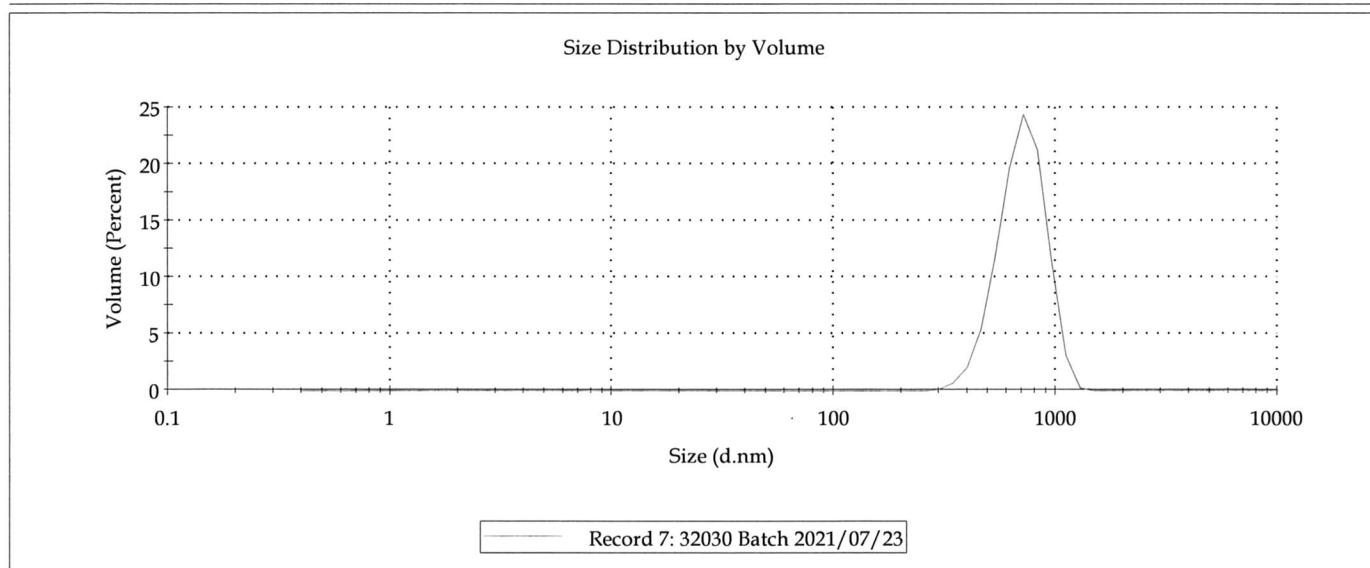
Sample Name: 32030 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:21:24

Userid: brj

D10%(V): 496 nm	D50%(V): 704 nm	D90%(V): 948 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 714.1	100.0	166.1
Peak 2: 0.000	0.0	0.000
Peak 3: 0.000	0.0	0.000
Z-Average (d.nm): 621.9		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.070		
Count Rate (kcps): 290.7		



General Notes: Average result created from record number(s): 1 2 3

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	8
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

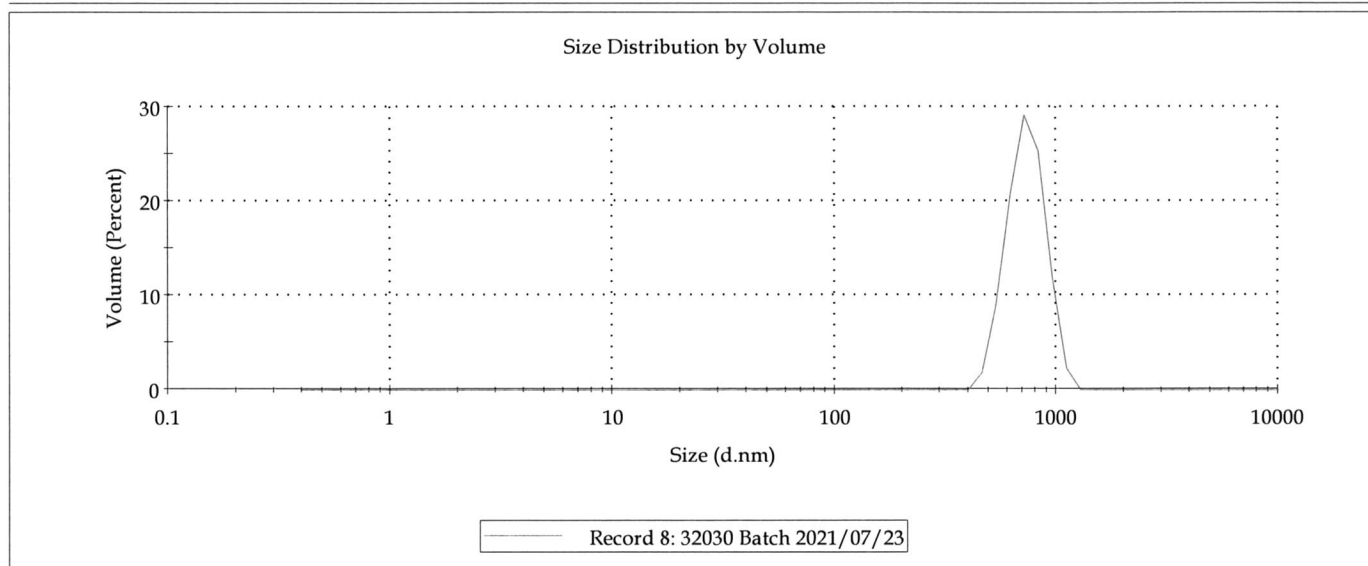
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32030 Batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 11:21:35
 Userid: brj

D10%(V): 552 nm	D50%(V): 730 nm	D90%(V): 944 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 738.4	100.0	138.8
Peak 2: 0.000	0.0	0.000
Peak 3: 0.000	0.0	0.000
Z-Average (d.nm): 684.9		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.102		
Count Rate (kcps): 275.1		



General Notes: Average result created from record number(s): 4 5 6

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	8
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 [Signature]

Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

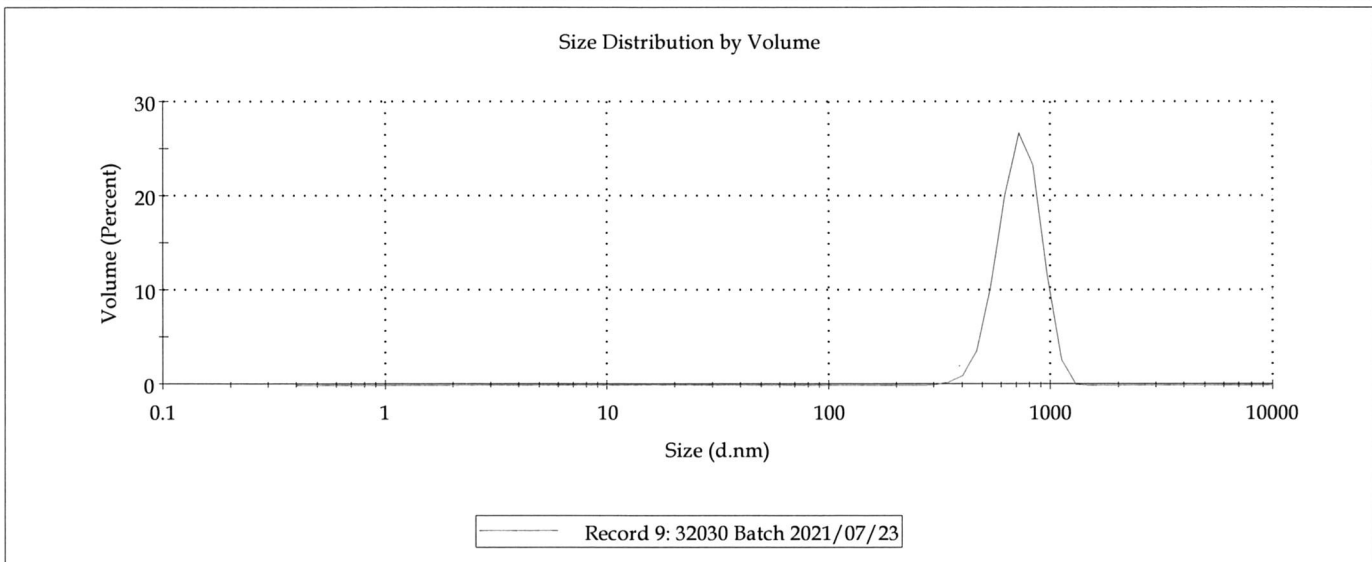
Sample Name: 32030 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:21:47

Userid: brj

D10%(V): 529 nm	D50%(V): 718 nm	D90%(V): 946 nm	
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm): 653.4
Peak 1: 726.3	100.0	153.6	<i>Note: Z-average and Pdl are based on the intensity distribution</i>
Peak 2: 0.000	0.0	0.000	PdI: 0.086
Peak 3: 0.000	0.0	0.000	Count Rate (kcps): 290.7



General Notes: Average result created from record number(s): 1 2 3 4 5 6

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	8
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	13

Operator: 27 JULI 2021 BRJ

Zetasizer Ver. 7.13
Serial Number : MAL500686

Approved: 28 JULI 2021 *[Signature]*
File name: 32030
Record Number: 5
27 jul 2021 14:12



CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 1100nm
Batch: 2021/07/23
Internal number: 32031

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	D _{10%} (nm)**		D _{50%} (nm)**		D _{90%} (nm)**		Z-average*		PDI*	
Run 1	527		873		1250		789.6		0.147	
Run 2	736		953		1230		873.5		0.04	
Average	620		922		1240		831.5		0.093	
Specification	-	-	-	-	-	-	-	-	-	-
Evaluation	-		-		-		-		-	

*The parameter is based on the intensity size distribution

**The parameter is based on the volume size distribution

Written by: *Robert Dumpe*

Date: 28 JULI 2021

Reviewed by: *Wenbo Wang*

Date: 28 JULI 2021

Approved by: *Wenbo Wang*
QC

Date: 28 JULI 2021

*The validity of the method is the responsibility of the sponsor
 Quality agreement not in place*

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32031 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:32:43

Userid: brj

D10%(V): 849 nm D50%(V): 1100 nm D90%(V): 1420 nm

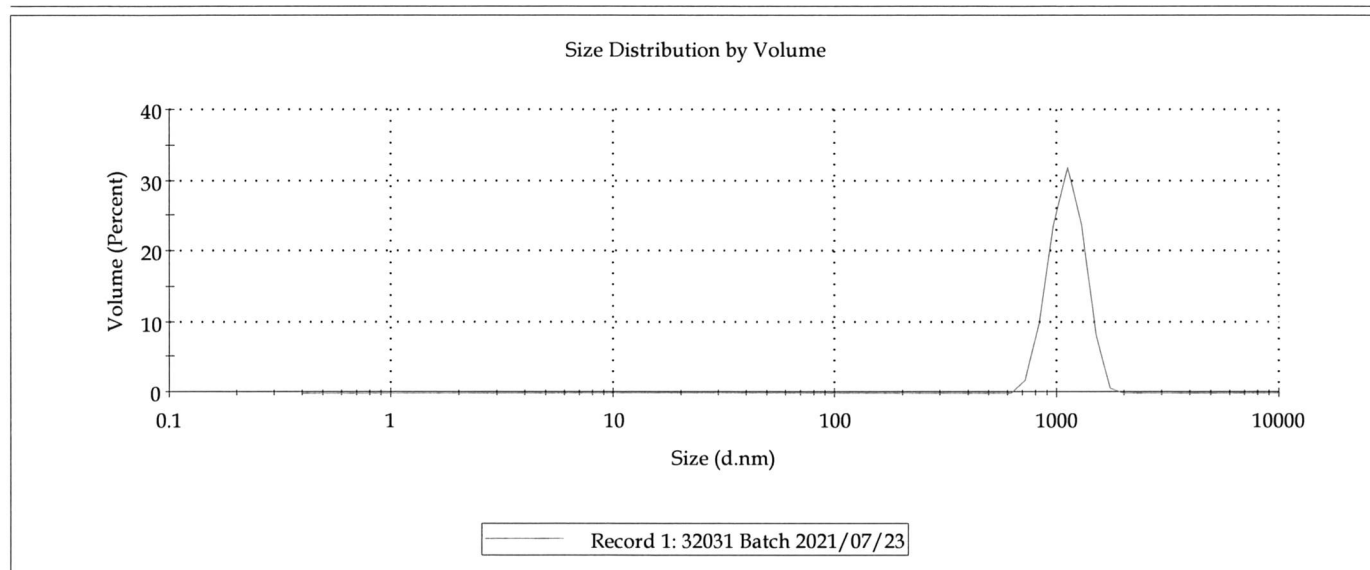
	Diam. (nm)	% Volume	Width (nm)
Peak 1:	1112	100.0	194.5
Peak 2:	0.000	0.0	0.000
Peak 3:	0.000	0.0	0.000

Z-Average (d.nm): 975.6

Pdl: 0.106

Note: Z-average and Pdl are based on the intensity distribution

Count Rate (kcps): 272.1



General Notes: 32031 Run 1

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 9

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: 27 JULI 2021 BRJ

Approved:

28 JULI 2021

Size Distribution Report by Volume


PARTICLE
ANALYTICAL
 EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32031 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:34:57

Userid: brj

D10%(V): 430 nm D50%(V): 609 nm D90%(V): 841 nm

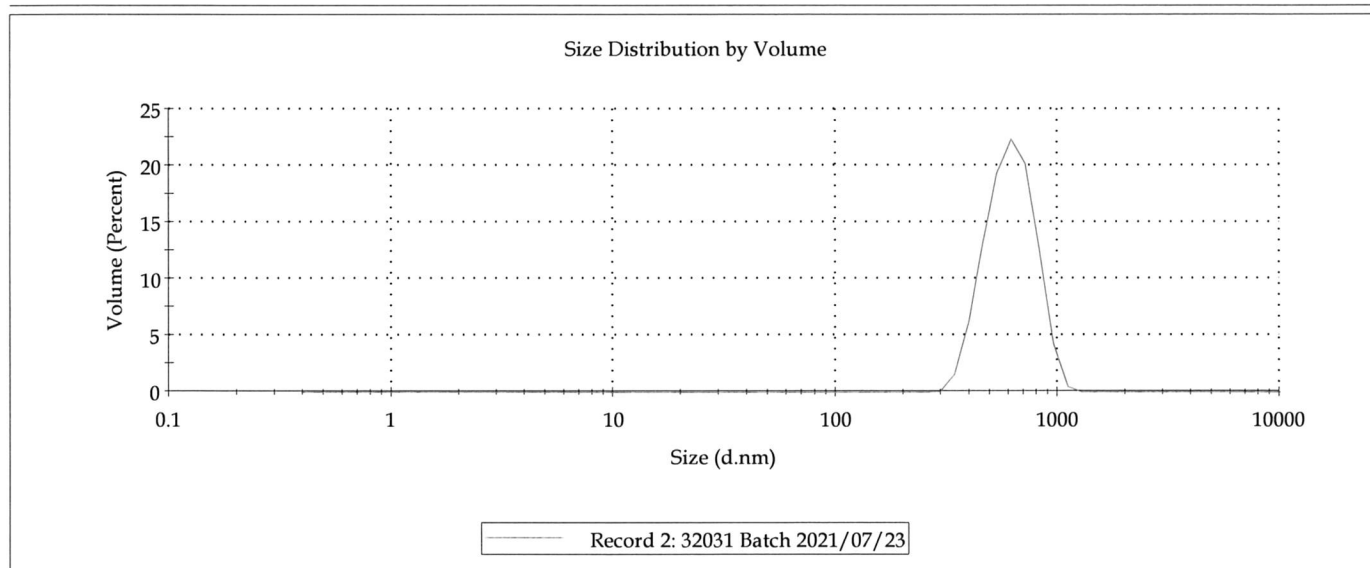
	Diam. (nm)	% Volume	Width (nm)
Peak 1:	623.1	100.0	149.4
Peak 2:	0.000	0.0	0.000
Peak 3:	0.000	0.0	0.000

Z-Average (d.nm): 592.9

PDI: 0.264

Note: Z-average and PDI are based on the intensity distribution

Count Rate (kcps): 269.5



General Notes: 32031 Run 1

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 9

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

28 JULI 2021

Operator:

27 JULI 2021 BRJ

Approved:

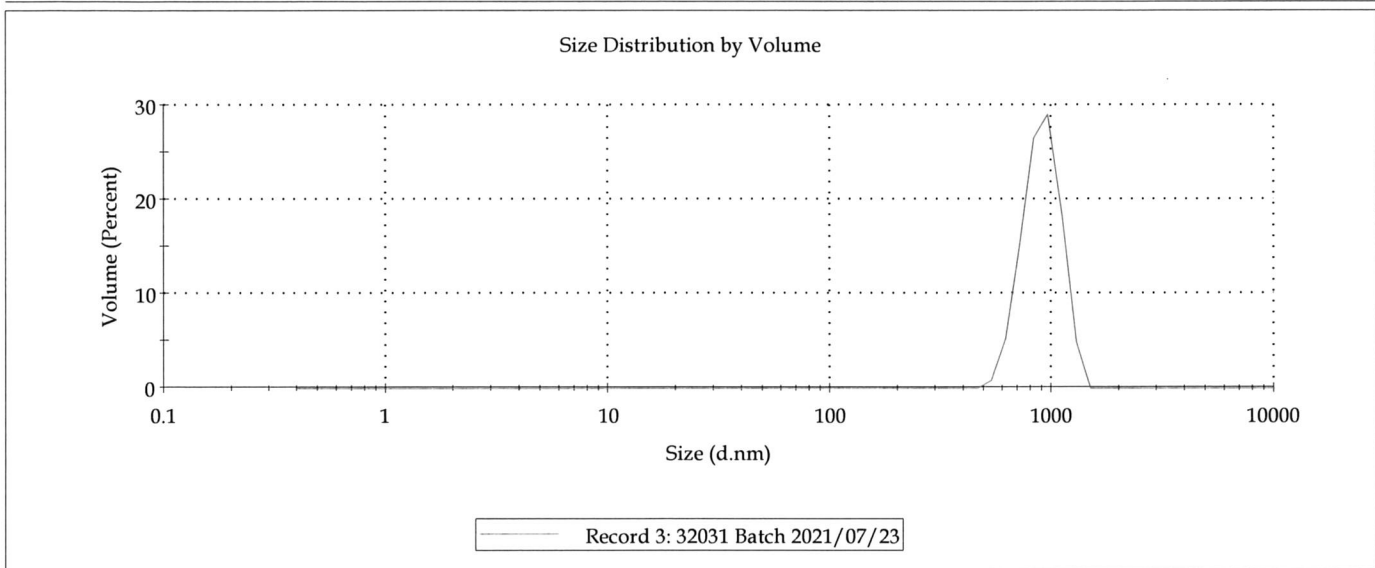
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32031 Batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 11:37:10
 Userid: brj

D10%(V): 677 nm	D50%(V): 897 nm	D90%(V): 1170 nm	
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm): 800.2
Peak 1: 905.8	100.0	167.7	<i>Note: Z-average and Pdl are based on the intensity distribution</i>
Peak 2: 0.000	0.0	0.000	
Peak 3: 0.000	0.0	0.000	PdI: 0.071
			Count Rate (kcps): 271.1



General Notes: 32031 Run 1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	9
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 [Signature]
 Zetasizer Ver. 7.13
 Serial Number : MAL500686
 File name: 32031
 Record Number: 1
 27 jul 2021 14:12

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

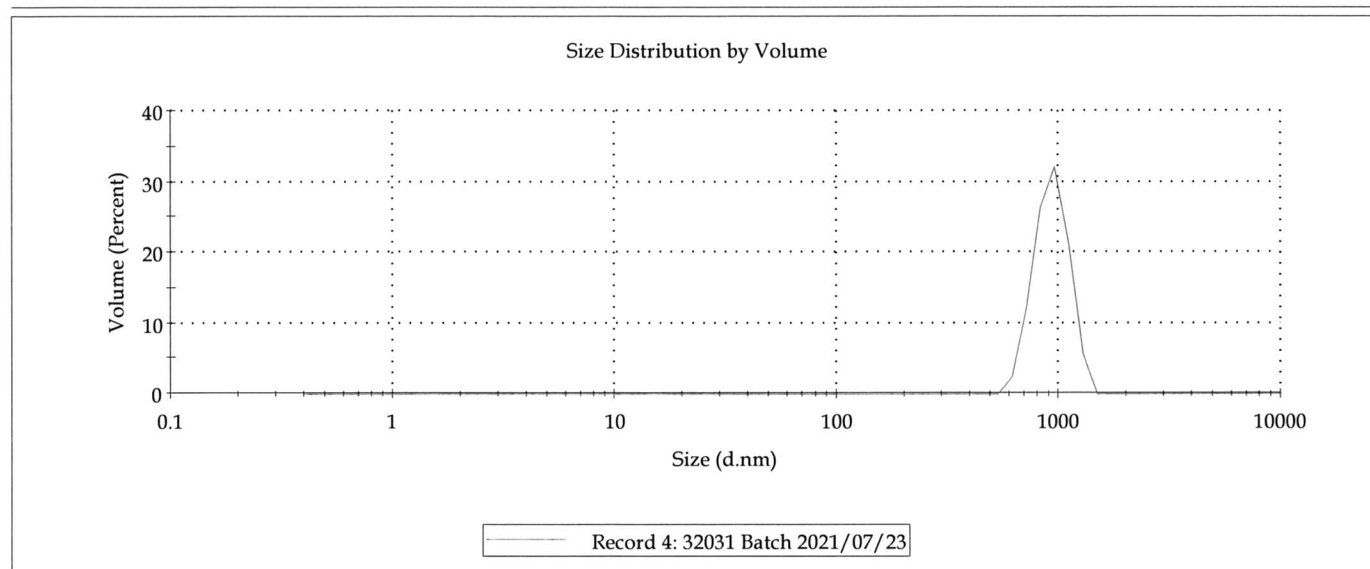
Sample Name: 32031 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:43:54

Userid: brj

D10%(V): 721 nm	D50%(V): 924 nm	D90%(V): 1190 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	859.6
Peak 1: 933.9	100.0	158.5	PdI: 0.088	Note: Z-average and PdI are based on the intensity distribution
Peak 2: 0.000	0.0	0.000		
Peak 3: 0.000	0.0	0.000	Count Rate (kcps):	263.8



General Notes: 32031 Run 2

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 9

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: 27 JULI 2021 BRJApproved: 28 JULI 2021 wj

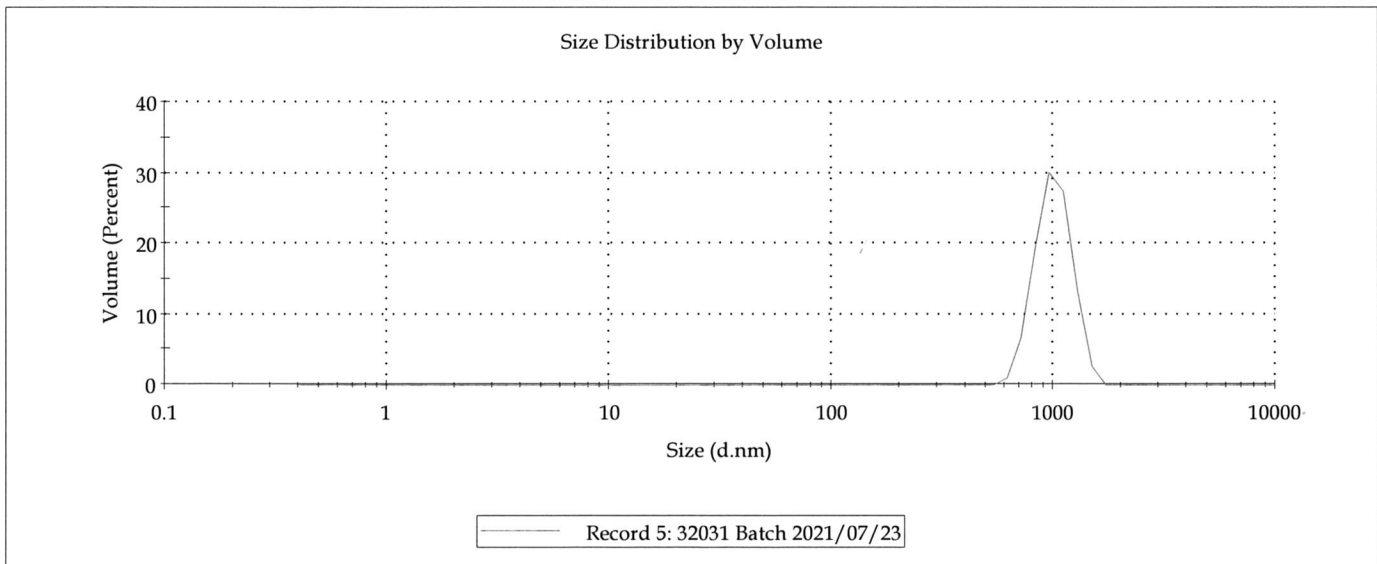
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32031 Batch 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 11:46:07
 Userid: brj

D10%(V): 762 nm	D50%(V): 999 nm	D90%(V): 1280 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 1010	100.0	182.1
Peak 2: 0.000	0.0	0.000
Peak 3: 0.000	0.0	0.000
Z-Average (d.nm): 904.9		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.012		
Count Rate (kcps): 265.3		



General Notes: 32031 Run 2

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	9
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021 *WJD*

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32031 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:48:20

Userid: brj

D10%(V): 732 nm D50%(V): 944 nm D90%(V): 1210 nm

Diam. (nm) % Volume Width (nm)

Peak 1: 954.1 100.0 162.4

Peak 2: 0.000 0.0 0.000

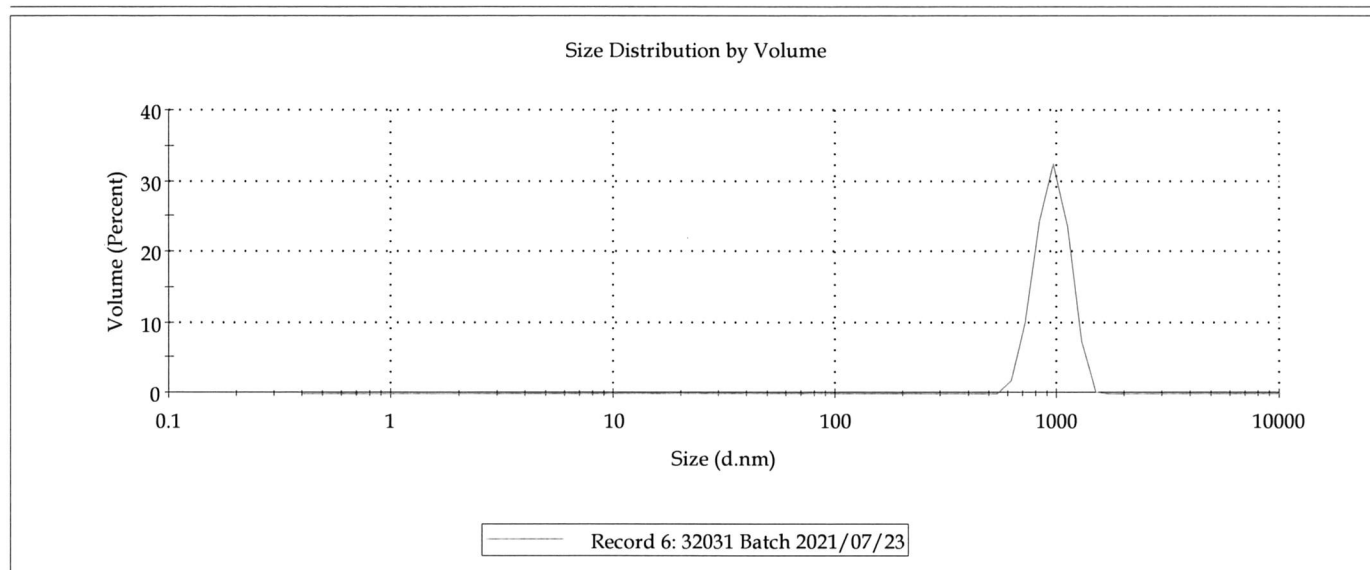
Peak 3: 0.000 0.0 0.000

Z-Average (d.nm): 856.0

Pdl: 0.019

Note: Z-average and Pdl are based on the intensity distribution

Count Rate (kcps): 264.1



General Notes: 32031 Run 2

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Dispersant Name: Water

Material Absorbtion: 0.010

Dispersant RI: 1.330

Analysis Model: General Purpose

Viscosity (cP): 0.8872

Lower Size Threshold: 0.050

Temperature (°C): 25.0

Upper Size Threshold: 0.010

Equilibration Time Set (min): 180

Size range: 0.6000 to 6000 nm

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Measurement Position (mm): 4.65

Auto Attenuate Enabled: True

Attenuator: 9

Auto Size Measurement Time: True

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021



Size Distribution Report by Volume

Sample Name: 32031 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

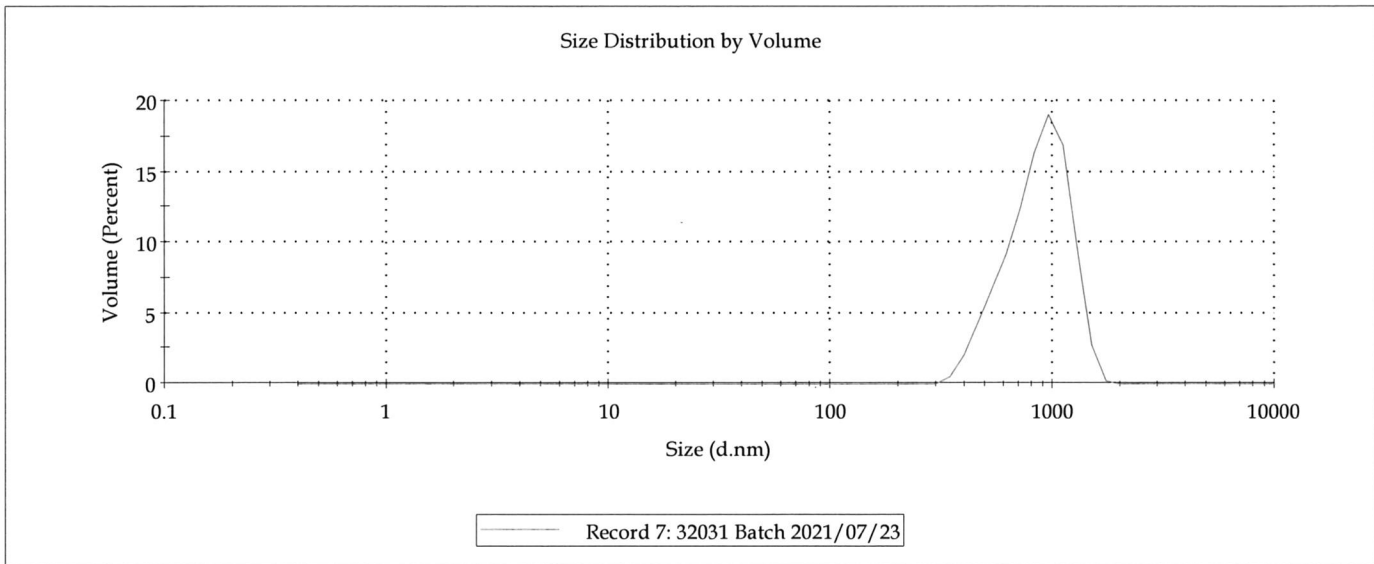
Measurement Date and Time: 27. juli 2021 11:48:41

Userid: brj

D10%(V): 527 nm D50%(V): 873 nm D90%(V): 1250 nm

Peak	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	PdI:	Note: Z-average and PdI are based on the intensity distribution
Peak 1:	880.3	100.0	263.8	789.6	0.147	
Peak 2:	0.000	0.0	0.000			
Peak 3:	0.000	0.0	0.000			

Count Rate (kcps): 272.1



General Notes: Average result created from record number(s): 1 2 3

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Dispersant Name: Water

Material Absorbtion: 0.010

Dispersant RI: 1.330

Analysis Model: General Purpose

Viscosity (cP): 0.8872

Lower Size Threshold: 0.050

Temperature (°C): 25.0

Upper Size Threshold: 0.010

Equilibration Time Set (min): 180

Size range: 0.6000 to 6000 nm

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Measurement Position (mm): 4.65

Auto Attenuate Enabled: True

Attenuator: 9

Auto Size Measurement Time: True

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

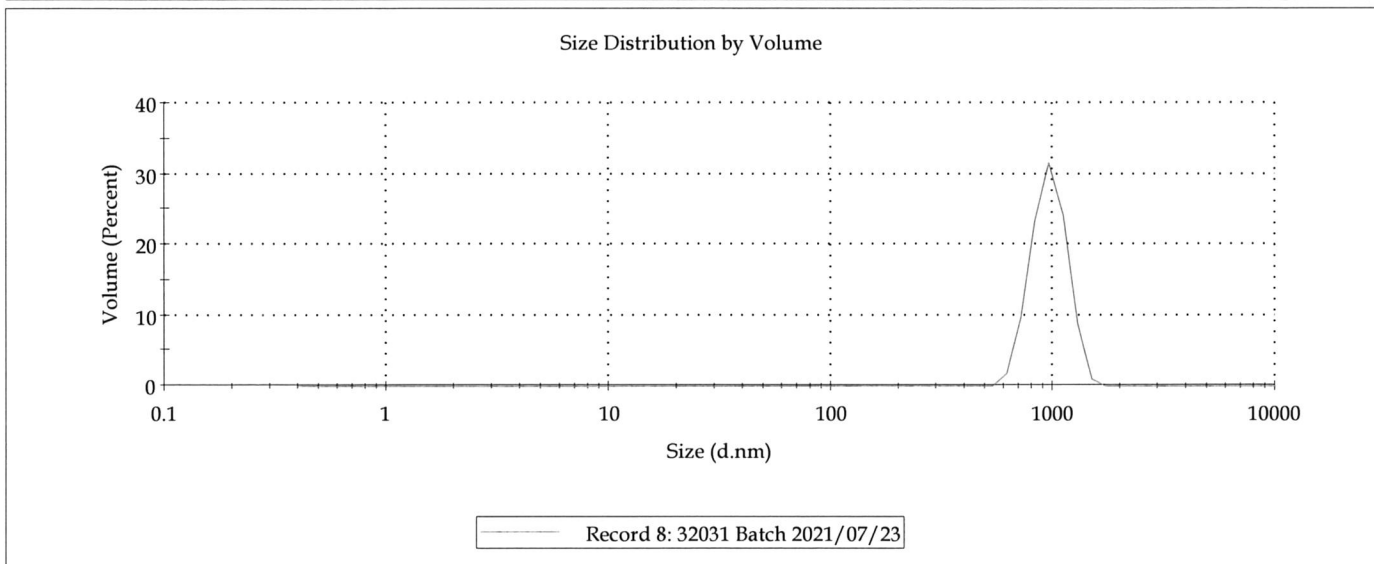
Sample Name: 32031 Batch 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:48:50

Userid: brj

D10%(V): 736 nm		D50%(V): 953 nm		D90%(V): 1230 nm	
Peak 1:	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	Note: Z-average and Pdl are based on the intensity distribution
Peak 2:	965.9	100.0	171.0	PdI: 0.040	
Peak 3:	0.000	0.0	0.000	Count Rate (kcps):	263.8



General Notes: Average result created from record number(s): 4 5 6

Cell Description:	Disposable sizing cuvette				
Material RI:	1.59	Dispersant Name:	Water		
Material Absorbtion:	0.010	Dispersant RI:	1.330		
Analysis Model:	General Purpose	Viscosity (cP):	0.8872		
Lower Size Threshold:	0.050	Temperature (°C):	25.0		
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180		
Size range:	0.6000 to 6000 nm	Number of measurements:	3		
		Size Measure Delay (s):	0		
Auto Position Enabled:	False	Measurement Position (mm):	4.65		
Auto Attenuate Enabled:	True	Attenuator:	9		
Auto Size Measurement Time:	True	Duration (s):	10	Extend duration for large particles:	False
		Size Runs:	13		

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Zetasizer Ver. 7.13
Serial Number : MAL500686

File name: 32031
Record Number: 1
27 jul 2021 14:12

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32031 Batch 2021/07/23

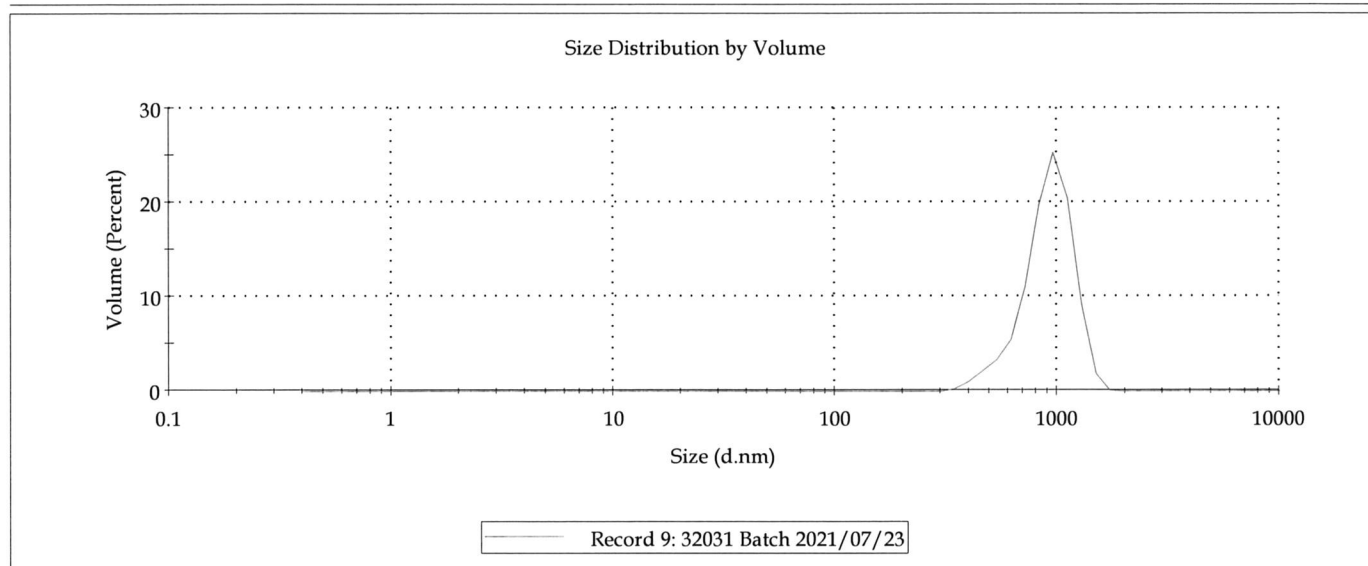
SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 11:49:02

Userid: brj

D10%(V): 620 nm	D50%(V): 922 nm	D90%(V): 1240 nm		
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	831.5
Peak 1: 923.1	100.0	226.4	PdI:	0.093
Peak 2: 0.000	0.0	0.000		
Peak 3: 0.000	0.0	0.000	Count Rate (kcps):	272.1

Note: Z-average and PdI are based on the intensity distribution



General Notes: Average result created from record number(s): 1 2 3 4 5 6

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Dispersant Name: Water

Material Absorbtion: 0.010

Dispersant RI: 1.330

Analysis Model: General Purpose

Viscosity (cP): 0.8872

Lower Size Threshold: 0.050

Temperature (°C): 25.0

Upper Size Threshold: 0.010

Equilibration Time Set (min): 180

Size range: 0.6000 to 6000 nm

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Measurement Position (mm): 4.65

Auto Attenuate Enabled: True

Attenuator: 9

Auto Size Measurement Time: True

Duration (s): 10 Extend duration for large particles: False

Size Runs: 13

Operator:

27 JULI 2021 BRJ

Approved:

28 JULI 2021



CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 3000nm
Batch: 2021/07/23
Internal number: 32032

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	D _{10%} (nm)**		D _{50%} (nm)**		D _{90%} (nm)**		Z-average*		PDI*	
Run 1	1040		1690		4030		2698		0.365	
Run 2	1150		1480		2290		2756		0.334	
Average	1110		1550		3570		2727		0.349	
Specification	-	-	-	-	-	-	-	-	-	-
Evaluation	-		-		-		-		-	

*The parameter is based on the intensity size distribution

**The parameter is based on the volume size distribution

Written by: *Britt Kluge*

Date: 28 JULI 2021

Reviewed by: *Wenbo Wang*

Date: 28 JULI 2021

Approved by: *Wenbo Wang*
QC

Date: 28 JULI 2021

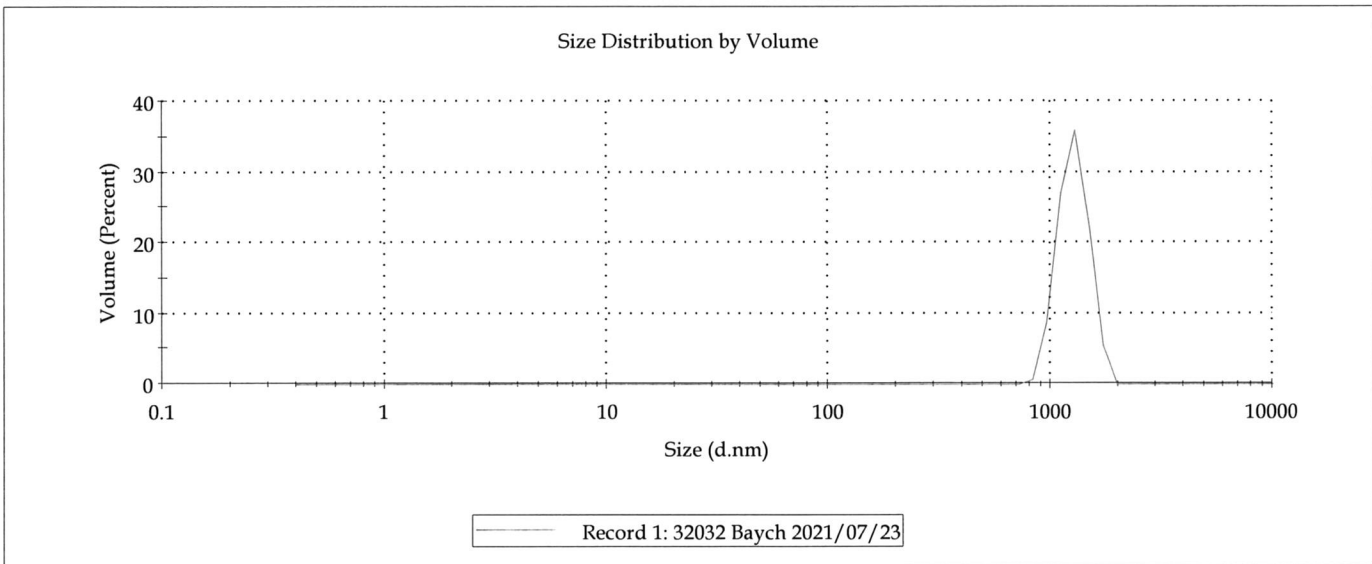
*The validity of the method is the responsibility of the sponsor
Quality agreement not in place*



Size Distribution Report by Volume

Sample Name: 32032 Baych 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 12:47:28
 Userid: brj

D10%(V): 997	nm	D50%(V): 1260	nm	D90%(V): 1600	nm
Peak 1:	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	2751
Peak 2:	1272	100.0	196.0	PdI:	0.649
Peak 3:	0.000	0.0	0.000	<i>Note: Z-average and PdI are based on the intensity distribution</i>	
	0.000	0.0	0.000	Count Rate (kcps):	220.2



General Notes: 32032 Run 1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	14

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

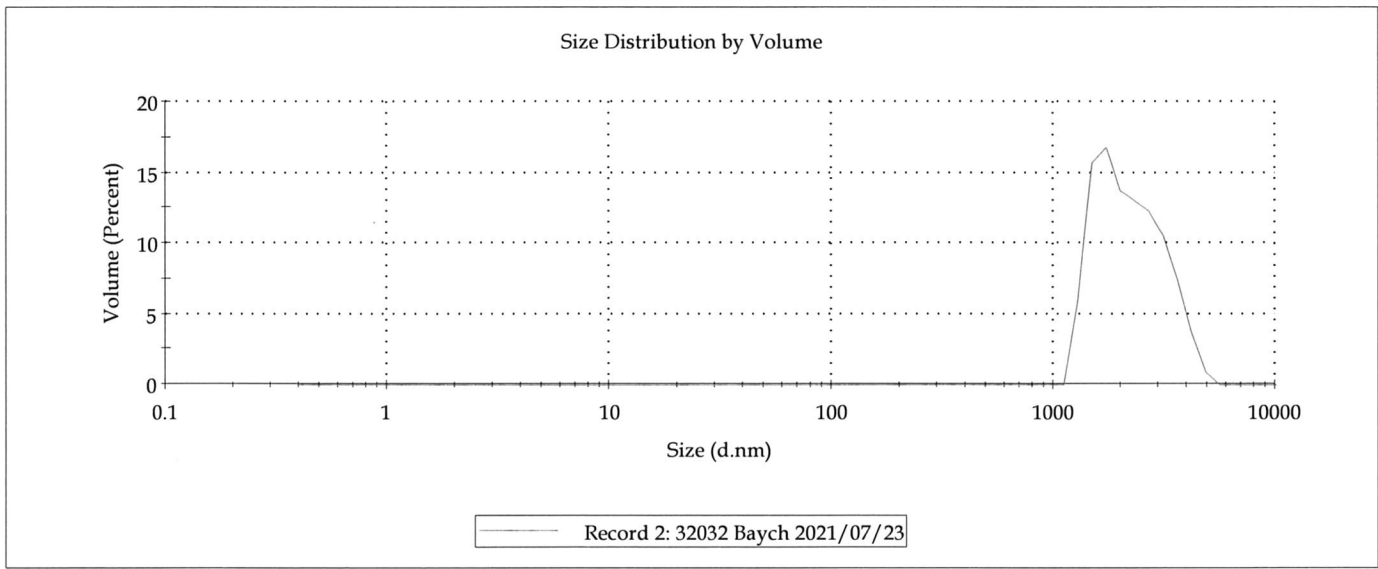
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32032 Baych 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 12:49:52
 Userid: brj

D10%(V): 1410 nm		D50%(V): 2100 nm		D90%(V): 3490 nm	
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	2779	
Peak 1:	2289	100.0	792.3	PdI:	0.208
Peak 2:	0.000	0.0	0.000	Note: Z-average and PdI are based on the intensity distribution	
Peak 3:	0.000	0.0	0.000	Count Rate (kcps):	211.2



General Notes: 32032 Run 1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	14

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

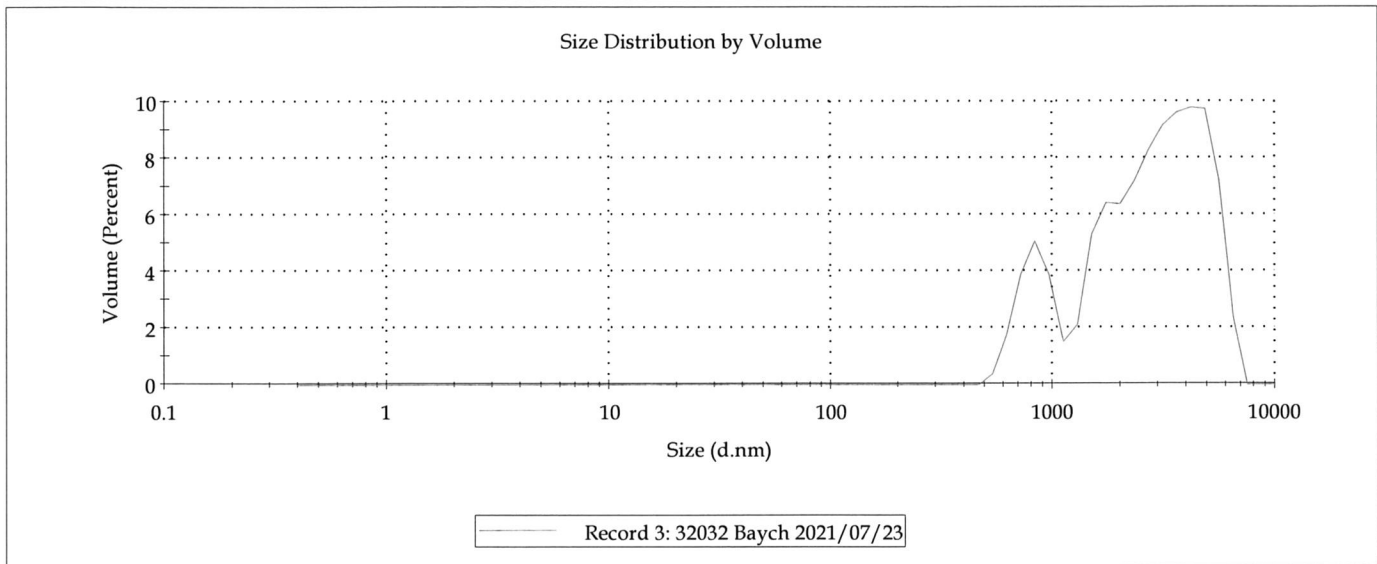
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32032 Baych 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 12:52:15
 Userid: brj

D10%(V): 866 nm	D50%(V): 2760 nm	D90%(V): 5200 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 825.6	15.3	145.0
Peak 2: 1655	20.2	275.6
Peak 3: 3683	64.5	1207
Z-Average (d.nm): 2563		<i>Note: Z-average and Pdl are based on the intensity distribution</i>
PdI: 0.238		
Count Rate (kcps): 191.0		



General Notes: 32032 Run 1

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	14

Operator: 27 JULI 2021 *BRJ*

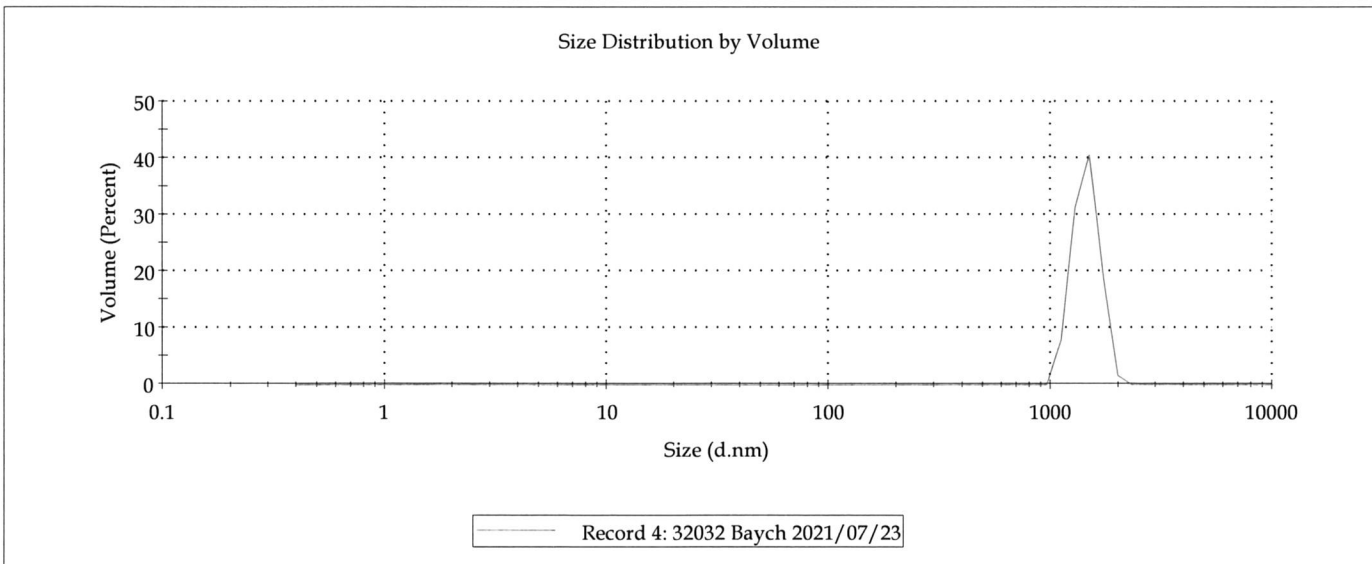
Approved: 28 JULI 2021 *WMP*



Size Distribution Report by Volume

Sample Name: 32032 Baych 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 12:59:22
 Userid: brj

D10%(V): 1160 nm	D50%(V): 1430 nm	D90%(V): 1750 nm	
Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm): 3136
Peak 1: 1443	100.0	192.2	<i>Note: Z-average and Pdl are based on the intensity distribution</i>
Peak 2: 0.000	0.0	0.000	PdI: 0.444
Peak 3: 0.000	0.0	0.000	Count Rate (kcps): 217.0



General Notes: 32032 Run 2

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	15

Operator: 27 JULI 2021 brj

Approved: 28 JULI 2021 [Signature]

File name: 32032
 Record Number: 4
 27 jul 2021 14:13:

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32032 Baych 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 13:01:56

Userid: brj

D10%(V): 1230 nm

D50%(V): 1570 nm

D90%(V): 2270 nm

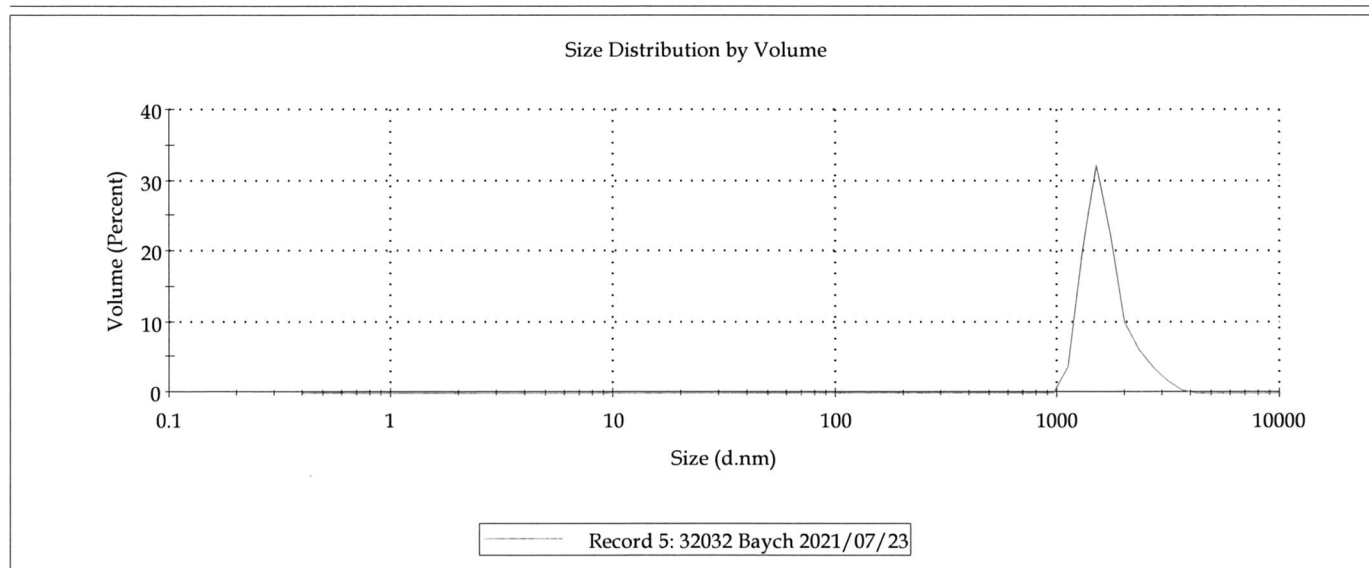
	Diam. (nm)	% Volume	Width (nm)
Peak 1:	1668	100.0	427.5
Peak 2:	0.000	0.0	0.000
Peak 3:	0.000	0.0	0.000

Z-Average (d.nm): 2690

Note: Z-average and Pdl are based on the intensity distribution

PdI: 0.265

Count Rate (kcps): 191.6



General Notes: 32032 Run 2

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Dispersant Name: Water

Material Absorbtion: 0.010

Dispersant RI: 1.330

Analysis Model: General Purpose

Viscosity (cP): 0.8872

Lower Size Threshold: 0.050

Temperature (°C): 25.0

Upper Size Threshold: 0.010

Equilibration Time Set (min): 180

Size range: 0.6000 to 6000 nm

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Measurement Position (mm): 4.65

Auto Attenuate Enabled: True

Attenuator: 6

Auto Size Measurement Time: True

Duration (s): 10 Extend duration for large particles: False

Size Runs: 15

Operator: 27 JULI 2021 BRJ

Approved: 28 JULI 2021

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

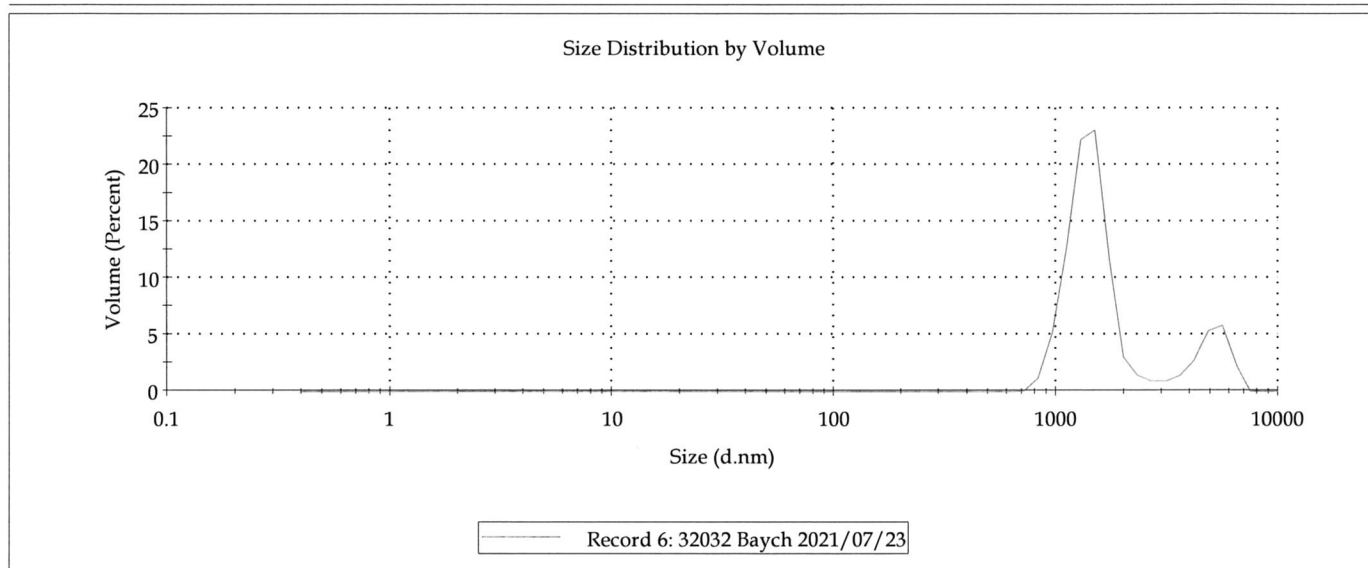
Sample Name: 32032 Baych 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 13:04:29

Userid: brj

D10%(V): 1060 nm		D50%(V): 1460 nm		D90%(V): 4910 nm	
	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	2442
Peak 1:	1425	81.6	357.4	PdI:	0.293
Peak 2:	4966	18.4	899.5	Note: Z-average and PdI are based on the intensity distribution	
Peak 3:	0.000	0.0	0.000	Count Rate (kcps):	173.8



General Notes: 32032 Run 2

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Material Absorbtion: 0.010

Analysis Model: General Purpose

Lower Size Threshold: 0.050

Upper Size Threshold: 0.010

Size range: 0.6000 to 6000 nm

Dispersant Name: Water

Dispersant RI: 1.330

Viscosity (cP): 0.8872

Temperature (°C): 25.0

Equilibration Time Set (min): 180

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Auto Attenuate Enabled: True

Auto Size Measurement Time: True

Measurement Position (mm): 4.65

Attenuator: 6

Duration (s): 10 Extend duration for large particles: False

Size Runs: 15

Operator: 27 JULI 2021 BRJApproved: 28 JULI 2021

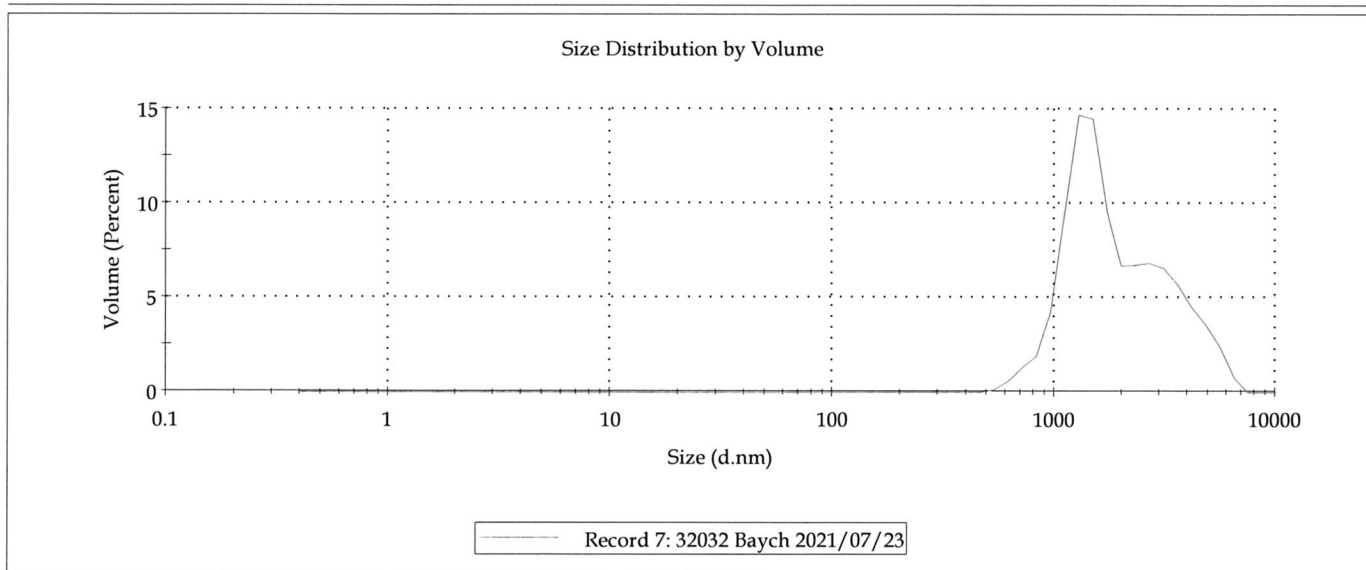
Size Distribution Report by Volume



PARTICLE ANALYTICAL
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32032 Baych 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 13:06:01
 Userid: brj

D10%(V): 1040 nm		D50%(V): 1690 nm		D90%(V): 4030 nm	
	Diam. (nm)	% Volume	Width (nm)	Z-Average (d.nm):	2698
Peak 1:	1388	59.0	332.3	PdI:	0.365
Peak 2:	3243	41.0	1098	Note: Z-average and PdI are based on the intensity distribution	
Peak 3:	0.000	0.0	0.000	Count Rate (kcps):	220.2



General Notes: Average result created from record number(s): 1 2 3

Cell Description:	Disposable sizing cuvette		
Material RI:	1.59	Dispersant Name:	Water
Material Absorbtion:	0.010	Dispersant RI:	1.330
Analysis Model:	General Purpose	Viscosity (cP):	0.8872
Lower Size Threshold:	0.050	Temperature (°C):	25.0
Upper Size Threshold:	0.010	Equilibration Time Set (min):	180
Size range:	0.6000 to 6000 nm	Number of measurements:	3
		Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	14

Operator: 27 JULI 2021 BRJ

28 JULI 2021
Approved: [Signature]

Size Distribution Report by Volume


**PARTICLE
ANALYTICAL**
EXPERTS IN SIZE AND CRYSTALS

Sample Name: 32032 Baych 2021/07/23

SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop

Measurement Date and Time: 27. juli 2021 13:06:11

Userid: brj

D10%(V): 1150 nm

D50%(V): 1480 nm

D90%(V): 2290 nm

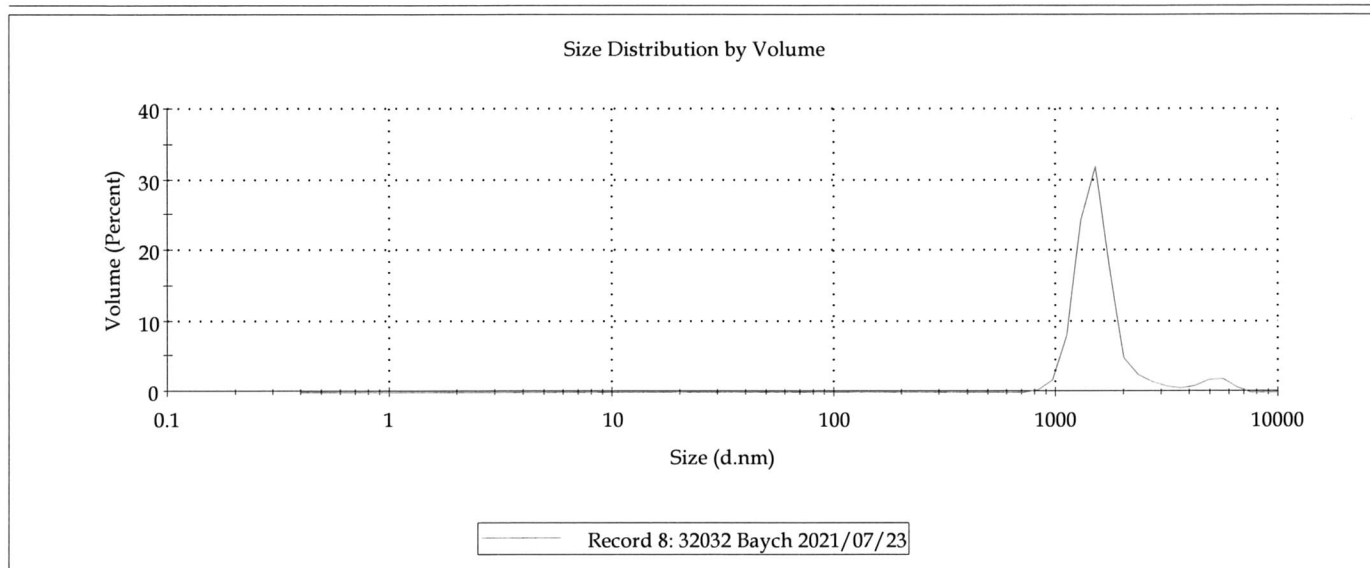
	Diam. (nm)	% Volume	Width (nm)
Peak 1:	1527	94.0	383.5
Peak 2:	5020	6.0	836.9
Peak 3:	0.000	0.0	0.000

Z-Average (d.nm): 2756

Note: Z-average and Pdl are based on the intensity distribution

Pdl: 0.334

Count Rate (kcps): 217.0



General Notes: Average result created from record number(s): 4 5 6

Cell Description: Disposable sizing cuvette

Material RI: 1.59

Dispersant Name: Water

Material Absorbtion: 0.010

Dispersant RI: 1.330

Analysis Model: General Purpose

Viscosity (cP): 0.8872

Lower Size Threshold: 0.050

Temperature (°C): 25.0

Upper Size Threshold: 0.010

Equilibration Time Set (min): 180

Size range: 0.6000 to 6000 nm

Number of measurements: 3

Size Measure Delay (s): 0

Auto Position Enabled: False

Measurement Position (mm): 4.65

Auto Attenuate Enabled: True

Attenuator: 6

Auto Size Measurement Time: True

Duration (s): 10 Extend duration for large particles: False

Size Runs: 15

Operator:

27 JULI 2021 BRJ

Approved:

28 JULI 2021



Size Distribution Report by Volume

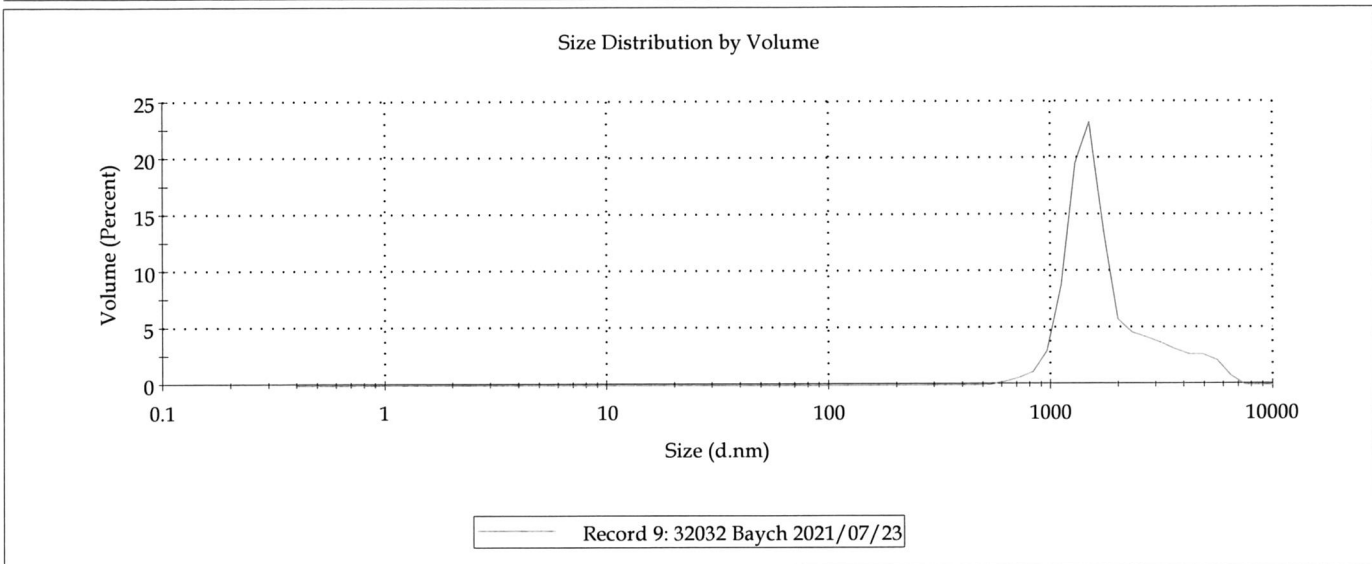
Sample Name: 32032 Baych 2021/07/23
 SOP Name: OQ - 173 degree, 633nm laser, 60 nm dilute latex.sop
 Measurement Date and Time: 27. juli 2021 13:06:47
 Userid: brj

D10%(V): 1110 nm	D50%(V): 1550 nm	D90%(V): 3570 nm
Diam. (nm)	% Volume	Width (nm)
Peak 1: 1943	100.0	1103
Peak 2: 0.000	0.0	0.000
Peak 3: 0.000	0.0	0.000

Z-Average (d.nm): 2727
PdI: 0.349

Count Rate (kcps): 220.2

Note: Z-average and PdI are based on the intensity distribution



General Notes: Average result created from record number(s): 1 2 3 4 5 6

Cell Description:	Disposable sizing cuvette	Dispersant Name:	Water
Material RI:	1.59	Dispersant RI:	1.330
Material Absorbtion:	0.010	Viscosity (cP):	0.8872
Analysis Model:	General Purpose	Temperature (°C):	25.0
Lower Size Threshold:	0.050	Equilibration Time Set (min):	180
Upper Size Threshold:	0.010	Number of measurements:	3
Size range:	0.6000 to 6000 nm	Size Measure Delay (s):	0
Auto Position Enabled:	False	Measurement Position (mm):	4.65
Auto Attenuate Enabled:	True	Attenuator:	6
Auto Size Measurement Time:	True	Duration (s):	10
		Extend duration for large particles:	False
		Size Runs:	14

Operator: 27 JULI 2021 BRJ

Approved: _____

28 JULI 2021