

APPLICATION NOTE

Printer Toner Quality Assurance With the FlowCam[®] Particle Analyzer

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 (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.

The FlowCam is an ideal replacement to aging Sysmex FPIA-3000 systems that are no longer being supported by the manufacturer.

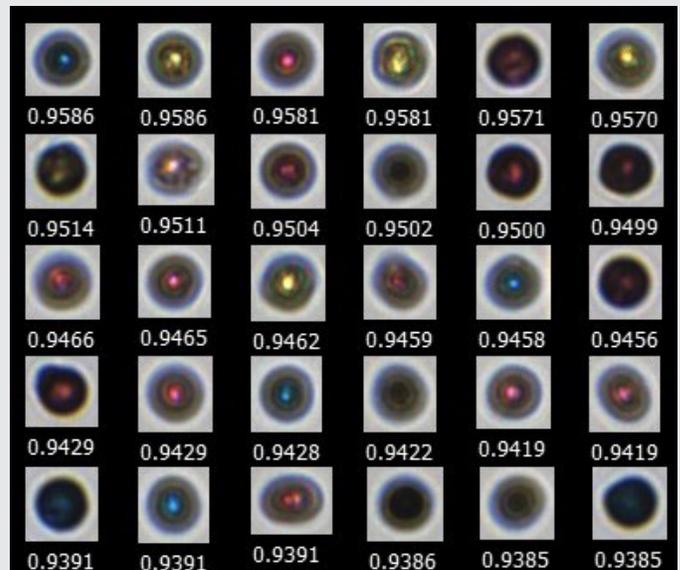
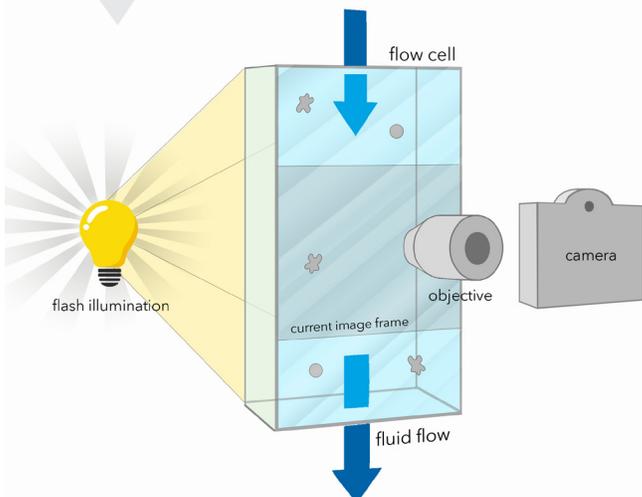


Figure 1. Color printer toner particles imaged by the FlowCam. Circularity value is shown beneath each image. Particles are shown in order of decreasing circularity, where 1 is a perfect circle.



FLOWCAM ANALYSIS

In order to analyze a sample of printer toner using the FlowCam, the toner is mixed with deionized water to create an aqueous slurry. The slurry is then fed into the FlowCam where it is drawn through the flow cell and an image of each singular printer toner particle is captured. VisualSpreadsheet software then compiles a collage of all of the individual particle images from the sample run and measures 40+ properties of the particles from these images.

Figure 2. (Left) A diagram of the flow cell

Printer Toner Quality Assurance with the FlowCam

FLOWCAM ANALYSIS Continued

Each particle image collected by VisualSpreadsheet is associated with an ID number and correlated particle property values. The software measures every particle to 4 decimal places for each property value, and these can be exported from VisualSpreadsheet into CSV format for further data manipulation and analysis (Fig. 3 & Table 1).

A software filter was created in VisualSpreadsheet for this analysis to distinguish between printer toner images that meet the given quality parameters from those that do not. This filter was created with an allowed Equivalent Spherical Diameter (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.

The images and data can be easily sorted to calculate the percentage of particles that meet the parameters specified. The user can also generate a Summary Statistics table that shows selected particle properties that update as the sample runs. This allows for rapid evaluation in real time (Table 2).

SUMMARY

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 using the FlowCam, enhances the quality control process essential to printer toner manufacturers.



Figure 3. (Left) Printer toner particles imaged by the FlowCam. Particle ID shown beneath each image correlates with data in Table 1.

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

Table 1. (Left) Exported diameter and circularity data for particles in Figure 3. 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.

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

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.

Implementing a QA/QC filter can help assess the general quality of each analyzed sample. The 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.