FLUID IMAGING TECHNOLOGIES, INC.

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Quantification & Characterization of Suspended Solids with Nano-Flow Imaging Technology

Steve Bowen
Director of Industrial Sales

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FlowCam
Particle Analysis with Vision
FLUID IMAGING TECHNOLOGIES, INC.

Agenda

1. What is Subvisible Dynamic Particle Imaging?
2. How Does Nano-Flow Imaging™ Work?
3. Applications for Produced Water
4. Advantages / Limitations of Nano-Flow Imaging ™

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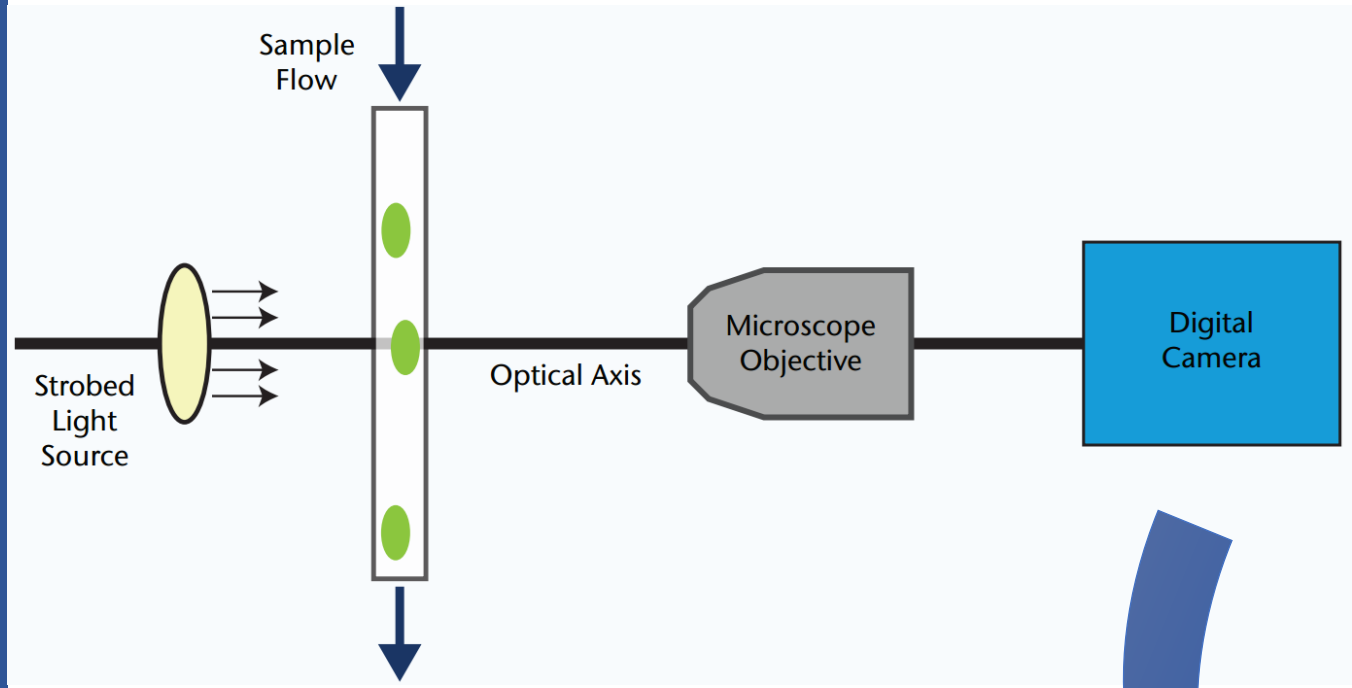
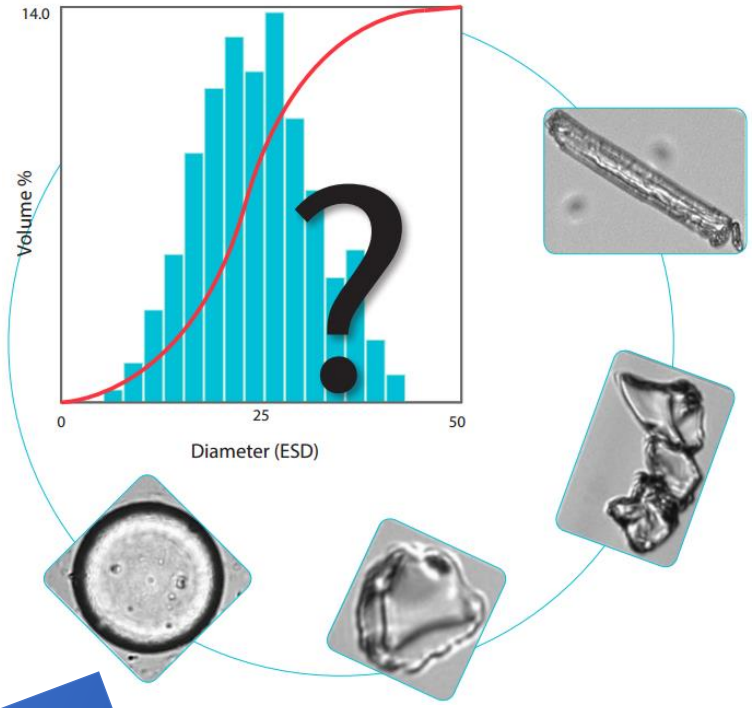
Dynamic Particle Imaging Analysis





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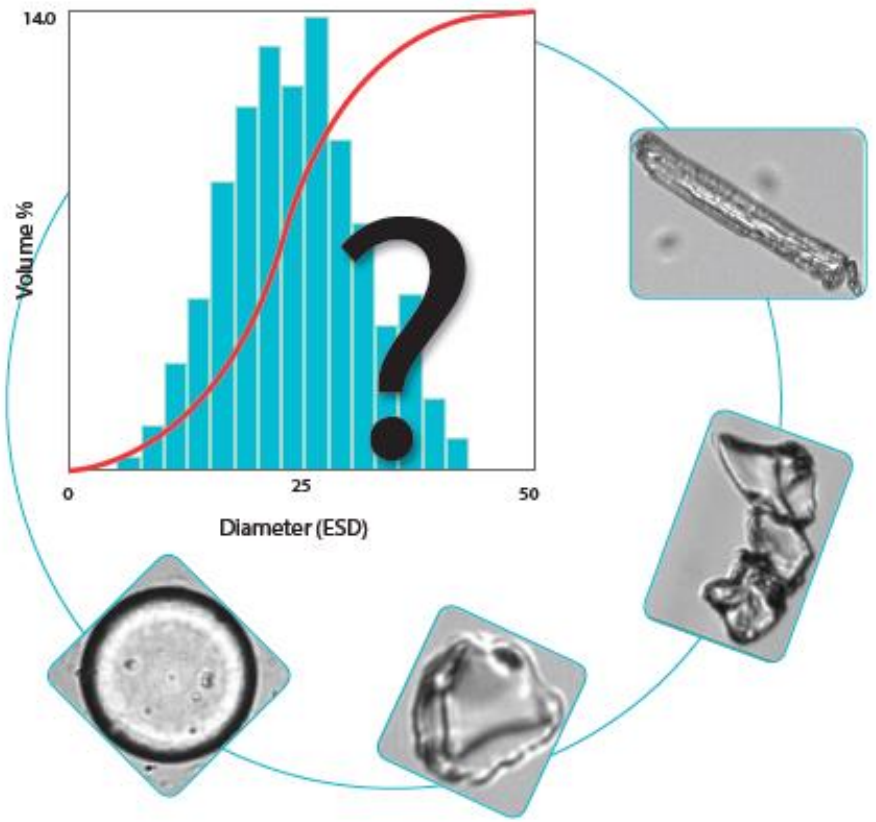
Dynamic Particle Imaging Analysis



- Particle size distribution
- Particle count
- Particle concentration
- Particle shape analysis
- Display of individual particles

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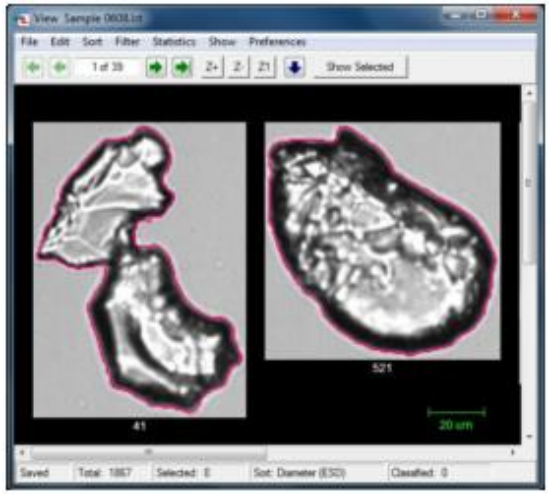
Common Particle Measurements

- Equivalent spherical diameter (ESD)
- Length, width, and aspect ratio
- Area and volume
- Circularity and elongation
- Circular fit
- Edge Gradient
- Intensity
- Transparency



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Flow Imaging Value Proposition

Automated flow imaging technology enables users to analyze particles accurately, reliably and quickly, in order to advance research, increase productivity, and ensure quality.

- High statistical significance
- High reproducibility
- Greater level of particle information
- Ability to search and filter results for analysis
- Ability to differentiate between particle types
- Wide particle size range 300nm---5mm

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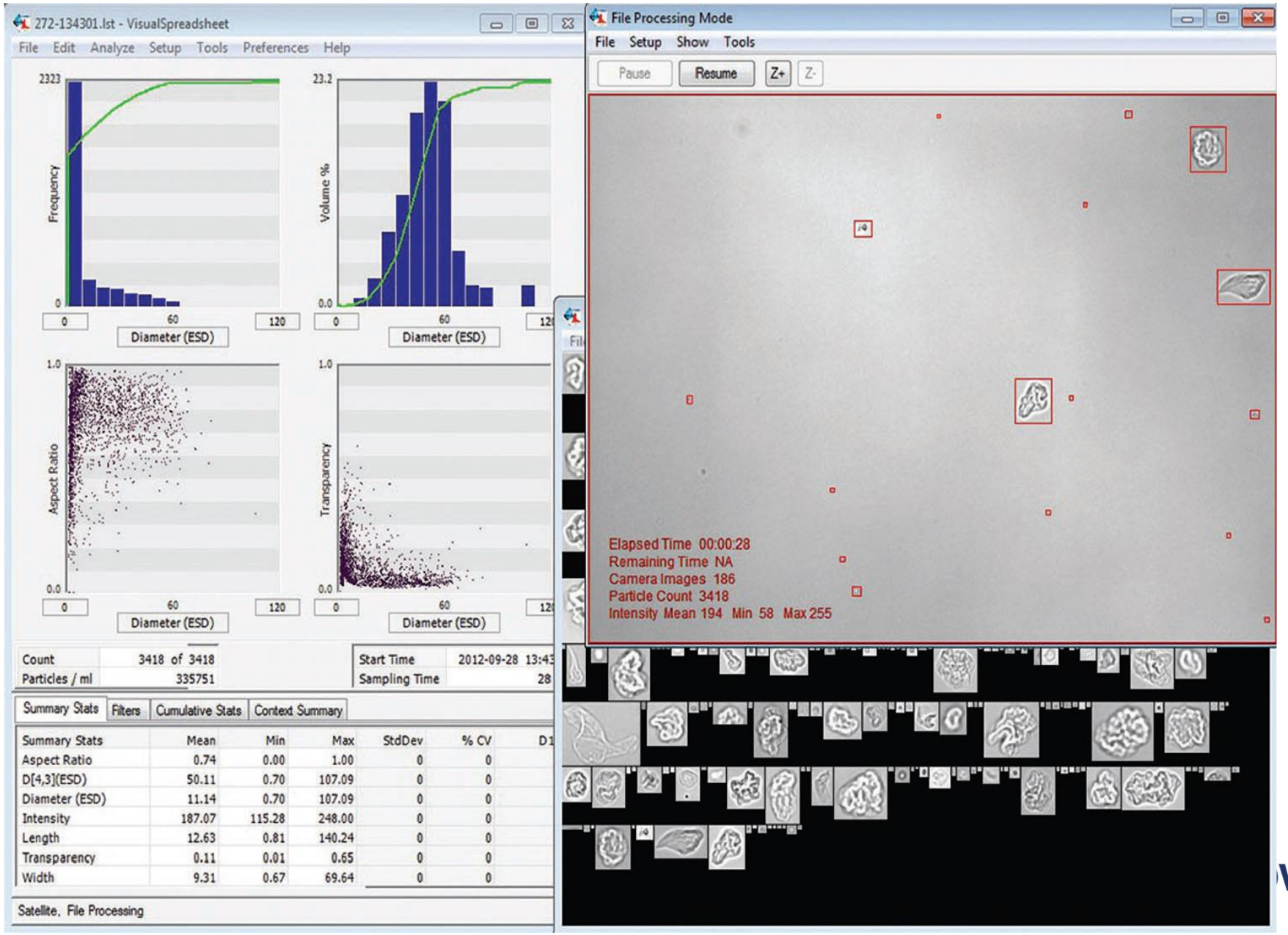
272-134301.lst - VisualSpreadsheet
File Edit Analyze Setup Tools Preferences Help
Frequency
Volume %
Aspect Ratio
Transparency
Diameter (ESD)
Count 3418 of 3418
Particles / ml 335751
Start Time 2012-09-28 13:43
Sampling Time 28
Summary Stats | Filters | Cumulative Stats | Context Summary
Summary Stats Mean Min Max StdDev % CV
Aspect Ratio 0.74 0.00 1.00 0 0
D[4,3](ESD) 50.11 0.70 107.09 0 0
Diameter (ESD) 11.14 0.70 107.09 0 0
Intensity 187.07 115.28 248.00 0 0
Length 12.63 0.81 140.24 0 0
Transparency 0.11 0.01 0.65 0 0
Width 9.31 0.67 69.64 0 0
Satellite, File Processing
File Processing Mode
File Setup Show Tools
Pause Resume Z+ Z-
Elapsed Time 00:00:28
Remaining Time NA
Camera Images 186
Particle Count 3418
Intensity Mean 194 Min 58 Max 255

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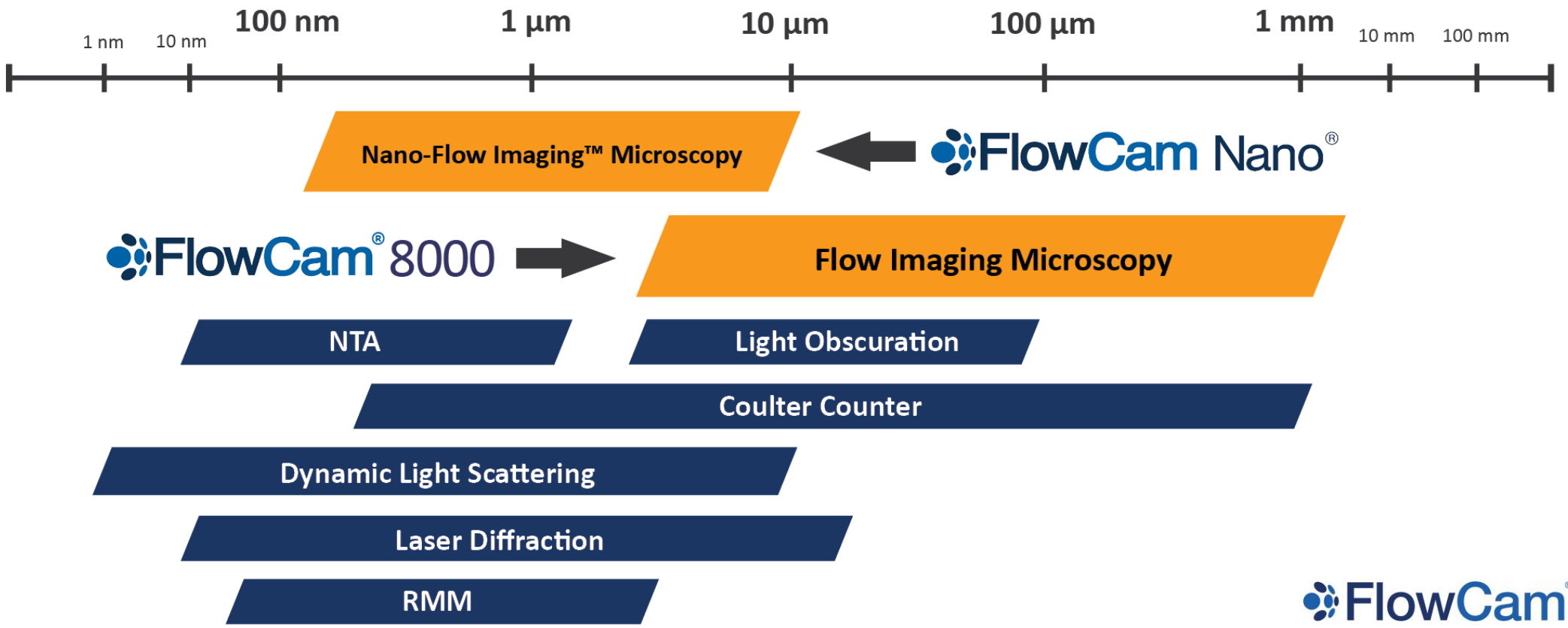
Flow Imaging in Action (FlowCam)

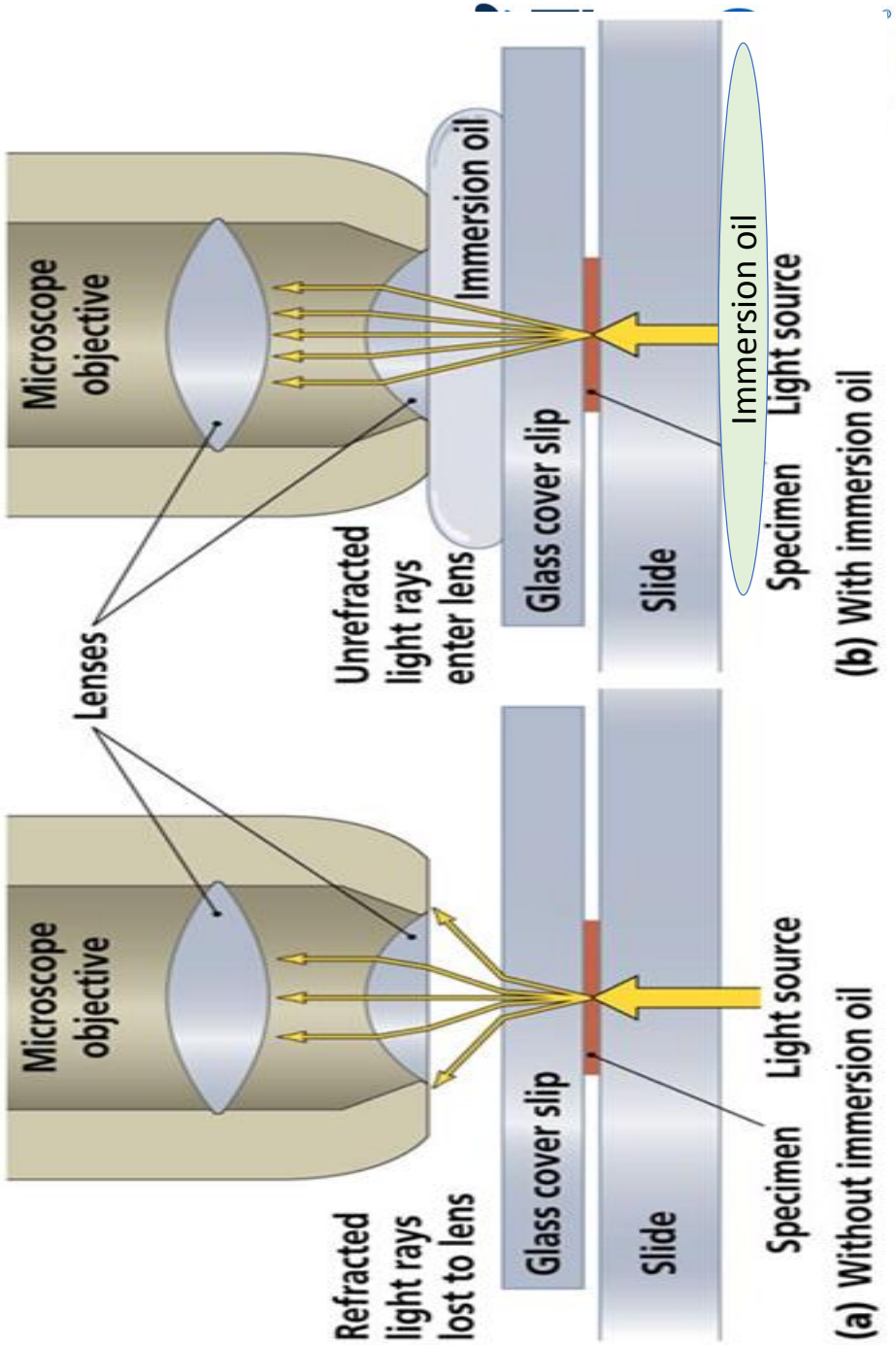
Extending Visual Particle Analysis Below 1 µm



How Nano-Flow Imaging™ Works

Physics of Nana Optical/Light Microscopes

1. In the space between the microscope objective lens and the flow cell (where air is), light is refracted, the light scatters and it is lost. Figure (a)
2. The refractive index of air is approximately 1.0, while the refractive index of glass is approximately 1.5.
3. Light of different wavelengths bends at different angles, so as objects are magnified, images become less distinct.
4. One way of increasing the optical resolving power (resolution) of the microscope is to use immersion oil between the front lens of the objective and the flow cell. Figure (b)



How Nano-Flow Imaging™ Works

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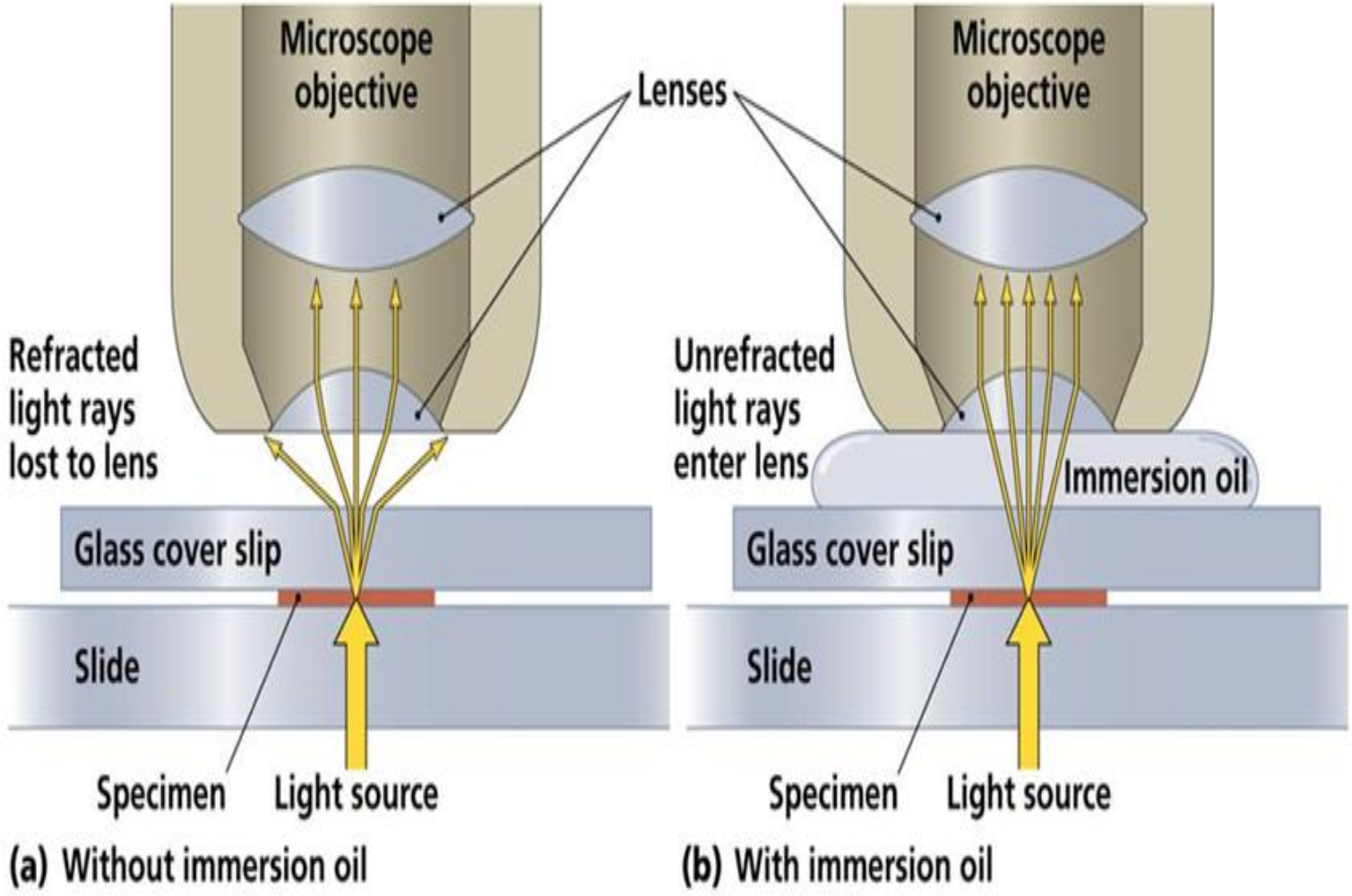

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FlowCam Nano
Condenser and Optics Array

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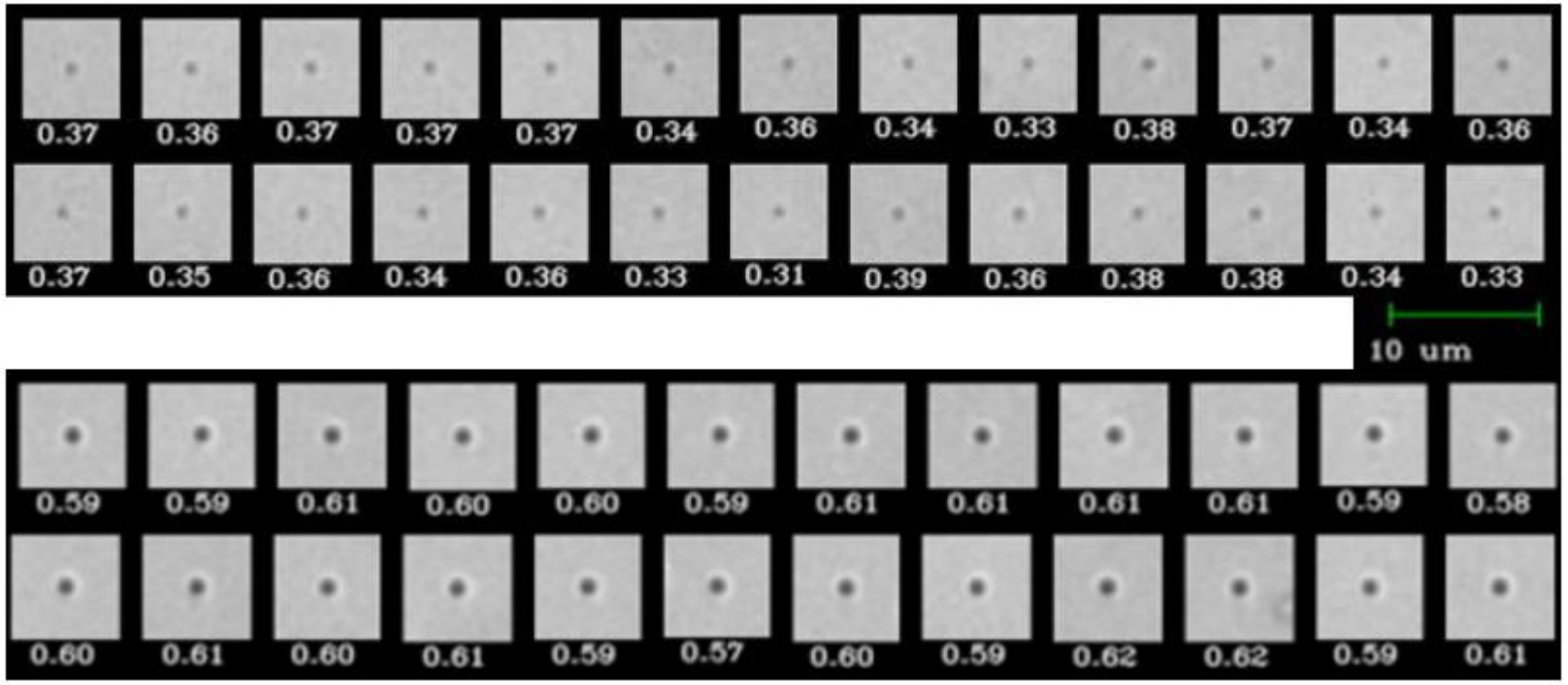
Nano Level Certified Calibration Beads

0.345 um

(+- 0.007 um)



0.600 um

(+- 0.009 um)

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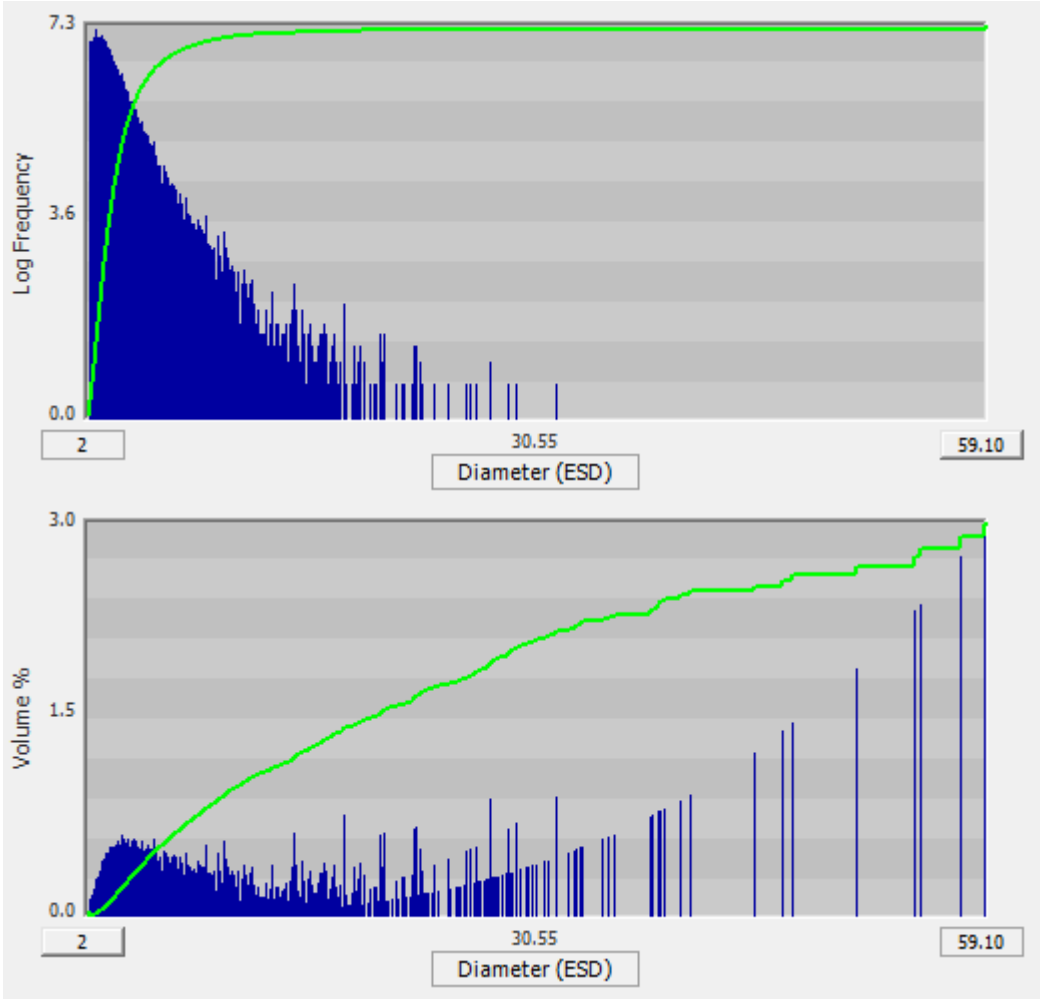
Produced Water Sample – Finished Product

FlowCam 8100



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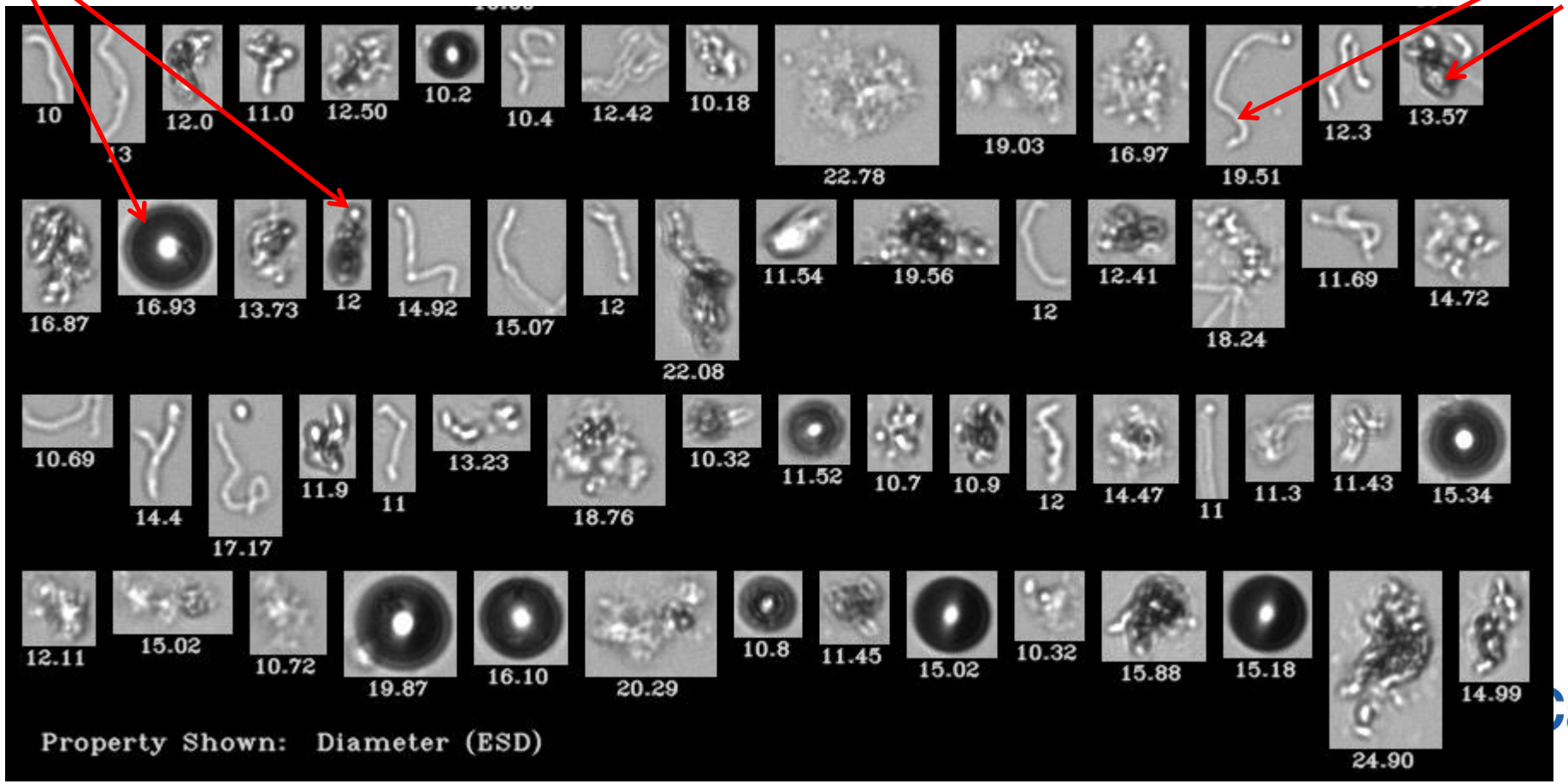
FlowCam 8100 Series Particle Images (10 um – 25 um)

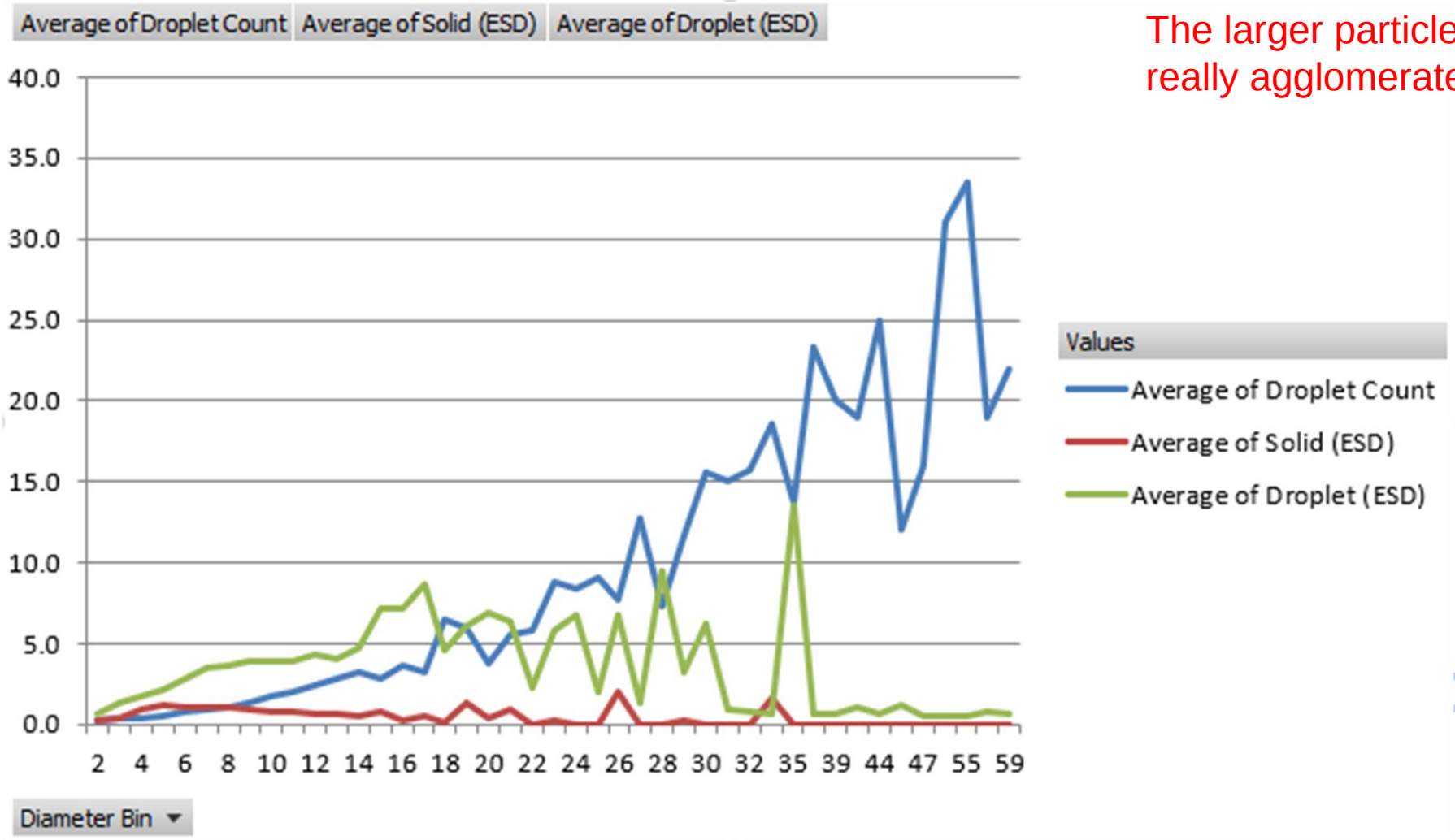
Oil Droplets

Non-Droplets (solids, fibers, organics)



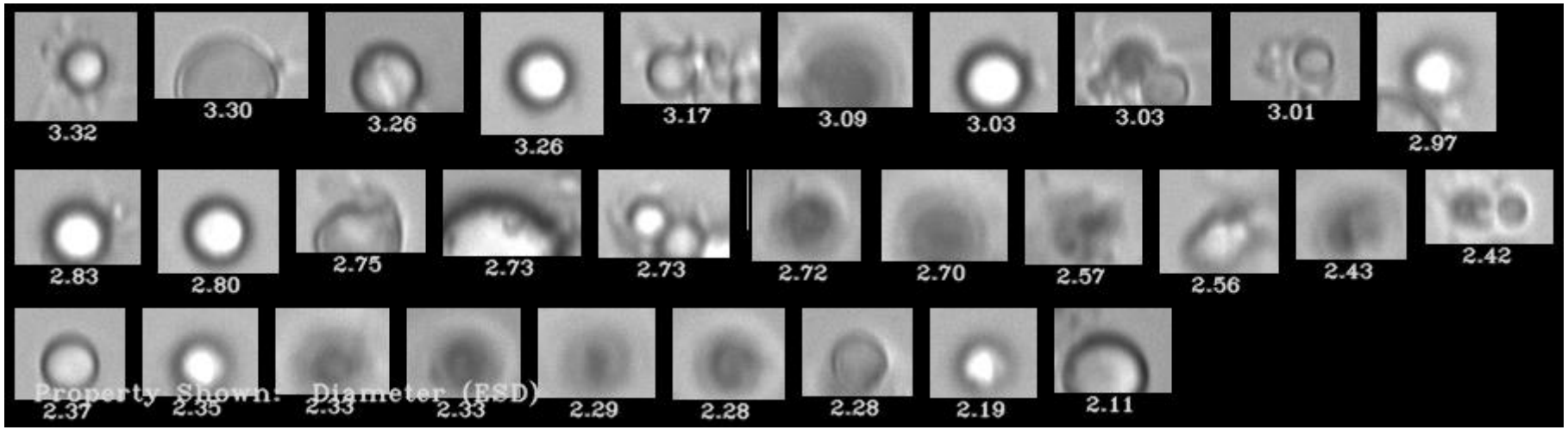
Software calculates the number and volume of all the droplets per particle

FlowCam 8100 Series Particle Images (10 um – 25 um)



The larger particles are really agglomerates

FlowCam Nano Particle Images
(2 um – 4 um)



As the particle size range gets smaller, there is less agglomeration

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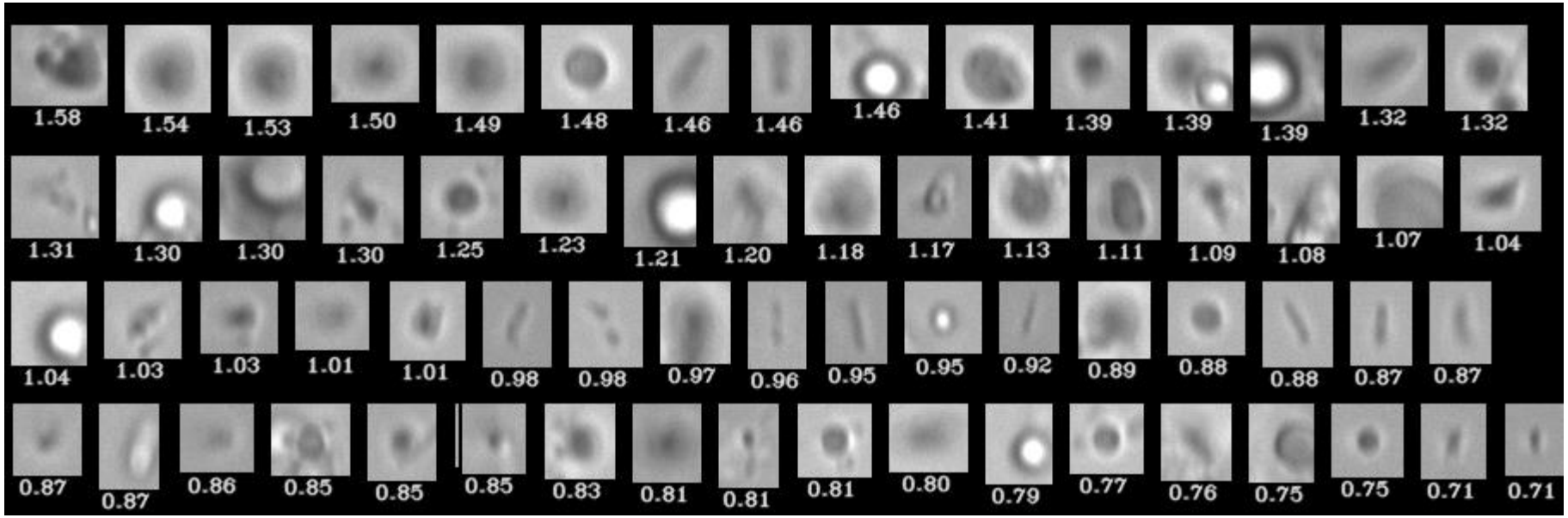
FlowCam Nano Particle Images (1 um – 2 um)



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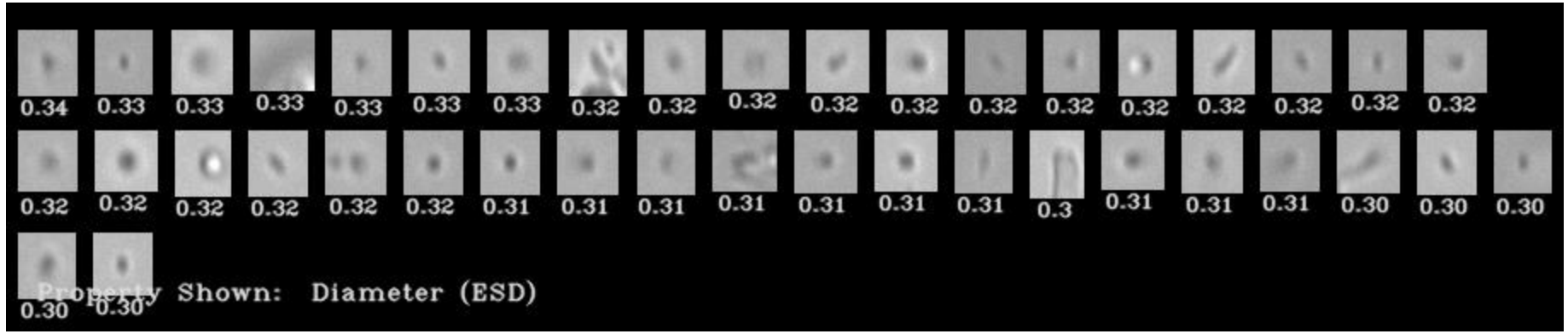
FlowCam Nano Particle Images (300 nm)



Very little agglomeration in the nano range

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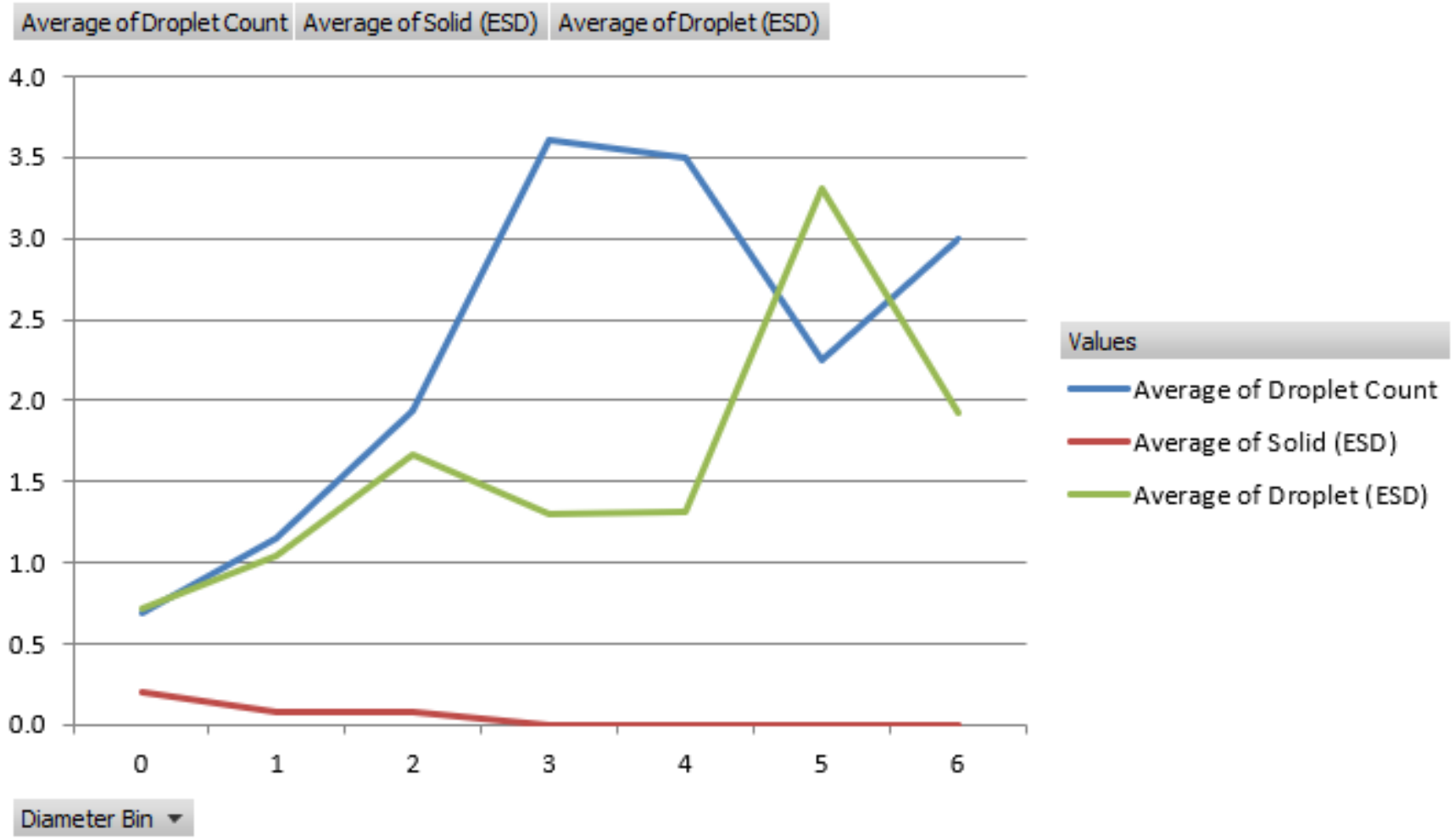
FlowCam Nano Particle Images (300 nm – 5 um)



Sub-Micron Particle Analysis Summary

Advantages

- Combines benefits of microscopy with volumetric techniques.
- Yields statistically significant data
- Provides multiple particle measurements
- Ability to view individual particle images
- Powerful software for analysis and classification of particles

Limitations

- Low size limited to > 300nm
- Flow cell size limited to > 50 um
- High size recommended to 10 um

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Questions?

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THANK YOU

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