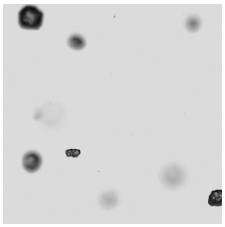
HORIBA Scientific

20 YEARS 1819-2019 HORIBA JOBIN YVON

PCA

Comparison of results between laser diffraction and image analysis



Application Note

PCA12

Nicolas BUTON, Fanny ROUSSEL, Geoffrey LAINÉ

HORIBA FRANCE SAS, Palaiseau, France

Abstract: There are multiple analytical techniques for particle characterization. Laser diffraction is a popular method due to its ease of use, wide dynamic range and fast measurement time. We have coupled this technique with an image analysis unit (LY-9610) where we can compare in real time the classical values of D10, 50, 90 and also get information about the shape or dispersion state of our particles. We prove the usefulness of the image analysis unit as a complementary analysis to laser diffraction through alumina measurements.

Keywords: Laser diffraction, image unit, LA-960 Serie, LY-9610, Correlation.

Introduction

LY-9610 imaging unit is designed for systems from LA series. It is suitable for the latest generation systems and also for LA-950V2*, LA-960.

It is designed for use with the standard flow cell; compatibility with organic solvents is dependent on the LA unit specifications. The image analysis unit provides fast optical imaging of the particles within the flow path.

This imaging unit is small and integrated inside the cell chamber without increasing instrument footprint. The measurable range for image analysis is 9-1000 µm

The imaging unit allows observation, particle image acquisition, and assessment of the particles in the wet circulation system. The dedicated software allows the particle state to be monitored in real time, as the sample and dispersion medium are circulated through the flow system.

The imaging unit contributes to a better understanding of the samples and the results obtained.

Visualization of the samples in real time allow many benefits, such as:

- Identification of trace amounts of large particle contaminants or aggregates
- Improvement of analysis methods by developing an intuitive understanding of the effect of stirring, sonication, surfactant addition, etc
- Understanding particle shape parameters, including aspect ratio, circularity, length, width, $X_{Fe\ max}$, $X_{c\ min}$.
- Following the development of D10, 50, 90 with time
- Detection of bubbles within the wet circulation system.

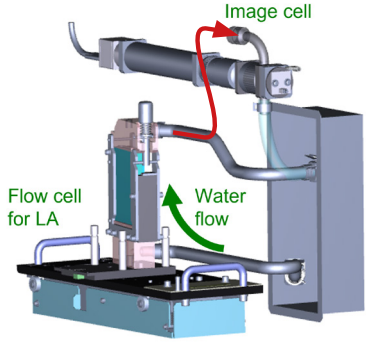


Figure 1: Integration of imaging unit inside the LA-960V2

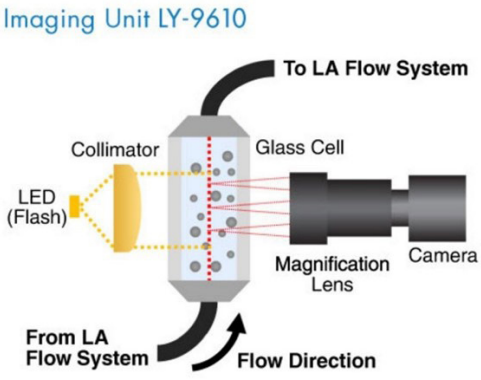


Figure 2: Description of the imaging unit

* Only for Europe, Middle-East, Africa

Aim of experiment

Here the purpose of the experiment is to compare the D10/ D50/D90 and the mean obtained by the imaging unit and by the LA-960V2 in wet and dry mode on alumina powder.

Alumina is used primarily as a source of aluminum, with the remainder used in applications that take advantage of its chemical, thermal and electrical resistance. For example, it is used as a refractory material due to its high melting point, as a ceramic, as an abrasive due to its hardness or in polishing applications.

Depending on the Particle Size Distribution (PSD), the physico-chemical properties are completely different (e.g. variation of the calcination time).

Imaging unit	
Total particles	22268
Number of bins	200
Minimum number of pixels for particles identification	10
Distribution base	Volume

Laser diffraction	Wet mode	Dry mode
Sample data acquisition times (R)	15000	15000
Refractive index (R)	1.7-0.1i	1.7-0.1i
Distribution base	Volume	Volume
Transmittance (R)	88.1%	93.8%
Transmittance (B)	92.0%	N/A
Refractive index (dispersion media)	1.333 (water)	N/A
Air	N/A	0.20MPa
Circulation speed	7	N/A
Agitation speed	7	N/A

Measurement results:

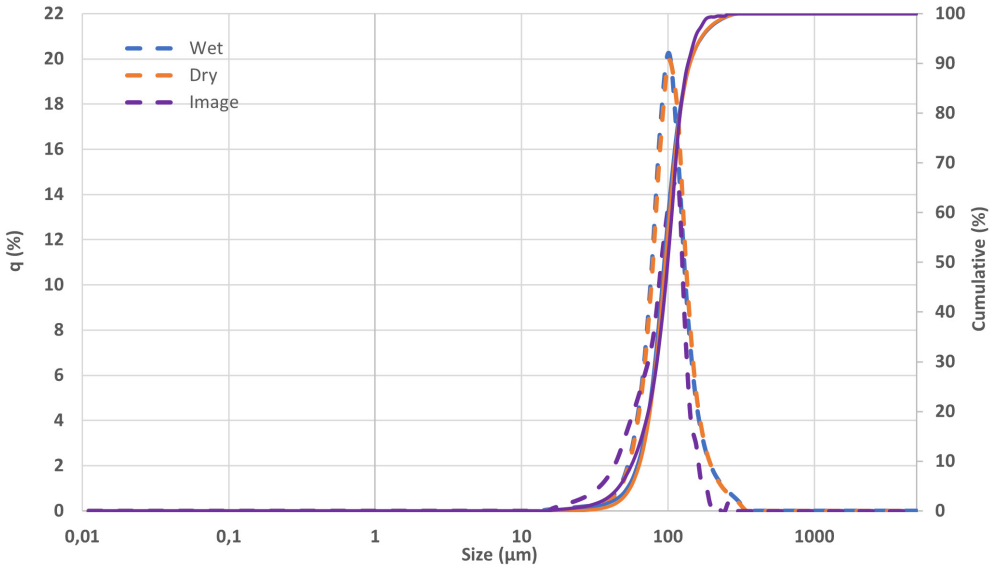


Figure 3: Comparison of PSD and the cumulative curves for the three methods

	D(v,0.1)	D(v,0.5)	D(v,0.9)	Mean Size
Average dry result	64,18 µm	95,78 µm	143,2 µm	101,3 µm
Average wet result	62,29 µm	93,84 µm	142,6 µm	99,62 µm
LY-9610 result	58.62 µm	99.16 µm	137,2 µm	99,13 µm
Average	61.70 µm	96.26 µm	141,0 µm	100,0 µm
Std. Dev.	2.308 µm	2.198 µm	2.712 µm	0,936 µm
CV (%)	3.741	2.284	1,924	0,936

Experimental conditions

In addition, the camera allowed optimization of particle dispersion within the suspension, as shown in the image.

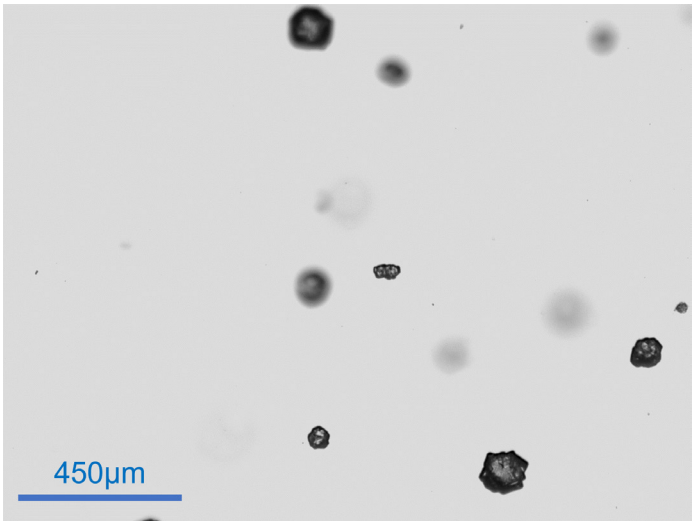


Figure 4: Image obtained with the LY-9610 on the state of dispersion of the particles

Conclusion

These experiments performed in parallel on the LA-960V2 by laser diffraction and by the LY-9610 imaging unit proved that three measurement modes are able to characterize the particle size distribution with high accuracy regardless of the type of measurement used.

We have also shown with this example that the LY-9610 imaging unit over a short period of time is able to obtain the classical values like D10/D50/D90 and the mean with close correlation to the laser diffraction results. According to the ISO norm 13320, the Coefficient Variation (CV) is less than 5% in D(v,0.1) and D(v,0.9), and is less than 3% for D(v,0.5) (See the Table above). Whilst also allowing optimization of sample dispersion and confirming the absence of bubbles.

info.sci@horiba.com

www.horiba.com/scientific

USA: +1 732 494 8660
UK: +44 (0)1604 542 500
China: +86 (0)21 6289 6060
Taiwan: +886 3 5600606
France: +33 (0)1 69 74 72 00
Italy: +39 06 51 59 22 1
India: +91 (80) 4127 3637
Brazil: +55 (0)11 2923 5400
Germany: +49 (0) 6251 8475 0
Japan: +81(75)313-8121
Singapore: +65 (6) 745-8300
Other: +33 (0)1 69 74 72 00