Sympatec GmbH
System-Partikel-Technik

QICPIC Particle Size Analysis
WINDOX 5

QICPIC (QP0104) & GRADIS, 2.00 63.0 mm - M6 (5 ... 1705 µm)
120209af_JLS_S_M6 **2012-02-09, 13:05:37**,918

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: Sorbent R
Operator: Jennie Stoffa
Sample Mass: 0.00
Run Number: 0.00

evaluation: WINDOX 5.8.2.0	
calculation mode:	EQPC
class limits:	Variable

product: 120209af_JLS_S_M6	
C_{opt}:	0.66 %

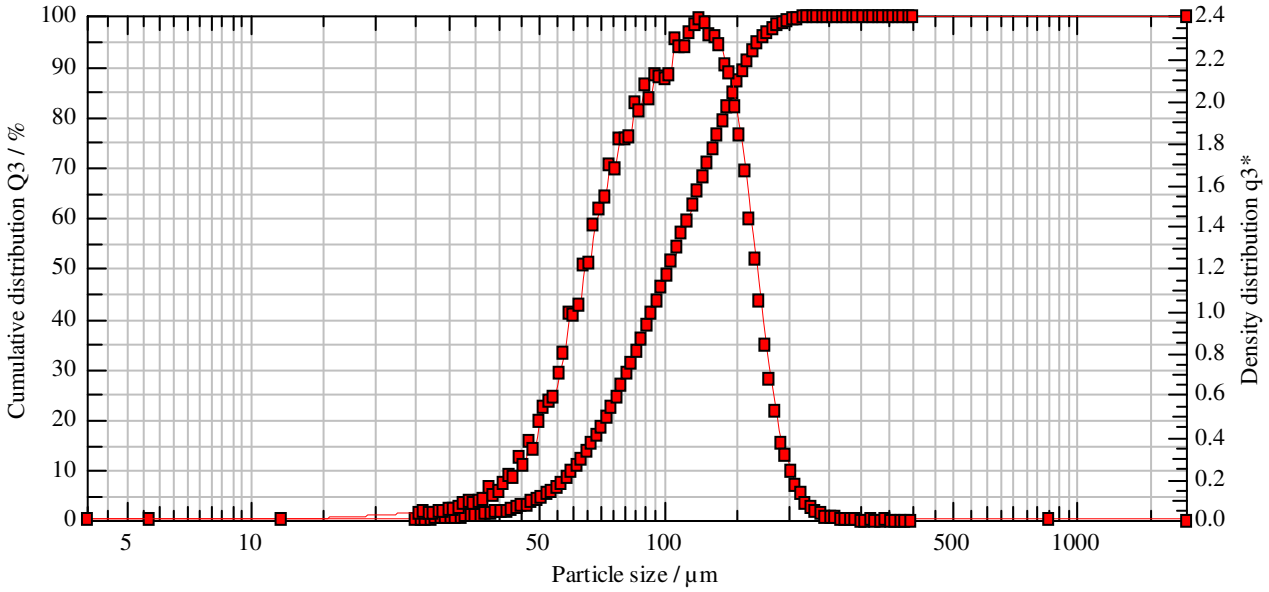
Size Distribution

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 = 51.21 µm	**x_{50} = 102.92 µm**	**x_{90} = 156.16 µm**	**SMD = 91.11 µm**	**VMD = 106.03 µm**
x_{16} = 60.00 µm	x_{84} = 145.10 µm	x_{95} = 169.97 µm	**#PI = 5321144**	



cumulative distribution

upper band limit x_0/µm	cumulative distribution Q_3/%	residue distribution $(1-Q_3)$/%	fraction in band dQ_3/%
5.64	0.00	100.00	0.00
25.00	0.26	99.74	0.26
25.71	0.31	99.69	0.04
26.44	0.36	99.64	0.05
27.19	0.40	99.60	0.04
27.96	0.44	99.56	0.04
28.76	0.49	99.51	0.05
29.57	0.54	99.46	0.05
30.41	0.60	99.40	0.06
31.28	0.66	99.34	0.06
32.17	0.73	99.27	0.07
33.08	0.83	99.17	0.10
34.02	0.94	99.06	0.11
34.99	1.03	98.97	0.09
35.98	1.14	98.86	0.11
37.00	1.26	98.74	0.12
38.05	1.44	98.56	0.19
39.13	1.59	98.41	0.15
40.25	1.76	98.24	0.17
41.39	1.97	98.03	0.22
42.56	2.23	97.77	0.26
43.77	2.48	97.52	0.24
45.02	2.84	97.16	0.37
46.29	3.16	96.84	0.32
47.61	3.62	96.38	0.46
48.96	4.03	95.97	0.41
50.35	4.61	95.39	0.58
51.78	5.26	94.74	0.65
53.25	5.95	94.05	0.69
54.77	6.67	93.33	0.72
56.32	7.52	92.48	0.86
57.92	8.49	91.51	0.97
59.57	9.70	90.30	1.20
61.26	10.88	89.12	1.19
63.00	12.13	87.87	1.25
64.79	13.61	86.39	1.48
66.63	15.10	84.90	1.49
68.52	16.81	83.19	1.71
70.46	18.61	81.39	1.80
72.47	20.48	79.52	1.87
74.52	22.53	77.47	2.06
76.64	24.57	75.43	2.04
78.82	26.78	73.22	2.21
81.06	28.98	71.02	2.21
83.36	31.20	68.80	2.22
85.72	33.62	66.38	2.42
88.16	36.00	64.00	2.37
90.66	38.52	61.48	2.52
93.24	40.96	59.04	2.44
95.89	43.53	56.47	2.57
98.61	46.10	53.90	2.57
101.41	48.65	51.35	2.55
104.29	51.22	48.78	2.58
107.25	54.01	45.99	2.78
110.30	56.75	43.25	2.74
113.43	59.49	40.51	2.74
116.65	62.32	37.68	2.82
119.97	65.19	34.81	2.87
123.37	68.09	31.91	2.90
126.88	70.96	29.04	2.87
130.48	73.77	26.23	2.81
134.19	76.57	23.43	2.80
138.00	79.32	20.68	2.75
141.92	81.95	18.05	2.63
145.95	84.55	15.45	2.59
150.09	86.95	13.05	2.40
154.36	89.17	10.83	2.23
158.74	91.19	8.81	2.02
163.25	92.93	7.07	1.74
167.89	94.44	5.56	1.51
172.65	95.71	4.29	1.27
177.56	96.73	3.27	1.02
182.60	97.54	2.46	0.82
187.79	98.17	1.83	0.63

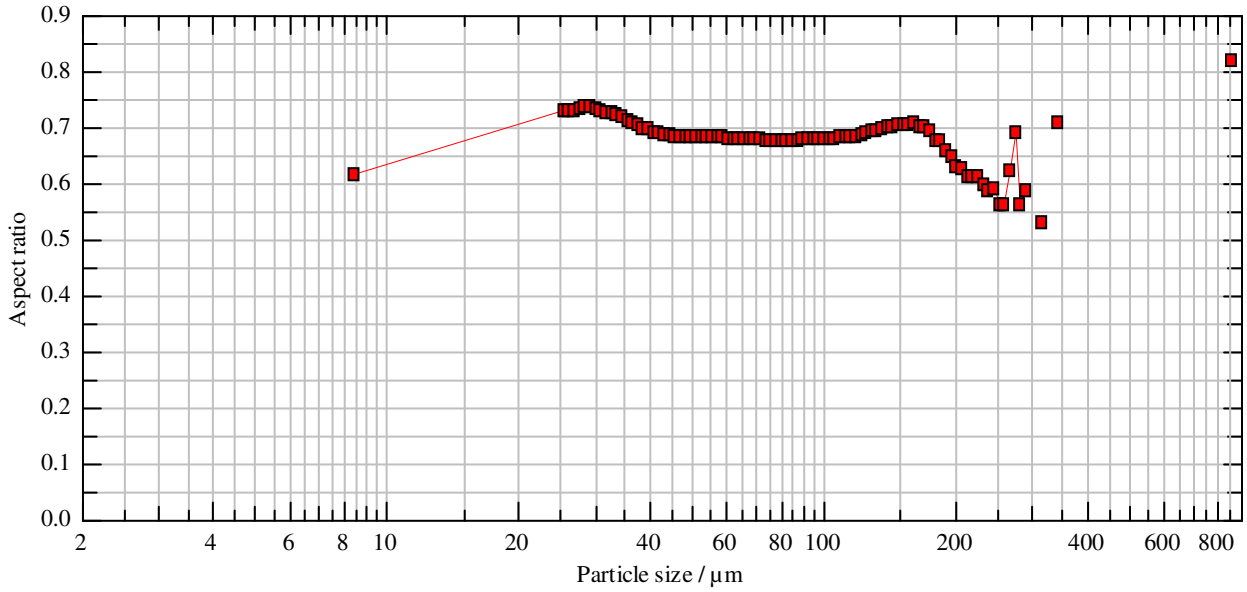
density distribution (log.)

mean size for band x_m/µm	density distribution $q_3$lg
3.99	0.00
11.88	0.00
25.35	0.04
26.07	0.04
26.81	0.03
27.57	0.03
28.36	0.04
29.16	0.04
29.99	0.05
30.84	0.05
31.72	0.06
32.62	0.08
33.55	0.09
34.50	0.08
35.48	0.09
36.49	0.10
37.52	0.15
38.59	0.12
39.69	0.14
40.81	0.18
41.97	0.21
43.16	0.20
44.39	0.30
45.65	0.26
46.95	0.38
48.28	0.34
49.65	0.47
51.06	0.54
52.51	0.57
54.00	0.59
55.54	0.70
57.11	0.80
58.74	0.99
60.40	0.97
62.12	1.02
63.88	1.22
65.70	1.22
67.56	1.41
69.48	1.48
71.46	1.54
73.49	1.69
75.57	1.67
77.72	1.81
79.93	1.82
82.20	1.82
84.53	1.99
86.93	1.95
89.40	2.08
91.94	2.00
94.55	2.11
97.24	2.11
100.00	2.10
102.84	2.12
105.76	2.29
108.76	2.25
111.85	2.26
115.03	2.32
118.30	2.36
121.66	2.39
125.11	2.36
128.67	2.31
132.32	2.30
136.08	2.26
139.94	2.17
143.92	2.13
148.01	1.97
152.21	1.83
156.53	1.66
160.98	1.43
165.55	1.24
170.25	1.04
175.09	0.84
180.06	0.67
185.17	0.52

193.12	98.62	1.38	0.45	190.43	0.37
198.61	99.00	1.00	0.38	195.84	0.31
204.25	99.29	0.71	0.28	201.41	0.23
210.05	99.49	0.51	0.20	207.13	0.17
216.01	99.64	0.36	0.15	213.01	0.13
222.15	99.74	0.26	0.10	219.06	0.08
228.46	99.81	0.19	0.07	225.28	0.06
234.95	99.87	0.13	0.06	231.68	0.05
241.62	99.91	0.09	0.04	238.26	0.03
248.48	99.93	0.07	0.02	245.02	0.02
255.54	99.94	0.06	0.01	251.98	0.01
262.80	99.96	0.04	0.01	259.14	0.01
270.26	99.97	0.03	0.01	266.50	0.01
277.94	99.97	0.03	0.00	274.07	0.00
285.83	99.98	0.02	0.01	281.85	0.01
293.95	99.98	0.02	0.00	289.86	0.00
302.30	99.98	0.02	0.00	298.09	0.00
310.88	99.98	0.02	0.00	306.56	0.00
319.71	99.98	0.02	0.00	315.27	0.00
328.79	99.98	0.02	0.00	324.22	0.00
338.13	99.98	0.02	0.00	333.43	0.00
347.73	99.99	0.01	0.00	342.90	0.00
357.61	99.99	0.01	0.00	352.64	0.00
367.77	99.99	0.01	0.00	362.65	0.00
378.21	99.99	0.01	0.00	372.95	0.00
388.95	99.99	0.01	0.00	383.54	0.00
400.00	99.99	0.01	0.00	394.44	0.00
1826.94	100.00	0.00	0.01	854.86	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.

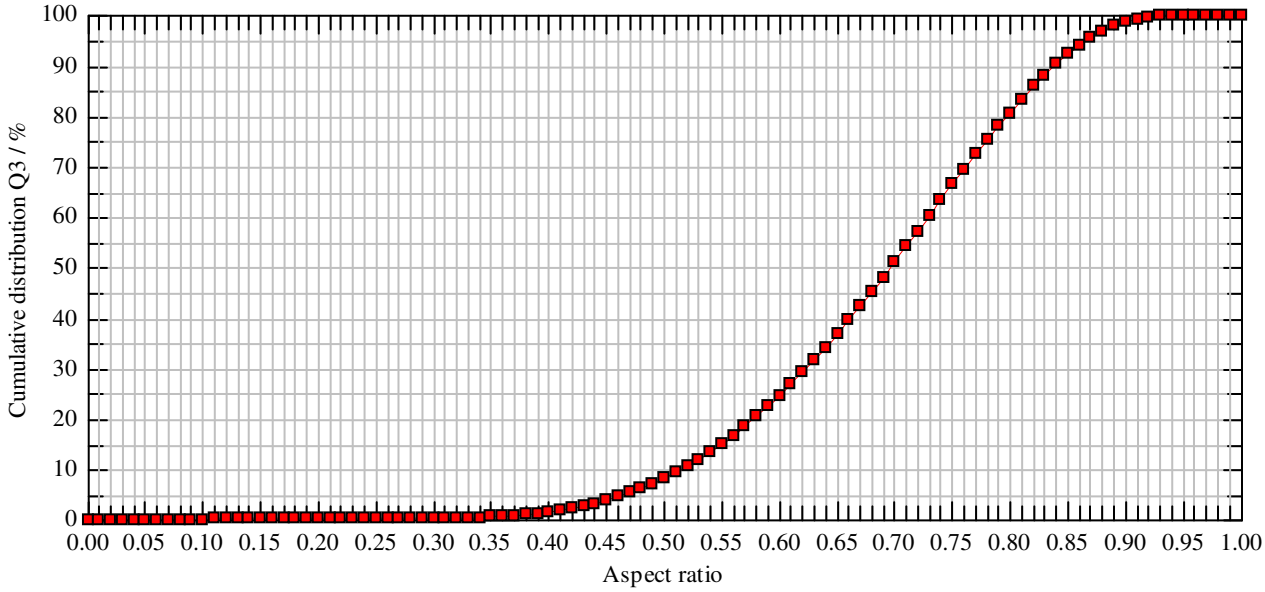


x_m/µm	aspect ratio	x_m/µm	aspect ratio	x_m/µm	aspect ratio	x_m/µm	aspect ratio
8.40	0.617	51.06	0.682	105.76	0.681	219.06	0.612
25.35	0.729	52.51	0.683	108.76	0.683	225.28	0.614
26.07	0.729	54.00	0.683	111.85	0.684	231.68	0.599
26.81	0.730	55.54	0.683	115.03	0.685	238.26	0.588
27.57	0.733	57.11	0.683	118.30	0.686	245.02	0.592
28.36	0.736	58.74	0.683	121.66	0.687	251.98	0.562
29.16	0.737	60.40	0.682	125.11	0.690	259.14	0.563
29.99	0.734	62.12	0.681	128.67	0.694	266.50	0.622
30.84	0.731	63.88	0.681	132.32	0.696	274.07	0.691
31.72	0.728	65.70	0.680	136.08	0.698	281.85	0.561
32.62	0.725	67.56	0.680	139.94	0.700	289.86	0.589
33.55	0.724	69.48	0.679	143.92	0.703	298.09	
34.50	0.719	71.46	0.679	148.01	0.705	306.56	
35.48	0.713	73.49	0.678	152.21	0.706	315.27	0.529
36.49	0.708	75.57	0.678	156.53	0.706	324.22	
37.52	0.704	77.72	0.678	160.98	0.709	333.43	
38.59	0.700	79.93	0.678	165.55	0.701	342.90	0.707
39.69	0.698	82.20	0.677	170.25	0.702	352.64	
40.81	0.693	84.53	0.678	175.09	0.694	362.65	
41.97	0.690	86.93	0.678	180.06	0.678	372.95	
43.16	0.689	89.40	0.679	185.17	0.678	383.54	
44.39	0.686	91.94	0.679	190.43	0.660	394.44	
45.65	0.685	94.55	0.679	195.84	0.647	854.86	0.819
46.95	0.684	97.24	0.680	201.41	0.629		
48.28	0.684	100.00	0.680	207.13	0.626		
49.65	0.684	102.84	0.680	213.01	0.614		

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} = 0.516	**a_{50} = 0.697**	**a_{90} = 0.839**
a_{16} = 0.556	a_{84} = 0.813	a_{99} = 0.907



cumulative distribution

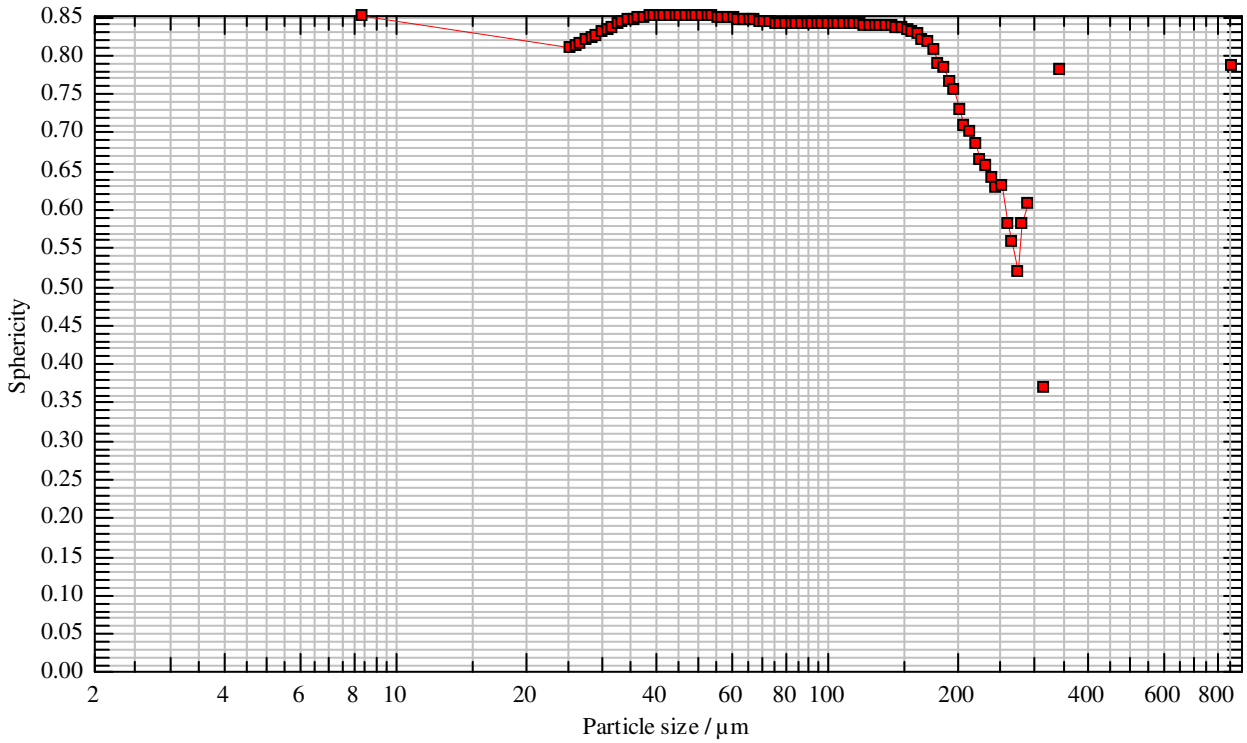
aspect ratio a_O	cumulative distribution Q_3 / %	residue distribution $(1-Q_3)$ / %
0.050	0.00	100.00
0.100	0.00	100.00
0.150	0.00	100.00
0.200	0.00	100.00
0.250	0.01	99.99
0.300	0.09	99.91
0.350	0.43	99.57
0.400	1.42	98.58
0.450	3.73	96.27
0.500	8.07	91.93
0.550	14.88	85.12
0.600	24.46	75.54
0.650	36.67	63.33
0.700	50.98	49.02
0.750	66.32	33.68
0.800	80.55	19.45
0.850	92.11	7.89
0.900	98.58	1.42
0.950	99.99	0.01
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	0.000
0.245	0.005
0.295	0.028
0.345	0.104
0.395	0.279
0.445	0.605
0.495	1.095
0.545	1.594
0.595	2.081
0.645	2.613
0.695	2.983
0.745	3.199
0.795	2.721
0.845	1.928
0.895	0.818
0.945	0.048
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.

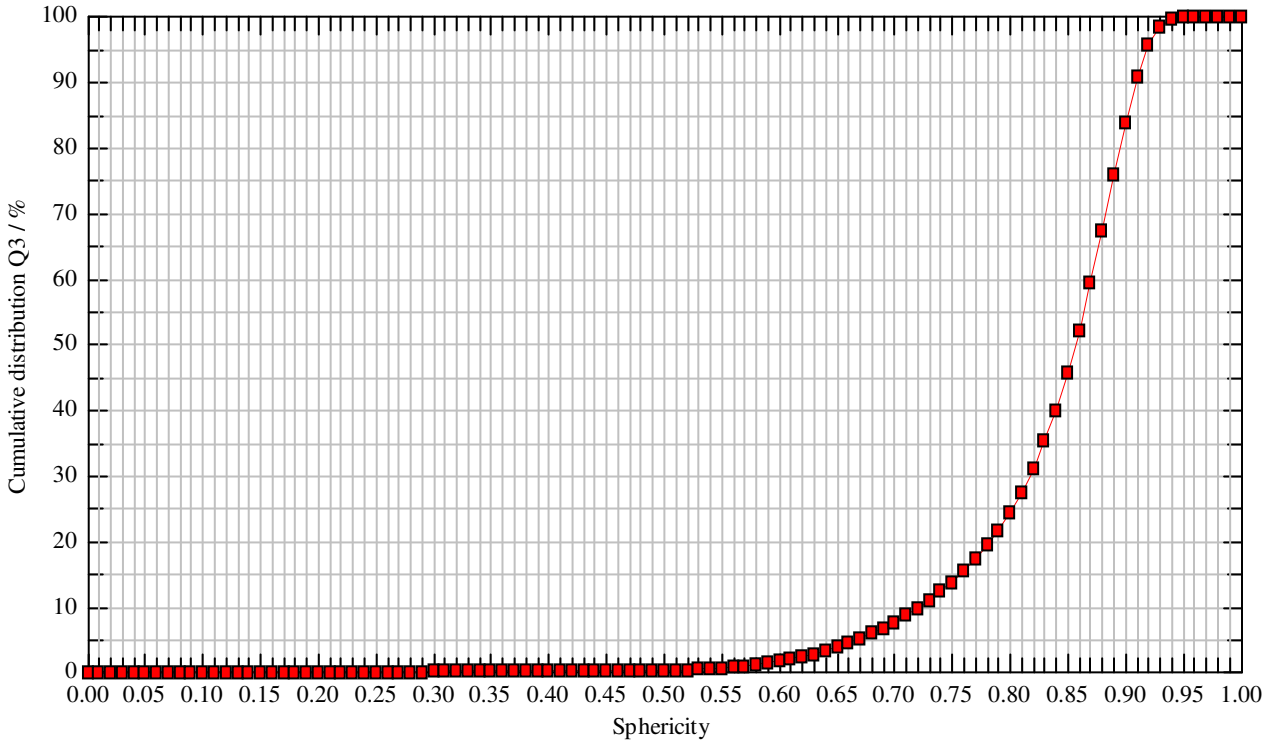


x_m/µm	sphericity	x_m/µm	sphericity	x_m/µm	sphericity	x_m/µm	sphericity
8.40	0.850	51.06	0.848	105.76	0.838	219.06	0.683
25.35	0.806	52.51	0.848	108.76	0.838	225.28	0.662
26.07	0.809	54.00	0.848	111.85	0.838	231.68	0.655
26.81	0.813	55.54	0.847	115.03	0.838	238.26	0.640
27.57	0.817	57.11	0.846	118.30	0.838	245.02	0.626
28.36	0.820	58.74	0.846	121.66	0.837	251.98	0.629
29.16	0.824	60.40	0.845	125.11	0.837	259.14	0.579
29.99	0.829	62.12	0.845	128.67	0.837	266.50	0.555
30.84	0.831	63.88	0.844	132.32	0.837	274.07	0.518
31.72	0.834	65.70	0.843	136.08	0.836	281.85	0.579
32.62	0.838	67.56	0.842	139.94	0.835	289.86	0.605
33.55	0.841	69.48	0.841	143.92	0.834	298.09	
34.50	0.843	71.46	0.841	148.01	0.832	306.56	
35.48	0.845	73.49	0.840	152.21	0.831	315.27	0.367
36.49	0.846	75.57	0.839	156.53	0.827	324.22	
37.52	0.846	77.72	0.839	160.98	0.826	333.43	
38.59	0.848	79.93	0.839	165.55	0.818	342.90	0.780
39.69	0.849	82.20	0.839	170.25	0.814	352.64	
40.81	0.848	84.53	0.838	175.09	0.805	362.65	
41.97	0.849	86.93	0.838	180.06	0.787	372.95	
43.16	0.848	89.40	0.838	185.17	0.781	383.54	
44.39	0.848	91.94	0.838	190.43	0.762	394.44	
45.65	0.848	94.55	0.838	195.84	0.753	854.86	0.783
46.95	0.848	97.24	0.838	201.41	0.727		
48.28	0.848	100.00	0.838	207.13	0.706		
49.65	0.848	102.84	0.838	213.01	0.699		

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} = 0.723	**s_{50} = 0.857**	**s_{90} = 0.909**
s_{16} = 0.764	s_{84} = 0.900	s_{99} = 0.936



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	0.00	100.00
0.350	0.00	100.00
0.400	0.01	99.99
0.450	0.04	99.96
0.500	0.15	99.85
0.550	0.55	99.45
0.600	1.54	98.46
0.650	3.77	96.23
0.700	7.60	92.40
0.750	13.69	86.31
0.800	24.28	75.72
0.850	45.50	54.50
0.900	83.72	16.28
0.950	99.88	0.12
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	0.000
0.295	0.001
0.345	0.000
0.395	0.001
0.445	0.008
0.495	0.036
0.545	0.119
0.595	0.275
0.645	0.581
0.695	0.924
0.745	1.463
0.795	2.689
0.845	5.611
0.895	8.066
0.945	0.388
0.995	0.000

Summary and Comparrisons

EQPC SMD *(Preffered)* = 91.11 µm 90% Distribution: x_5 = 51.21 µm / x_{95} = 169.97 µm

Sphericity =	0.857	(0.723 ~ 0.909)
Aspect Ratio =	0.697	(0.516 ~ 0.839)
Convexity =	0.904	(0.820 ~ 0.937)
Straightness =	0.992	(0.925 ~ 0.998)
Elongation =	0.439	(0.266 ~ 0.640)

Feret Max SMD = 123.61 µm 90% Distribution: x_5 = 68.03 µm / x_{95} = 250.55 µm

Sphericity =	0.838	(0.679 ~ 0.903)
Aspect Ratio =	0.651	(0.464 ~ 0.816)
Convexity =	0.896	(0.790 ~ 0.934)
Straightness =	0.992	(0.918 ~ 0.998)
Elongation =	0.399	(0.232 ~ 0.604)

Feret Min SMD = 82.13 µm 90% Distribution: x_5 = 44.79 µm / x_{95} = 158.73 µm

Sphericity =	0.862	(0.722 ~ 0.911)
Aspect Ratio =	0.728	(0.558 ~ 0.855)
Convexity =	0.904	(0.815 ~ 0.937)
Straightness =	0.992	(0.915 ~ 0.998)
Elongation =	0.453	(0.267 ~ 0.659)

Feret Mean SMD = 103.30 µm 90% Distribution: x_5 = 57.73 µm / x_{95} = 199.04 µm

Sphericity =	0.847	(0.692 ~ 0.906)
Aspect Ratio =	0.680	(0.491 ~ 0.832)
Convexity =	0.899	(0.797 ~ 0.935)
Straightness =	0.992	(0.916 ~ 0.998)
Elongation =	0.417	(0.242 ~ 0.626)