FlowCam®

Printer Toner Quality Assurance with FlowCam

OVERVIEW

The size and shape of printer toner particles can considerably impact the image resolution and efficiency of a printer. The consistency of these particles also influences the distribution of charge the particles hold and, as a consequence, can affect overall image quality.

Image characterization can help to determine the size, shape, circularity and material uniformity of printer toner particles during and after production (Figure 1).

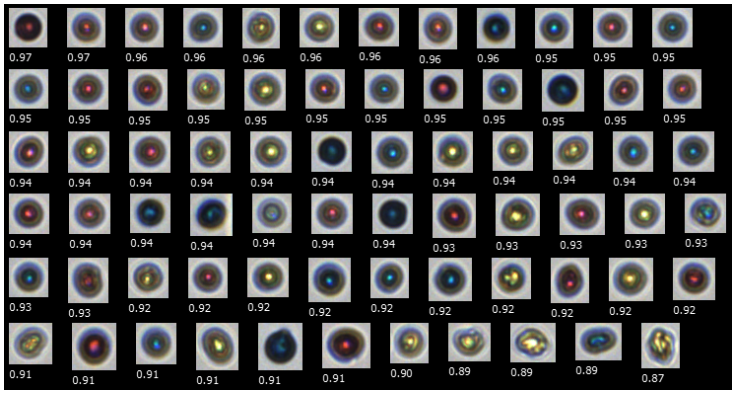

Figure 1. Color printer toner particles imaged by FlowCam. Circularity value is shown beneath each image. Particles are shown in order of decreasing circularity, where 1.00 is a perfect circle.

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

FLOWCAM ANALYSIS

In order to analyze a sample of printer toner using FlowCam, the toner was mixed with deionized water to create an aqueous slurry. The slurry was then fed into the FlowCam's sample port, where it was drawn through the flow cell and an image of each singular printer toner particle was captured. VisualSpreadsheet software then compiled a collage of all of the individual particle images from the sample run and recorded more than 40 morphological properties of the particles from these images.

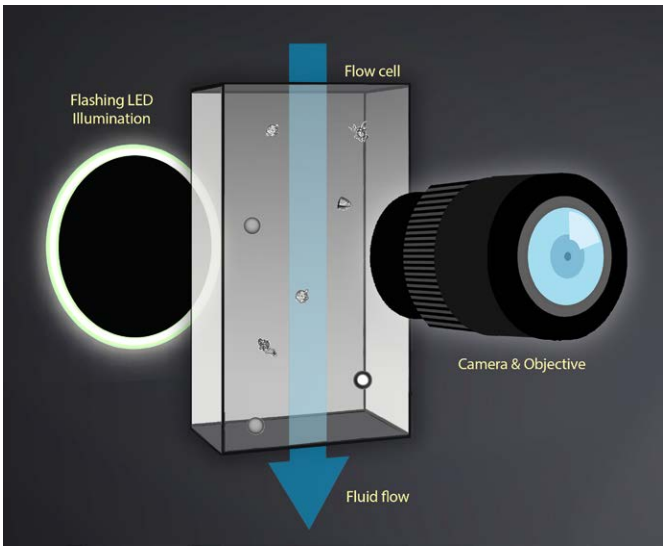

Figure 2. Flow path and optical components of the FlowCam system

Each particle image collected by VisualSpreadsheet is associated with an ID number and correlated particle property values that can be exported from VisualSpreadsheet into CSV format for further data manipulation and analysis (Figure 3 & Table 1).

For the purpose of this analysis, a software filter was created in VisualSpreadsheet to distinguish between printer toner images that met the given quality parameters from those that did not. This filter was created with an allowed Equavalent Spherical Diameter (ESD) of 4 µm to 8 µm, and an allowed Circularity of 0.80 to 1.00, where 1.00 is a perfect circle/sphere.

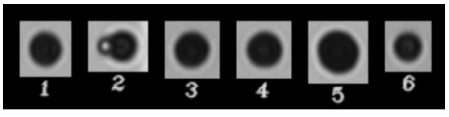

Figure 3. Black printer toner particles imaged by FlowCam. The particle ID number is shown beneath each image and correlates with the data in Table 1.

Particle ID	Diameter ESD (µm)	Circularity
1	6.25	1.00
2	6.62	0.89
3	6.62	0.96
4	6.62	0.94
5	7.91	0.97
6	5.18	1.00

Table 1. Exported diameter and circularity data for particles in Figure 3. Any and all particle properties can be selected for export to a CSV file format from VisualSpreadsheet.

The images and data were easily sorted to calculate the percentage of particles that met the specified parameters. A Summary Statistics table was created to show selected particle properties. The table automatically updated as the sample was run, allowing for rapid evaluation in real time. The final statistics from the run are shown in Table 2.

Summary Stats	Mean	Minimum	Maximum	Std. Dev.	% CV
Circularity	0.93	0.80	1.00	0.04	4.18
Diameter (ESD)	5.86	4.00	8.00	0.97	16.40

Table 2. 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 0.80 and 1.00, and Diameter (ESD) ranging from 4.00 µm to 8.00 µm. Summary statistics are calculated in real-time to reflect the analysis.

SUMMARY AND CONCLUSIONS

Image analysis enabled by flow imaging microscopy is crucial to the ability to measure particle circularity, one of the principal properties relevant to quality control analysis in the manufacturing of printer toner. Other high-volume particle analysis techniques are able to determine particle size, but since they assume that all particles are spheres, they do not allow for particle shape analysis. The combination of particle size and shape monitoring, as made possible with FlowCam, enhances the quality control process essential to printer toner manufacturers.

Implementing a QA/QC filter can help assess the general quality of each analyzed sample. FlowCam is well adapted for a broad range of applications that necessitate rapid, quantitative results. The instrument has an intuitive design that enables an operator to conduct on-site testing of a product with conformational data, statistics and reporting.