

Flow Imaging Microscopy for the Oil and Gas Industry

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.

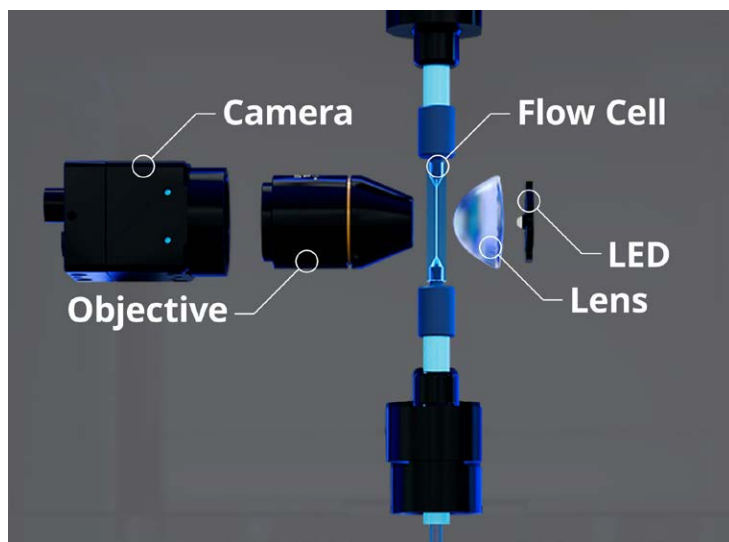


Figure 1. Schematic of the internal components of the FlowCam system

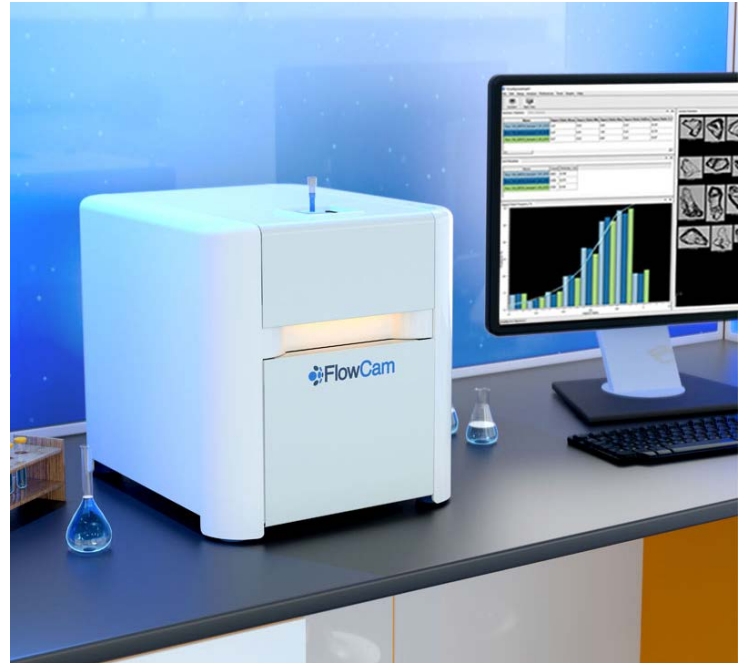


Figure 2. FlowCam 8000 instrument

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

Skim Tank Analysis

The quality of produced water is important with respect to the efficiency of a well. A treatment process—including skim tanks and filtration systems—is often employed to ensure water quality is maintained. Using FlowCam to analyze produced water throughout this process provides greater insight on the quality of produced water than other commonly-used methods. The analyst can calculate real-time particle count reduction and distinguish between different types of particles.

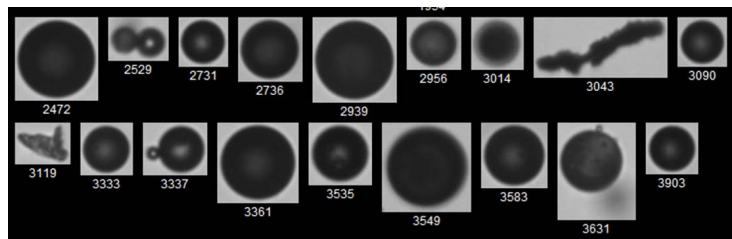


Figure 3. FlowCam images of oil droplets in skim tank inlet sample

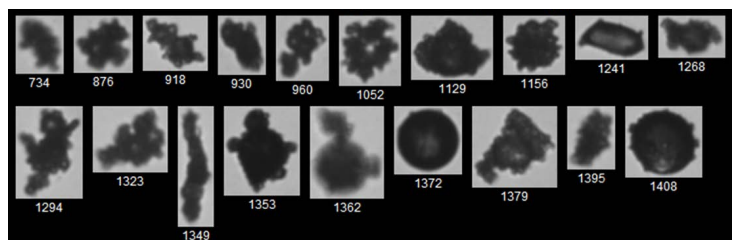


Figure 4. FlowCam images of particulates in skim tank outlet sample

The images above show that much of the oil was removed within the skim tank, however some fouling occurred and some oil droplets were seen in the outlet sample. Filter fouling downstream in the treatment process can also affect quality, so this data can be helpful for determining when filters need to be replaced. Monitoring particle count and characterization throughout the produced water treatment process can help ensure water quality and in turn keep the well running smoothly.

Characterization of Drilling Mud

The size and shape of the particulates in drilling fluid are critical to the performance of the drilling operation. FlowCam allows the user to obtain more than particle size and closely monitor drilling fluid behavior. The viscosity and rheological characteristics of fluids are directly related to the shape of its particulates, therefore the ability to monitor and quantify particle shape enables proactive, real-time management of drilling fluids.

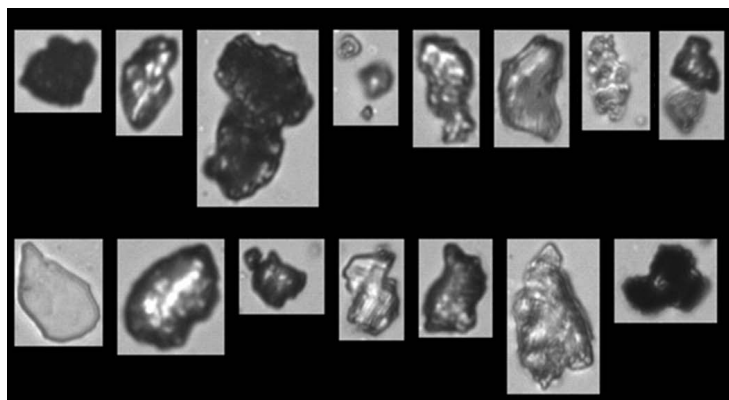


Figure 5. FlowCam images of particles in drilling mud

Oil in Produced and Flowback Water

FlowCam can help improve the accuracy and characterization of oil volume in produced and frac flowback water by distinguishing oil droplets from other particulates based on particle shape data.

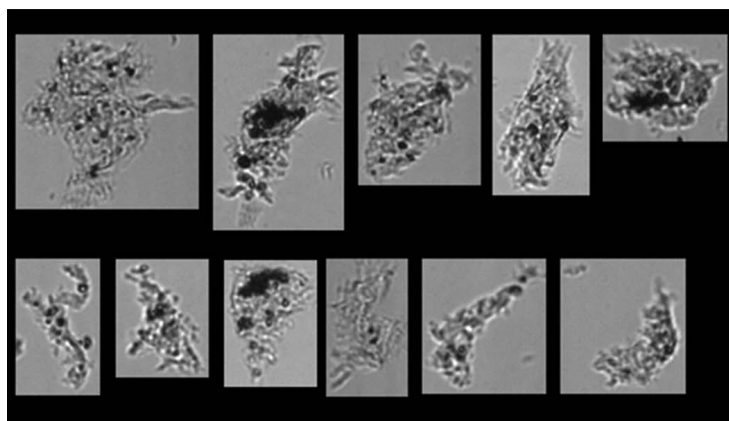


Figure 6. FlowCam images of particles in frac flowback water

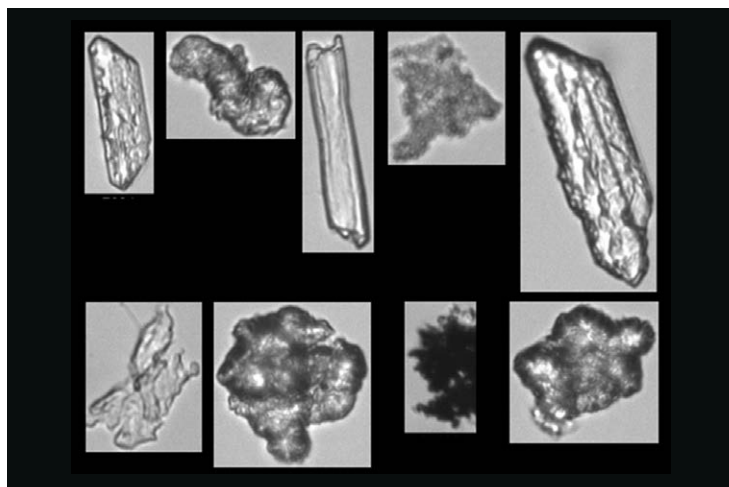
Quality Control and Assurance of Frac Proppants

Frac proppant particles affect the production performance of a well due to their effect on conductivity. Flow imaging microscopy provides an accurate and automated way to evaluate the sphericity of particles. This method can provide timely and accurate information to ensure the quality of your frac proppant.

Hydraulic Fluid Monitoring

Proactive contaminant monitoring of hydraulic fluids can keep systems running efficiently. FlowCam can quickly detect particles ranging from 1 μm to 10 μm - typically too small to be filtered out. FlowCam provides immediate concentration counts and summary statistics of numerous parameters on all particulates.

Figure 7 (right). FlowCam images of particles in completion fluid



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 5000

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



ALH for FlowCam™

Optimized Automated liquid handling for unsupervised analysis with FlowCam 8000.



VisualSpreadsheet®

Powerful software to analyze images and visualize your results.