Real time in line size monitoring with the commercially available DLS system: Accuracy and Repeatability assessment

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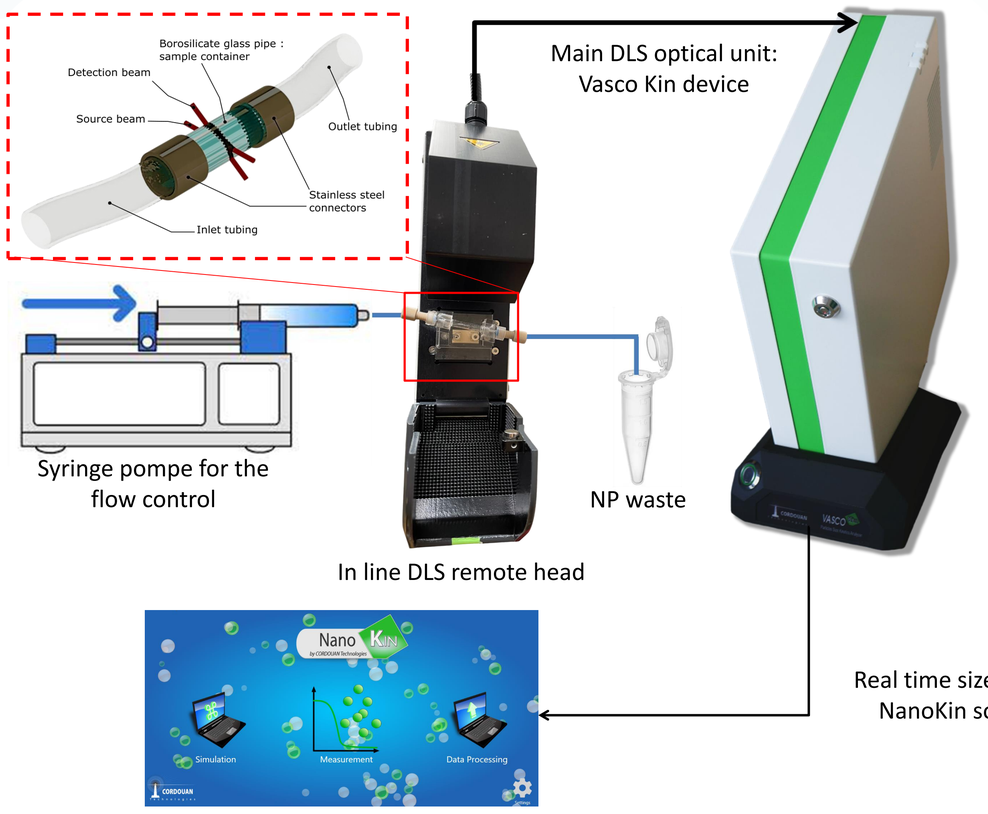
BACKGROUND & OBJECTIVE

In the field of precision measurement and quality control, advancements in technology have paved the way for innovative solutions to address the challenges of characterizing particle sizes in various materials. One such breakthrough lies in the realm of ***Dynamic Light Scattering*** (DLS), a powerful technique employed for sizing particles in the nanometer to submicron range. The need for accurate and efficient ***in line size measurement*** has become increasingly crucial across industries such as pharmaceuticals, biotechnology, chemicals, and materials science.

In this work we show experimental results of size determinations for three polystyrene latex standards under continuous flow as well as at stop flow using the ***Vasco Kin***[1] instrument with its Milli-fluidic optical head for the in line particle size monitoring. The effect of the flow on the particle size as well as repeatability of in line measurements will be presented.

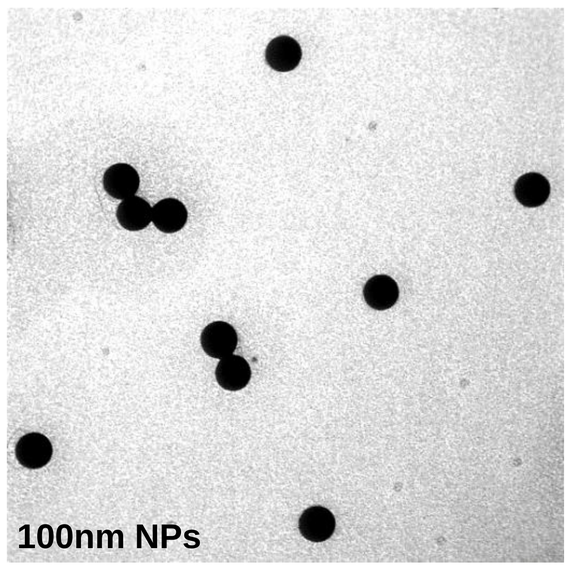
1 FLUIDIC SETUP WITH IN LINE DLS SIZE MONITORING



2 SYSTEM OF STANDARD NANOSPHERES

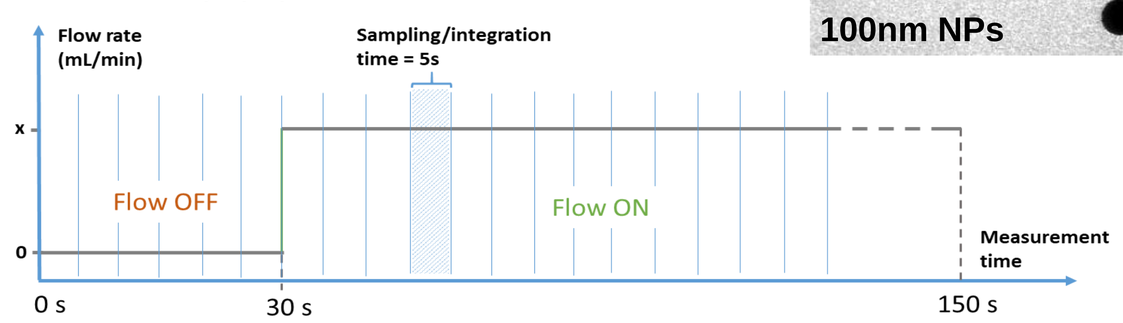
For the purpose of this study, we have selected three polystyrene latex standards manufactured by “Polysciences Europe GmbH”:

40 nm, 0.1% wt. in ultrapure water
100 nm, 0,01% wt. in ultrapure water
200 nm, 0,01% wt. in ultrapure water



3 MEASUREMENTS CONDITIONS

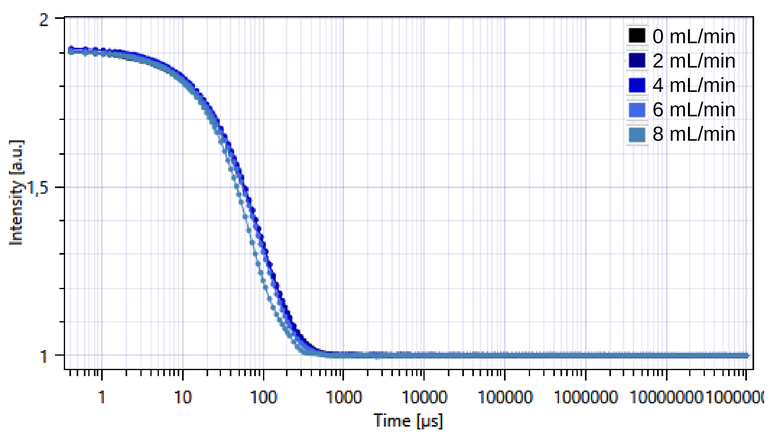
In line head capilary: **4 mm inner diameter**
Flow rates**: 0, 2, 4, 6 or 8 mL/min**

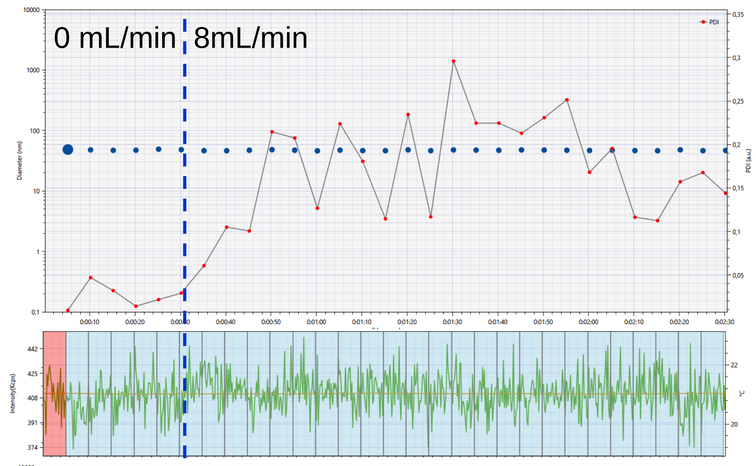


RESULTS

Nominal Diameter 40 nm

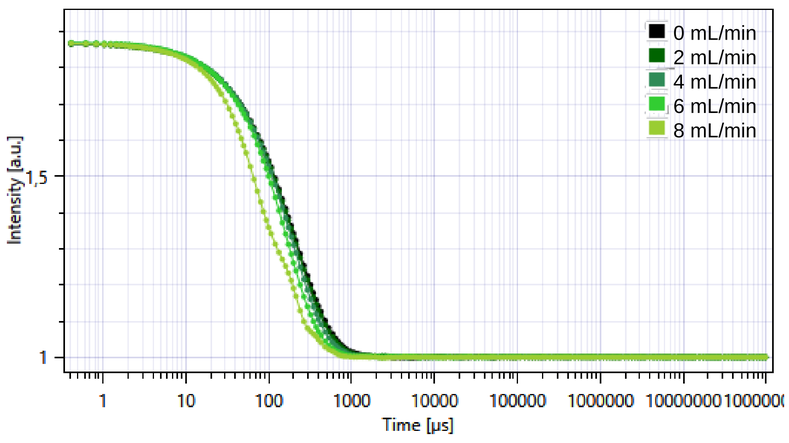
Flow rate (mL/min)	0	2	4	6	8
Mean Z_{av} (nm)	47.0	47.8	47.8	47.0	43.6
Std Dev (nm)	0.46	0.46	0.53	0.37	1.7
Mean PDI	0.08	0.06	0.10	0.08	0.15





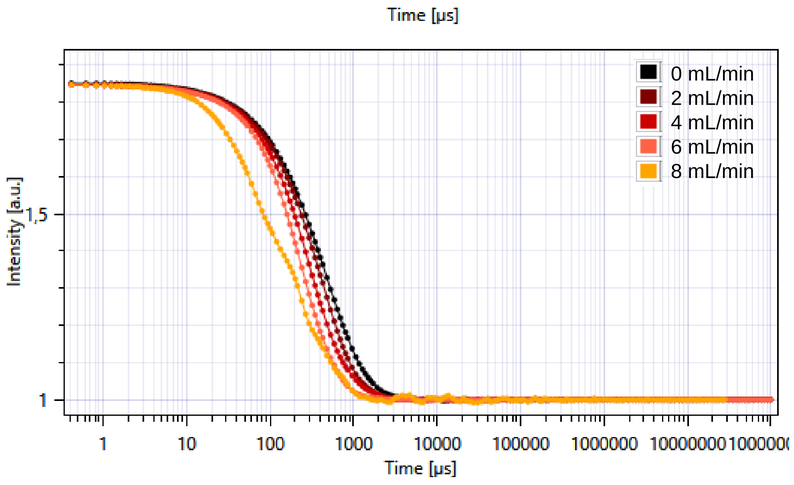
Nominal Diameter 100 nm

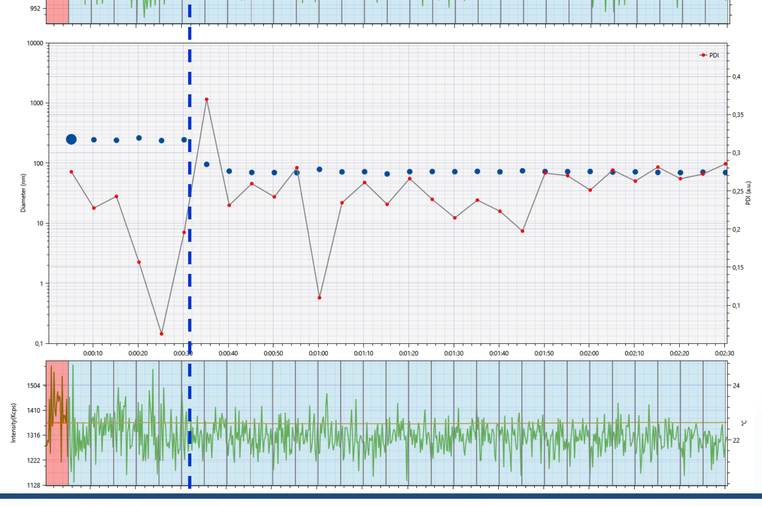
Flow rate (mL/min)	0	2	4	6	8
Mean Z_{av} (nm)	109.3	110	106.3	99.7	62.7
Std Dev (nm)	2	1.2	2.8	1.3	1.7
Mean PDI	0.05	0.07	0.22	0.27	0.11



Nominal Diameter 200 nm

Flow rate (mL/min)	0	2	4	6	8
Mean Z_{av} (nm)	245	232	189	166	72
Std Dev (nm)	3.8	3.9	2.6	3	2.9
Mean PDI	0.04	0.18	0.14	0.25	0.25





CONCLUSIONS

This study utilizing in line DLS measurements of polystyrene latex standards reveals significant insights. The impact of flow rates on particle sizes is evident and, as was shown earlier, the smaller particles exhibiting greater resilience to flow-induced changes[2]. Thus, in case of 40 nm NPs, no matter the flow rate is in the 4 mm tube, the deviation of the Z_{av} remains below 10%. In contrast, for larger NPs, this effect is more pronounced. Consequently, at a flow rate of 8 mL/min, achieving precise size determination for NPs larger than 40 nm necessitates adjustments to the experimental setup. Despite the observable impact of flow on measured Z_{av}, the standard deviations of the results remain within 5%, underscoring the robustness of this measurement methodology for continuous monitoring of processes and NP size variations under constant flow conditions.

[1] www.cordouan-tech.com/products/vasco-kin/
[2] Luis M. G. Torquato et al, Lab Chip, 2023,23, 2540-2552