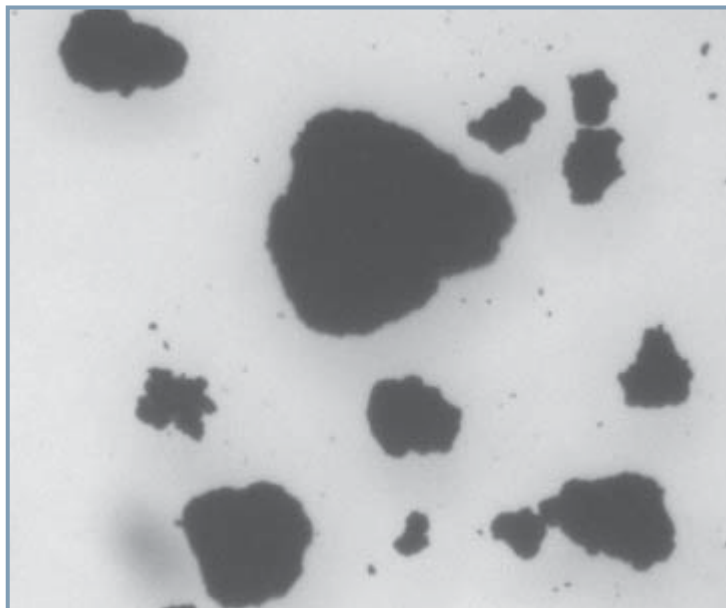


**CLEMEX**  
intelligent microscopy

**# 768**

## **Particle Size Analysis**



Prepared by Myriam Savard Eng.  
Clemex Technologies Inc.  
For Macco Organiques Inc.

### Sample Description

Two powder samples of calcium propionate were submitted for analysis. The bottle identified as "272J #60 cal. pro. séchoir #1 is further referred to as sample 1, and the bottle identified as "cal pro aggro séchoir #4 sac #150 5007-J" is further referred to as sample 2.

### Purpose of Analysis

To demonstrate that the Clemex Vision image analysis system can measure all particles, especially the small ones.

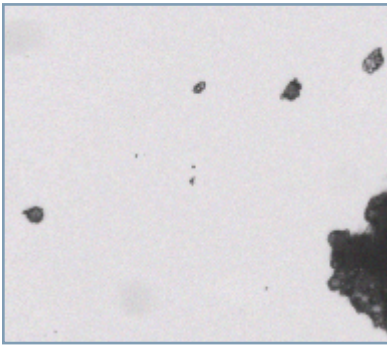


Figure 1: Part of the original image at 200x (0.3113 micron/pixel).

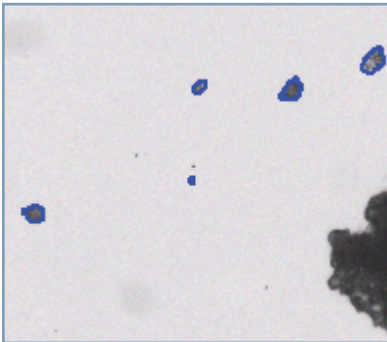


Figure 2: Outline of particles as measured in blue bitplane.

### Procedure<sup>1</sup>

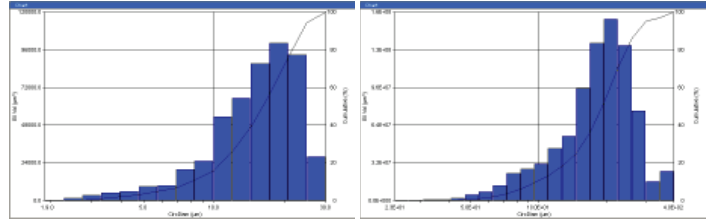
Particles were binarized into the blue bitplane using their gray levels. Connected features were identified, based on their roughness, and separated. When analyzing the largest particles (at 25x), features having a length of 30 microns and smaller were eliminated, and when analyzing the smallest ones (at 200x), features shorter than 3 microns (5 times the optical resolution) and those longer than 30 microns were eliminated. In both cases, small artifacts were eliminated prior to measurements.

### Results<sup>2</sup>

Area, Length, Circular Diameter, Roundness, Aspect Ratio, and Volume measurements were performed on each feature. Automated statistics and graphs were generated. Final results were

<sup>1</sup> Images taken during the procedure are available in appendix A  
<sup>2</sup> Complete results are available in appendix B.

printed directly from Clemex Vision and saved for further use. A customized report was built using the Report Generator module. Raw data is linked to their respective objects for validation purposes. Raw data could also be exported in Excel format.



Magnification:	200x	25x
Calibration:	0.3113 micron/pixel	2.5278 microns/pixel
Minimum:	1.92 microns	22.82 microns
Maximum:	26.03 microns	371.37 microns
Mean:	15.95 microns	193.65 microns
Std Dev.:	5.68 microns	69.79 microns

Figure 3: Equivalent diameter distributions and corresponding statistics for sample 1.

### Equipment

Image Analysis System:	Clemex Vision PE
Microscope:	Leica DM LA
Illumination:	Transmitted Light
Camera:	Clemex L 2.1M
Motorized Stage:	Marzhauser EK32IM 75x50mm
Stage Controller:	Clemex ST-2000

### Discussion

The main difficulty of this analysis was to measure a large range of particle size, while keeping a good resolution as measuring the smallest features.

To overcome this problem, a fast run was performed at 100x to evaluate the size distribution, and two distinctive size distributions were found. These two distributions were separated at around 30 microns. Consequently, two runs were performed: one at high magnification (200x) keeping only the particles having a length below 30 microns, and the other at lower magnification (25x) keeping only the particles having a length greater than 30 microns.

At 200x, the depth of field being thin, the large particles were not in focus when the smallest ones were. This might not seem important since we don't measure the large particles at 200x; however, they create noise whose size range falls inside the range distribution of the small particles. Consequently, an additional step was used at 200x to eliminate the noise detection found around the large particles.

If only one distribution had been found, both charts could have been combined into one to obtain overall statistics, as the same area was covered at both magnifications.



## **Appendix A: Image Analysis Steps**



## Image Analysis Steps

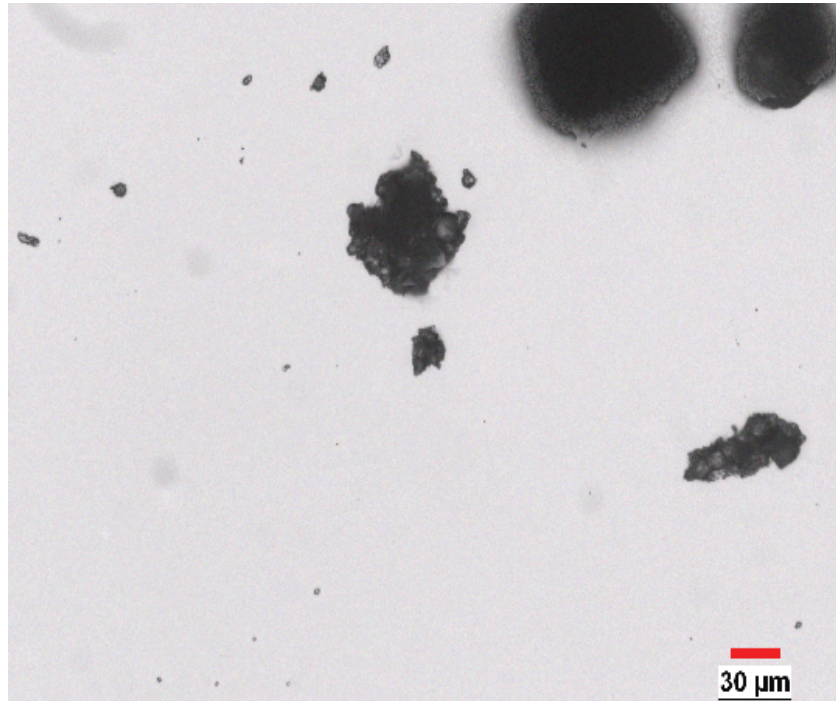


Image 1: Part of the original image at 200x (0.3113 micron/pixel).

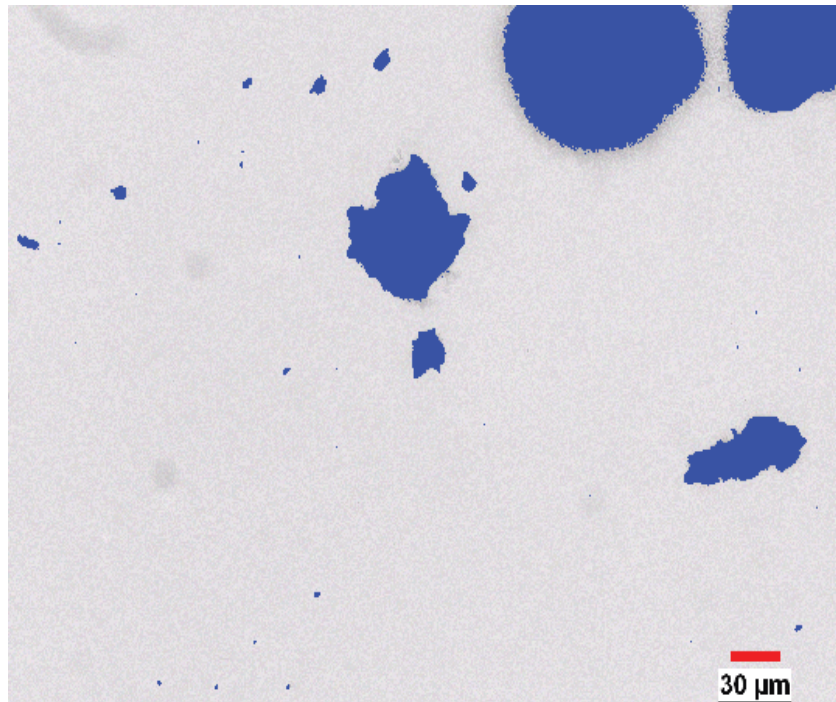
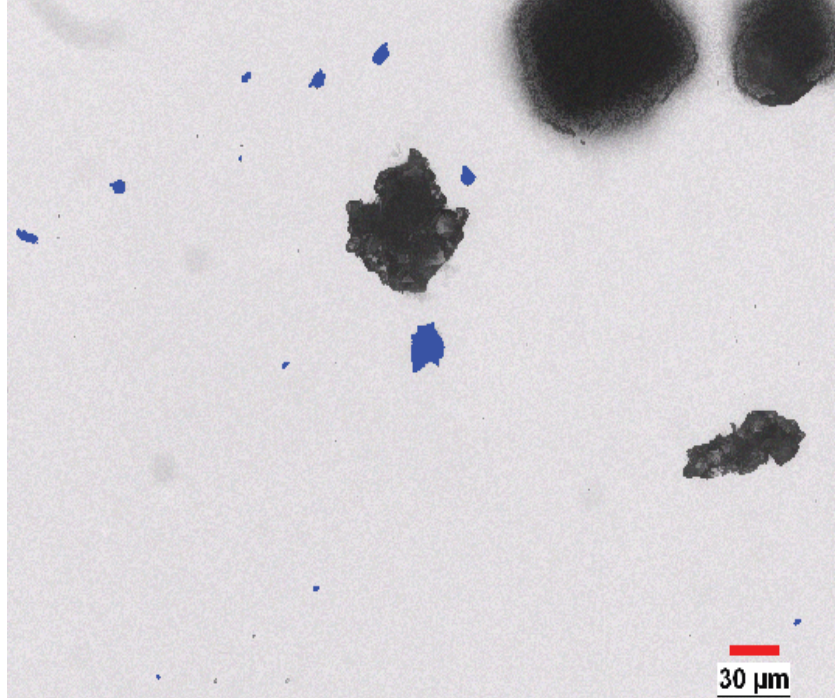
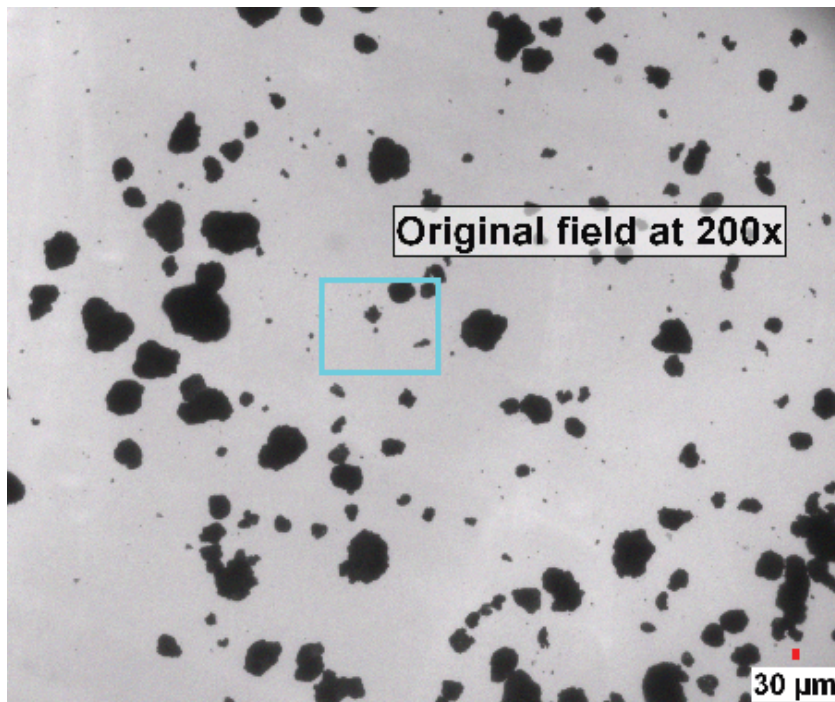


Image 2: Particles were binarized into the blue bitplane.

## Image Analysis Steps

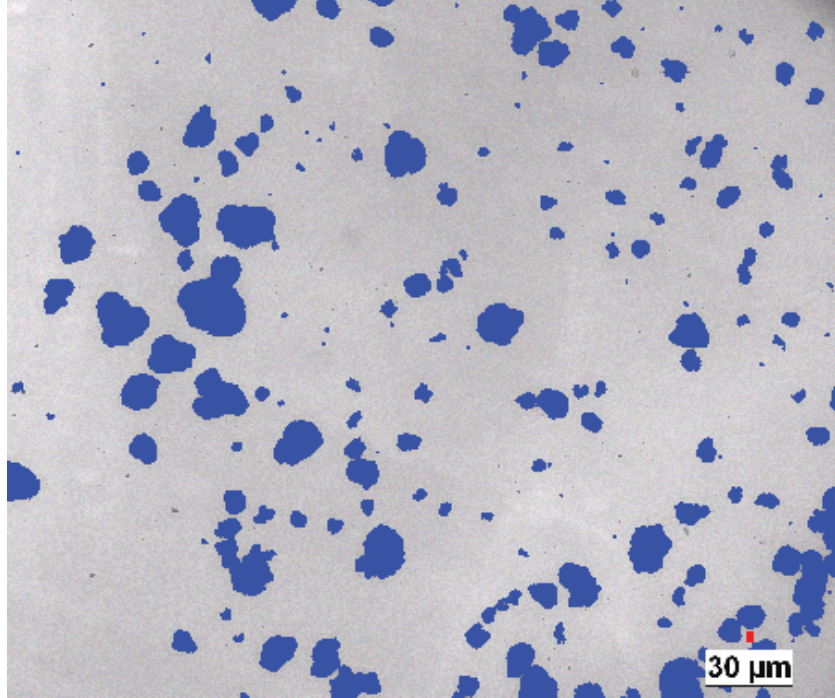


*Image 3: Particles were separated, and features that had a length greater than 30 microns or smaller than 3 microns (5 times the optical resolution) were eliminated prior to measurement.*

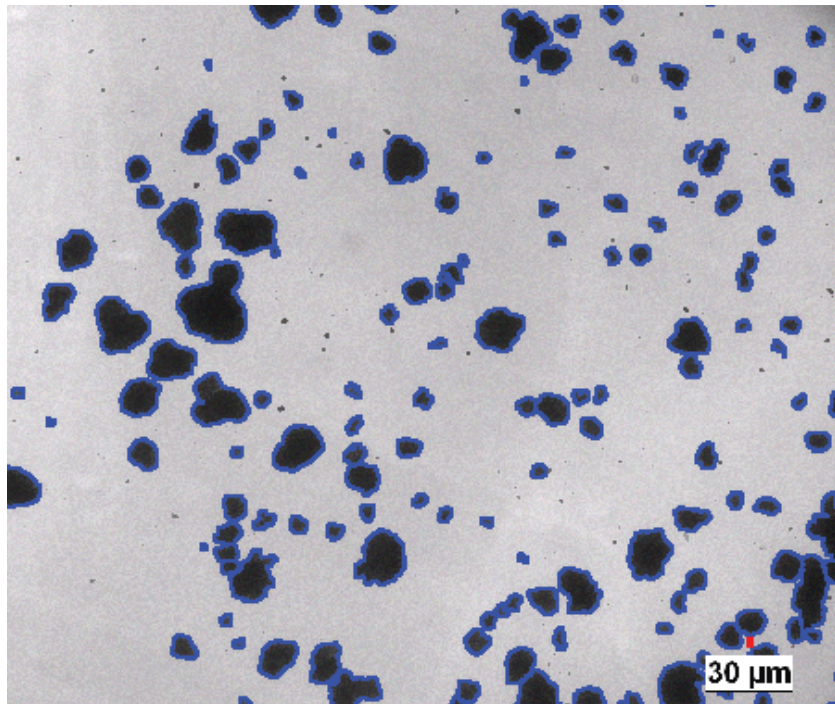


*Image 4: Same zone than shown in the previous images, but at lower magnification (25x - 2.5278 microns/pixel). The cyan box shows the area treated in the previous images at 200x magnification.*

## Image Analysis Steps



*Image 3: Features were binarized into the blue bitplane.*



*Image 4: Connected features were separated, and features having a length smaller than 30 microns were eliminated prior to measurement.*



## **Appendix B: Results**



**Sample # 1 -  
272J #60 cal. pro. séchoir #1**

# Particle Size Analysis

**Date:** 2008-Mar-31, 2:36:22 PM -04'00'  
**Company:** Clemex  
**Department:** Laboratory  
**User Name:** Generic User Name (s...)  
**Sample ID:** S1 length > 30 microns

**Magnification:** 25xT  
**Calibration:** 2.5278  $\mu\text{m}/\text{pixel}$   
**Units:** microns  
**# Fields:** 9  
**Particle Count:** 817

Figure 1: Typical field of view as captured.

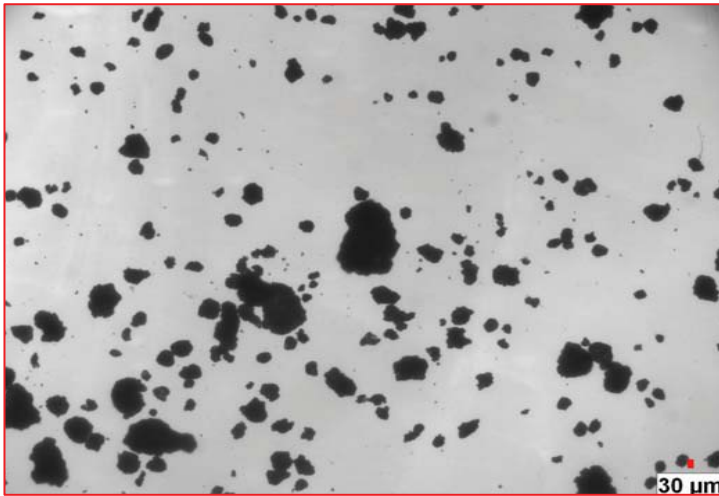
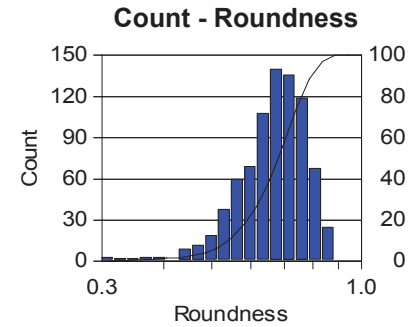
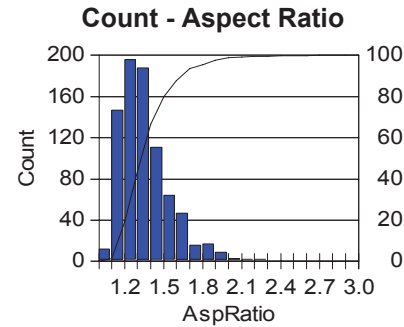
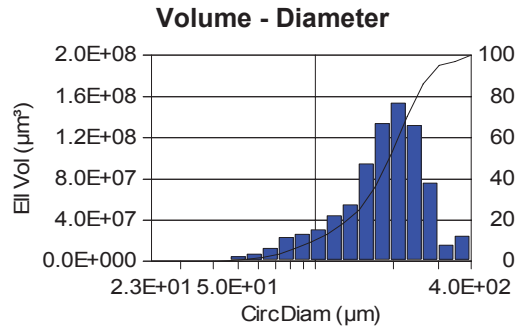
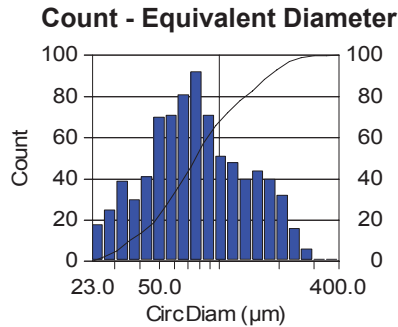
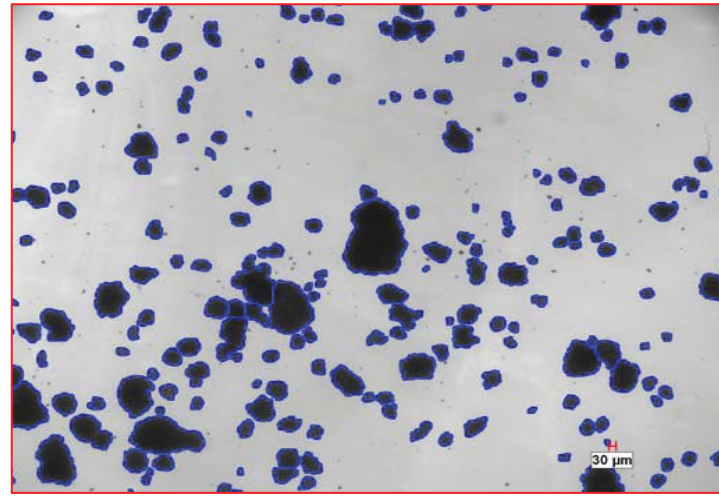


Figure 2: Measured particles appear in blue.



Units:	microns	microns	(ratio)	(ratio)
Min:	22.82	22.82	1.06	0.26
Max.:	371.37	371.37	2.60	0.88
Mean:	92.77	193.65	1.37	0.67
Std. Dev.:	56.50	69.79	0.21	0.10
D10:	35.15	98.34	1.16	0.54
D50:	76.20	192.70	1.33	0.68
D90:	180.75	287.95	1.64	0.79

# Particle Size Analysis

**Date:** 2008-Mar-31, 11:01:38 AM -04'00'  
**Company:** Clemex  
**Department:** Laboratory  
**User Name:** Generic User Name (s...)  
**Sample ID:** S1 length < 30 microns

**Magnification:** 200xT  
**Calibration:** 0.3113  $\mu\text{m}/\text{pixel}$   
**Units:** microns  
**# Fields:** 196  
**Particle Count:** 1374

Figure 1: Typical field of view as captured.

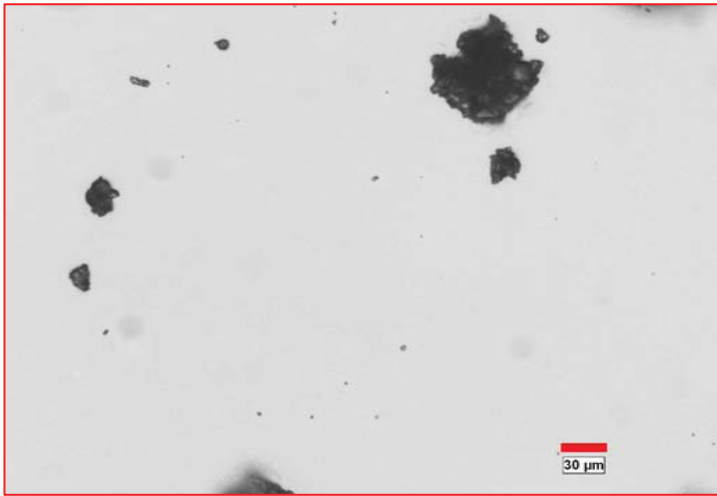
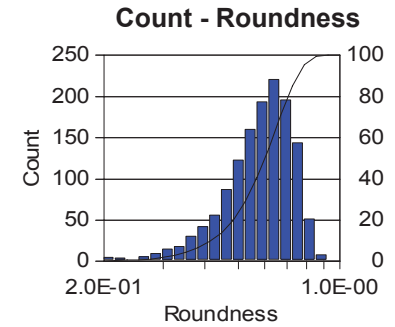
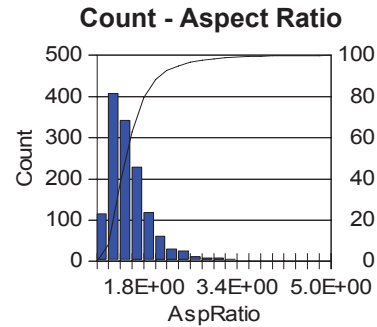
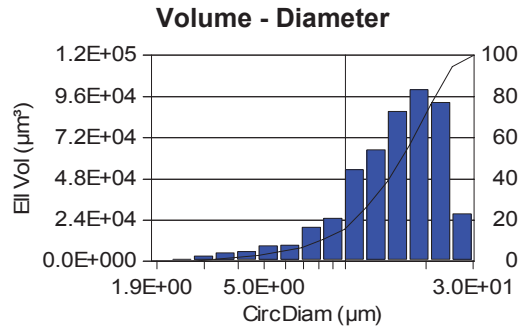
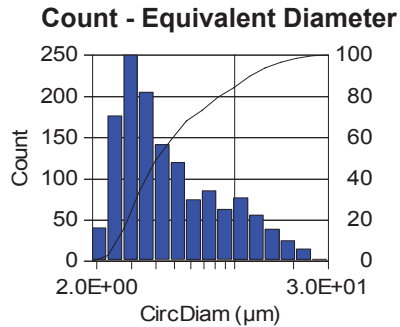
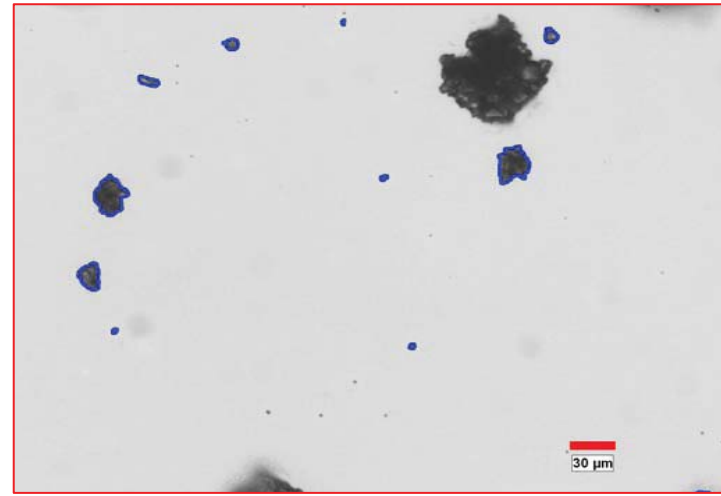


Figure 2: Measured particles appear in blue.



Units:	microns	microns	(ratio)	(ratio)
Min:	1.92	1.92	1.08	0.19
Max.:	26.03	26.03	5.00	0.89
Mean:	5.84	15.95	1.60	0.59
Std. Dev.:	4.28	5.68	0.43	0.13
D10:	2.54	8.07	1.22	0.42
D50:	4.01	16.35	1.49	0.60
D90:	12.02	22.93	2.07	0.75

## **Printed Results**

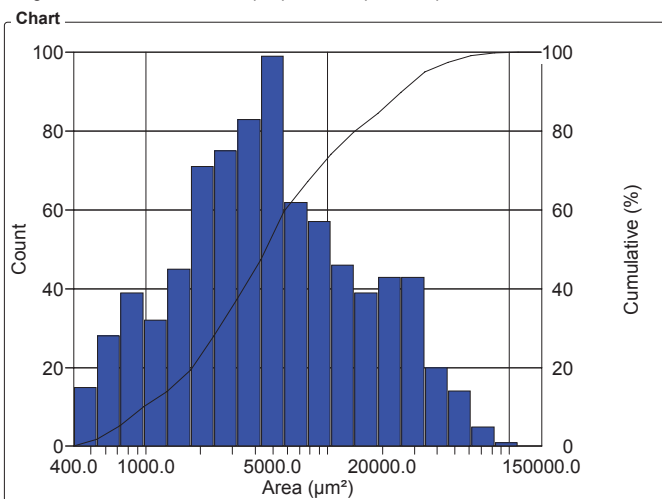
## 25x S1

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:11:09 AM**  
 Sample: **S1 Tr**

### OBJM1 Count - Area

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1

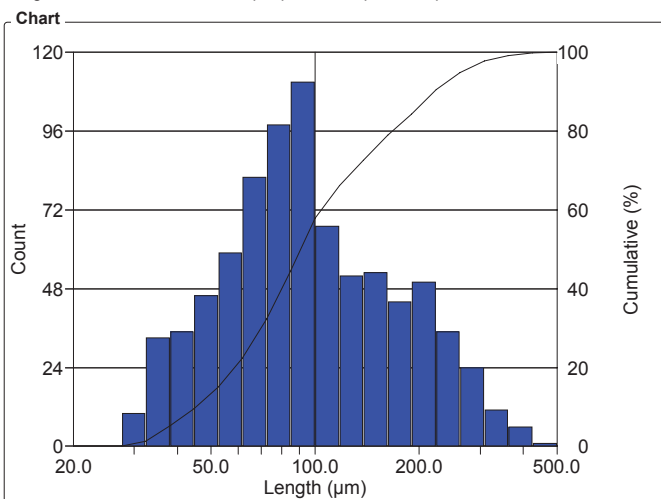


Area Intervals (µm <sup>2</sup> )	Count	%	Cumul%
400 - 538	15	1.84	1.84
538 - 724	28	3.43	5.26
724 - 973	39	4.77	10.04
973 - 1309	32	3.92	13.95
1309 - 1760	45	5.51	19.46
1760 - 2367	71	8.69	28.15
2367 - 3184	75	9.18	37.33
3184 - 4282	83	10.16	47.49
4282 - 5759	99	12.12	59.61
5759 - 7746	62	7.59	67.20
7746 - 10418	57	6.98	74.17
10418 - 14011	46	5.63	79.80
14011 - 18844	39	4.77	84.58
18844 - 25344	43	5.26	89.84
25344 - 34087	43	5.26	95.10
34087 - 45844	20	2.45	97.55
45844 - 61658	14	1.71	99.27
61658 - 82926	5	0.61	99.88
82926 - 111529	1	0.12	100
111529 - 150000	0	0	100

Statistics		
Minimum:	408.9	µm <sup>2</sup>
Maximum:	108319.9	µm <sup>2</sup>
Mean:	9263.9	µm <sup>2</sup>
Std Dev.:	11996.3	µm <sup>2</sup>
Sum:	7568593.3	µm <sup>2</sup>
Count:	817	
Under:	0	
Over:	0	
Accepted:	100.0	%
Field Count:	9	
Field Area:	8530105.2	µm <sup>2</sup>
Total Area:	76770946.5	µm <sup>2</sup>

### OBJM1 Count - Length

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1



Length Intervals (µm)	Count	%	Cumul%
20 - 23.5	0	0	0
23.5 - 27.6	0	0	0
27.6 - 32.4	10	1.22	1.22
32.4 - 38.1	33	4.04	5.26
38.1 - 44.7	35	4.28	9.55
44.7 - 52.5	46	5.63	15.18
52.5 - 62	59	7.22	22.40
62 - 72	82	10.04	32.44
72 - 85	98	12.00	44.43
85 - 100	111	13.59	58.02
100 - 117	67	8.20	66.22
117 - 138	52	6.36	72.58
138 - 162	53	6.49	79.07
162 - 190	44	5.39	84.46
190 - 224	50	6.12	90.58
224 - 263	35	4.28	94.86
263 - 309	24	2.94	97.80
309 - 362	11	1.35	99.14
362 - 426	6	0.73	99.88
426 - 500	1	0.12	100

Statistics	
Minimum:	30.6 µm
Maximum:	444.6 µm
Mean:	114.3 µm
Std Dev.:	71.8 µm
Sum:	93413.8 µm
Count:	817
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	9
Field Area:	8530105.2 µm <sup>2</sup>
Total Area:	76770946.5 µm <sup>2</sup>

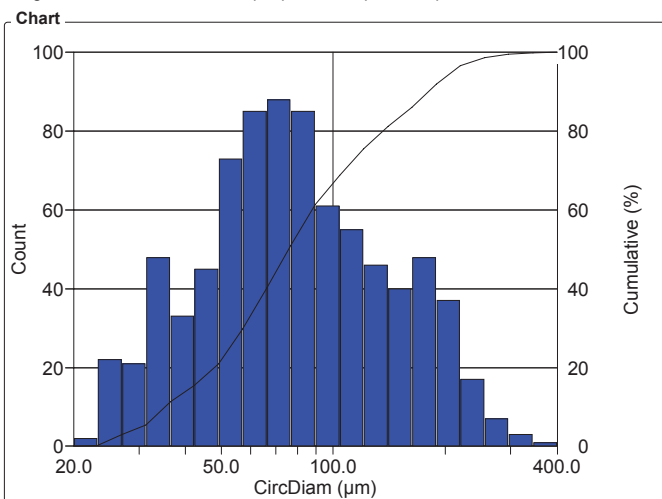
## 25x S1

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:11:09 AM**  
 Sample: **S1 Tr**

### OBJM1 Count - CircDiam

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1

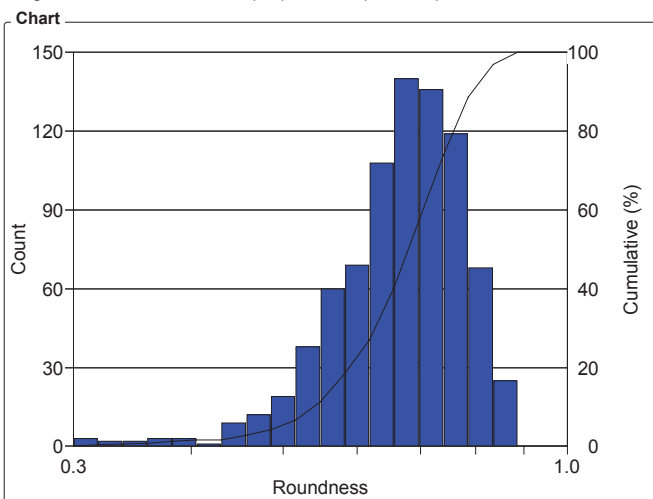


CircDiam Intervals (µm)	Count	%	Cumul%
20	2	0.24	0.24
23.2	22	2.69	2.94
27	21	2.57	5.51
31.3	48	5.88	11.38
36.4	33	4.04	15.42
42.3	45	5.51	20.93
49.1	73	8.94	29.87
57.1	85	10.40	40.27
66	88	10.77	51.04
77	85	10.40	61.44
89	61	7.47	68.91
104	55	6.73	75.64
121	46	5.63	81.27
140	40	4.90	86.17
163	48	5.88	92.04
189	37	4.53	96.57
220	17	2.08	98.65
255	7	0.86	99.51
296	3	0.37	99.88
344	1	0.12	100

Statistics	
Minimum:	22.8 µm
Maximum:	371.4 µm
Mean:	92.8 µm
Std Dev.:	56.5 µm
Sum:	75795.7 µm
Count:	817
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	9
Field Area:	8530105.2 µm <sup>2</sup>
Total Area:	76770946.5 µm <sup>2</sup>

### OBJM1 Count - Roundness

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1



Roundness Intervals	Count	%	Cumul%
0.30	3	0.37	0.37
0.32	2	0.24	0.61
0.34	2	0.24	0.86
0.36	3	0.37	1.22
0.38	3	0.37	1.59
0.41	1	0.12	1.71
0.43	9	1.10	2.82
0.46	12	1.47	4.28
0.49	19	2.33	6.61
0.52	38	4.65	11.26
0.55	60	7.34	18.60
0.58	69	8.45	27.05
0.62	108	13.22	40.27
0.66	140	17.14	57.41
0.70	136	16.65	74.05
0.74	119	14.57	88.62
0.79	68	8.32	96.94
0.83	25	3.06	100
0.89	0	0	100
0.94	0	0	100

Statistics	
Minimum:	0.3
Maximum:	0.9
Mean:	0.7
Std Dev.:	0.1
Count:	817
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	9
Field Area:	8530105.2 µm <sup>2</sup>
Total Area:	76770946.5 µm <sup>2</sup>

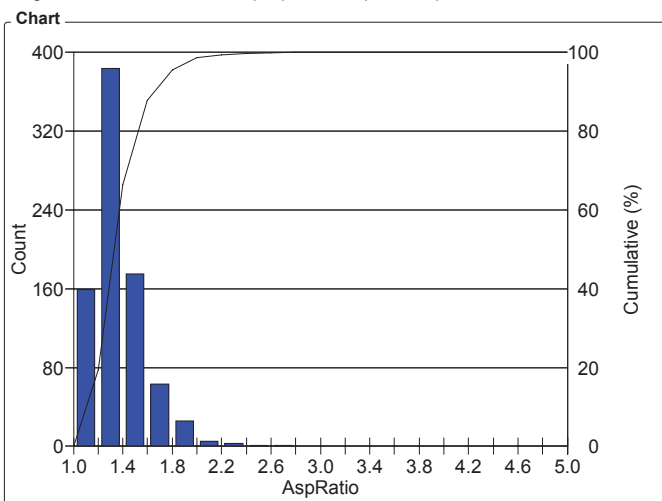
## 25x S1

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:11:09 AM**  
 Sample: **S1 Tr**

### OBJM1 Count - AspRatio

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1

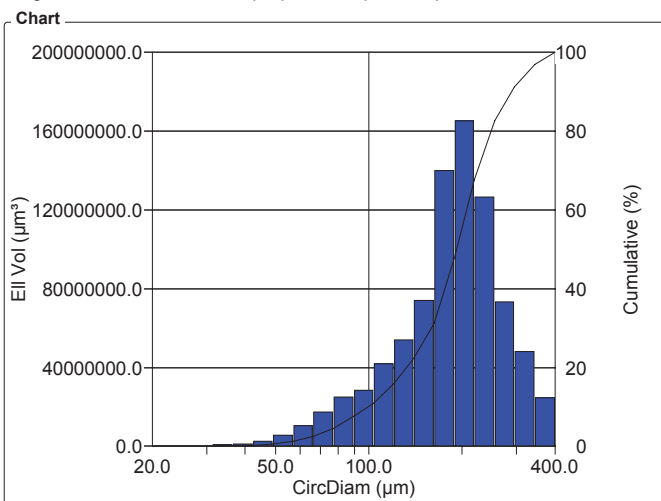


AspRatio Intervals	Count	%	Cumul%
1 - 1.20	159	19.46	19.46
1.20 - 1.40	384	47.00	66.46
1.40 - 1.60	175	21.42	87.88
1.60 - 1.80	63	7.71	95.59
1.80 - 2	26	3.18	98.78
2 - 2.20	5	0.61	99.39
2.20 - 2.40	3	0.37	99.76
2.40 - 2.60	1	0.12	99.88
2.60 - 2.80	1	0.12	100
2.80 - 3	0	0	100
3 - 3.20	0	0	100
3.20 - 3.40	0	0	100
3.40 - 3.60	0	0	100
3.60 - 3.80	0	0	100
3.80 - 4	0	0	100
4 - 4.20	0	0	100
4.20 - 4.40	0	0	100
4.40 - 4.60	0	0	100
4.60 - 4.80	0	0	100
4.80 - 5	0	0	100

Statistics	
Minimum:	1.1
Maximum:	2.6
Mean:	1.4
Std Dev.:	0.2
Count:	817
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	9
Field Area:	8530105.2 µm <sup>2</sup>
Total Area:	76770946.5 µm <sup>2</sup>

### OBJM1 EII Vol - CircDiam

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1



CircDiam Intervals (µm)	EII Vol (µm <sup>3</sup> )	%	Cumul%
20 - 23.2	10544.9	1.25e-03	1.25e-03
23.2 - 27	188528.8	0.02	0.02
27 - 31.3	255313.3	0.03	0.05
31.3 - 36.4	1012246.8	0.12	0.17
36.4 - 42.3	1113556.4	0.13	0.31
42.3 - 49.1	2456305.3	0.29	0.60
49.1 - 57.1	5590231	0.66	1.26
57.1 - 66	10.7e+06	1.27	2.53
66 - 77	17.4e+06	2.08	4.61
77 - 89	25.2e+06	2.99	7.60
89 - 104	28.3e+06	3.37	10.97
104 - 121	42.0e+06	4.99	15.97
121 - 140	54.0e+06	6.42	22.39
140 - 163	74.2e+06	8.82	31.21
163 - 189	140.1e+06	16.67	47.88
189 - 220	165.4e+06	19.68	67.56
220 - 255	126.6e+06	15.06	82.61
255 - 296	73.4e+06	8.73	91.34
296 - 344	48.0e+06	5.71	97.06
344 - 400	24.8e+06	2.94	100

Statistics	
Minimum:	22.8 µm
Maximum:	371.4 µm
Mean:	193.7 µm
Std Dev.:	69.8 µm
Sum:	162794732791.0 µm
Count:	817
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	9
Field Area:	8530105.2 µm <sup>2</sup>
Total Area:	76770946.5 µm <sup>2</sup>

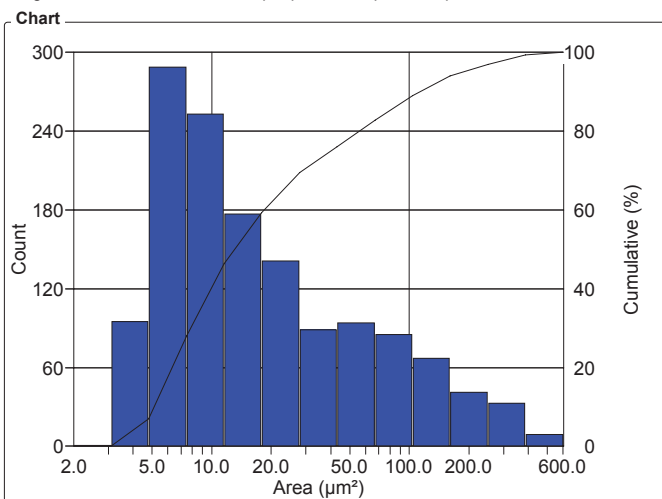
## 200x S1

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:15:36 AM**  
 Sample: **S1 tr**

### OBJM1 Count - Area

Magn.: 200xT Calib.: 0.3113  $\mu\text{m}/\text{pixel}$  Bitplane: Bitplane 1

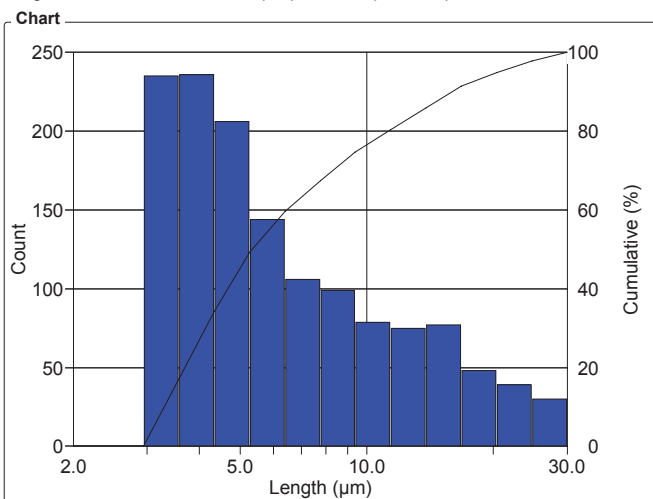


Area Intervals ( $\mu\text{m}^2$ )	Count	%	Cumul%
2 - 3.1	1	0.07	0.07
3.1 - 4.8	95	6.91	6.99
4.8 - 7.5	289	21.03	28.02
7.5 - 11.6	253	18.41	46.43
11.6 - 17.9	177	12.88	59.32
17.9 - 28	141	10.26	69.58
28 - 43	89	6.48	76.06
43 - 67	94	6.84	82.90
67 - 104	85	6.19	89.08
104 - 161	67	4.88	93.96
161 - 249	41	2.98	96.94
249 - 387	33	2.40	99.34
387 - 600	9	0.66	100

Statistics	
Minimum:	2.9 $\mu\text{m}^2$
Maximum:	532.0 $\mu\text{m}^2$
Mean:	41.2 $\mu\text{m}^2$
Std Dev.:	69.4 $\mu\text{m}^2$
Sum:	56586.4 $\mu\text{m}^2$
Count:	1374
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	196
Field Area:	155216.5 $\mu\text{m}^2$
Total Area:	30422435.2 $\mu\text{m}^2$

### OBJM1 Count - Length

Magn.: 200xT Calib.: 0.3113  $\mu\text{m}/\text{pixel}$  Bitplane: Bitplane 1



Length Intervals ( $\mu\text{m}$ )	Count	%	Cumul%
2 - 2.4	0	0	0
2.4 - 2.9	0	0	0
2.9 - 3.6	235	17.10	17.10
3.6 - 4.3	236	17.18	34.28
4.3 - 5.3	206	14.99	49.27
5.3 - 6.4	144	10.48	59.75
6.4 - 7.7	106	7.71	67.47
7.7 - 9.4	99	7.21	74.67
9.4 - 11.4	79	5.75	80.42
11.4 - 13.8	75	5.46	85.88
13.8 - 16.8	77	5.60	91.48
16.8 - 20.4	48	3.49	94.98
20.4 - 24.7	39	2.84	97.82
24.7 - 30	30	2.18	100

Statistics	
Minimum:	3.1 $\mu\text{m}$
Maximum:	30.0 $\mu\text{m}$
Mean:	7.7 $\mu\text{m}$
Std Dev.:	5.6 $\mu\text{m}$
Sum:	10583.2 $\mu\text{m}$
Count:	1374
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	196
Field Area:	155216.5 $\mu\text{m}^2$
Total Area:	30422435.2 $\mu\text{m}^2$

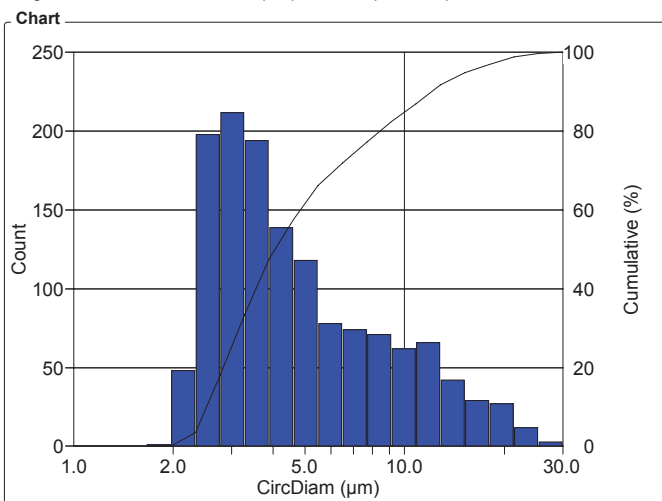
## 200x S1

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:15:37 AM**  
 Sample: **S1 tr**

### OBJM1 Count - CircDiam

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1



**Values**

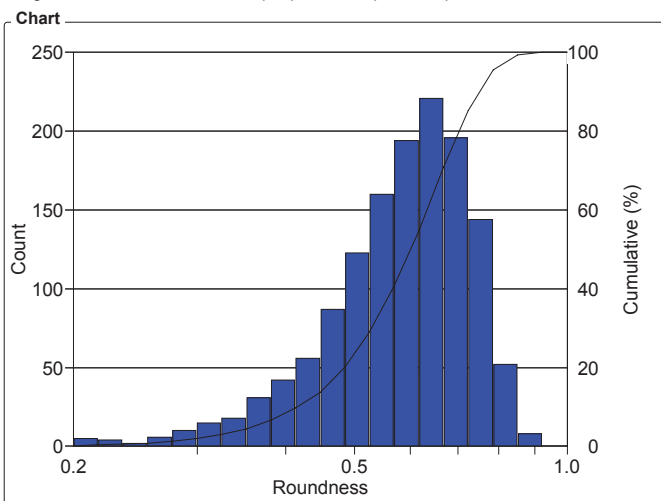
CircDiam Intervals (µm)	Count	%	Cumul%
1 - 1.2	0	0	0
1.2 - 1.4	0	0	0
1.4 - 1.7	0	0	0
1.7 - 2.0	1	0.07	0.07
2.0 - 2.3	48	3.49	3.57
2.3 - 2.8	198	14.41	17.98
2.8 - 3.3	212	15.43	33.41
3.3 - 3.9	194	14.12	47.53
3.9 - 4.6	139	10.12	57.64
4.6 - 5.5	118	8.59	66.23
5.5 - 6.5	78	5.68	71.91
6.5 - 7.7	74	5.39	77.29
7.7 - 9.1	71	5.17	82.46
9.1 - 10.8	62	4.51	86.97
10.8 - 12.8	66	4.80	91.78
12.8 - 15.2	42	3.06	94.83
15.2 - 18	29	2.11	96.94
18 - 21.4	27	1.97	98.91
21.4 - 25.3	12	0.87	99.78
25.3 - 30	3	0.22	100

**Statistics**

Minimum:	1.9	µm
Maximum:	26.0	µm
Mean:	5.8	µm
Std Dev.:	4.3	µm
Sum:	8024.2	µm
Count:	1374	
Under:	0	
Over:	0	
Accepted:	100.0	%
Field Count:	196	
Field Area:	155216.5	µm <sup>2</sup>
Total Area:	30422435.2	µm <sup>2</sup>

### OBJM1 Count - Roundness

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1



**Values**

Roundness Intervals	Count	%	Cumul%
0.20 - 0.22	5	0.36	0.36
0.22 - 0.23	4	0.29	0.66
0.23 - 0.25	2	0.15	0.80
0.25 - 0.28	6	0.44	1.24
0.28 - 0.30	10	0.73	1.97
0.30 - 0.32	15	1.09	3.06
0.32 - 0.35	18	1.31	4.37
0.35 - 0.38	31	2.26	6.62
0.38 - 0.41	42	3.06	9.68
0.41 - 0.45	56	4.08	13.76
0.45 - 0.49	87	6.33	20.09
0.49 - 0.52	123	8.95	29.04
0.52 - 0.57	160	11.64	40.68
0.57 - 0.62	194	14.12	54.80
0.62 - 0.67	221	16.08	70.89
0.67 - 0.73	196	14.26	85.15
0.73 - 0.79	144	10.48	95.63
0.79 - 0.85	52	3.78	99.42
0.85 - 0.92	8	0.58	100
0.92 - 1	0	0	100

**Statistics**

Minimum:	0.2	
Maximum:	0.9	
Mean:	0.6	
Std Dev.:	0.1	
Count:	1374	
Under:	0	
Over:	0	
Accepted:	100.0	%
Field Count:	196	
Field Area:	155216.5	µm <sup>2</sup>
Total Area:	30422435.2	µm <sup>2</sup>

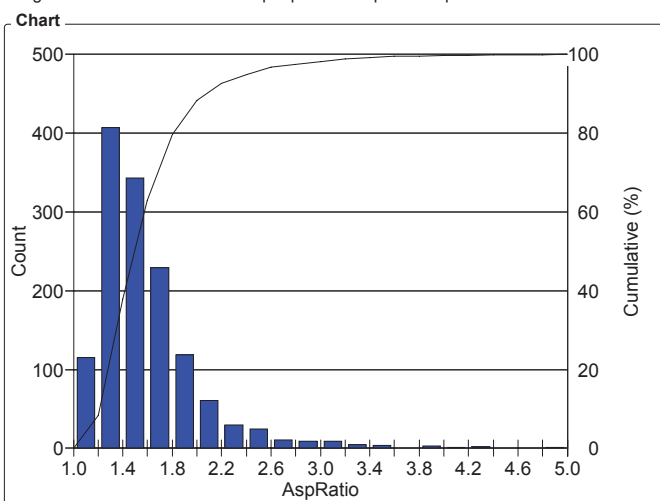
## 200x S1

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:15:37 AM**  
 Sample: **S1 tr**

### OBJM1 Count - AspRatio

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1

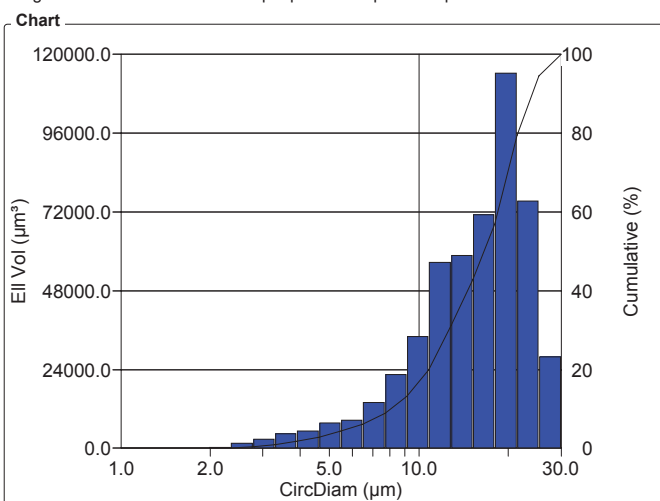


AspRatio Intervals	Count	%	Cumul%
1 - 1.20	115	8.37	8.37
1.20 - 1.40	407	29.62	37.99
1.40 - 1.60	343	24.96	62.95
1.60 - 1.80	229	16.67	79.62
1.80 - 2	119	8.66	88.28
2 - 2.20	61	4.44	92.72
2.20 - 2.40	30	2.18	94.91
2.40 - 2.60	25	1.82	96.72
2.60 - 2.80	11	0.80	97.53
2.80 - 3	9	0.66	98.18
3 - 3.20	9	0.66	98.84
3.20 - 3.40	5	0.36	99.20
3.40 - 3.60	4	0.29	99.49
3.60 - 3.80	0	0	99.49
3.80 - 4	3	0.22	99.71
4 - 4.20	1	0.07	99.78
4.20 - 4.40	2	0.15	99.93
4.40 - 4.60	0	0	99.93
4.60 - 4.80	0	0	99.93
4.80 - 5	1	0.07	100

Statistics	
Minimum:	1.1
Maximum:	5.0
Mean:	1.6
Std Dev.:	0.4
Count:	1374
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	196
Field Area:	155216.5 µm²
Total Area:	30422435.2 µm²

### OBJM1 Ell Vol - CircDiam

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1



CircDiam Intervals (µm)	Ell Vol (µm³)	%	Cumul%
1 - 1.2	0	0	0
1.2 - 1.4	0	0	0
1.4 - 1.7	0	0	0
1.7 - 2.0	3.3	656.26e-06	656.26e-06
2.0 - 2.3	210.9	0.04	0.04
2.3 - 2.8	1617.5	0.32	0.36
2.8 - 3.3	2889.3	0.57	0.93
3.3 - 3.9	4440.1	0.88	1.81
3.9 - 4.6	5297.1	1.05	2.86
4.6 - 5.5	7790.1	1.54	4.40
5.5 - 6.5	8509.4	1.68	6.08
6.5 - 7.7	13962.3	2.76	8.85
7.7 - 9.1	22385.7	4.43	13.27
9.1 - 10.8	34146.2	6.75	20.03
10.8 - 12.8	56600.0	11.20	31.22
12.8 - 15.2	58856.4	11.64	42.87
15.2 - 18	71199.5	14.08	56.95
18 - 21.4	114325.5	22.61	79.56
21.4 - 25.3	75409.4	14.92	94.48
25.3 - 30	27910.4	5.52	100

Statistics	
Minimum:	1.9 µm
Maximum:	26.0 µm
Mean:	15.9 µm
Std Dev.:	5.7 µm
Sum:	8062843.2 µm
Count:	1374
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	196
Field Area:	155216.5 µm²
Total Area:	30422435.2 µm²

**Sample # 2 -  
cal pro aggro séchoir #4 sac # 150 5007-J**

# Particle Size Analysis

**Date:** 2008-Mar-31, 2:49:24 PM -04'00'  
**Company:** Clemex  
**Department:** Laboratory  
**User Name:** Generic User Name (s ...)  
**Sample ID:** S2 length > 30 microns

**Magnification:** 25xT  
**Calibration:** 2.5278  $\mu\text{m}/\text{pixel}$   
**Units:** microns  
**# Fields:** 9  
**Particle Count:** 495

Figure 1: Typical field of view as captured.

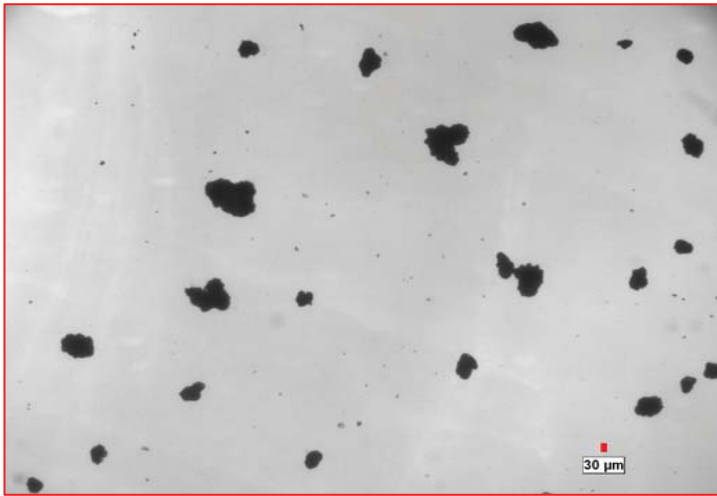
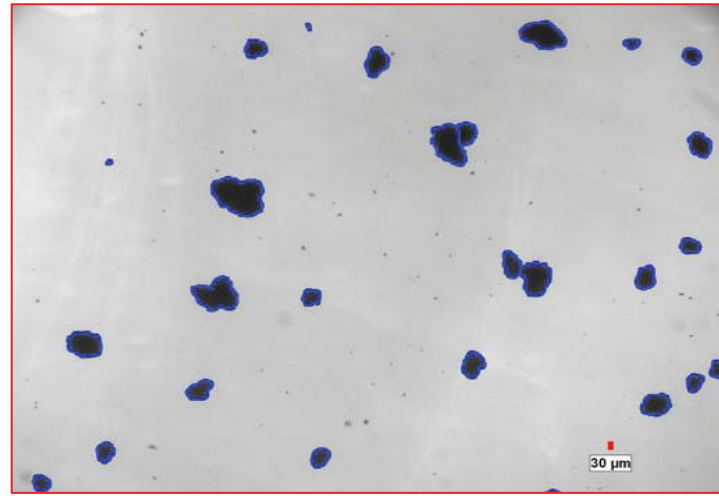
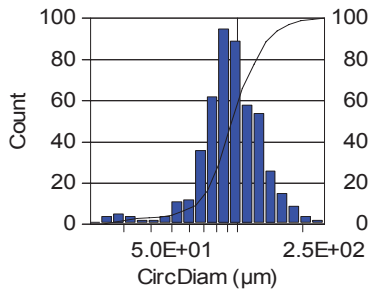


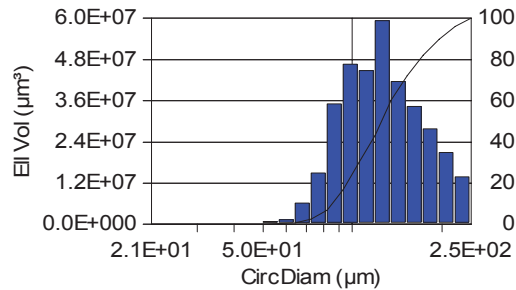
Figure 2: Measured particles appear in blue.



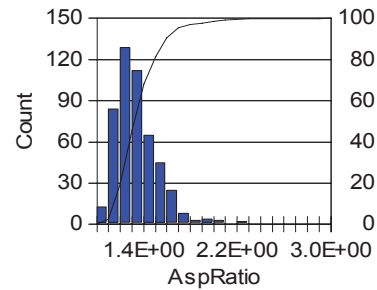
Count - Equivalent Diameter



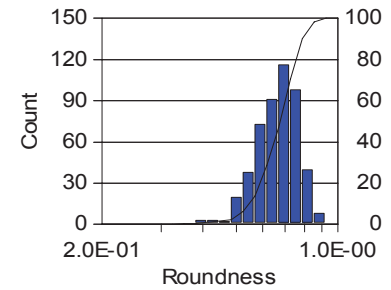
Volume - Diameter



Count - Aspect Ratio



Count - Roundness



Units:	microns	microns	(ratio)	(ratio)
Min:	20.57	20.57	1.06	0.24
Max.:	238.76	238.76	2.97	0.90
Mean:	98.60	132.33	1.36	0.67
Std. Dev.:	32.26	41.32	0.20	0.09
D10:	64.64	86.41	1.15	0.55
D50:	95.05	126.12	1.31	0.67
D90:	137.89	189.73	1.59	0.78

# Particle Size Analysis

**Date:** 2008-Mar-31, 12:37:02 PM -04'00'  
**Company:** Clemex  
**Department:** Laboratory  
**User Name:** Generic User Name (s ...)  
**Sample ID:** S2 length < 30 microns

**Magnification:** 200xT  
**Calibration:** 0.3113  $\mu\text{m}/\text{pixel}$   
**Units:** microns  
**# Fields:** 196  
**Particle Count:** 1220

Figure 1: Typical field of view as captured.

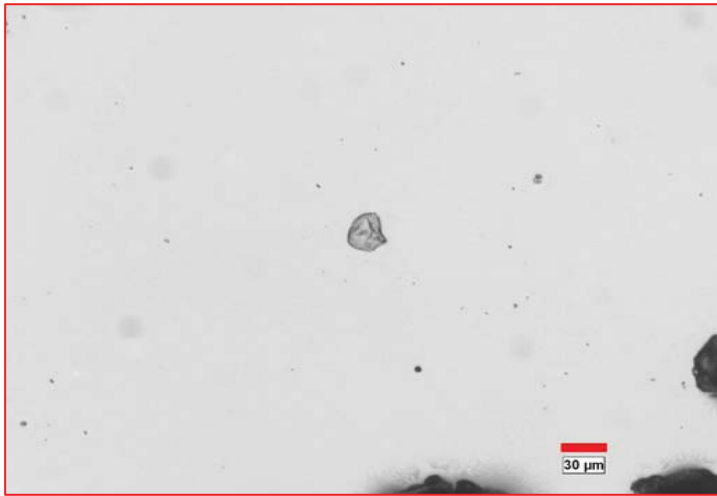
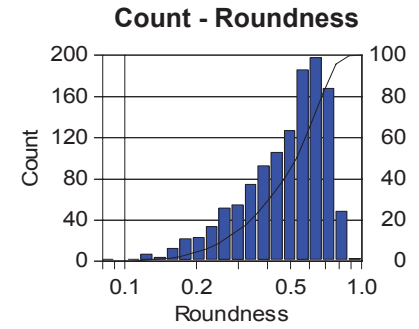
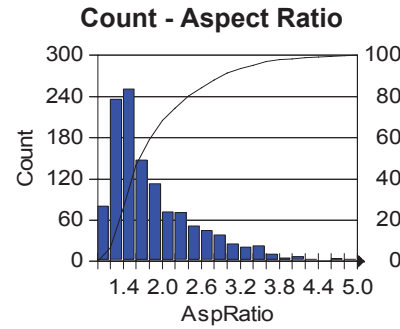
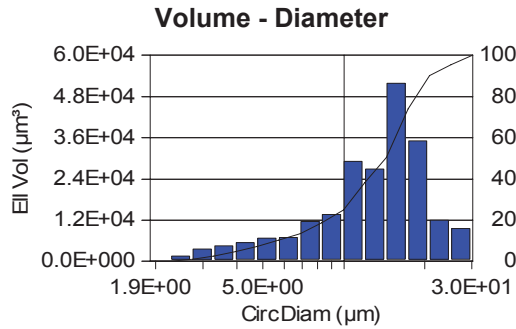
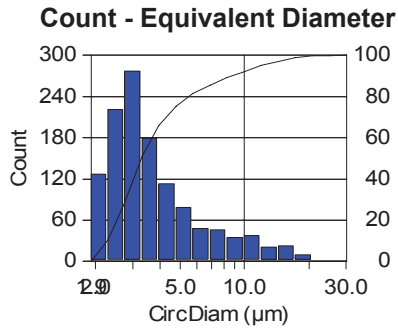
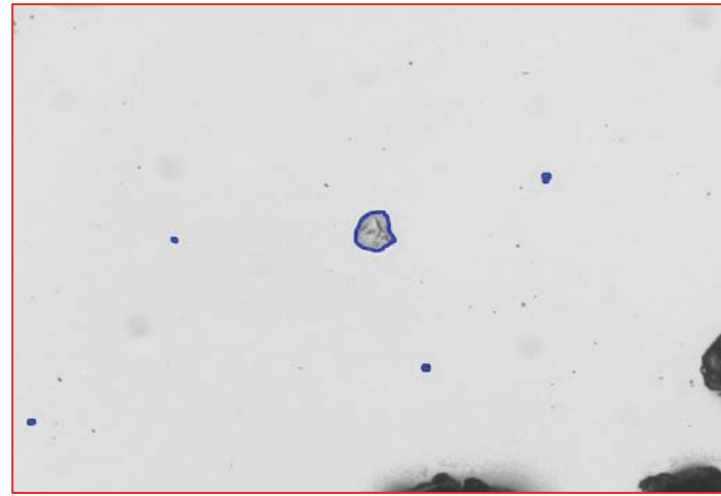


Figure 2: Measured particles appear in blue.



Units:	microns	microns	(ratio)	(ratio)
Min:	1.86	1.86	1.07	0.08
Max.:	25.68	25.68	4.96	0.89
Mean:	4.49	13.75	1.89	0.51
Std. Dev.:	3.27	5.55	0.70	0.18
D10:	2.27	5.58	1.25	0.26
D50:	3.24	14.30	1.65	0.53
D90:	8.60	19.67	2.93	0.73

## **Printed Results**

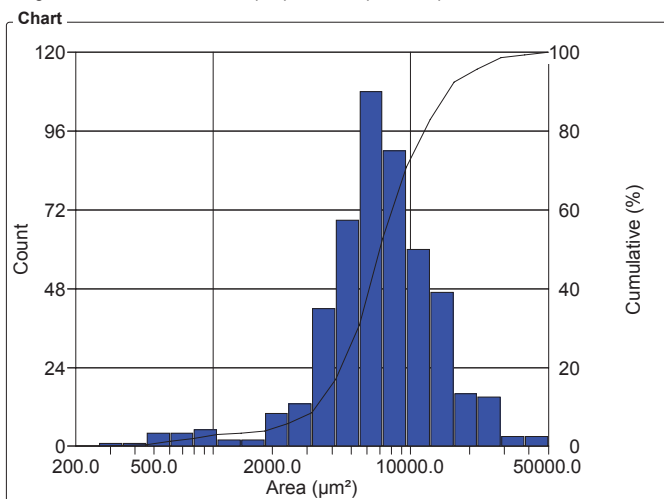
## 25x S2

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:19:11 AM**  
 Sample: **S2 Tr**

### OBJM1 Count - Area

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1

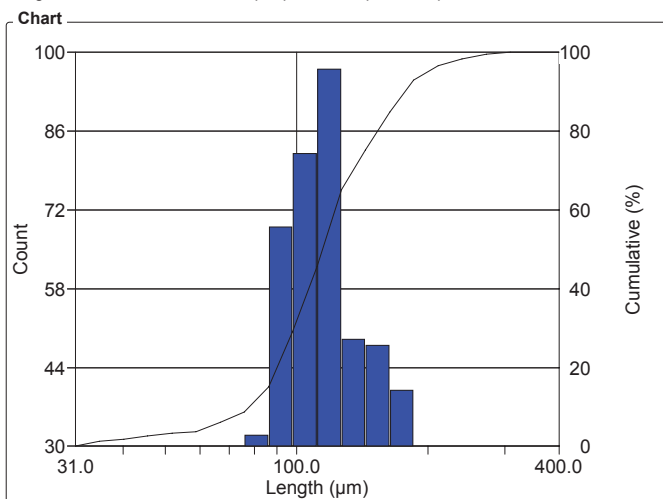


Area Intervals (µm²)	Count	%	Cumul%
200 - 264	0	0	0
264 - 347	1	0.20	0.20
347 - 458	1	0.20	0.40
458 - 603	4	0.81	1.21
603 - 795	4	0.81	2.02
795 - 1048	5	1.01	3.03
1048 - 1381	2	0.40	3.43
1381 - 1821	2	0.40	3.84
1821 - 2399	10	2.02	5.86
2399 - 3162	13	2.63	8.48
3162 - 4168	42	8.48	16.97
4168 - 5493	69	13.94	30.91
5493 - 7239	108	21.82	52.73
7239 - 9541	90	18.18	70.91
9541 - 12574	60	12.12	83.03
12574 - 16572	47	9.49	92.53
16572 - 21841	16	3.23	95.76
21841 - 28786	15	3.03	98.79
28786 - 37938	3	0.61	99.39
37938 - 50000	3	0.61	100

Statistics		
Minimum:	332.3	µm²
Maximum:	44773.3	µm²
Mean:	8451.5	µm²
Std Dev.:	5797.5	µm²
Sum:	4183486.8	µm²
Count:	495	
Under:	0	
Over:	0	
Accepted:	100.0	%
Field Count:	9	
Field Area:	8530105.2	µm²
Total Area:	76770946.5	µm²

### OBJM1 Count - Length

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1



Length Intervals (µm)	Count	%	Cumul%
31 - 35.2	6	1.21	1.21
35.2 - 40	3	0.61	1.82
40 - 45.5	4	0.81	2.63
45.5 - 51.7	4	0.81	3.43
51.7 - 58.8	1	0.20	3.64
58.8 - 66.8	12	2.42	6.06
66.8 - 76	13	2.63	8.69
76 - 86	32	6.46	15.15
86 - 98	69	13.94	29.09
98 - 111	82	16.57	45.66
111 - 127	97	19.60	65.25
127 - 144	49	9.90	75.15
144 - 163	48	9.70	84.85
163 - 186	40	8.08	92.93
186 - 211	18	3.64	96.57
211 - 240	9	1.82	98.38
240 - 273	6	1.21	99.60
273 - 310	2	0.40	100
310 - 352	0	0	100
352 - 400	0	0	100

Statistics		
Minimum:	30.6	µm
Maximum:	304.0	µm
Mean:	121.5	µm
Std Dev.:	41.6	µm
Sum:	60135.6	µm
Count:	495	
Under:	0	
Over:	0	
Accepted:	100.0	%
Field Count:	9	
Field Area:	8530105.2	µm²
Total Area:	76770946.5	µm²

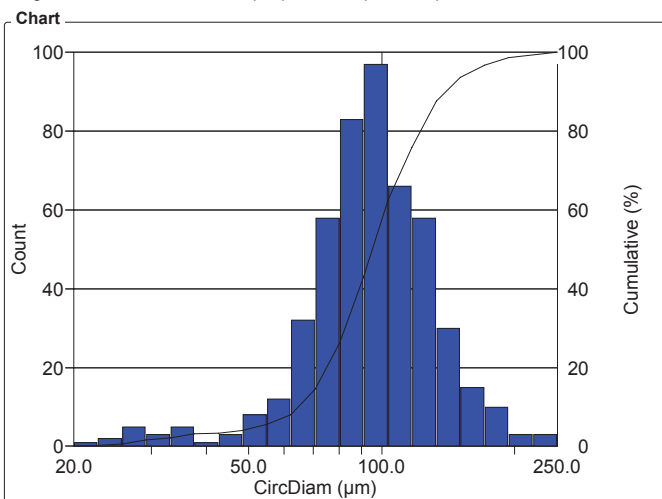
## 25x S2

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:19:11 AM**  
 Sample: **S2 Tr**

### OBJM1 Count - CircDiam

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1

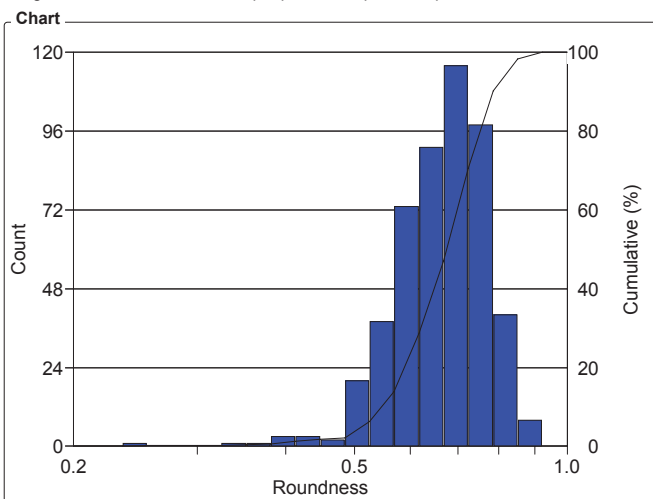


Values			
CircDiam Intervals (µm)	Count	%	Cumul%
20 - 22.7	1	0.20	0.20
22.7 - 25.7	2	0.40	0.61
25.7 - 29.2	5	1.01	1.62
29.2 - 33.1	3	0.61	2.22
33.1 - 37.6	5	1.01	3.23
37.6 - 42.7	1	0.20	3.43
42.7 - 48.4	3	0.61	4.04
48.4 - 54.9	8	1.62	5.66
54.9 - 62.3	12	2.42	8.08
62.3 - 70.7	32	6.46	14.55
70.7 - 80	58	11.72	26.26
80 - 91	83	16.77	43.03
91 - 103	97	19.60	62.63
103 - 117	66	13.33	75.96
117 - 133	58	11.72	87.68
133 - 151	30	6.06	93.74
151 - 171	15	3.03	96.77
171 - 194	10	2.02	98.79
194 - 220	3	0.61	99.39
220 - 250	3	0.61	100

Statistics	
Minimum:	20.6 µm
Maximum:	238.8 µm
Mean:	98.6 µm
Std Dev.:	32.3 µm
Sum:	48806.8 µm
Count:	495
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	9
Field Area:	8530105.2 µm <sup>2</sup>
Total Area:	76770946.5 µm <sup>2</sup>

### OBJM1 Count - Roundness

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1



Values			
Roundness Intervals	Count	%	Cumul%
0.20 - 0.22	0	0	0
0.22 - 0.23	0	0	0
0.23 - 0.25	1	0.20	0.20
0.25 - 0.28	0	0	0.20
0.28 - 0.30	0	0	0.20
0.30 - 0.32	0	0	0.20
0.32 - 0.35	1	0.20	0.40
0.35 - 0.38	1	0.20	0.61
0.38 - 0.41	3	0.61	1.21
0.41 - 0.45	3	0.61	1.82
0.45 - 0.49	2	0.40	2.22
0.49 - 0.52	20	4.04	6.26
0.52 - 0.57	38	7.68	13.94
0.57 - 0.62	73	14.75	28.69
0.62 - 0.67	91	18.38	47.07
0.67 - 0.73	116	23.43	70.51
0.73 - 0.79	98	19.80	90.30
0.79 - 0.85	40	8.08	98.38
0.85 - 0.92	8	1.62	100
0.92 - 1	0	0	100

Statistics	
Minimum:	0.2
Maximum:	0.9
Mean:	0.7
Std Dev.:	0.1
Count:	495
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	9
Field Area:	8530105.2 µm <sup>2</sup>
Total Area:	76770946.5 µm <sup>2</sup>

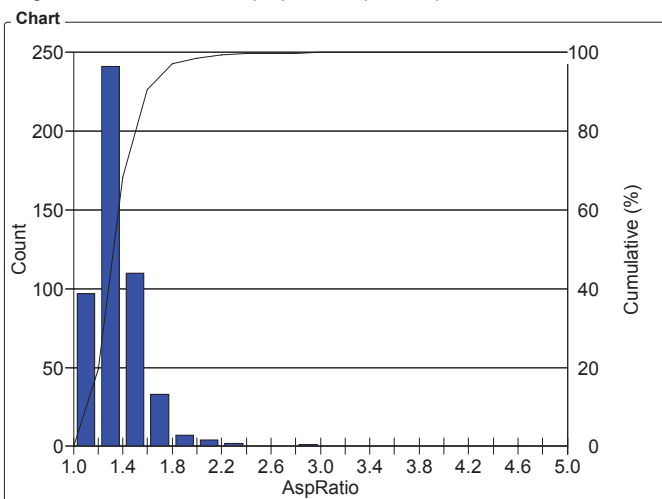
## 25x S2

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:19:11 AM**  
 Sample: **S2 Tr**

### OBJM1 Count - AspRatio

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1

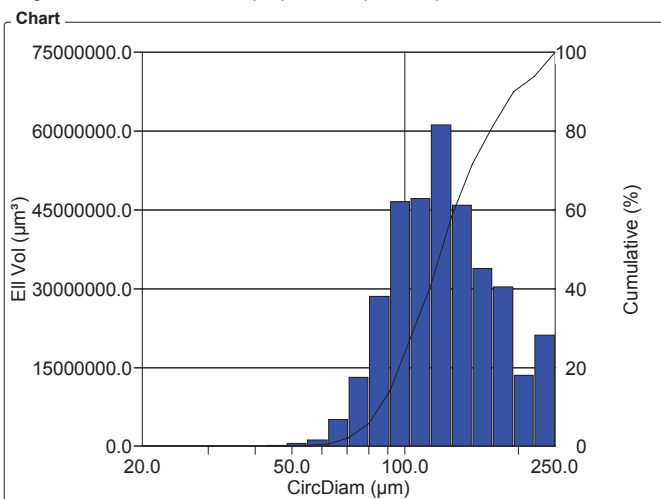


AspRatio Intervals	Count	%	Cumul%
1 - 1.20	97	19.60	19.60
1.20 - 1.40	241	48.69	68.28
1.40 - 1.60	110	22.22	90.51
1.60 - 1.80	33	6.67	97.17
1.80 - 2	7	1.41	98.59
2 - 2.20	4	0.81	99.39
2.20 - 2.40	2	0.40	99.80
2.40 - 2.60	0	0	99.80
2.60 - 2.80	0	0	99.80
2.80 - 3	1	0.20	100
3 - 3.20	0	0	100
3.20 - 3.40	0	0	100
3.40 - 3.60	0	0	100
3.60 - 3.80	0	0	100
3.80 - 4	0	0	100
4 - 4.20	0	0	100
4.20 - 4.40	0	0	100
4.40 - 4.60	0	0	100
4.60 - 4.80	0	0	100
4.80 - 5	0	0	100

Statistics	
Minimum:	1.1
Maximum:	3.0
Mean:	1.4
Std Dev.:	0.2
Count:	495
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	9
Field Area:	8530105.2 µm²
Total Area:	76770946.5 µm²

### OBJM1 EII Vol - CircDiam

Magn.: 25xT Calib.: 2.5278 µm/pixel Bitplane: Bitplane 1



CircDiam Intervals (µm)	EII Vol (µm³)	%	Cumul%
20 - 22.7	4283.3	1.23e-03	1.23e-03
22.7 - 25.7	14741.7	4.23e-03	5.46e-03
25.7 - 29.2	58003.7	0.02	0.02
29.2 - 33.1	52676.4	0.02	0.04
33.1 - 37.6	114310.6	0.03	0.07
37.6 - 42.7	39091.0	0.01	0.08
42.7 - 48.4	155899.1	0.04	0.13
48.4 - 54.9	582757.9	0.17	0.29
54.9 - 62.3	1245096.8	0.36	0.65
62.3 - 70.7	5079960	1.46	2.11
70.7 - 80	13.1e+06	3.76	5.86
80 - 91	28.5e+06	8.17	14.04
91 - 103	46.6e+06	13.35	27.39
103 - 117	47.2e+06	13.54	40.92
117 - 133	61.2e+06	17.54	58.46
133 - 151	45.9e+06	13.16	71.62
151 - 171	33.9e+06	9.72	81.33
171 - 194	30.4e+06	8.71	90.04
194 - 220	13.6e+06	3.89	93.93
220 - 250	21.2e+06	6.07	100

Statistics	
Minimum:	20.6 µm
Maximum:	238.8 µm
Mean:	132.3 µm
Std Dev.:	41.3 µm
Sum:	46148125953.8 µm
Count:	495
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	9
Field Area:	8530105.2 µm²
Total Area:	76770946.5 µm²

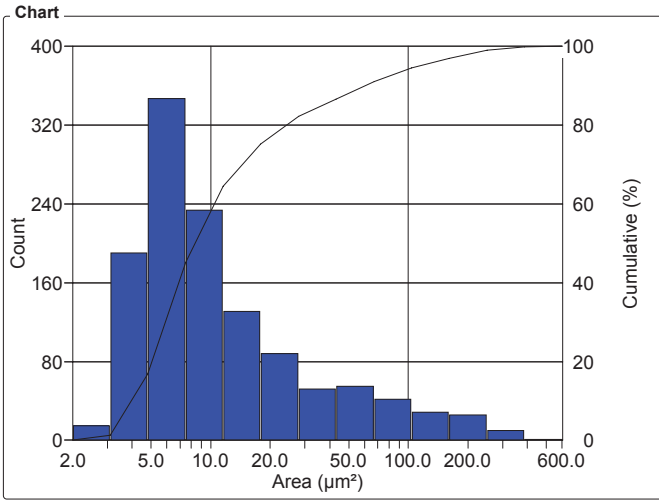
## 200x S2

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:43:19 AM**  
 Sample: **S2 tr**

### OBJM1 Count - Area

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1

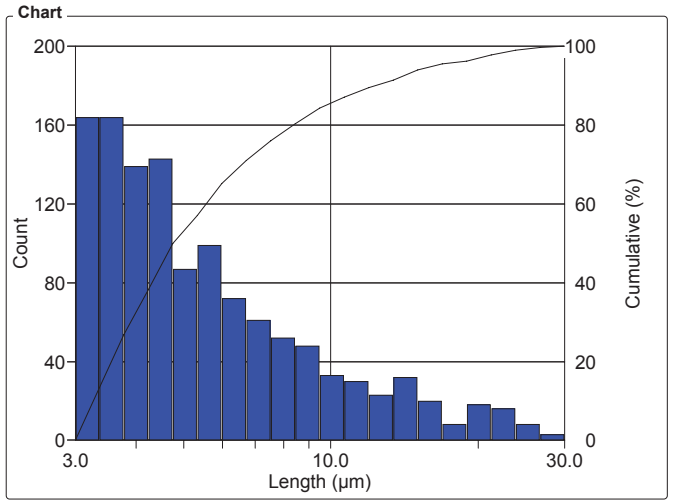


Area Intervals (µm <sup>2</sup> )	Count	%	Cumul%
2 - 3.1	15	1.23	1.23
3.1 - 4.8	190	15.57	16.80
4.8 - 7.5	347	28.44	45.25
7.5 - 11.6	234	19.18	64.43
11.6 - 17.9	131	10.74	75.16
17.9 - 28	88	7.21	82.38
28 - 43	52	4.26	86.64
43 - 67	55	4.51	91.15
67 - 104	42	3.44	94.59
104 - 161	29	2.38	96.97
161 - 249	26	2.13	99.10
249 - 387	10	0.82	99.92
387 - 600	1	0.08	100

Statistics		
Minimum:	2.7	µm <sup>2</sup>
Maximum:	517.8	µm <sup>2</sup>
Mean:	24.2	µm <sup>2</sup>
Std Dev.:	46.2	µm <sup>2</sup>
Sum:	29570.7	µm <sup>2</sup>
Count:	1220	
Under:	0	
Over:	0	
Accepted:	100.0	%
Field Count:	196	
Field Area:	155216.5	µm <sup>2</sup>
Total Area:	30422435.2	µm <sup>2</sup>

### OBJM1 Count - Length

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1



Length Intervals (µm)	Count	%	Cumul%
3 - 3.4	164	13.44	13.44
3.4 - 3.8	164	13.44	26.89
3.8 - 4.2	139	11.39	38.28
4.2 - 4.8	143	11.72	50
4.8 - 5.3	87	7.13	57.13
5.3 - 6.0	99	8.11	65.25
6.0 - 6.7	72	5.90	71.15
6.7 - 7.5	61	5.00	76.15
7.5 - 8.5	52	4.26	80.41
8.5 - 9.5	48	3.93	84.34
9.5 - 10.6	33	2.70	87.05
10.6 - 11.9	30	2.46	89.51
11.9 - 13.4	23	1.89	91.39
13.4 - 15	32	2.62	94.02
15 - 16.9	20	1.64	95.66
16.9 - 18.9	8	0.66	96.31
18.9 - 21.2	18	1.48	97.79
21.2 - 23.8	16	1.31	99.10
23.8 - 26.7	8	0.66	99.75
26.7 - 30	3	0.25	100

Statistics	
Minimum:	3.1 µm
Maximum:	29.1 µm
Mean:	6.5 µm
Std Dev.:	4.4 µm
Sum:	7897.1 µm
Count:	1220
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	196
Field Area:	155216.5 µm <sup>2</sup>
Total Area:	30422435.2 µm <sup>2</sup>

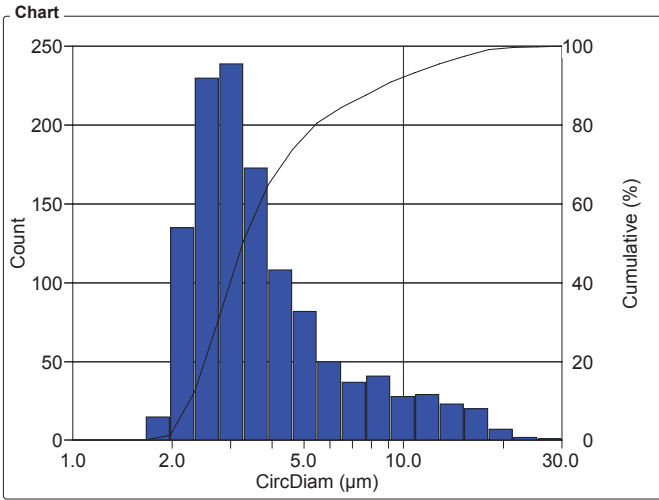
## 200x S2

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:43:19 AM**  
 Sample: **S2 tr**

### OBJM1 Count - CircDiam

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1



**Values**

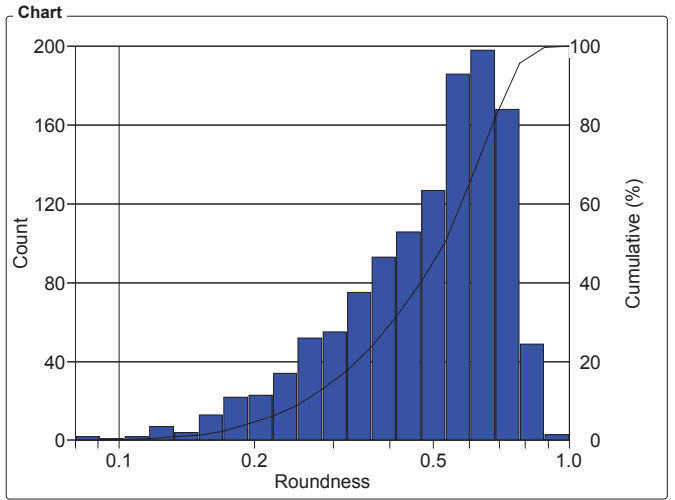
CircDiam Intervals (µm)	Count	%	Cumul%
1 - 1.2	0	0	0
1.2 - 1.4	0	0	0
1.4 - 1.7	0	0	0
1.7 - 2.0	15	1.23	1.23
2.0 - 2.3	135	11.07	12.30
2.3 - 2.8	230	18.85	31.15
2.8 - 3.3	239	19.59	50.74
3.3 - 3.9	173	14.18	64.92
3.9 - 4.6	108	8.85	73.77
4.6 - 5.5	82	6.72	80.49
5.5 - 6.5	50	4.10	84.59
6.5 - 7.7	37	3.03	87.62
7.7 - 9.1	41	3.36	90.98
9.1 - 10.8	28	2.30	93.28
10.8 - 12.8	29	2.38	95.66
12.8 - 15.2	23	1.89	97.54
15.2 - 18	20	1.64	99.18
18 - 21.4	7	0.57	99.75
21.4 - 25.3	2	0.16	99.92
25.3 - 30	1	0.08	100

**Statistics**

Minimum:	1.9	µm
Maximum:	25.7	µm
Mean:	4.5	µm
Std Dev.:	3.3	µm
Sum:	5481.9	µm
Count:	1220	
Under:	0	
Over:	0	
Accepted:	100.0	%
Field Count:	196	
Field Area:	155216.5	µm <sup>2</sup>
Total Area:	30422435.2	µm <sup>2</sup>

### OBJM1 Count - Roundness

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1



**Values**

Roundness Intervals	Count	%	Cumul%
0.08 - 0.09	2	0.16	0.16
0.09 - 0.10	1	0.08	0.25
0.10 - 0.12	2	0.16	0.41
0.12 - 0.13	7	0.57	0.98
0.13 - 0.15	4	0.33	1.31
0.15 - 0.17	13	1.07	2.38
0.17 - 0.19	22	1.80	4.18
0.19 - 0.22	23	1.89	6.07
0.22 - 0.25	34	2.79	8.85
0.25 - 0.28	52	4.26	13.11
0.28 - 0.32	55	4.51	17.62
0.32 - 0.36	75	6.15	23.77
0.36 - 0.41	93	7.62	31.39
0.41 - 0.47	106	8.69	40.08
0.47 - 0.53	127	10.41	50.49
0.53 - 0.60	186	15.25	65.74
0.60 - 0.69	198	16.23	81.97
0.69 - 0.78	168	13.77	95.74
0.78 - 0.88	49	4.02	99.75
0.88 - 1	3	0.25	100

**Statistics**

Minimum:	0.1	
Maximum:	0.9	
Mean:	0.5	
Std Dev.:	0.2	
Count:	1220	
Under:	0	
Over:	0	
Accepted:	100.0	%
Field Count:	196	
Field Area:	155216.5	µm <sup>2</sup>
Total Area:	30422435.2	µm <sup>2</sup>

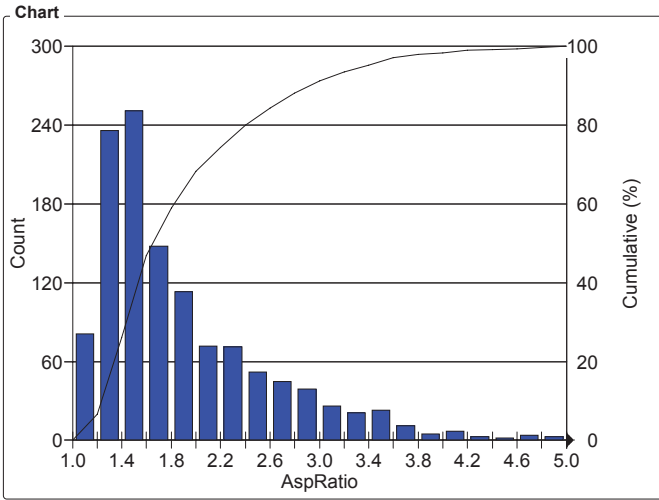
## 200x S2

Organization: **Clemex**  
 Department:  
 User: **Myriam Savard**

Date & Time: **03/04/2008 9:43:19 AM**  
 Sample: **S2 tr**

### OBJM1 Count - AspRatio

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1



#### Values

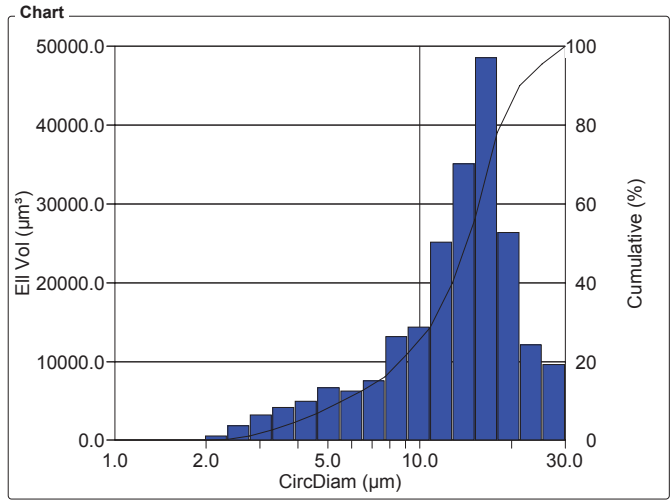
AspRatio Intervals	Count	%	Cumul%
1 - 1.20	81	6.68	6.68
1.20 - 1.40	236	19.46	26.13
1.40 - 1.60	251	20.69	46.83
1.60 - 1.80	148	12.20	59.03
1.80 - 2	113	9.32	68.34
2 - 2.20	72	5.94	74.28
2.20 - 2.40	71	5.85	80.13
2.40 - 2.60	52	4.29	84.42
2.60 - 2.80	45	3.71	88.13
2.80 - 3	39	3.22	91.34
3 - 3.20	26	2.14	93.49
3.20 - 3.40	21	1.73	95.22
3.40 - 3.60	23	1.90	97.11
3.60 - 3.80	11	0.91	98.02
3.80 - 4	5	0.41	98.43
4 - 4.20	7	0.58	99.01
4.20 - 4.40	3	0.25	99.26
4.40 - 4.60	2	0.16	99.42
4.60 - 4.80	4	0.33	99.75
4.80 - 5	3	0.25	100

#### Statistics

Minimum:	1.1
Maximum:	5.0
Mean:	1.9
Std Dev.:	0.7
Count:	1213
Under:	0
Over:	7
Accepted:	99.4 %
Field Count:	196
Field Area:	155216.5 µm <sup>2</sup>
Total Area:	30422435.2 µm <sup>2</sup>

### OBJM1 Ell Vol - CircDiam

Magn.: 200xT Calib.: 0.3113 µm/pixel Bitplane: Bitplane 1



#### Values

CircDiam Intervals (µm)	Ell Vol (µm <sup>3</sup> )	%	Cumul%
1 - 1.2	0	0	0
1.2 - 1.4	0	0	0
1.4 - 1.7	0	0	0
1.7 - 2.0	42.6	0.02	0.02
2.0 - 2.3	603.2	0.27	0.29
2.3 - 2.8	1826.4	0.83	1.12
2.8 - 3.3	3273.8	1.49	2.61
3.3 - 3.9	4162.8	1.89	4.51
3.9 - 4.6	4928.4	2.24	6.75
4.6 - 5.5	6670.6	3.03	9.78
5.5 - 6.5	6296.6	2.86	12.64
6.5 - 7.7	7517.4	3.42	16.06
7.7 - 9.1	13180.0	5.99	22.06
9.1 - 10.8	14406.6	6.55	28.61
10.8 - 12.8	25165.8	11.44	40.05
12.8 - 15.2	35090.6	15.96	56.01
15.2 - 18	48612.3	22.11	78.12
18 - 21.4	26379.5	12.00	90.11
21.4 - 25.3	12099.6	5.50	95.61
25.3 - 30	9646.0	4.39	100

#### Statistics

Minimum:	1.9 µm
Maximum:	25.7 µm
Mean:	13.7 µm
Std Dev.:	5.6 µm
Sum:	3023298.6 µm
Count:	1220
Under:	0
Over:	0
Accepted:	100.0 %
Field Count:	196
Field Area:	155216.5 µm <sup>2</sup>
Total Area:	30422435.2 µm <sup>2</sup>

# CLEMEX

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