:: FlowCam®

APPLICATION NOTE

Printer Toner Quality Assurance With the FlowCam® Particle Analyzer

The shape and size of printer toner particles affect image resolution and printer efficiency. The uniformity of a printer toner particle affects the distribution of charge the particle holds and as a result can affect image quality.

Image characterization can be used to determine shape, size, circularity and material uniformity of printer toner particles during and after production **(Fig. 1)**.

In this application note, we demonstrate that the FlowCam®, a flow imaging microscope, and paired image analysis software VisualSpreadsheet® can be used for rapid quality control characterization of printer toner.
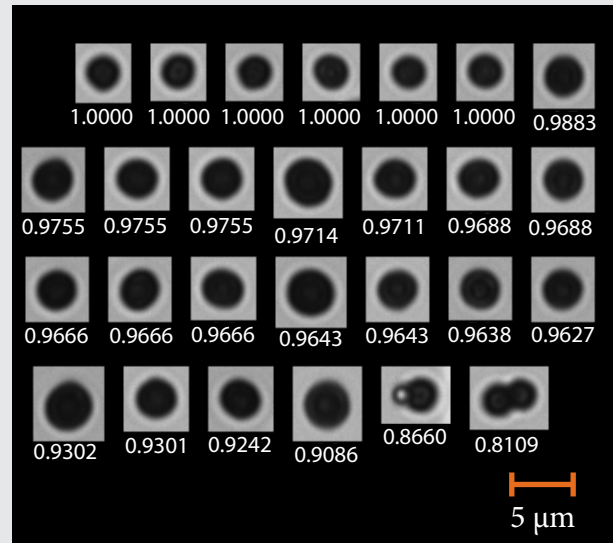

Figure 1. Black printer toner particles imaged by the FlowCam. Circularity value is shown beneath each image. Particles are shown in order of decreasing circularity, where 1 is a perfect circle.

SAMPLE PREPARTION

Toner was added to deionized water to form an aqueous slurry. The slurry was analyzed on the FlowCam and images of each toner particle were captured by VisualSpreadsheet, the FlowCam's imaging analysis software. Of the 40+ physical particle properties measured by VisualSpreadsheet for each particle, Circularity and Equivalent Spherical Diameter (ESD) were used to evaluate the uniformity and quality of the toner particles.

THE ANALYSIS

The slurry was introduced into the FlowCam, where it was pulled down through the flow cell and every individual printer toner particle was imaged. VisualSpreadsheet assembled a collage file of all particle images from the sample run and measured all particle properties from these images (Fig. 1).

THE ANALYSIS Continued

Each particle image is associated with an ID number and correlated particle property values. Every particle property is measured to 4 decimal places, and all property values 40+ measured particle property values can be exported from VisualSpreadsheet into CSV format for additional data manipulation and study (Fig. 2 & Table 1).

A software filter was built in VisualSpreadsheet to differentiate printer toner images that met the specified quality parameters from those that did not. This filter was built with an allowed ESD of 4 µm to 8 µm, and an allowed circularity of 0.8000 to 1.0000, where 1.0000 is a perfect circle/sphere. VisualSpreadsheet calculates the percentage of images that meet the specified parameters.

VisualSpreadsheet produces a Summary Statistics table that displays selected particle property statistics in real-time to reflect the analysis. This enables quick evaluation of particle property statistics for each analysis (Table 2).

Particle ID	Diameter ESD (µm)	Circularity
1	6.2522	1.0000
2	6.6205	0.8860
3	6.6205	0.9627
4	6.6205	0.9405
5	7.9145	0.9714
6	5.1755	1.0000

Summary Stats	Mean	Minimum	Maximum	Std. Dev.	% CV
Circularity	0.9301	0.8000	1.0000	0.0408	4.1781
Diameter (ESD)	5.8562	4.0000	8.0000	0.9657	16.4021

Figure 2. (Left) Printer toner particles imaged by the FlowCam. Particle ID shown beneath each image correlates with data in Table 1.

Table 1. (Left) Exported diameter and circularity data for particles in Figure 2. Each particle property is recorded to 4 decimal places, and any or all particle properties can be selected for export to a CSV file format from VisualSpreadsheet.

Table 2. (Above) Summary Statistics calculated by VisualSpreadsheet from a single run of printer toner. A software filter was applied to this run to include particles with Circularity values between 0.8000 and 1.0000, and Diameter (ESD) ranging from 4.0000 µm to 8.0000 µm. Summary statistics are calculated in real-time to reflect the analysis.

SUMMARY

Image characterization is essential to determine measures of circularity (uniformity), the primary property for quality control analysis in printer toner manufacturing. Diagnostic assessment of size classes and extraction of conformational images allows the end user to rapidly identify outliers in the sample during and after the manufacturing process. The combination of particle size and shape monitoring provided by the FlowCam improves the process of quality control required among printer toner manufacturers.

In this study, we demonstrate that the FlowCam particle analyzer coupled with VisualSpreadsheet software allows the user to analyze printer toner particle quality using image characterization and measured particle properties. A QA/QC filter can be implemented to assess the overall quality of each sample analyzed.

The FlowCam is well suited for a wide variety of applications which require rapid, quantitative results. The intuitive design of this instrument allows an operator to carry out on-site testing of a product with conformational data, reporting and statistics. The FlowCam particle analyzer offers a rapid method of sample preparation coupled with image recognition capabilities of VisualSpreadsheet software.

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