

**CLEMEX**  
intelligent microscopy

**# 717**

## **Particle Size Analysis**



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For Elnor, SA

### Sample Description

Two samples of micronized rubber powder were submitted for image analysis. A small quantity of particles was withdrawn from each sample and spread-out on a slide for analysis suitability.

### Purpose of Analysis

To demonstrate that the Clemex Vision image analysis system can discriminate the rubber particles and perform size and shape measurements on them.

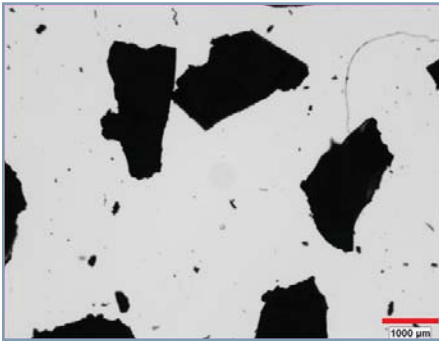


Figure 1: Original image from sample 1 (4.84 microns/pixel).

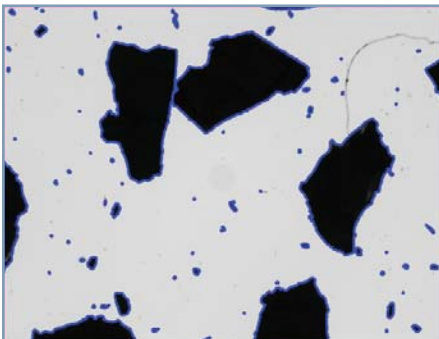


Figure 2: Outline of particles as measured in blue bitplane.

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

A Guard Frame was used to avoid measuring incomplete features that are sectioned by the field of view.

After an automated light adjustment, particles were binarized into the blue bitplane using Gray Threshold. A cleaning was done to eliminate small particles of 3 x 3 pixels or less.

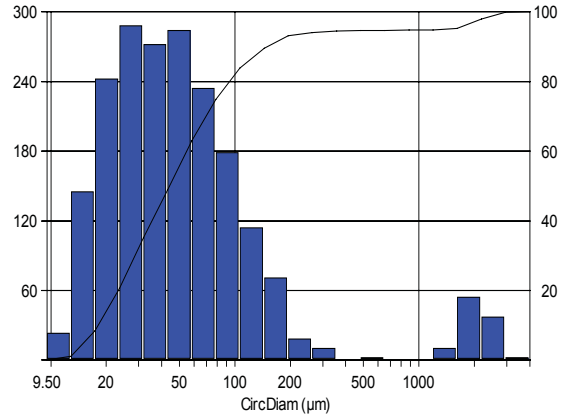
Connected particles were separated prior to measurements.

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

Area, Length, Width, Feret Average, Circular Diameter, Sphericity Roundness, Aspect Ratio, Compactness and Roughness measurements were performed on each feature. Automated statistics

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

and graphs were generated and printed in pdf format. Final results can be saved from Clemex Vision and loaded back 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 were also exported in Excel format.



Minimum: 10.92 microns  
Maximum: 3116.50 microns  
Mean: 163.92 microns  
Std Dev.: 467.90 microns

Figure 3: Particle's Circular Diameter distribution and corresponding statistics.

### Equipment

Image Analysis System: Clemex Vision PS3  
Stereoscope: Leica Z6  
Illumination: Reflected Light  
Calibration: 4.8376 microns/pixel  
Camera: Clemex L 2.1M (1608 x 1212)  
Motorized Stage: Marzhauser EK32IM 75x50mm

### Discussion

The main difficulty of this analysis was to detect small and large particles without sectioning the large ones or measuring a cluster as a unique large feature.

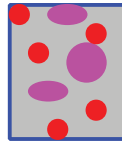
A stereoscope was used allowing to see the largest features while still seeing small ones. The use of a guard frame allowed to consider only complete features.

In both samples, two size distributions were observed. Sample one was composed of some very large particles mixed with a large quantity of very small ones. Sample two also presented two distributions but with a smallest variation between both. The results were printed out in two versions: one with all particles together and one including only the largest distribution (for Length and Diameter only). In that case, the old statistics (for all particles) appear in parenthesis for comparison purpose. If desired, the small distribution can be automatically excluded from the analysis.

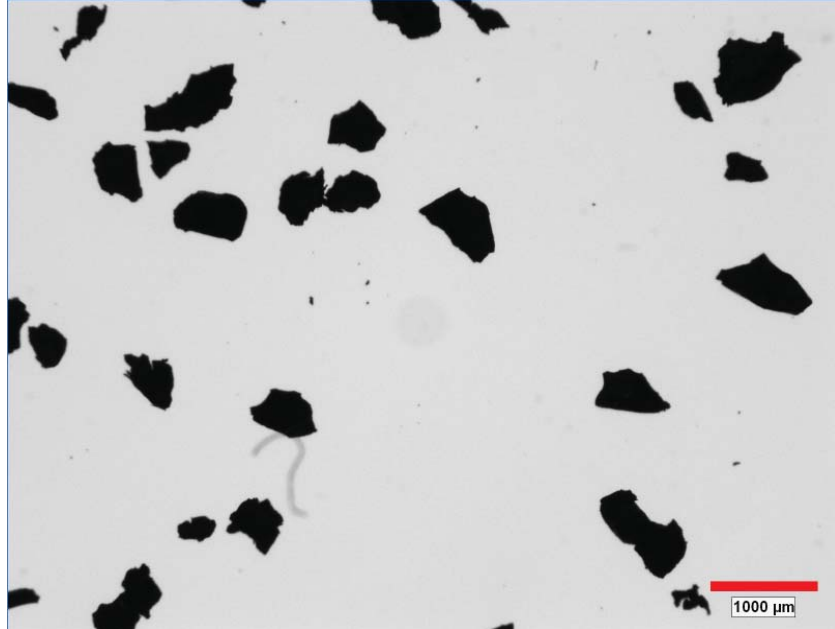
Results are reproducible.



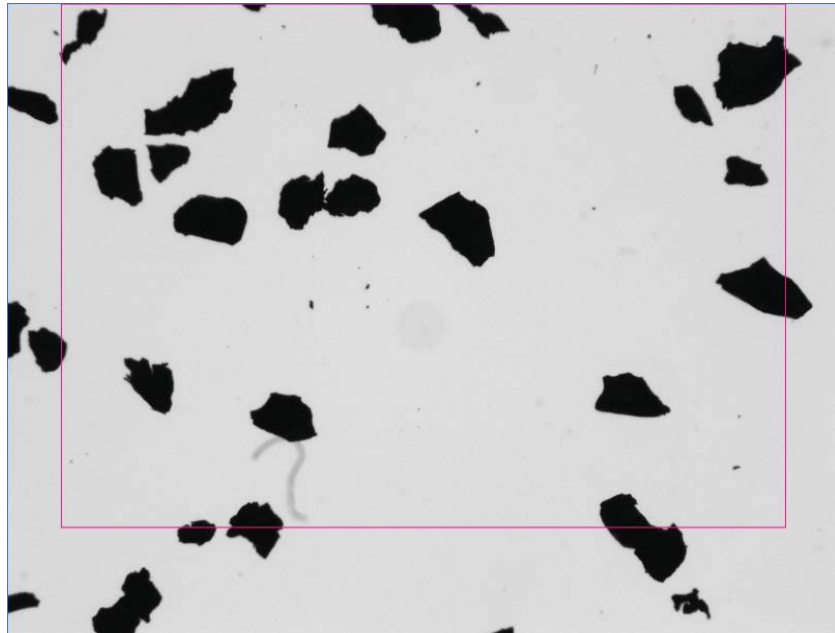
## Appendix A: Image Analysis Steps



## Image Analysis Steps

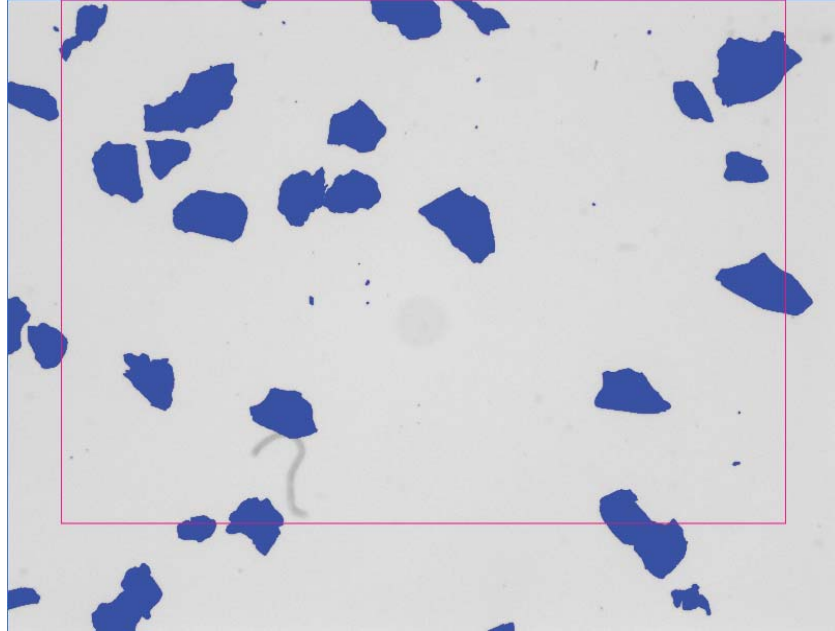


*Image 1: Original image as captured using the Leica Z6 stereoscope (4.8376 microns / pixel).*

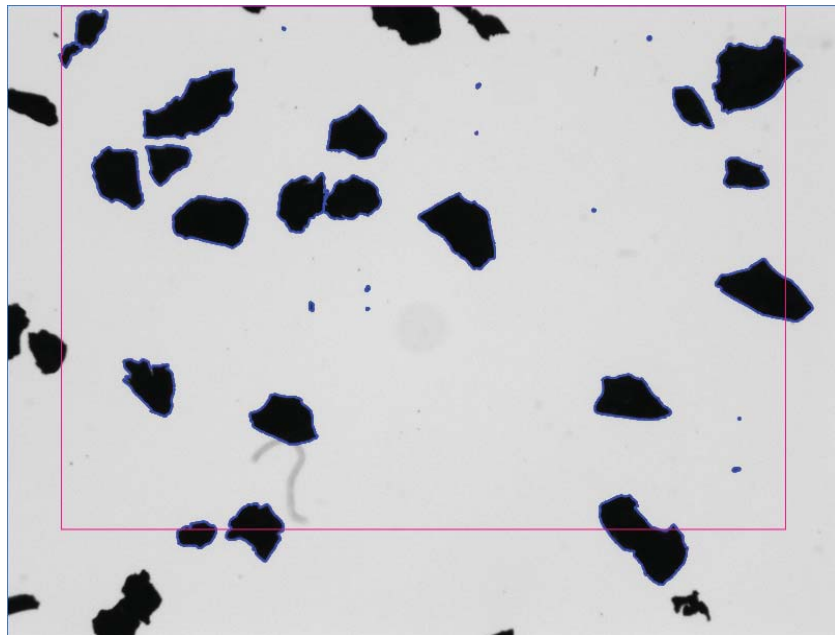


*Image 2: A Guard Frame is used to avoid measuring part of features. Doing so, only complete features are measured and those not considered in one field are considered in a subsequent field so all particles are measured.*

## Image Analysis Steps



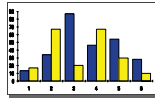
*Image 3: Particles are binarized into the blue bitplane using Gray Thresholding tool.*



*Image 4: Small particles (3x3 pixels or less) are eliminated, connected ones are separated and only complete ones are measured.*



## Appendix B: Results



## **Sample # 1 - Automated Report**

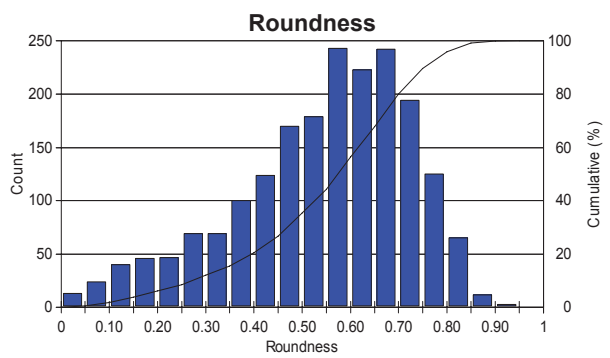
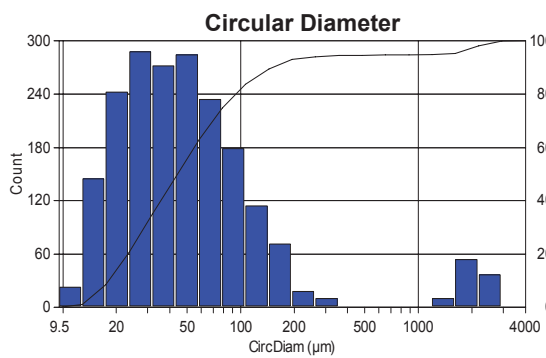
# Particle Size Analysis

<b>Date:</b>	2007-Jun-06, 2:21:29 PM -04'00'	<b>Magnification:</b>	115x (on Z6)
<b>Company:</b>	Clemex	<b>Calibration:</b>	4.8376 $\mu\text{m}/\text{pixel}$
<b>Department:</b>	Quality Control	<b>Units:</b>	microns
<b>User Name:</b>	Myriam Savard	<b># Fields:</b>	320
<b>Sample ID:</b>	S1	<b>Count:</b>	1988

Figure 1: Typical field of view.



Comment:



**Min:** 10.92  
**Max.:** 3116.50  
**Mean:** 163.92  
**Std. Dev.:** 467.90  
**D10:** 18.00  
**D50:** 43.94  
**D90:** 147.08

**Min:** 0.02  
**Max.:** 0.93  
**Mean:** 0.54  
**Std. Dev.:** 0.18  
**D10:** 0.27  
**D50:** 0.57  
**D90:** 0.75



**Sample # 1 - Printed Results**

# All Particles

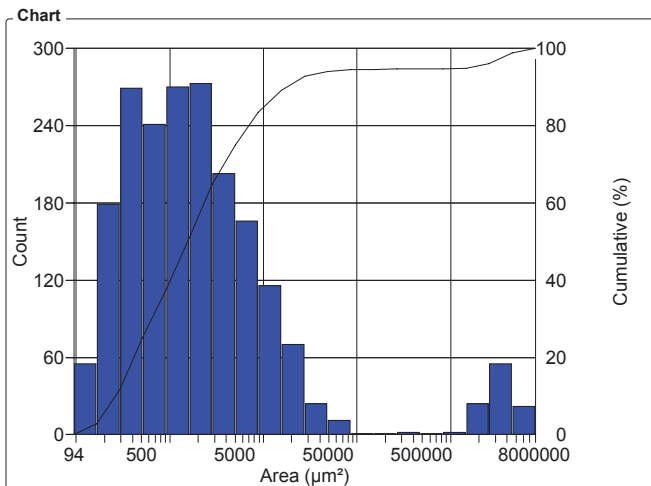
## Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:29:13 PM**  
 Sample:

### OBJM1 Count - Area

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



#### Values

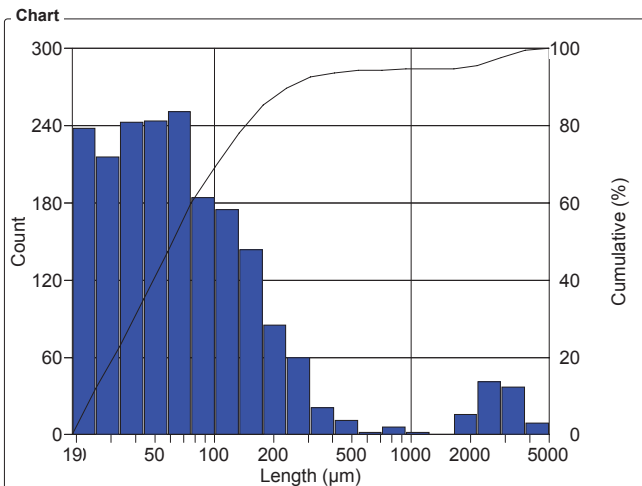
Area Intervals (µm <sup>2</sup> )	Count	%	Cumul%
94 - 166	55	2.77	2.77
166 - 292	179	9.02	11.79
292 - 516	269	13.55	25.34
516 - 910	241	12.14	37.48
910 - 1606	270	13.60	51.08
1606 - 2832	273	13.75	64.84
2832 - 4996	203	10.23	75.06
4996 - 8813	166	8.36	83.43
8813 - 15546	116	5.84	89.27
15546 - 27423	70	3.53	92.80
27423 - 48373	24	1.21	94.01
48373 - 85331	11	0.55	94.56
85331 - 150523	1	0.05	94.61
150523 - 265523	1	0.05	94.66
265523 - 468381	2	0.10	94.76
468381 - 826224	1	0.05	94.81
826224 - 1457457	2	0.10	94.91
1457457 - 2570951	24	1.21	96.12
2570951 - 4535152	55	2.77	98.89
4535152 - 8000000	22	1.11	100

#### Statistics

Minimum: 93.61 µm<sup>2</sup>  
 Maximum: 7628245.50 µm<sup>2</sup>  
 Mean: 192961.87 µm<sup>2</sup>  
 Std Dev.: 860935.25 µm<sup>2</sup>  
 Sum: 383.03e+06 µm<sup>2</sup>  
 Count: 1985  
 Under: 0  
 Over: 0  
 Accepted: 100 %  
 Field Count: 320  
 Field Area: 7009464.46 µm<sup>2</sup>  
 Total Area: 2.24e+09 µm<sup>2</sup>  
 D10: 254.65 µm<sup>2</sup>  
 D50: 1516.65 µm<sup>2</sup>  
 D90: 16989.94 µm<sup>2</sup>

### OBJM1 Count - Length

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



#### Values

Length Intervals (µm)	Count	%	Cumul%
19 - 25.10	238	11.99	11.99
25.10 - 33	216	10.88	22.87
33 - 44	243	12.24	35.11
44 - 58	244	12.29	47.41
58 - 77	251	12.64	60.05
77 - 101	184	9.27	69.32
101 - 134	175	8.82	78.14
134 - 177	144	7.25	85.39
177 - 233	85	4.28	89.67
233 - 308	60	3.02	92.70
308 - 407	21	1.06	93.75
407 - 538	11	0.55	94.31
538 - 711	2	0.10	94.41
711 - 940	6	0.30	94.71
940 - 1241	2	0.10	94.81
1241 - 1640	0	0	94.81
1640 - 2167	16	0.81	95.62
2167 - 2864	41	2.07	97.68
2864 - 3784	37	1.86	99.55
3784 - 5000	9	0.45	100

#### Statistics

Minimum: 19.35 µm  
 Maximum: 4821.87 µm  
 Mean: 229.36 µm  
 Std Dev.: 633.69 µm  
 Sum: 455282.39 µm  
 Count: 1985  
 Under: 0  
 Over: 0  
 Accepted: 100 %  
 Field Count: 320  
 Field Area: 7009464.46 µm<sup>2</sup>  
 Total Area: 2.24e+09 µm<sup>2</sup>  
 D10: 23.28 µm  
 D50: 60.76 µm  
 D90: 236.74 µm

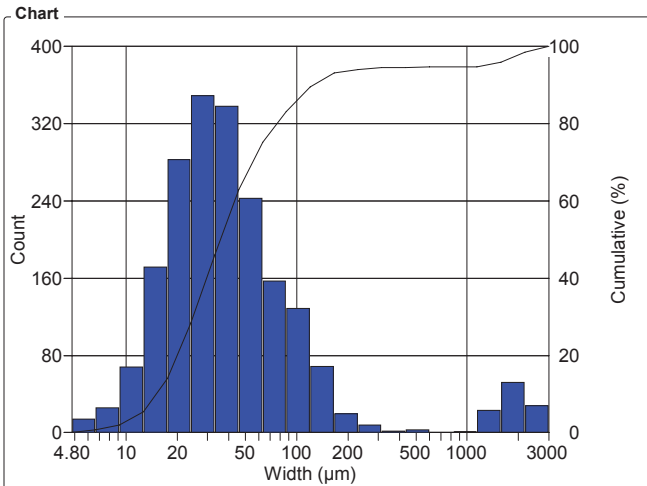
# Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:29:13 PM**  
 Sample:

## OBJM1 Count - Width

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

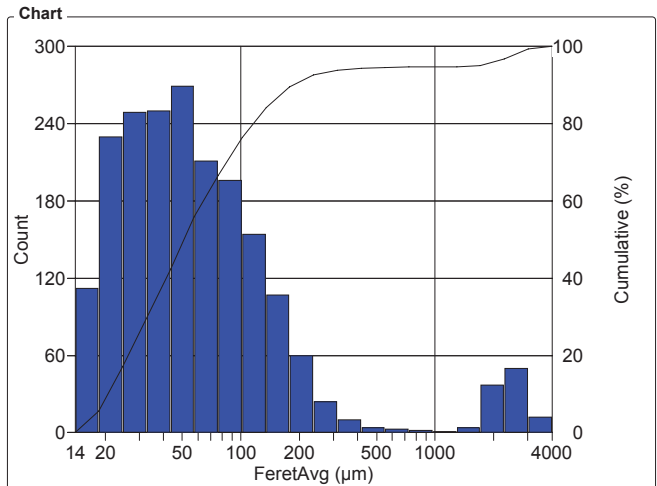


Width Intervals (µm)	Count	%	Cumul%
4.80 - 6.60	14	0.71	0.71
6.60 - 9.10	26	1.31	2.02
9.10 - 12.60	68	3.43	5.44
12.60 - 17.40	172	8.66	14.11
17.40 - 24	283	14.26	28.36
24 - 33	349	17.58	45.94
33 - 46	338	17.03	62.97
46 - 63	243	12.24	75.21
63 - 87	157	7.91	83.12
87 - 120	129	6.50	89.62
120 - 166	69	3.48	93.10
166 - 228	20	1.01	94.11
228 - 315	8	0.40	94.51
315 - 435	2	0.10	94.61
435 - 600	3	0.15	94.76
600 - 828	0	0	94.76
828 - 1142	1	0.05	94.81
1142 - 1576	23	1.16	95.97
1576 - 2174	52	2.62	98.59
2174 - 3000	28	1.41	100

Statistics	
Minimum:	4.84 µm
Maximum:	2809.43 µm
Mean:	142.85 µm
Std Dev.:	421.31 µm
Sum:	283561.68 µm
Count:	1985
Under:	0
Over:	0
Accepted:	100 %
Field Count:	320
Field Area:	7009464.46 µm <sup>2</sup>
Total Area:	2.24e+09 µm <sup>2</sup>
D10:	14.22 µm
D50:	34.81 µm
D90:	124.72 µm

## OBJM1 Count - FeretAvg

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



FeretAvg Intervals (µm)	Count	%	Cumul%
14 - 18.60	112	5.64	5.64
18.60 - 24.60	230	11.59	17.23
24.60 - 33	249	12.54	29.77
33 - 43	250	12.59	42.37
43 - 58	269	13.55	55.92
58 - 76	211	10.63	66.55
76 - 101	196	9.87	76.42
101 - 134	154	7.76	84.18
134 - 178	107	5.39	89.57
178 - 237	60	3.02	92.59
237 - 314	24	1.21	93.80
314 - 417	10	0.50	94.31
417 - 553	4	0.20	94.51
553 - 733	3	0.15	94.66
733 - 973	2	0.10	94.76
973 - 1291	1	0.05	94.81
1291 - 1713	4	0.20	95.01
1713 - 2272	37	1.86	96.88
2272 - 3015	50	2.52	99.40
3015 - 4000	12	0.60	100

Statistics	
Minimum:	13.78 µm
Maximum:	3689.83 µm
Mean:	190.60 µm
Std Dev.:	533.09 µm
Sum:	378333.81 µm
Count:	1985
Under:	0
Over:	0
Accepted:	100 %
Field Count:	320
Field Area:	7009464.46 µm <sup>2</sup>
Total Area:	2.24e+09 µm <sup>2</sup>
D10:	20.31 µm
D50:	50.98 µm
D90:	184.91 µm

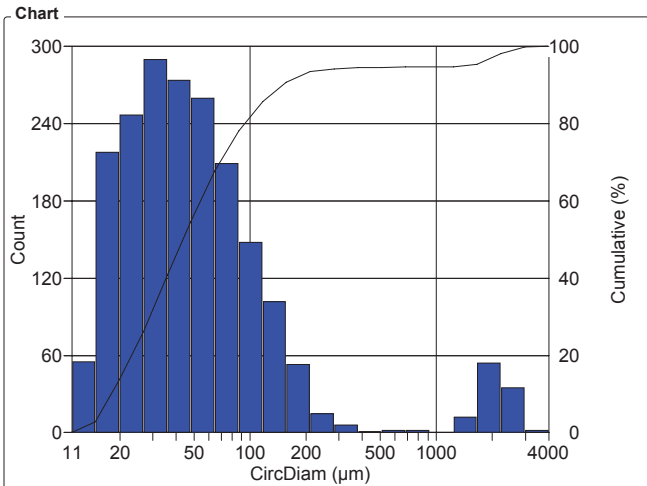
# Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:29:13 PM**  
 Sample:

## OBJM1 Count - CircDiam

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

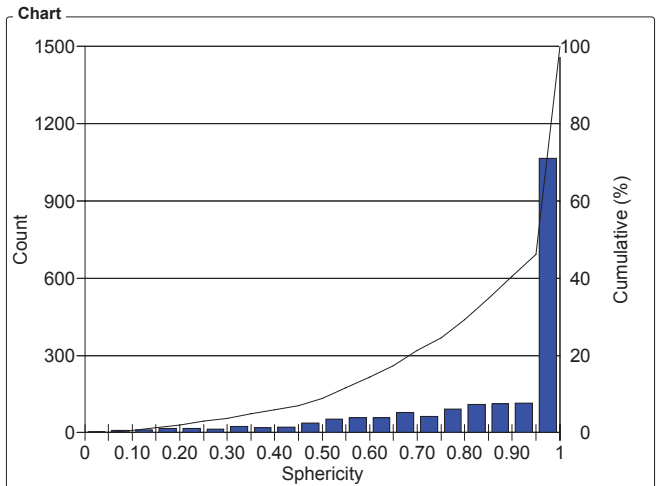


CircDiam Intervals (µm)	Count	%	Cumul%
11 - 14.80	55	2.77	2.77
14.80 - 19.80	218	10.98	13.75
19.80 - 26.60	247	12.44	26.20
26.60 - 36	290	14.61	40.81
36 - 48	274	13.80	54.61
48 - 65	260	13.10	67.71
65 - 87	209	10.53	78.24
87 - 116	148	7.46	85.69
116 - 156	102	5.14	90.83
156 - 210	53	2.67	93.50
210 - 282	15	0.76	94.26
282 - 378	6	0.30	94.56
378 - 508	1	0.05	94.61
508 - 682	2	0.10	94.71
682 - 916	2	0.10	94.81
916 - 1230	0	0	94.81
1230 - 1652	12	0.60	95.42
1652 - 2218	54	2.72	98.14
2218 - 2979	35	1.76	99.90
2979 - 4000	2	0.10	100

Statistics	
Minimum:	10.92 µm
Maximum:	3116.50 µm
Mean:	163.92 µm
Std Dev.:	467.90 µm
Sum:	325388.68 µm
Count:	1985
Under:	0
Over:	0
Accepted:	100 %
Field Count:	320
Field Area:	7009464.46 µm <sup>2</sup>
Total Area:	2.24e+09 µm <sup>2</sup>
D10:	18.00 µm
D50:	43.94 µm
D90:	147.08 µm

## OBJM1 Count - Sphericity

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



Sphericity Intervals	Count	%	Cumul%
0 - 0.05	3	0.15	0.15
0.05 - 0.10	10	0.50	0.65
0.10 - 0.15	11	0.55	1.21
0.15 - 0.20	17	0.86	2.07
0.20 - 0.25	18	0.91	2.97
0.25 - 0.30	15	0.76	3.73
0.30 - 0.35	25	1.26	4.99
0.35 - 0.40	20	1.01	5.99
0.40 - 0.45	21	1.06	7.05
0.45 - 0.50	37	1.86	8.92
0.50 - 0.55	53	2.67	11.59
0.55 - 0.60	57	2.87	14.46
0.60 - 0.65	59	2.97	17.43
0.65 - 0.70	79	3.98	21.41
0.70 - 0.75	63	3.17	24.58
0.75 - 0.80	93	4.69	29.27
0.80 - 0.85	110	5.54	34.81
0.85 - 0.90	112	5.64	40.45
0.90 - 0.95	115	5.79	46.25
0.95 - 1	1067	53.75	100

Statistics	
Minimum:	0.03
Maximum:	1
Mean:	0.848
Std Dev.:	0.218
Count:	1985
Under:	0
Over:	0
Accepted:	100 %
Field Count:	320
Field Area:	7009464.46 µm <sup>2</sup>
Total Area:	2.24e+09 µm <sup>2</sup>
D10:	0.52
D50:	0.98
D90:	1.00

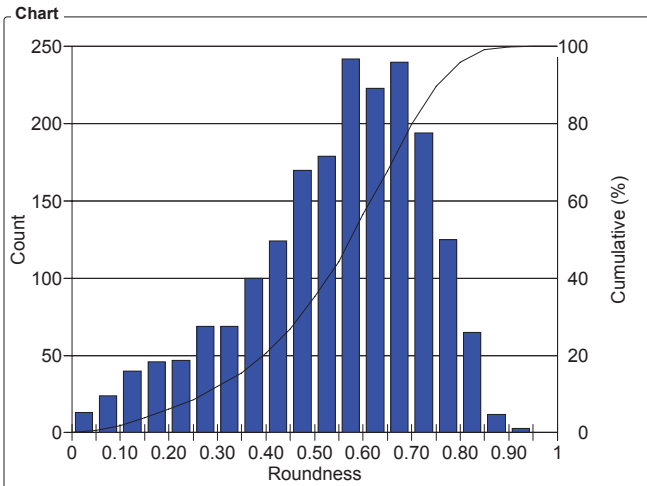
# Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:29:13 PM**  
 Sample:

## OBJM1 Count - Roundness

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

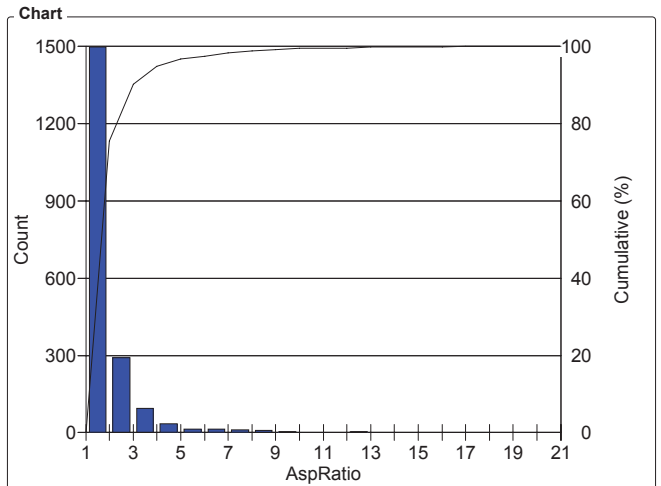


Roundness Intervals	Count	%	Cumul%
0 - 0.05	13	0.65	0.65
0.05 - 0.10	24	1.21	1.86
0.10 - 0.15	40	2.02	3.88
0.15 - 0.20	46	2.32	6.20
0.20 - 0.25	47	2.37	8.56
0.25 - 0.30	69	3.48	12.04
0.30 - 0.35	69	3.48	15.52
0.35 - 0.40	100	5.04	20.55
0.40 - 0.45	124	6.25	26.80
0.45 - 0.50	170	8.56	35.37
0.50 - 0.55	179	9.02	44.38
0.55 - 0.60	242	12.19	56.57
0.60 - 0.65	223	11.23	67.81
0.65 - 0.70	240	12.09	79.90
0.70 - 0.75	194	9.77	89.67
0.75 - 0.80	125	6.30	95.97
0.80 - 0.85	65	3.27	99.24
0.85 - 0.90	12	0.60	99.85
0.90 - 0.95	3	0.15	100
0.95 - 1	0	0	100

Statistics	
Minimum:	0.02
Maximum:	0.93
Mean:	0.543
Std Dev.:	0.182
Count:	1985
Under:	0
Over:	0
Accepted:	100 %
Field Count:	320
Field Area:	7009464.46 µm <sup>2</sup>
Total Area:	2.24e+09 µm <sup>2</sup>
D10:	0.27
D50:	0.57
D90:	0.75

## OBJM1 Count - AspRatio

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



AspRatio Intervals	Count	%	Cumul%
1 - 2	1499	75.52	75.52
2 - 3	292	14.71	90.23
3 - 4	94	4.74	94.96
4 - 5	36	1.81	96.78
5 - 6	15	0.76	97.53
6 - 7	15	0.76	98.29
7 - 8	12	0.60	98.89
8 - 9	8	0.40	99.29
9 - 10	4	0.20	99.50
10 - 11	1	0.05	99.55
11 - 12	2	0.10	99.65
12 - 13	4	0.20	99.85
13 - 14	1	0.05	99.90
14 - 15	1	0.05	99.95
15 - 16	0	0	99.95
16 - 17	1	0.05	100
17 - 18	0	0	100
18 - 19	0	0	100
19 - 20	0	0	100
20 - 21	0	0	100

Statistics	
Minimum:	1.04
Maximum:	17
Mean:	1.97
Std Dev.:	1.36
Count:	1985
Under:	0
Over:	0
Accepted:	100 %
Field Count:	320
Field Area:	7009464.46 µm <sup>2</sup>
Total Area:	2.24e+09 µm <sup>2</sup>
D10:	1.23
D50:	1.57
D90:	2.99

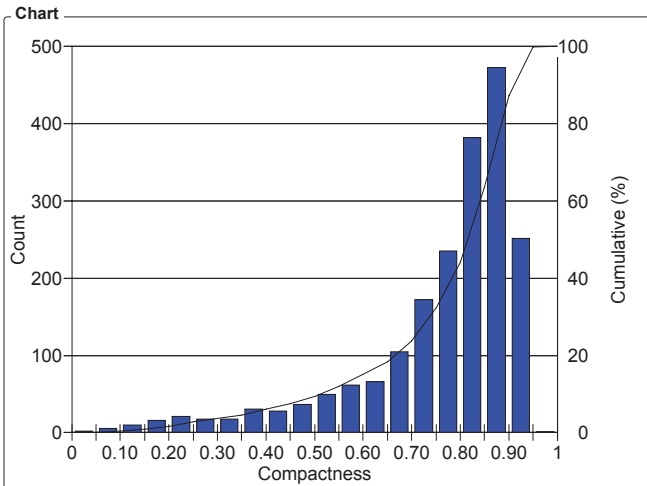
# Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:29:13 PM**  
 Sample:

## OBJM1 Count - Compactness

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

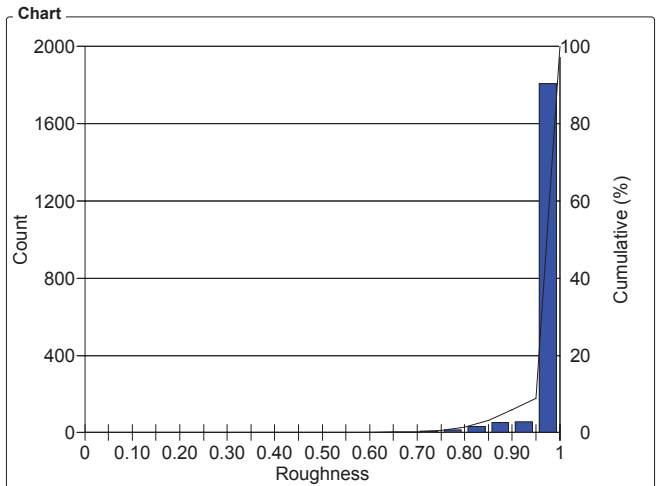


Compactness Intervals	Count	%	Cumul%
0 - 0.05	2	0.10	0.10
0.05 - 0.10	6	0.30	0.40
0.10 - 0.15	10	0.50	0.91
0.15 - 0.20	16	0.81	1.71
0.20 - 0.25	21	1.06	2.77
0.25 - 0.30	18	0.91	3.68
0.30 - 0.35	18	0.91	4.58
0.35 - 0.40	31	1.56	6.15
0.40 - 0.45	28	1.41	7.56
0.45 - 0.50	37	1.86	9.42
0.50 - 0.55	50	2.52	11.94
0.55 - 0.60	62	3.12	15.06
0.60 - 0.65	66	3.32	18.39
0.65 - 0.70	105	5.29	23.68
0.70 - 0.75	172	8.66	32.34
0.75 - 0.80	235	11.84	44.18
0.80 - 0.85	382	19.24	63.43
0.85 - 0.90	473	23.83	87.25
0.90 - 0.95	252	12.70	99.95
0.95 - 1	1	0.05	100

Statistics	
Minimum:	0.04
Maximum:	0.96
Mean:	0.758
Std Dev.:	0.172
Count:	1985
Under:	0
Over:	0
Accepted:	100 %
Field Count:	320
Field Area:	7009464.46 µm <sup>2</sup>
Total Area:	2.24e+09 µm <sup>2</sup>
D10:	0.51
D50:	0.82
D90:	0.91

## OBJM1 Count - Roughness

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



Roughness Intervals	Count	%	Cumul%
0 - 0.05	0	0	0
0.05 - 0.10	0	0	0
0.10 - 0.15	0	0	0
0.15 - 0.20	0	0	0
0.20 - 0.25	0	0	0
0.25 - 0.30	0	0	0
0.30 - 0.35	0	0	0
0.35 - 0.40	0	0	0
0.40 - 0.45	1	0.05	0.05
0.45 - 0.50	0	0	0.05
0.50 - 0.55	0	0	0.05
0.55 - 0.60	1	0.05	0.10
0.60 - 0.65	2	0.10	0.20
0.65 - 0.70	1	0.05	0.25
0.70 - 0.75	8	0.40	0.65
0.75 - 0.80	17	0.86	1.51
0.80 - 0.85	34	1.71	3.22
0.85 - 0.90	54	2.72	5.94
0.90 - 0.95	57	2.87	8.82
0.95 - 1	1810	91.18	100

Statistics	
Minimum:	0.43
Maximum:	1
Mean:	0.986
Std Dev.:	0.046
Count:	1985
Under:	0
Over:	0
Accepted:	100 %
Field Count:	320
Field Area:	7009464.46 µm <sup>2</sup>
Total Area:	2.24e+09 µm <sup>2</sup>
D10:	0.96
D50:	1.00
D90:	1.00

# Largest Distribution of Particles

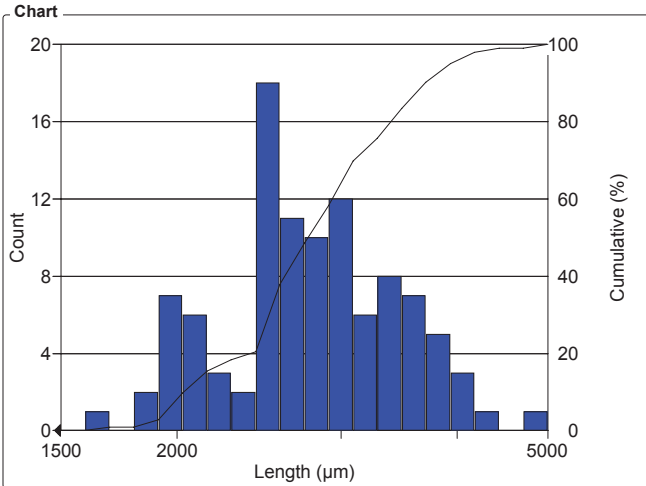
## Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:31:36 PM**  
 Sample:

### OBJM1 Count - Length

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

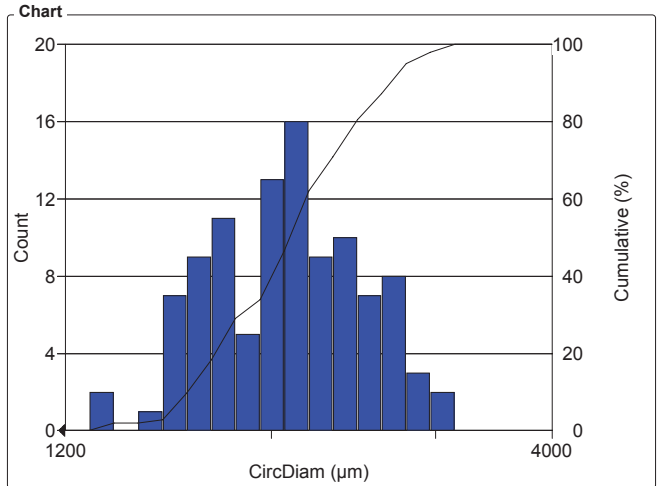


Length Intervals (µm)	Count	%	Cumul%
1500 - 1593	0	0	0
1593 - 1692	1	0.97	0.97
1692 - 1797	0	0	0.97
1797 - 1908	2	1.94	2.91
1908 - 2027	7	6.80	9.71
2027 - 2153	6	5.83	15.53
2153 - 2286	3	2.91	18.45
2286 - 2428	2	1.94	20.39
2428 - 2579	18	17.48	37.86
2579 - 2739	11	10.68	48.54
2739 - 2909	10	9.71	58.25
2909 - 3089	12	11.65	69.90
3089 - 3281	6	5.83	75.73
3281 - 3484	8	7.77	83.50
3484 - 3700	7	6.80	90.29
3700 - 3930	5	4.85	95.15
3930 - 4174	3	2.91	98.06
4174 - 4433	1	0.97	99.03
4433 - 4708	0	0	99.03
4708 - 5000	1	0.97	100

Statistics		
Minimum:	1667.16 ( 19.35 )	µm
Maximum:	4821.87 ( 4821.87 )	µm
Mean:	2845.50 ( 229.36 )	µm
Std Dev.:	606.35 ( 633.69 )	µm
Sum:	293086.90 ( 455282.39 )	µm
Count:	103 ( 1985 )	
Under:	1882	
Over:	0	
Accepted:	5.19 %	
Field Count:	320	
Field Area:	7009464.46 µm <sup>2</sup>	
Total Area:	2.24e+09 µm <sup>2</sup>	
D10:	2019.15 ( 23.28 )	µm
D50:	2752.59 ( 60.76 )	µm
D90:	3668.11 ( 236.74 )	µm

### OBJM1 Count - CircDiam

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



CircDiam Intervals (µm)	Count	%	Cumul%
1200 - 1274	0	0	0
1274 - 1354	2	1.94	1.94
1354 - 1438	0	0	1.94
1438 - 1527	1	0.97	2.91
1527 - 1621	7	6.80	9.71
1621 - 1722	9	8.74	18.45
1722 - 1829	11	10.68	29.13
1829 - 1942	5	4.85	33.98
1942 - 2063	13	12.62	46.60
2063 - 2191	16	15.53	62.14
2191 - 2327	9	8.74	70.87
2327 - 2471	10	9.71	80.58
2471 - 2625	7	6.80	87.38
2625 - 2787	8	7.77	95.15
2787 - 2960	3	2.91	98.06
2960 - 3144	2	1.94	100
3144 - 3339	0	0	100
3339 - 3546	0	0	100
3546 - 3766	0	0	100
3766 - 4000	0	0	100

Statistics		
Minimum:	1315.17 ( 10.92 )	µm
Maximum:	3116.50 ( 3116.50 )	µm
Mean:	2114.22 ( 163.92 )	µm
Std Dev.:	392.44 ( 467.90 )	µm
Sum:	217764.34 ( 325388.68 )	µm
Count:	103 ( 1985 )	
Under:	1882	
Over:	0	
Accepted:	5.19 %	
Field Count:	320	
Field Area:	7009464.46 µm <sup>2</sup>	
Total Area:	2.24e+09 µm <sup>2</sup>	
D10:	1613.03 ( 18.00 )	µm
D50:	2088.70 ( 43.94 )	µm
D90:	2672.73 ( 147.08 )	µm

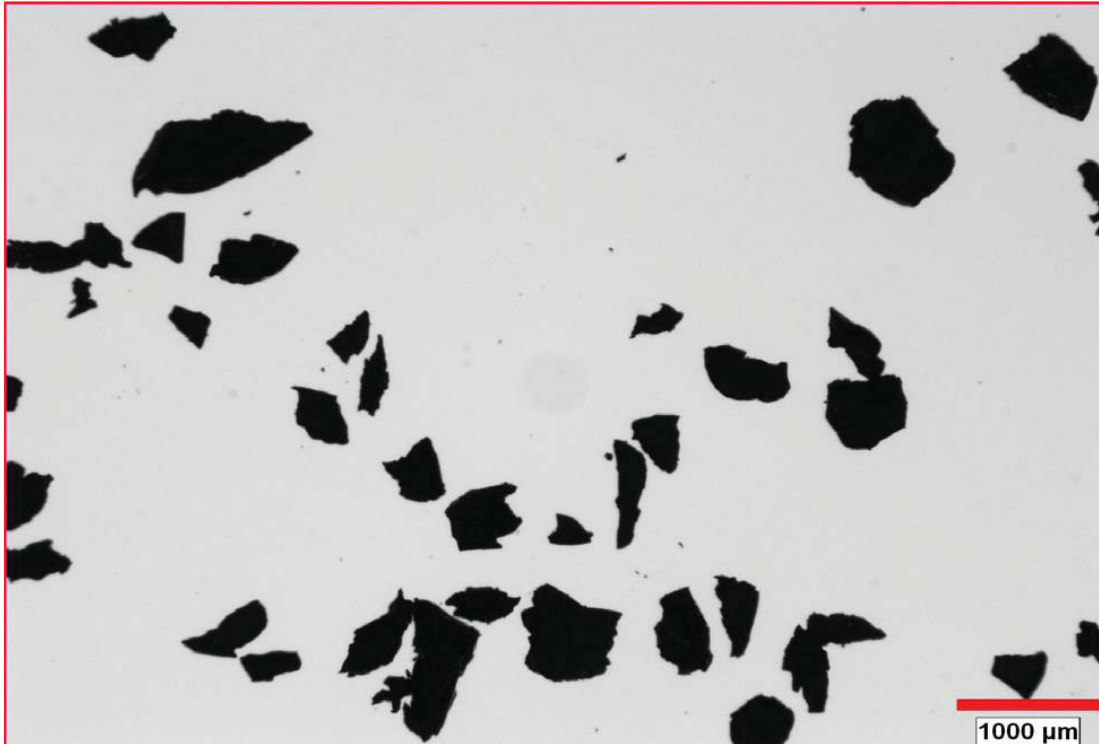
## **Sample # 2 - Automated Report**



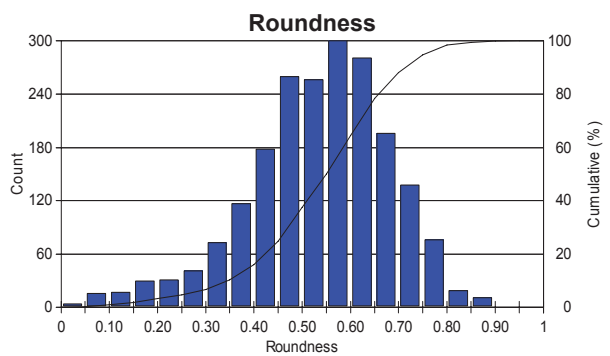
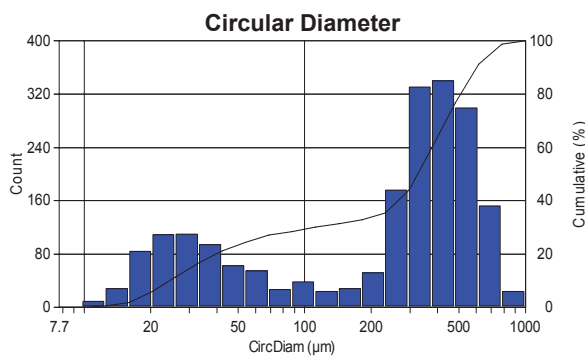
# Particle Size Analysis

<b>Date:</b>	2007-Jun-07, 9:38:13 AM -04'00'	<b>Magnification:</b>	115x (on Z6)
<b>Company:</b>	Clemex	<b>Calibration:</b>	4.8376 µm/pixel
<b>Department:</b>	Quality Control	<b>Units:</b>	microns
<b>User Name:</b>	Myriam Savard	<b># Fields:</b>	64
<b>Sample ID:</b>	S2	<b>Count:</b>	2045

Figure 1: Typical field of view.



Comment:



<b>Min:</b>	10.92	0.04
<b>Max.:</b>	967.98	0.93
<b>Mean:</b>	310.73	0.54
<b>Std. Dev.:</b>	220.54	0.15
<b>D10:</b>	24.26	0.35
<b>D50:</b>	330.19	0.55
<b>D90:</b>	604.12	0.71

## **Sample # 2 - Printed Results**

# All Particles

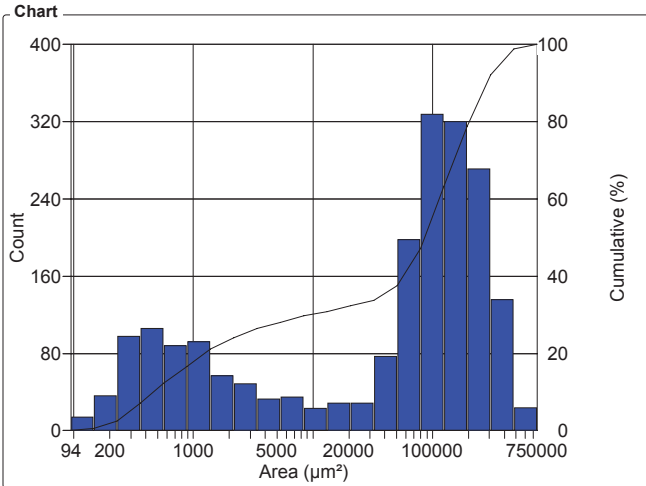
## Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:28:10 PM**  
 Sample:

### OBJM1 Count - Area

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

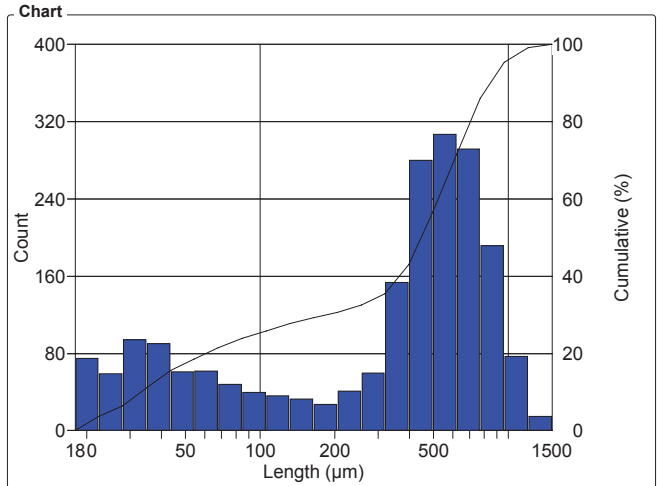


Area Intervals (µm <sup>2</sup> )	Count	%	Cumul%
94 - 147	14	0.69	0.69
147 - 231	36	1.76	2.45
231 - 362	98	4.80	7.24
362 - 567	106	5.19	12.43
567 - 888	88	4.31	16.74
888 - 1392	92	4.50	21.24
1392 - 2182	57	2.79	24.03
2182 - 3419	49	2.40	26.43
3419 - 5358	33	1.62	28.05
5358 - 8396	35	1.71	29.76
8396 - 13158	23	1.13	30.89
13158 - 20620	29	1.42	32.31
20620 - 32314	29	1.42	33.72
32314 - 50639	77	3.77	37.49
50639 - 79356	198	9.69	47.19
79356 - 124358	328	16.05	63.24
124358 - 194882	320	15.66	78.90
194882 - 305399	271	13.26	92.17
305399 - 478591	136	6.66	98.83
478591 - 750000	24	1.17	100

Statistics	
Minimum:	93.61 µm <sup>2</sup>
Maximum:	735909.50 µm <sup>2</sup>
Mean:	114011.76 µm <sup>2</sup>
Std Dev.:	120717.88 µm <sup>2</sup>
Sum:	232.93e+06 µm <sup>2</sup>
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	462.30 µm <sup>2</sup>
D50:	85629.08 µm <sup>2</sup>
D90:	286641.63 µm <sup>2</sup>

### OBJM1 Count - Length

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



Length Intervals (µm)	Count	%	Cumul%
18 - 22.50	75	3.67	3.67
22.50 - 28	59	2.89	6.56
28 - 34.90	94	4.60	11.16
34.90 - 44	90	4.41	15.57
44 - 54	61	2.99	18.55
54 - 68	62	3.03	21.59
68 - 85	48	2.35	23.94
85 - 106	40	1.96	25.89
106 - 132	36	1.76	27.66
132 - 164	33	1.62	29.27
164 - 205	27	1.32	30.59
205 - 256	41	2.01	32.60
256 - 319	60	2.94	35.54
319 - 398	154	7.54	43.07
398 - 496	280	13.71	56.78
496 - 619	307	15.03	71.81
619 - 773	292	14.29	86.10
773 - 964	192	9.40	95.50
964 - 1202	77	3.77	99.27
1202 - 1500	15	0.73	100

Statistics	
Minimum:	18.14 µm
Maximum:	1402.30 µm
Mean:	432.36 µm
Std Dev.:	307.72 µm
Sum:	883309.77 µm
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	32.06 µm
D50:	448.08 µm
D90:	842.59 µm

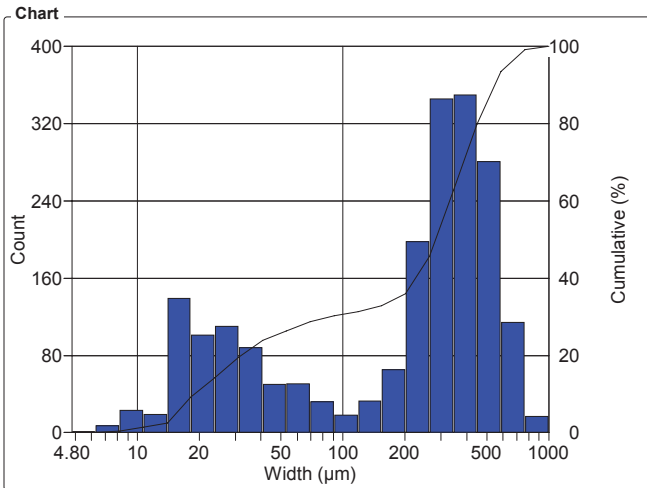
# Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:28:10 PM**  
 Sample:

## OBJM1 Count - Width

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

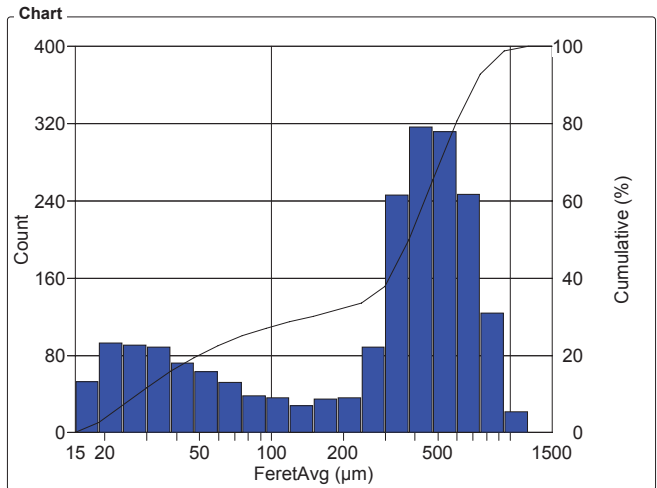


Width Intervals (µm)	Count	%	Cumul%
4.80 - 6.30	1	0.05	0.05
6.30 - 8.20	7	0.34	0.39
8.20 - 10.70	23	1.13	1.52
10.70 - 14	19	0.93	2.45
14 - 18.20	139	6.80	9.25
18.20 - 23.80	101	4.94	14.19
23.80 - 31.10	110	5.38	19.58
31.10 - 41	88	4.31	23.89
41 - 53	50	2.45	26.33
53 - 69	51	2.50	28.83
69 - 90	32	1.57	30.40
90 - 118	18	0.88	31.28
118 - 154	33	1.62	32.89
154 - 202	65	3.18	36.07
202 - 263	198	9.69	45.77
263 - 344	346	16.94	62.70
344 - 449	350	17.13	79.83
449 - 586	281	13.75	93.59
586 - 766	114	5.58	99.17
766 - 1000	17	0.83	100

Statistics	
Minimum:	4.84 µm
Maximum:	990.50 µm
Mean:	273.25 µm
Std Dev.:	201.23 µm
Sum:	558246.37 µm
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	18.89 µm
D50:	283.22 µm
D90:	535.97 µm

## OBJM1 Count - FeretAvg

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



FeretAvg Intervals (µm)	Count	%	Cumul%
15 - 18.90	53	2.59	2.59
18.90 - 23.80	93	4.55	7.15
23.80 - 29.90	91	4.45	11.60
29.90 - 37.70	89	4.36	15.96
37.70 - 47	72	3.52	19.48
47 - 60	63	3.08	22.56
60 - 75	52	2.55	25.11
75 - 95	38	1.86	26.97
95 - 119	36	1.76	28.73
119 - 150	28	1.37	30.10
150 - 189	35	1.71	31.82
189 - 238	36	1.76	33.58
238 - 299	89	4.36	37.93
299 - 377	246	12.04	49.98
377 - 474	317	15.52	65.49
474 - 597	312	15.27	80.76
597 - 752	247	12.09	92.85
752 - 946	124	6.07	98.92
946 - 1191	22	1.08	100
1191 - 1500	0	0	100

Statistics	
Minimum:	14.53 µm
Maximum:	1146.21 µm
Mean:	361.37 µm
Std Dev.:	255.96 µm
Sum:	738277.08 µm
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	27.11 µm
D50:	376.97 µm
D90:	701.56 µm

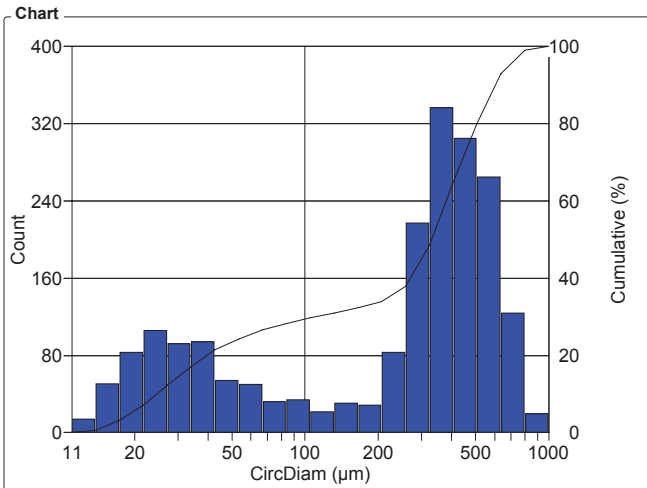
# Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:28:10 PM**  
 Sample:

## OBJM1 Count - CircDiam

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

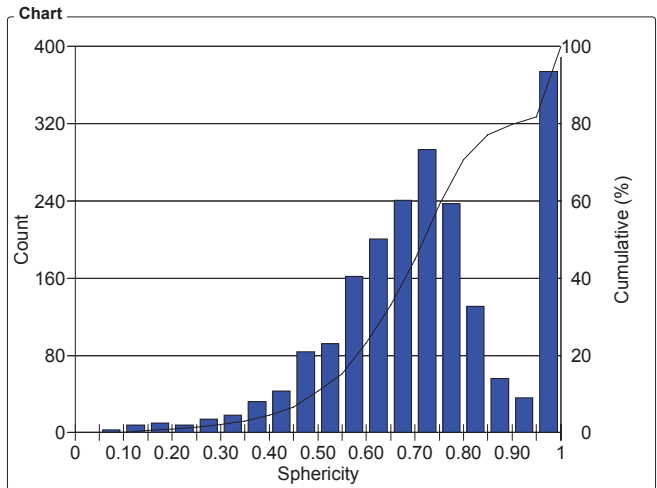


CircDiam Intervals (µm)	Count	%	Cumul%
11 - 13.80	14	0.69	0.69
13.80 - 17.30	51	2.50	3.18
17.30 - 21.60	83	4.06	7.24
21.60 - 27.10	106	5.19	12.43
27.10 - 34	92	4.50	16.94
34 - 43	94	4.60	21.54
43 - 53	54	2.64	24.18
53 - 67	50	2.45	26.63
67 - 84	32	1.57	28.19
84 - 105	34	1.66	29.86
105 - 131	22	1.08	30.93
131 - 165	31	1.52	32.45
165 - 206	29	1.42	33.87
206 - 258	83	4.06	37.93
258 - 324	217	10.62	48.56
324 - 406	337	16.50	65.05
406 - 508	305	14.93	79.98
508 - 637	265	12.97	92.95
637 - 798	124	6.07	99.02
798 - 1000	20	0.98	100

Statistics	
Minimum:	10.92 µm
Maximum:	967.98 µm
Mean:	310.73 µm
Std Dev.:	220.54 µm
Sum:	634815.08 µm
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	24.26 µm
D50:	330.19 µm
D90:	604.12 µm

## OBJM1 Count - Sphericity

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



Sphericity Intervals	Count	%	Cumul%
0 - 0.05	0	0	0
0.05 - 0.10	3	0.15	0.15
0.10 - 0.15	8	0.39	0.54
0.15 - 0.20	10	0.49	1.03
0.20 - 0.25	8	0.39	1.42
0.25 - 0.30	14	0.69	2.10
0.30 - 0.35	18	0.88	2.99
0.35 - 0.40	32	1.57	4.55
0.40 - 0.45	43	2.10	6.66
0.45 - 0.50	84	4.11	10.77
0.50 - 0.55	92	4.50	15.27
0.55 - 0.60	162	7.93	23.20
0.60 - 0.65	201	9.84	33.04
0.65 - 0.70	241	11.80	44.84
0.70 - 0.75	293	14.34	59.18
0.75 - 0.80	237	11.60	70.78
0.80 - 0.85	131	6.41	77.19
0.85 - 0.90	56	2.74	79.93
0.90 - 0.95	36	1.76	81.69
0.95 - 1	374	18.31	100

Statistics	
Minimum:	0.05
Maximum:	1
Mean:	0.722
Std Dev.:	0.185
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	0.49
D50:	0.72
D90:	1.00

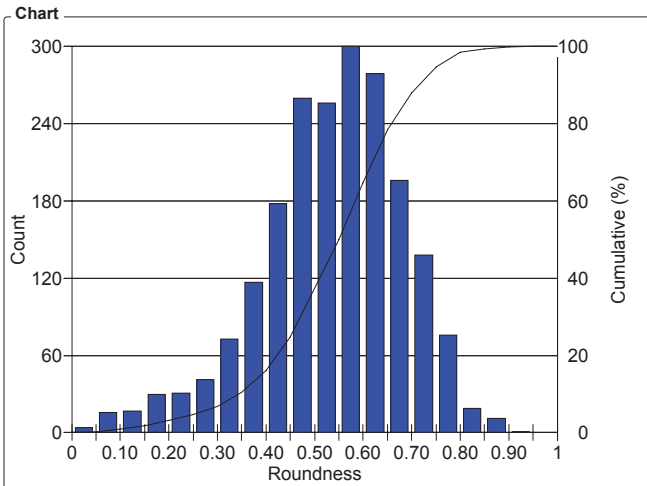
# Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:28:10 PM**  
 Sample:

## OBJM1 Count - Roundness

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

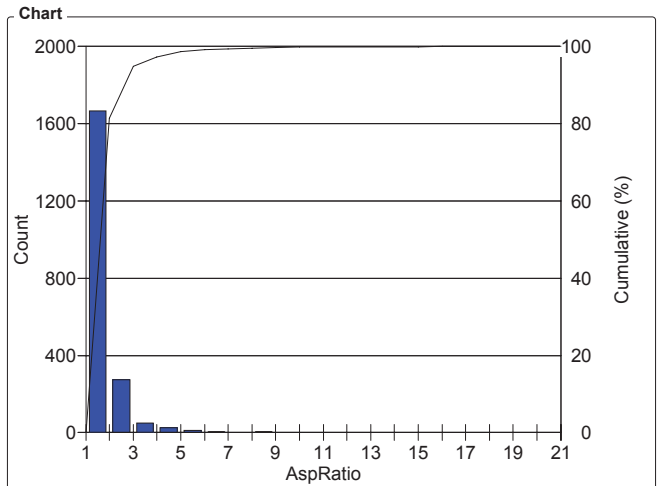


Roundness Intervals	Count	%	Cumul%
0 - 0.05	4	0.20	0.20
0.05 - 0.10	16	0.78	0.98
0.10 - 0.15	17	0.83	1.81
0.15 - 0.20	30	1.47	3.28
0.20 - 0.25	31	1.52	4.80
0.25 - 0.30	41	2.01	6.80
0.30 - 0.35	73	3.57	10.38
0.35 - 0.40	117	5.73	16.10
0.40 - 0.45	178	8.71	24.82
0.45 - 0.50	260	12.73	37.54
0.50 - 0.55	256	12.53	50.07
0.55 - 0.60	300	14.68	64.76
0.60 - 0.65	279	13.66	78.41
0.65 - 0.70	196	9.59	88.01
0.70 - 0.75	138	6.75	94.76
0.75 - 0.80	76	3.72	98.48
0.80 - 0.85	19	0.93	99.41
0.85 - 0.90	11	0.54	99.95
0.90 - 0.95	1	0.05	100
0.95 - 1	0	0	100

Statistics	
Minimum:	0.04
Maximum:	0.93
Mean:	0.535
Std Dev.:	0.148
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	0.35
D50:	0.55
D90:	0.71

## OBJM1 Count - AspRatio

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



AspRatio Intervals	Count	%	Cumul%
1 - 2	1665	81.50	81.50
2 - 3	274	13.41	94.91
3 - 4	50	2.45	97.36
4 - 5	26	1.27	98.63
5 - 6	12	0.59	99.22
6 - 7	4	0.20	99.41
7 - 8	2	0.10	99.51
8 - 9	5	0.24	99.76
9 - 10	2	0.10	99.85
10 - 11	0	0	99.85
11 - 12	0	0	99.85
12 - 13	2	0.10	99.95
13 - 14	0	0	99.95
14 - 15	0	0	99.95
15 - 16	1	0.05	100
16 - 17	0	0	100
17 - 18	0	0	100
18 - 19	0	0	100
19 - 20	0	0	100
20 - 21	0	0	100

Statistics	
Minimum:	1.07
Maximum:	15.74
Mean:	1.78
Std Dev.:	0.927
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	1.23
D50:	1.54
D90:	2.33

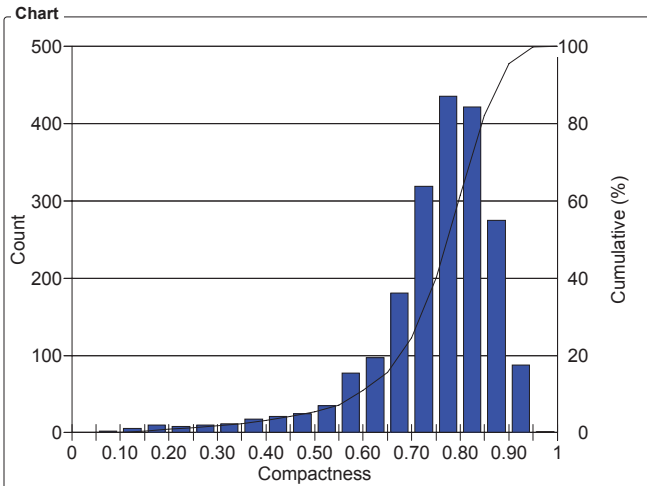
# Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:28:10 PM**  
 Sample:

## OBJM1 Count - Compactness

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

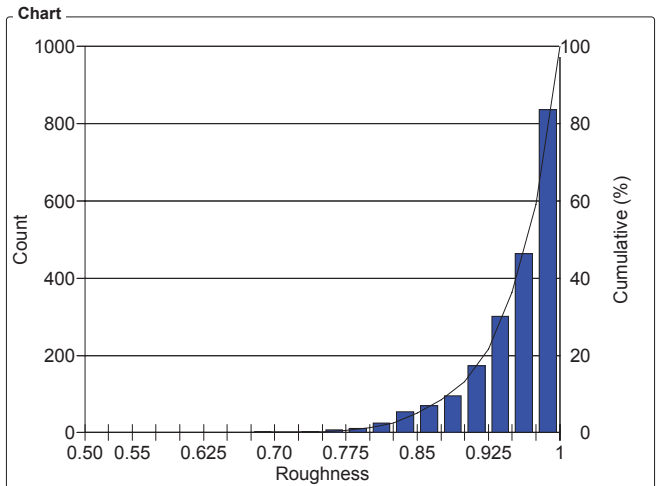


Values			
Compactness Intervals	Count	%	Cumul%
0 - 0.05	0	0	0
0.05 - 0.10	2	0.10	0.10
0.10 - 0.15	6	0.29	0.39
0.15 - 0.20	10	0.49	0.88
0.20 - 0.25	8	0.39	1.27
0.25 - 0.30	10	0.49	1.76
0.30 - 0.35	12	0.59	2.35
0.35 - 0.40	18	0.88	3.23
0.40 - 0.45	21	1.03	4.26
0.45 - 0.50	25	1.22	5.48
0.50 - 0.55	35	1.71	7.20
0.55 - 0.60	77	3.77	10.96
0.60 - 0.65	97	4.75	15.71
0.65 - 0.70	181	8.86	24.57
0.70 - 0.75	319	15.61	40.19
0.75 - 0.80	436	21.34	61.53
0.80 - 0.85	422	20.66	82.18
0.85 - 0.90	275	13.46	95.64
0.90 - 0.95	88	4.31	99.95
0.95 - 1	1	0.05	100

Statistics	
Minimum:	0.09
Maximum:	0.96
Mean:	0.746
Std Dev.:	0.133
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	0.59
D50:	0.77
D90:	0.87

## OBJM1 Count - Roughness

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



Values			
Roughness Intervals	Count	%	Cumul%
0.50 - 0.52	0	0	0
0.52 - 0.55	0	0	0
0.55 - 0.57	1	0.05	0.05
0.57 - 0.60	0	0	0.05
0.60 - 0.63	1	0.05	0.10
0.63 - 0.65	0	0	0.10
0.65 - 0.68	1	0.05	0.15
0.68 - 0.70	2	0.10	0.24
0.70 - 0.73	0	0	0.24
0.73 - 0.75	2	0.10	0.34
0.75 - 0.77	7	0.34	0.69
0.77 - 0.80	11	0.54	1.22
0.80 - 0.82	25	1.22	2.45
0.82 - 0.85	54	2.64	5.09
0.85 - 0.88	70	3.43	8.52
0.88 - 0.90	95	4.65	13.17
0.90 - 0.93	173	8.47	21.63
0.93 - 0.95	301	14.73	36.37
0.95 - 0.98	464	22.71	59.08
0.98 - 1	836	40.92	100

Statistics	
Minimum:	0.56
Maximum:	1
Mean:	0.953
Std Dev.:	0.051
Count:	2043
Under:	0
Over:	0
Accepted:	100 %
Field Count:	64
Field Area:	32.89e+06 µm <sup>2</sup>
Total Area:	2.11e+09 µm <sup>2</sup>
D10:	0.88
D50:	0.96
D90:	1.00

# Largest Distribution of Particles

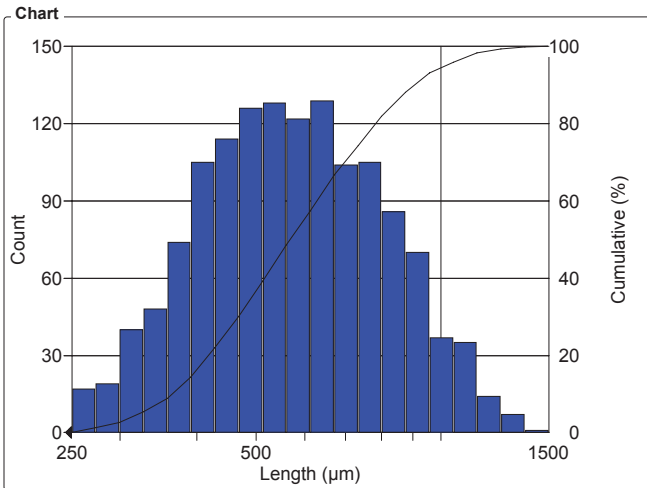
## Clemex Vision Report

Organization: **Clemex Technologies inc.**  
 Department:  
 User: **Myriam Savard (unauthenticated)**

Date & Time: **11/06/2007 13:32:45 PM**  
 Sample:

### OBJM1 Count - Length

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1

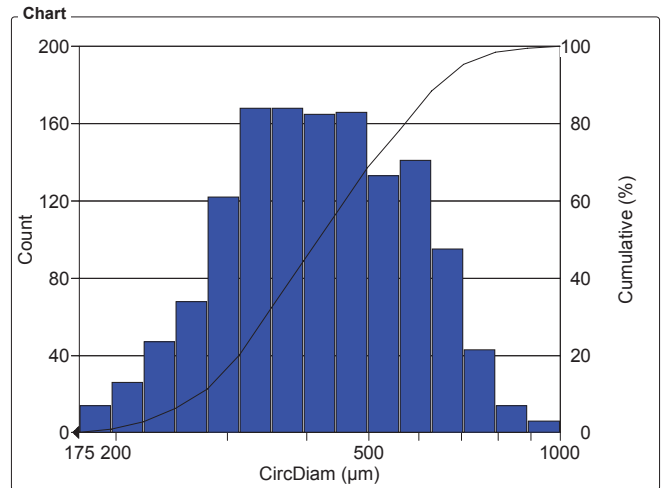


Length Intervals (µm)	Count	%	Cumul%
250 - 273	17	1.23	1.23
273 - 299	19	1.38	2.61
299 - 327	40	2.90	5.50
327 - 358	48	3.48	8.98
358 - 391	74	5.36	14.34
391 - 428	105	7.60	21.94
428 - 468	114	8.25	30.20
468 - 512	126	9.12	39.32
512 - 560	128	9.27	48.59
560 - 612	122	8.83	57.42
612 - 670	129	9.34	66.76
670 - 733	104	7.53	74.29
733 - 801	105	7.60	81.90
801 - 876	86	6.23	88.12
876 - 958	70	5.07	93.19
958 - 1048	37	2.68	95.87
1048 - 1146	35	2.53	98.41
1146 - 1254	14	1.01	99.42
1254 - 1371	7	0.51	99.93
1371 - 1500	1	0.07	100

Statistics		
Minimum:	251.55 ( 18.14 )	µm
Maximum:	1402.30 ( 1402.30 )	µm
Mean:	606.16 ( 432.36 )	µm
Std Dev.:	212.71 ( 307.72 )	µm
Sum:	837112.55 ( 883309.77 )	µm
Count:	1381 ( 2043 )	
Under:	662	
Over:	0	
Accepted:	67.60 %	
Field Count:	64	
Field Area:	32.89e+06 µm <sup>2</sup>	
Total Area:	2.11e+09 µm <sup>2</sup>	
D10:	364.09 ( 32.06 )	µm
D50:	570.84 ( 448.08 )	µm
D90:	906.99 ( 842.59 )	µm

### OBJM1 Count - CircDiam

Magn.: 115x Calib.: 4.8376 µm/pixel Bitplane: Bitplane 1



CircDiam Intervals (µm)	Count	%	Cumul%
175 - 197	14	1.02	1.02
197 - 221	26	1.89	2.91
221 - 248	47	3.42	6.32
248 - 279	68	4.94	11.26
279 - 313	122	8.87	20.13
313 - 351	168	12.21	32.34
351 - 395	168	12.21	44.55
395 - 443	165	11.99	56.54
443 - 498	166	12.06	68.60
498 - 559	133	9.67	78.27
559 - 628	141	10.25	88.52
628 - 706	95	6.90	95.42
706 - 793	43	3.13	98.55
793 - 890	14	1.02	99.56
890 - 1000	6	0.44	100

Statistics		
Minimum:	179.72 ( 10.92 )	µm
Maximum:	967.98 ( 967.98 )	µm
Mean:	439.11 ( 310.73 )	µm
Std Dev.:	145.28 ( 220.54 )	µm
Sum:	604213.97 ( 634815.08 )	µm
Count:	1376 ( 2043 )	
Under:	667	
Over:	0	
Accepted:	67.35 %	
Field Count:	64	
Field Area:	32.89e+06 µm <sup>2</sup>	
Total Area:	2.11e+09 µm <sup>2</sup>	
D10:	269.01 ( 24.26 )	µm
D50:	413.63 ( 330.19 )	µm
D90:	642.00 ( 604.12 )	µm



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