FlowCam®

# Flow Imaging Microscopy for Materials Characterization

## OVERVIEW

Flow Imaging Microscopy (FIM), also known as Dynamic Image Analysis (DIA), combines the benefits of traditional particle counters with high-resolution imaging to quickly and easily characterize the size, concentration, and shape of particles in a liquid sample.

FlowCam paired with VisualSpreadsheet® software provides more than 40 morphological parameters for every particle, enabling the identification of different particle types in a heterogeneous mixture.

FlowCam is a comprehensive particle analysis platform that provides an efficient way to obtain data or confirm data obtained from other particle analysis methods. Digital images allow the identification of particles and emulsions with ease.

## HOW FLOWCAM WORKS

The FlowCam imaging analysis system consists of a light microscopy apparatus with a sample flow cell placed in the optics path between the light source and the camera and objective. During analysis, a sample is introduced via a syringe pump, and images of particles that pass through the optics are automatically captured and recorded. The resulting microscopic images can then be analyzed to determine the sizes, concentration, morphology, and types of particles in the sample.

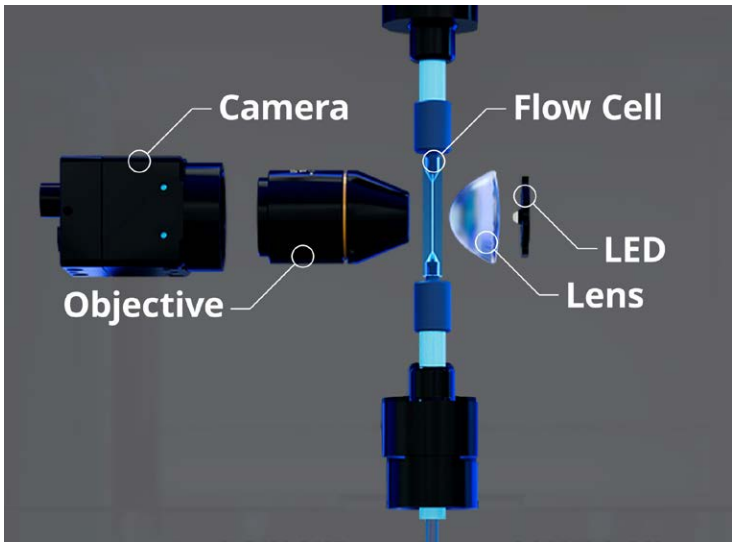


**Figure 1.** Schematic of the internal components of the FlowCam system

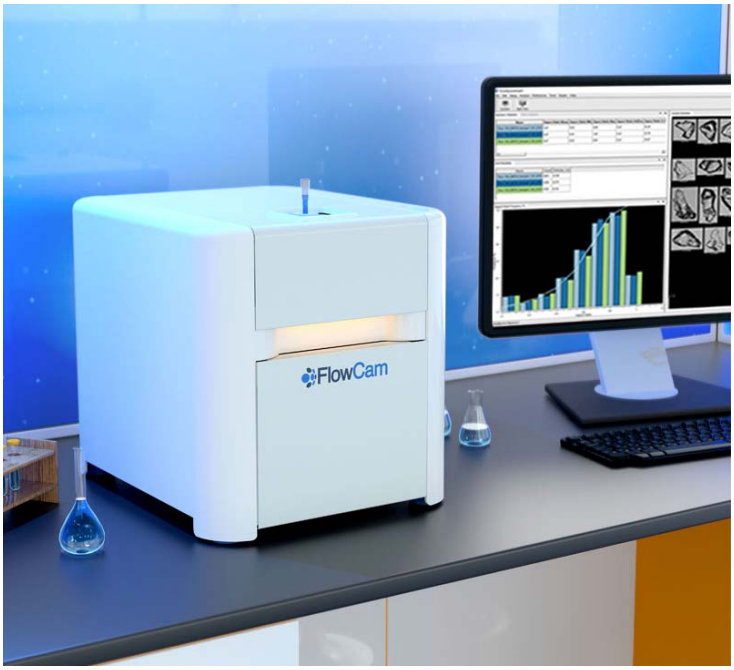


**Figure 2.** FlowCam 8000 instrument

## VISUALSPREADSHEET PARTICLE ANALYSIS SOFTWARE

### Turning Data into Insight

VisualSpreadsheet is a powerful and flexible software program for both data acquisition and analysis of images captured with FlowCam. The morphological properties determined by VisualSpreadsheet include diameter, area, aspect ratio, circularity, image intensity and average intensity and transparency. The user can filter and sort particles according to their properties and display results in interactive scattergrams or histograms.

Sophisticated pattern recognition allows users to immediately find and display all particles of similar morphology. Create, define, and save particle type libraries, then compare FlowCam data against existing libraries to instantly determine concentrations of specific particle types.

## APPLICATIONS

### Food and Beverage Characterization

Ingredients are critical in all facets of the food and beverage industry. FlowCam allows the user to isolate different particle types from a heterogeneous mixture in order to ensure the contents and detect process flaws early.

One example is hydrocolloids. Xanthan gum, guar gum, pectin, and other products are used to impart thickening, stabilizing, texturizing, and other properties to foods, beverages, and personal care products. Careful formulation, production, and packing are required to meet dispersability, hydration rate, powder flow, and other key performance characteristics. All of these are affected by individual particle size and shape.

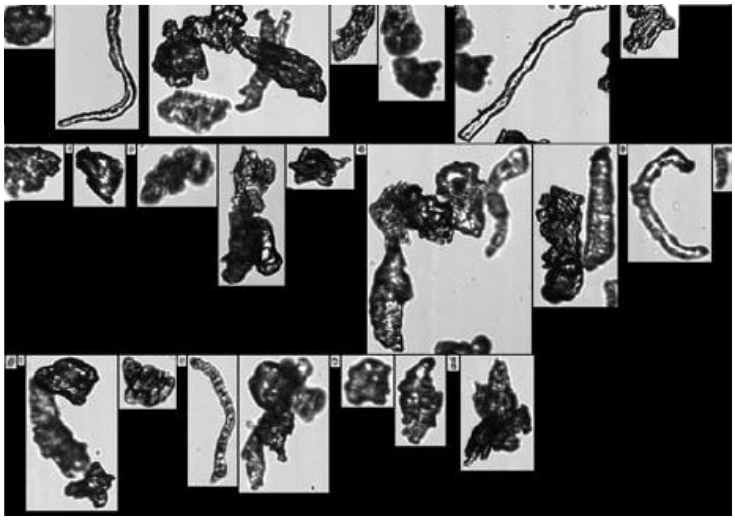

**Figure 3.** FlowCam images of cellulose particles used in food texturing applications

### Crop and Soil Sciences

FlowCam applications in Agronomy include: monitoring the microencapsulation process of fertilizer particles; determining presence of and monitoring health and growth of soil microbes, mites, forest litter invertebrates and nematodes; determining seed viability and observing naturally occuring defects in plant development; and analyzing pollen particles and pollen shell capsules.

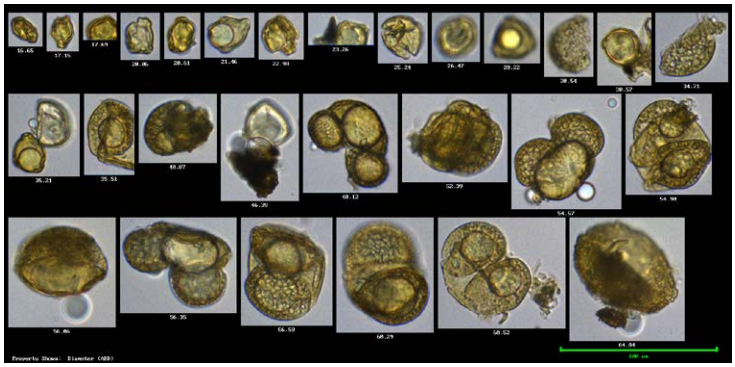

**Figure 4.** FlowCam images of pollen particles

### Printer Toner Quality Assurance

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 using FIM can help to determine the size, shape, circularity and material uniformity of printer toner particles during and after production.

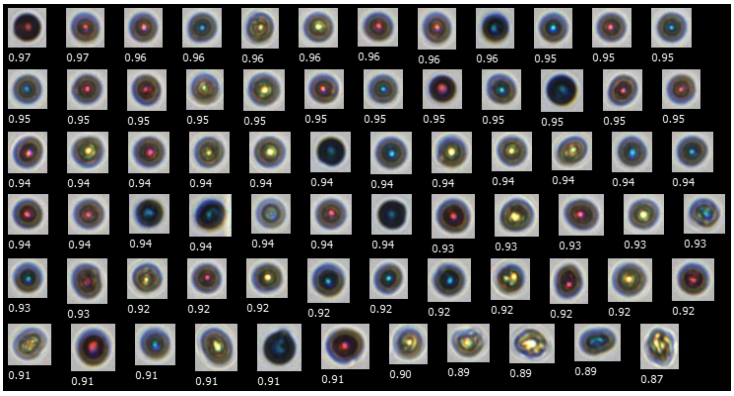


**Figure 5.** FlowCam images of color printer toner particles. Particles are shown in order of decreasing circularity, where 1 is a perfect circle.

### Microencapsulation Process Analysis

Microencapsulation is a commonly used technique in a wide range of applications - from pharmaceuticals to foods to detergents. The FlowCam imaging particle analyzer offers unique insight into the microencapsulation process. When studying the effects of temperature, concentration, pH and other variables, FlowCam can dynamically monitor capsule formation over time. This allows you to optimize the encapsulation process to yield the most clean coacervate formation.

By providing this insight into the process, FlowCam can be an indispensable tool for microencapsulation R&D and QC applications.

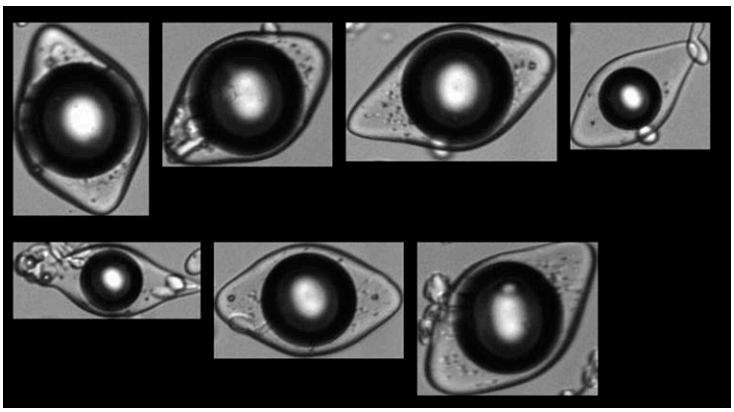

**Figure 6.** FlowCam images of encapsulated flavor particles

## Fiber Analysis

Geometry can play a crucial role in the performance of fibers in different applications. Shape factors that influence performance include length, width, and curl. Despite the importance of fiber geometry, many conventional particle sizing measurements struggle to accurately capture the morphology of these particles.

FlowCam expedites and streamlines fiber analysis. Integrated fiber morphology parameters include geodesic length, geodesic thickness, fiber straightness, and fiber curl. Using these measurements, FlowCam provides more accurate and reliable data than volumetric-based methods and offers a significant time-savings over manual microscopy. The option of building custom filters in VisualSpreadsheet allows for instantaneous reporting of results at the conclusion of sample analysis, saving users time and effort in assessing fiber quality.

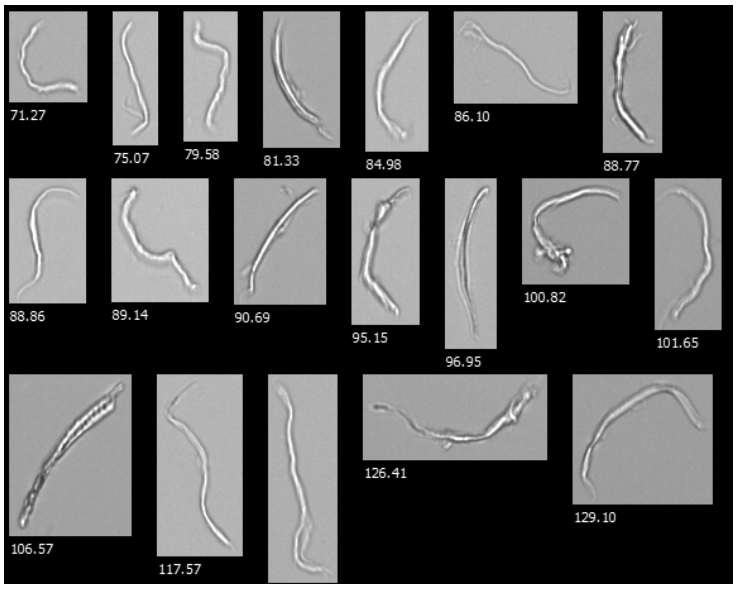


**Figure 7.** FlowCam images from a cellulose microfibril sample

## Characterization of Superabrasives

Superabrasives, such as micronized diamonds and cubic boron nitride (CBN), are used extensively in applications for cutting, grinding and drilling hard materials. The effectiveness of a particular superabrasive material in a given application is completely determined by both particle size and particle shape.

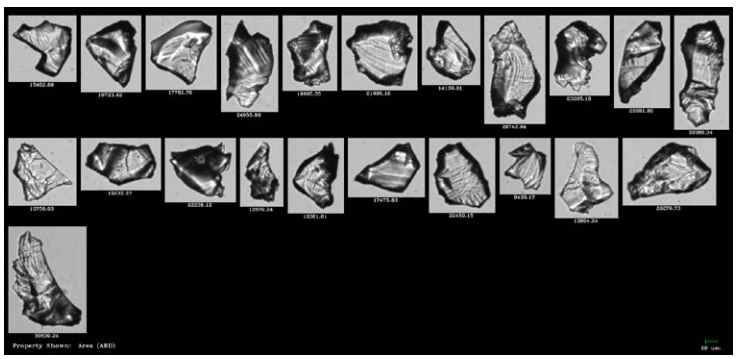

**Figure 8.** FlowCam images of zeolite particles

FlowCam can characterize thousands of particles per minute - making it quick and easy to determine if a batch of superabrasives meets the desired specification. It would take hours to make the same characterization using manual microscopy, and results would not be the same statistical significance.

## Wash Water: Heterogeneous Sample Analysis

In many applications, heterogeneous samples must be analyzed to characterize the types and quantities of particles present. In this example, water used to wash electronic devices after manufacturing is analyzed to determine particles present. Devices are washed to remove traces of fibers, metals and plastics that could remain from the manufacturing process, and it is important that the wash water contains less than a certain number of each of these particle types. Too many leftover particles could cause failures.

FlowCam makes it easy to sort and filter particle data and build libraries that will automatically quantify and characterize each particle type.

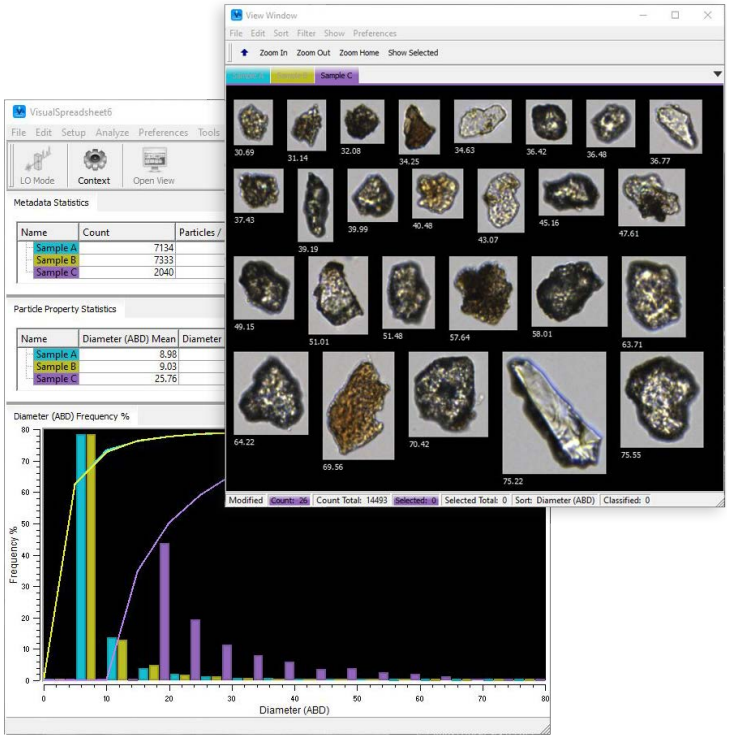


**Figure 9.** VisualSpreadsheet user interface showing particle data and images of various particle types in a heterogeneous sample

# FlowCam® Product Portfolio


### FlowCam 8000 Series

Our most versatile instrument for a wide range of applications. Laser excitation available. Particle size range: 2 µm - 1 mm.


### FlowCam Nano

Submicron particle imaging for particles from 300 nm to 2 µm.


### FlowCam 5000

Optimized for your application; our most compact instrument. Particle size range: 2 µm - 300 µm.


### FlowCam Macro

Analysis of visible particles from fibers to food and beverage ingredients. Particle size range: 300 µm - 5 mm.


### ALH for FlowCam™

Optimized Automated liquid handling for unsupervised analysis with FlowCam 8000.

### VisualSpreadsheet®

Powerful software to analyze images and visualize your results.