Sympatec GmbH
System-Partikel-Technik

QICPIC Particle Size Analysis

WINDOX 5

QICPIC (QP0104) & GRADIS, 0.50 63.0 mm - M6 (5...1705µm)
120221ab_JRT_S_M6 **2012-02-21, 14:46:02**,508

trigger condition: Gr_FR75_StaOpt0.05_StoOpt0.1..	
start:	c.opt >= 0.05%
valid:	always
stop:	30s c.opt <= 0.1% or 1200s real time

user parameters:
Sample Name: Aluminum Oxide (35~100)
Operator: Jonathan Tucker
Sample Mass: 0.00
Run Number: 0.00

evaluation: WINDOX 5.5.2.0	
calculation mode:	EQPC
class limits:	Variable

product: 120221ab_JRT_S_M6	
C_{opt}:	0.52 %

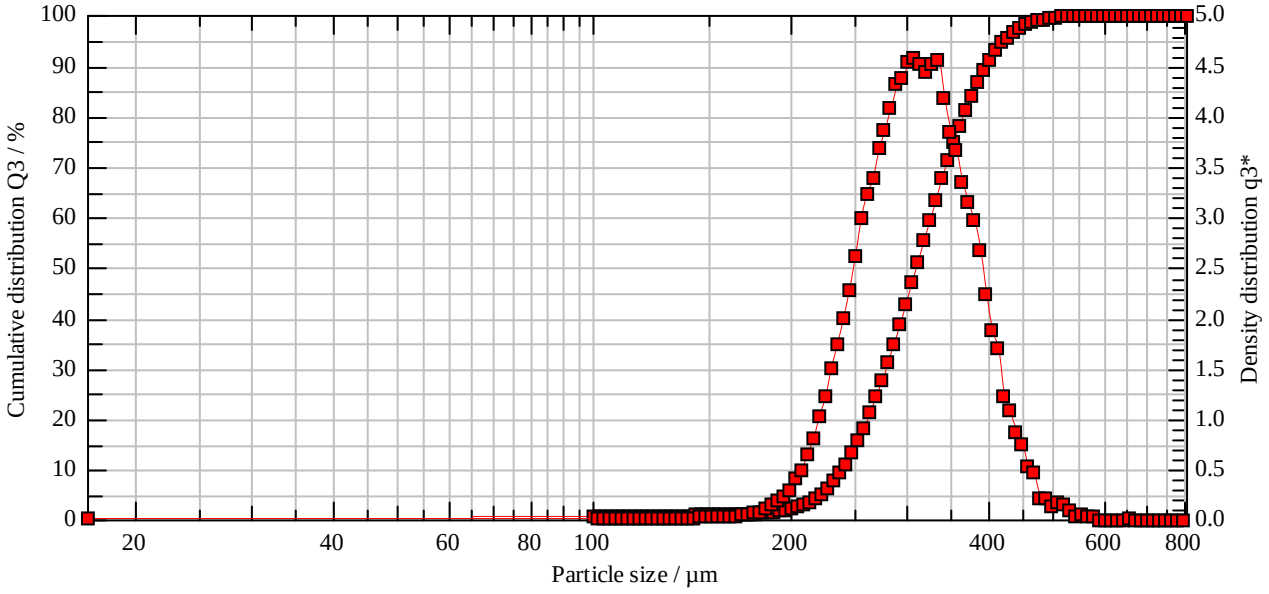
Size Distribution

Cumulative size distribution is a measure of the fraction of particles (based on volume) that could possibly pass through a sieve of a given opening. The
measure of particle size used is defined below under "calculation mode".

Diameter definitions are as follows:
EQPC: diameter of a circle that has the same area as the projected area of the particle
FERET: the distance between two parallel tangents in a well defined orientation (min, max, mean, max90, min90)
Chord Length: the distance of two points of the contour measured exactly across the center of gravity of the projected area (min, max, mean, vertical, horizontal, max90, min 90)
Martin Diameter: The chor dividing the projected area of the particle into two equal halves (min, max, mean)

Most common is EQPC and probably correlates most closely with laser measurements and is used most often. A well sieved sample may correlate better to FERET Minimum.

x_5 = 221.47 µm	**x_{50} = 309.23 µm**	**x_{90} = 394.99 µm**	**SMD = 293.97 µm**	**VMD = 312.92 µm**
x_{16} = 238.78 µm	x_{84} = 375.44 µm	x_{95} = 421.23 µm	**#PI = 200868**	



cumulative distribution

upper band limit x_0/µm	cumulative distribution Q_3/%	residue distribution $(1-Q_3)$/%	fraction in band dQ_3/%
100.00	0.57	99.43	0.57
102.12	0.58	99.42	0.01
104.29	0.59	99.41	0.01
106.50	0.61	99.39	0.01
108.77	0.62	99.38	0.01
111.07	0.63	99.37	0.01
113.43	0.64	99.36	0.01
115.84	0.65	99.35	0.01
118.30	0.67	99.33	0.01
120.81	0.68	99.32	0.01
123.37	0.69	99.31	0.01
125.99	0.70	99.30	0.01
128.67	0.72	99.28	0.02
131.40	0.74	99.26	0.02
134.19	0.75	99.25	0.01
137.04	0.77	99.23	0.02
139.94	0.78	99.22	0.01
142.91	0.80	99.20	0.02
145.95	0.82	99.18	0.02
149.05	0.84	99.16	0.02
152.21	0.86	99.14	0.02
155.44	0.88	99.12	0.02
158.74	0.90	99.10	0.03
162.11	0.93	99.07	0.03
165.55	0.97	99.03	0.03
169.07	1.01	98.99	0.04
172.65	1.06	98.94	0.05
176.32	1.12	98.88	0.06
180.06	1.19	98.81	0.07
183.88	1.29	98.71	0.10
187.79	1.43	98.57	0.14
191.77	1.61	98.39	0.18
195.84	1.82	98.18	0.20
200.00	2.08	97.92	0.27
204.25	2.45	97.55	0.37
208.58	2.89	97.11	0.44
213.01	3.48	96.52	0.59
217.53	4.20	95.80	0.73
222.15	5.14	94.86	0.93
226.86	6.26	93.74	1.12
231.68	7.62	92.38	1.37
236.60	9.21	90.79	1.59
241.62	11.03	88.97	1.82
246.75	13.10	86.90	2.07
251.98	15.48	84.52	2.39
257.33	18.21	81.79	2.72
262.80	21.15	78.85	2.94
268.37	24.24	75.76	3.09
274.07	27.59	72.41	3.35
279.89	31.11	68.89	3.52
285.83	34.84	65.16	3.73
291.90	38.77	61.23	3.93
298.09	42.76	57.24	3.99
304.42	46.89	53.11	4.14
310.88	51.07	48.93	4.17
317.48	55.18	44.82	4.11
324.22	59.23	40.77	4.05
331.10	63.34	36.66	4.11
338.13	67.49	32.51	4.15
345.31	71.30	28.70	3.80
352.64	74.80	25.20	3.51
360.12	78.14	21.86	3.34
367.77	81.19	18.81	3.05
375.57	84.05	15.95	2.86
383.54	86.75	13.25	2.70
391.69	89.19	10.81	2.44
400.00	91.22	8.78	2.03
408.49	92.93	7.07	1.71
417.16	94.48	5.52	1.55
426.02	95.60	4.40	1.12
435.06	96.58	3.42	0.98
444.29	97.37	2.63	0.79
453.73	98.06	1.94	0.68

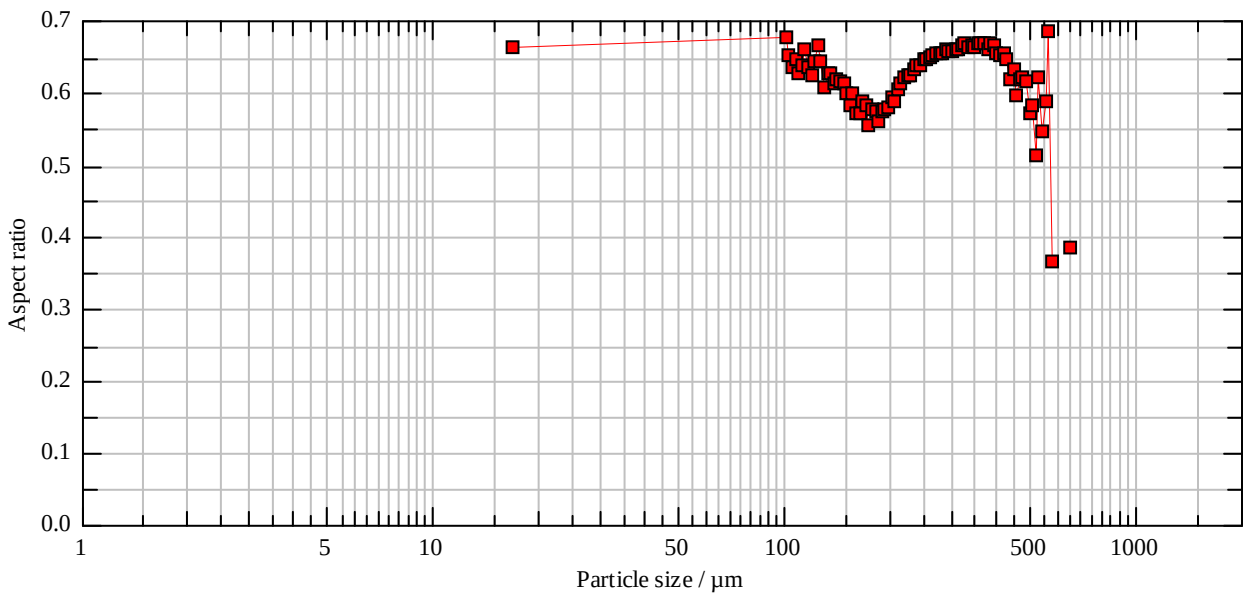
density distribution (log.)

mean size for band x_m/µm	density distribution $q_3$lg
16.80	0.00
101.06	0.01
103.20	0.01
105.39	0.01
107.63	0.01
109.91	0.01
112.25	0.01
114.63	0.01
117.06	0.01
119.55	0.02
122.08	0.01
124.68	0.01
127.32	0.02
130.02	0.02
132.79	0.02
135.60	0.02
138.48	0.01
141.42	0.02
144.42	0.02
147.49	0.02
150.62	0.02
153.82	0.02
157.08	0.03
160.42	0.03
163.82	0.04
167.30	0.05
170.85	0.06
174.48	0.07
178.18	0.08
181.96	0.11
185.82	0.15
189.77	0.20
193.80	0.22
197.91	0.30
202.11	0.40
206.40	0.48
210.78	0.64
215.26	0.80
219.83	1.02
224.49	1.23
229.26	1.50
234.12	1.74
239.09	1.99
244.17	2.27
249.35	2.62
254.64	2.98
260.05	3.23
265.57	3.39
271.21	3.67
276.96	3.86
282.84	4.09
288.85	4.31
294.98	4.37
301.24	4.53
307.63	4.58
314.16	4.51
320.83	4.44
327.64	4.51
334.60	4.55
341.70	4.17
348.95	3.85
356.36	3.66
363.92	3.34
371.65	3.14
379.54	2.96
387.59	2.68
395.82	2.23
404.22	1.87
412.80	1.70
421.57	1.23
430.51	1.07
439.65	0.87
448.98	0.75

463.36	98.53	1.47	0.47	458.52	0.52
473.19	98.95	1.05	0.42	468.25	0.46
483.24	99.14	0.86	0.20	478.19	0.22
493.49	99.34	0.66	0.20	488.34	0.22
503.97	99.46	0.54	0.12	498.70	0.13
514.67	99.63	0.37	0.16	509.29	0.18
525.59	99.77	0.23	0.14	520.10	0.15
536.75	99.85	0.15	0.08	531.14	0.09
548.14	99.88	0.12	0.03	542.41	0.03
559.78	99.92	0.08	0.04	553.93	0.05
571.66	99.96	0.04	0.03	565.69	0.04
583.79	99.98	0.02	0.02	577.69	0.03
596.18	99.98	0.02	0.00	589.96	0.00
608.84	99.98	0.02	0.00	602.48	0.00
621.76	99.98	0.02	0.00	615.27	0.00
634.96	99.98	0.02	0.00	628.33	0.00
648.44	99.98	0.02	0.00	641.66	0.00
662.20	100.00	0.00	0.02	655.28	0.02
676.26	100.00	0.00	0.00	669.19	0.00
690.61	100.00	0.00	0.00	683.40	0.00
705.27	100.00	0.00	0.00	697.91	0.00
720.24	100.00	0.00	0.00	712.72	0.00
735.53	100.00	0.00	0.00	727.85	0.00
751.15	100.00	0.00	0.00	743.30	0.00
767.09	100.00	0.00	0.00	759.08	0.00
783.37	100.00	0.00	0.00	775.19	0.00
800.00	100.00	0.00	0.00	791.64	0.00
1826.94	100.00	0.00	0.00	1208.95	0.00

Mean Aspect Ratio vs Mean Particle Size

Aspect ratio is defined as the ratio of the minimum to maximum FERET diameter. FERET diameter can be thought of as the kind of measure of diameter that one would achieve with a micrometer with the particle in a fixed geometric frame relative to the micrometer. The maximum diameter would correspond to the largest possible measurement of any particle orientation and viceversa for the minimum diameter. The values represent the mean measurement properties of the particles in the size class.

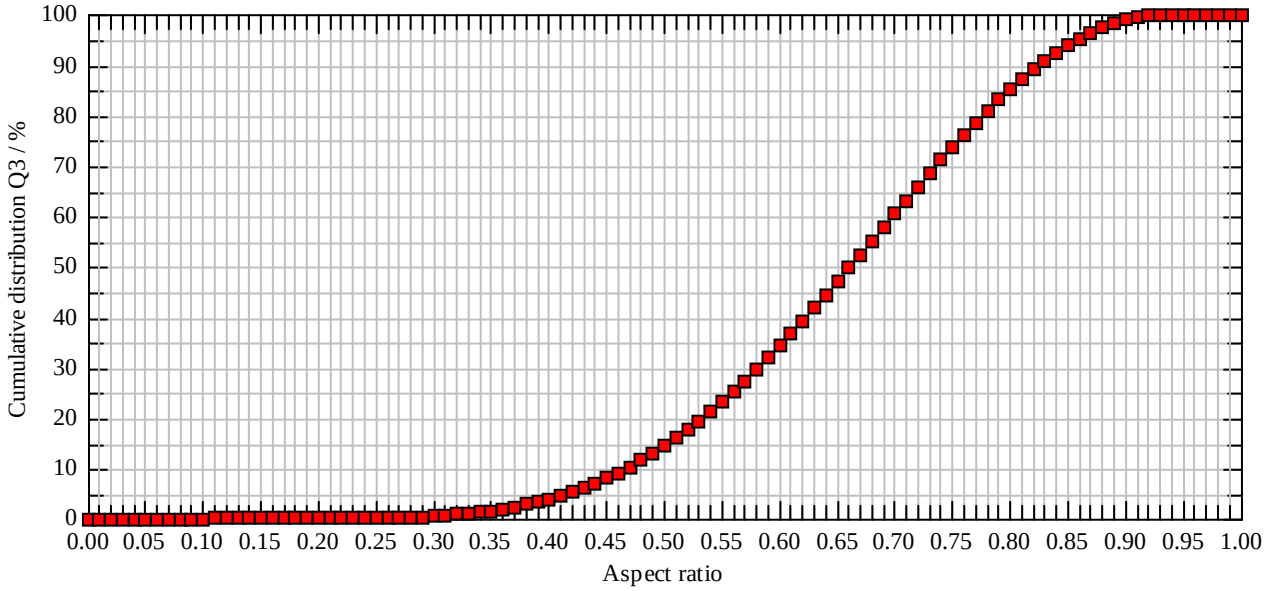


x_m/µm	aspect ratio	x_m/µm	aspect ratio	x_m/µm	aspect ratio	x_m/µm	aspect ratio
16.80	0.663	170.85	0.583	294.98	0.657	509.29	0.581
101.06	0.676	174.48	0.553	301.24	0.656	520.10	0.513
103.20	0.653	178.18	0.576	307.63	0.658	531.14	0.620
105.39	0.635	181.96	0.573	314.16	0.660	542.41	0.546
107.63	0.645	185.82	0.561	320.83	0.665	553.93	0.588
109.91	0.625	189.77	0.575	327.64	0.669	565.69	0.685
112.25	0.638	193.80	0.577	334.60	0.663	577.69	0.366
114.63	0.660	197.91	0.579	341.70	0.665	589.96	
117.06	0.634	202.11	0.592	348.95	0.663	602.48	
119.55	0.623	206.40	0.587	356.36	0.669	615.27	
122.08	0.644	210.78	0.603	363.92	0.669	628.33	
124.68	0.665	215.26	0.614	371.65	0.668	641.66	
127.32	0.643	219.83	0.622	379.54	0.660	655.28	0.383
130.02	0.608	224.49	0.622	387.59	0.667	669.19	
132.79	0.626	229.26	0.625	395.82	0.665	683.40	
135.60	0.627	234.12	0.631	404.22	0.654	697.91	
138.48	0.613	239.09	0.639	412.80	0.653	712.72	
141.42	0.617	244.17	0.636	421.57	0.653	727.85	
144.42	0.615	249.35	0.646	430.51	0.646	743.30	
147.49	0.613	254.64	0.646	439.65	0.618	759.08	
150.62	0.599	260.05	0.648	448.98	0.632	775.19	
153.82	0.583	265.57	0.652	458.52	0.596	791.64	
157.08	0.597	271.21	0.653	468.25	0.618	1208.95	
160.42	0.570	276.96	0.654	478.19	0.621		
163.82	0.570	282.84	0.654	488.34	0.616		
167.30	0.589	288.85	0.659	498.70	0.570		

CumulativeAspect Ratio Distribution

The cumulative aspect ratio distribution is the fraction of particles (based on volume) with aspect ratios less than the x-axis value.

a_{10} = 0.468	**a_{50} = 0.661**	**a_{90} = 0.826**
a_{16} = 0.511	a_{84} = 0.795	a_{99} = 0.904



cumulative distribution

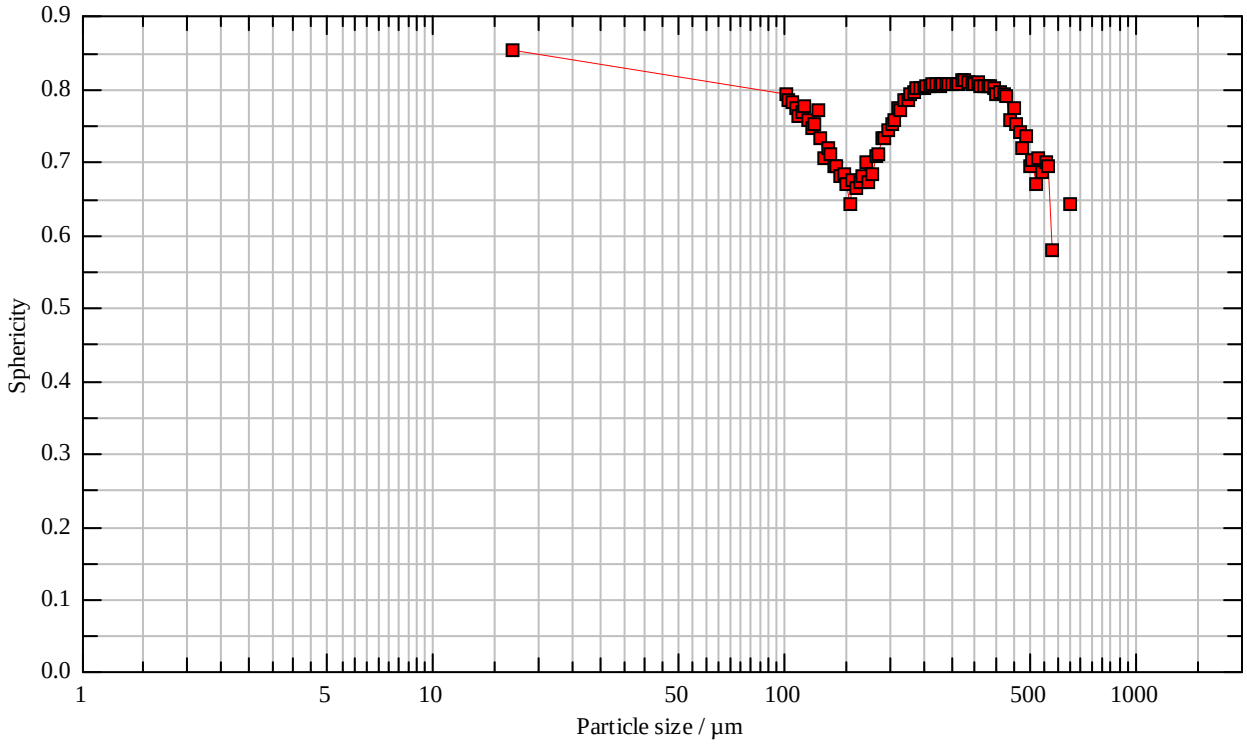
aspect ratio a_O	cumulative distribution Q_3 / %	residue distribution $(1-Q_3)$ / %
0.050	0.00	100.00
0.100	0.00	100.00
0.150	0.00	100.00
0.200	0.02	99.98
0.250	0.12	99.88
0.300	0.47	99.53
0.350	1.54	98.46
0.400	3.86	96.14
0.450	7.97	92.03
0.500	14.36	85.64
0.550	23.24	76.76
0.600	34.41	65.59
0.650	47.00	53.00
0.700	60.33	39.67
0.750	73.61	26.39
0.800	85.16	14.84
0.850	93.85	6.15
0.900	98.83	1.17
0.950	99.98	0.02
1.000	100.00	0.00

density distribution

mean aspect ratio for band a_m	density distribution q_3
0.045	0.000
0.095	0.000
0.145	0.000
0.195	0.007
0.245	0.035
0.295	0.105
0.345	0.280
0.395	0.554
0.445	0.954
0.495	1.470
0.545	2.075
0.595	2.347
0.645	2.660
0.695	2.630
0.745	2.516
0.795	2.167
0.845	1.484
0.895	0.681
0.945	0.039
0.995	0.000

Mean Sphericity vs Mean Particle Size

Sphericity is the ratio of the perimiter of the circle with the same projected area as the particle to the measured perimeter of the projected particle. Sphericity is a measure of surface roughness. The closer to 1, the smoother the surface. The data presented here is the mean property values for all particles in their respective size class.

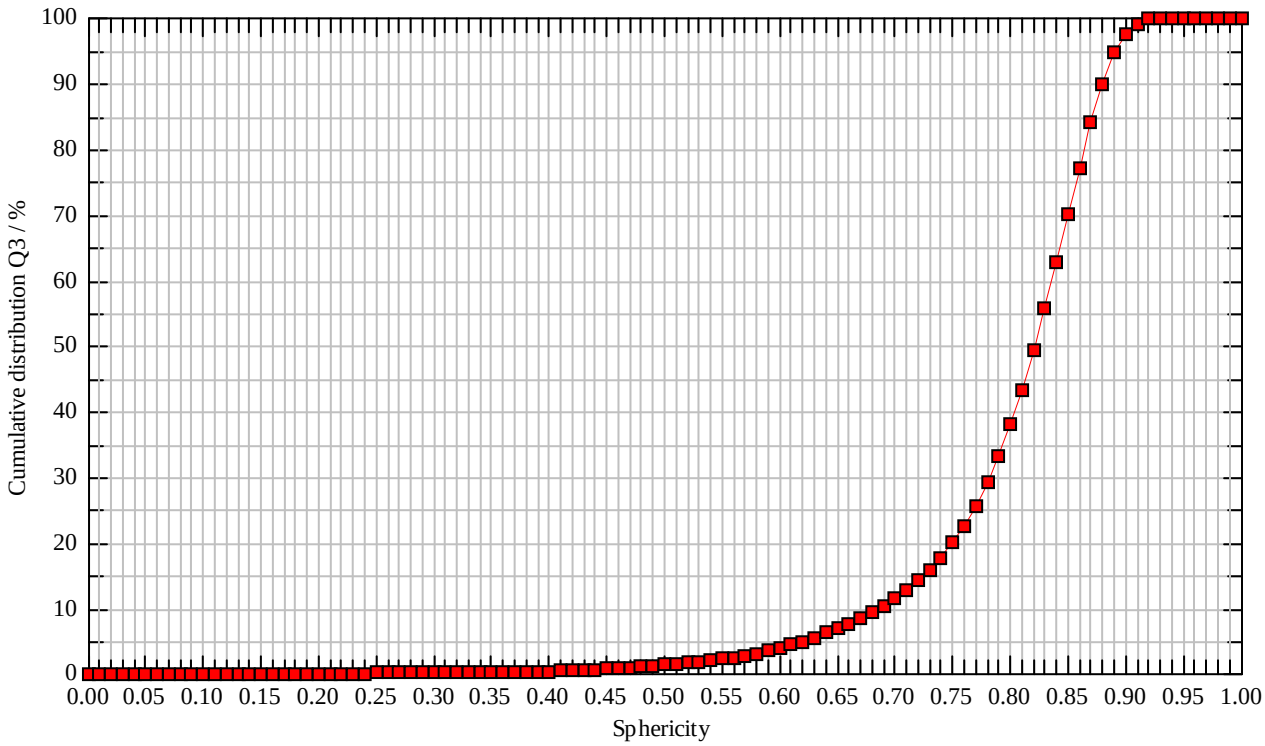


x_m/µm	sphericity	x_m/µm	sphericity	x_m/µm	sphericity	x_m/µm	sphericity
16.80	0.853	170.85	0.697	294.98	0.804	509.29	0.701
101.06	0.791	174.48	0.671	301.24	0.804	520.10	0.668
103.20	0.783	178.18	0.683	307.63	0.806	531.14	0.704
105.39	0.779	181.96	0.707	314.16	0.807	542.41	0.685
107.63	0.773	185.82	0.710	320.83	0.811	553.93	0.698
109.91	0.761	189.77	0.730	327.64	0.810	565.69	0.693
112.25	0.768	193.80	0.730	334.60	0.808	577.69	0.577
114.63	0.775	197.91	0.743	341.70	0.805	589.96	
117.06	0.755	202.11	0.750	348.95	0.805	602.48	
119.55	0.746	206.40	0.755	356.36	0.809	615.27	
122.08	0.751	210.78	0.772	363.92	0.802	628.33	
124.68	0.770	215.26	0.771	371.65	0.802	641.66	
127.32	0.731	219.83	0.784	379.54	0.802	655.28	0.640
130.02	0.705	224.49	0.784	387.59	0.802	669.19	
132.79	0.717	229.26	0.790	395.82	0.800	683.40	
135.60	0.709	234.12	0.795	404.22	0.792	697.91	
138.48	0.694	239.09	0.799	412.80	0.796	712.72	
141.42	0.694	244.17	0.800	421.57	0.792	727.85	
144.42	0.678	249.35	0.800	430.51	0.788	743.30	
147.49	0.683	254.64	0.803	439.65	0.756	759.08	
150.62	0.667	260.05	0.803	448.98	0.772	775.19	
153.82	0.641	265.57	0.806	458.52	0.752	791.64	
157.08	0.673	271.21	0.806	468.25	0.739	1208.95	
160.42	0.664	276.96	0.802	478.19	0.717		
163.82	0.672	282.84	0.805	488.34	0.734		
167.30	0.679	288.85	0.807	498.70	0.693		

Cumulative Sphericity Distribution

The cumulative sphericity distribution is the fraction of particles (based on volume) with sphericities less than the x-axis value.

s_{10} = 0.688	**s_{50} = 0.821**	**s_{90} = 0.880**
s_{16} = 0.731	s_{84} = 0.870	s_{99} = 0.909



cumulative distribution

sphericity s_O	cumulative distribution Q_3 / %	residue distribution $(1-Q_3)$ / %
0.050	0.00	100.00
0.100	0.00	100.00
0.150	0.00	100.00
0.200	0.00	100.00
0.250	0.00	100.00
0.300	0.01	99.99
0.350	0.08	99.92
0.400	0.29	99.71
0.450	0.65	99.35
0.500	1.27	98.73
0.550	2.19	97.81
0.600	3.83	96.17
0.650	6.72	93.28
0.700	11.30	88.70
0.750	19.95	80.05
0.800	37.93	62.07
0.850	69.91	30.09
0.900	97.54	2.46
0.950	99.98	0.02
1.000	100.00	0.00

density distribution

mean sphericity for band s_m	density distribution q_3
0.045	0.000
0.095	0.000
0.145	0.000
0.195	0.000
0.245	0.001
0.295	0.004
0.345	0.023
0.395	0.051
0.445	0.090
0.495	0.156
0.545	0.217
0.595	0.435
0.645	0.621
0.695	1.104
0.745	2.277
0.795	4.724
0.845	7.247
0.895	2.997
0.945	0.038
0.995	0.000

EQPC = 293.97 µm

Feret Max = 412.95 µm

Feret Min = 259.41 µm

Feret Mean = 334.77 µm