Wet grinding of activated carbon in a Retsch planetary ball mill

Instrument: SYNC

Activated Carbon

Activated carbon is a highly porous material with a large internal surface area, which has a wide range of applications due to its good adsorption properties, for example in water purifiers or in air filters. Activated carbon is usually produced from charcoal, and many substances with a high carbon content can be the precursor material: wood, nut shells, peat, petrochemical products, or bones. The internal structure of activated carbon consists of large pores created during the production process. Activated carbon is available in different specifications/forms - e. g. as powder, granulate or extrudate.

In the grinding experiment described here, a sample of activated carbon granulate from coconut shells with an initial particle size of 1-2 millimeters (Fig. 2) was to be ground to less than 1 µm. Such small particle sizes are hardly achievable by dry milling. Therefore, wet grinding was carried out in a Retsch PM100 planetary ball mill (Fig. 1). The liquid used was isopropanol, which has better wetting properties than water.
The grinding progress was continuously documented by laser diffraction. For the measurements, a Microtrac SYNC (Fig. 1) was used, which is suitable for particle analyses in the size range 10 nm to 4 mm.

Fig. 1: *Retsch Planetary Ball Mill PM100 (left) and Microtrac Laser Diffraction Analyzer SYNC (right).*

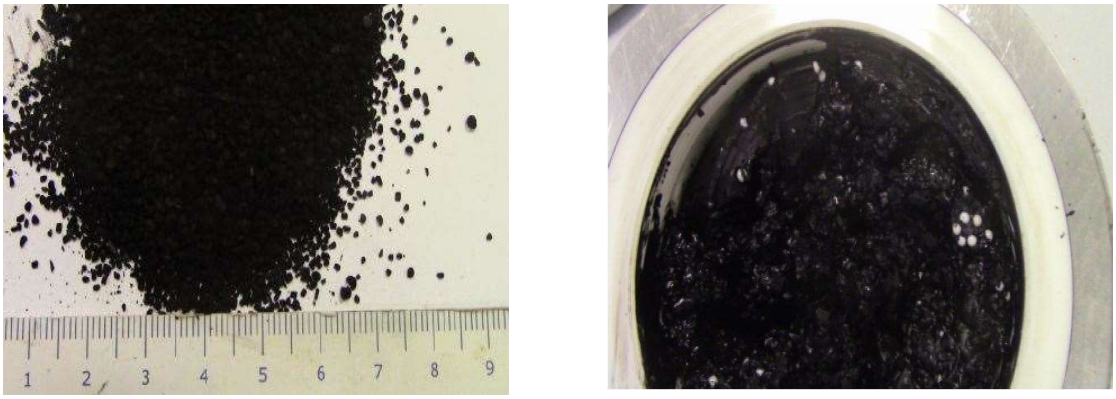

Fig. 2: *Feed material was granular activated carbon (left), ground sample paste in a zirconia (ZrO_2) jar (right). White zirconia grinding balls are clearly visible.*

Grinding Experiment and Measurement Conditions

Grinding Experiment:

- Material: Activated Carbon from coconut shells
- Feed size: approx. 1 mm
- Feed quantity: 32 g (approx. 125 ml)
- Material properties: hard, brittle
- Mill: Retsch PM100 Planetary Ball Mill
- Configuration: 500 ml zirconia grinding jar, 1000 g zirconia grinding balls, 3mm, 200 ml isopropanol
- Revolution Speed: 480 rpm
- Overall grinding time: 2 hours 30 minutes
- Particle Size Analysis with SYNC Laser Diffraction: after 5 min, 30 min, 60 min, 1 h 45 min und 2 h 30 min

After grinding, the sample can be separated from the grinding balls by sieving.

Measurement conditions Laser Diffraction:

- Instrument: SYNC, configuration 3R (three red lasers, wavelength 780 nm, Fig. 3)
- Dispersion: wet measurement with FlowSync in isopropanol
- Pump speed: 55 %
- Ultrasound: 60 seconds, Power 100 %
- Analysis time: 20 seconds
- Evaluation acc. to Mie theory, refractive index particle: 1.85, refractive index liquid: 1,38
- Particle model: irregular particles
- Standard: ISO 13320

The setup of laser diffraction analysis is illustrated in Fig. 3. The scattering or diffraction angle depends on the particle size, with large particles scattering light to small angles and small particles scattering light to large angles.

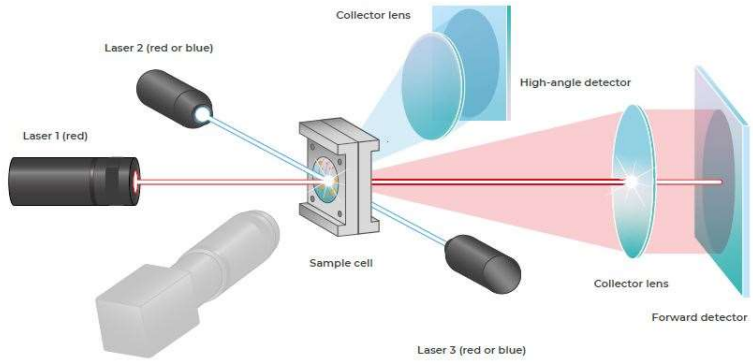

Fig. 3: *Operating principle of laser diffraction analysis with SYNC. The sample in the measuring cell is illuminated by three lasers. Two detector arrays record the scattered light over an angular range from 0° to 163°. The particle size distribution is calculated from the scattered light pattern.*

Results

The grinding results are shown in Table 1 and the corresponding diagram (Fig. 4). Usually, percentile values at 10%, 50% and 90% are given in particle analysis to describe the size distribution (d10, d50, d90). These values respectively indicate the size below which 10%, 50% or 90% of the sample is located (example: d90 = 1 µm means 90% of the sample is smaller than 1 µm). The percentages are always by volume.
After only 5 minutes, a d50 (median) of less than 5 µm and a d90 of approx. 10 µm is reached. After 60 minutes, the d50 is reduced to 1 µm, i. e. half of the sample volume consists of particles smaller than 1 µm.
After 150 minutes, a median of 680 nm is reached, and the d90 is just below 2 µm. No progress can be detected here compared to the measurement after 105 minutes, so there is hardly any further progress. Higher final fineness could possibly be achieved if smaller grinding balls were used.
The reports of the individual measurements are listed in the appendix.

Grinding time [min]	d10 [µm]	d50 [µm]	d90 [µm]
5	2,00	4,53	10,25
30	0,57	1,75	3,78
60	0,48	1,00	2,64
105	0,43	0,76	1,76
150	0,40	0,68	1,88

Table 1: *Grinding progress expressed as percentiles.*

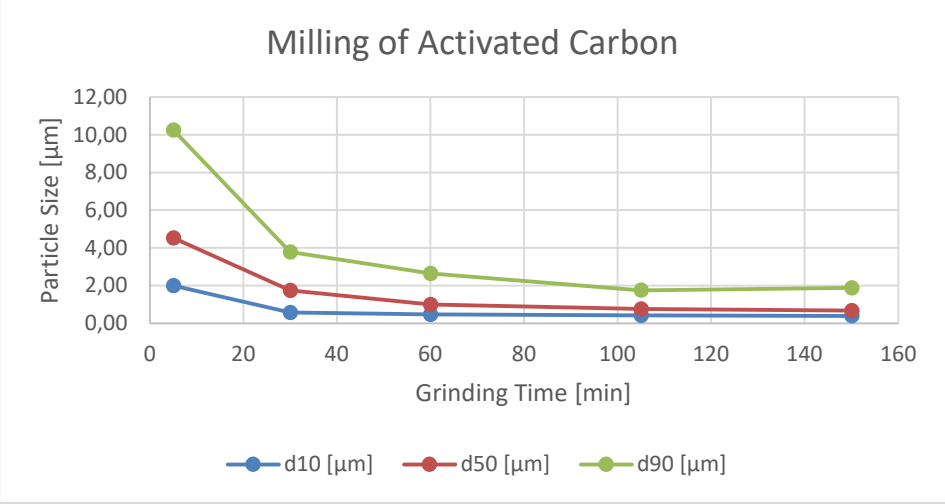

Fig. 4: *Change of d10, d50 and d90 with progressive grinding time.*

Summary

Thanks to the wide size range and short analysis times, the Microtrac SYNC is ideally suited for documenting grinding processes. By repeated sampling after a defined grinding time, it can be determined that the fastest progress is made at the beginning of the milling. This makes it easy to find out when the desired result has been achieved. When the particle size distribution no longer changes with extended grinding time, the final fineness has been reached.

For further information please contact us at:

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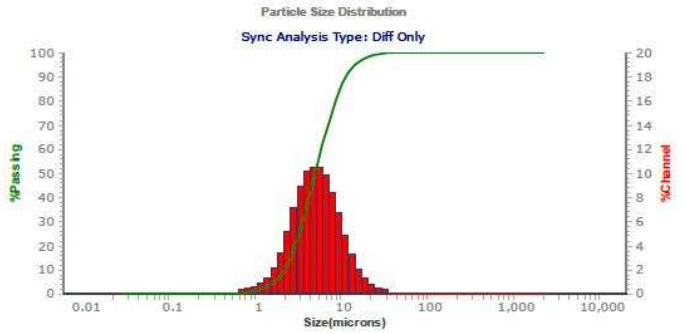
- Particle Size Analysis -

5 minutes grinding time

Tabular Data

Size(um)	%Chan	%Pass	Size(um)	%Chan	%Pass
2000	0.00	100.00	3.89	10.21	40.80
1674	0.00	100.00	3.27	9.00	30.59
1408	0.00	100.00	2.750	7.18	21.59
1184	0.00	100.00	2.313	5.16	14.41
995.6	0.00	100.00	1.945	3.40	9.25
837.2	0.00	100.00	1.635	2.14	5.85
704.0	0.00	100.00	1.375	1.33	3.71
592.0	0.00	100.00	1.156	0.87	2.38
497.8	0.00	100.00	0.972	0.62	1.51
418.6	0.00	100.00	0.818	0.49	0.89
352.0	0.00	100.00	0.688	0.40	0.40
296.0	0.00	100.00	0.578	0.00	0.00
248.9	0.00	100.00	0.486	0.00	0.00
209.3	0.00	100.00	0.409	0.00	0.00
176.0	0.00	100.00	0.344	0.00	0.00
148.0	0.00	100.00	0.2890	0.00	0.00
124.5	0.00	100.00	0.2430	0.00	0.00
104.7	0.00	100.00	0.2040	0.00	0.00
88.00	0.00	100.00	0.1720	0.00	0.00
74.00	0.00	100.00	0.1450	0.00	0.00
62.23	0.00	100.00	0.1220	0.00	0.00
52.33	0.00	100.00	0.1020	0.00	0.00
44.00	0.00	100.00	0.0860	0.00	0.00
37.00	0.00	100.00	0.0720	0.00	0.00
31.11	0.32	100.00	0.0610	0.00	0.00
26.16	0.48	99.68	0.0510	0.00	0.00
22.00	0.77	99.20	0.0430	0.00	0.00
18.50	1.27	98.43	0.0360	0.00	0.00
15.56	2.08	97.16	0.0300	0.00	0.00
13.08	3.28	95.08	0.02550	0.00	0.00
11.00	4.89	91.80			
9.25	6.74	86.91			
7.78	8.48	80.17			
6.54	9.80	71.69			
5.50	10.53	61.89			
4.63	10.56	51.36			



WARNING: NONE

Measurement Info

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Identifiers	
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Database Record	1
Run Number	1 of 1
Date	9/16/2020
Time	8:03 AM
Acquired Date	9/16/2020
Acquired Time	8:03 AM
Serial Number	H0045
Sample Cell ID	20039
Calculated Data	
Above Residual	0
Below Residual	0
Loading Factor	0.0111
Transmission	0.963
RMS Residual	1.331%
Calc SW Ver	12.0.1.0
User Defined Calculations	
Name	Value
Recalculation Status	
Live-Meas : : Original :	

SOP Info

21367_CARBON(*)	
Timing	
Setzero Time	20 (sec)
Run Time	20 (sec)
Number of Runs	1
Analysis	
21367_Carbon	
Refractive Index	1.85
Transparency	Transp
Shape	Irregular
Isopropyl alcohol	
Refractive Index	1.38
Options:	
Filter	Enabled
Analysis Gain	Default(2)
Analysis Mode	3R/Img L
Analysis Type	Diff Only
Enhanced Imaging	Disabled
Img Cor File:	Default
Perspective	
Progression	Standard
Distribution	Volume
Upper Edge(um)	2000
Lower Edge(um)	0.0215
Residuals	Disabled

Summary	
Data	Value
MV(um):	5.55
MN(um):	1.480
MA(um):	3.63
CS:	1.653
SD:	3.06
Mz:	5.16
si:	3.27
Ski:	0.394
Kg:	1.168

Percentiles	
%Tile	Size(um)
90.00	10.25
50.00	4.53
10.00	2.003

Peaks Summary		
Dia(um)	Vol%	Width
4.53	100	6.12

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Notes

PM100 + 500 ml jar of ZrO2 + 1 kg 3 mm balls + 125 ml sample + 200 ml IPA_480rpm

Sample System(Wet)	
Number of Rinses	2
Flow Rate (%)	55%
Deaeration Cycles	2

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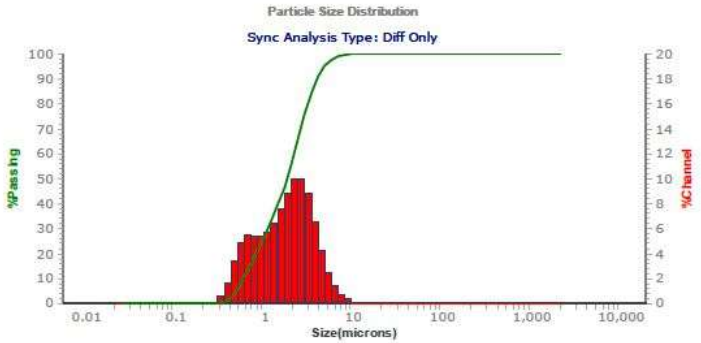
Tabular Data

Size(um)	%Chan	%Pass	Size(um)	%Chan	%Pass
2000	0.00	100.00	3.89	6.58	90.88
1674	0.00	100.00	3.27	8.82	84.30
1408	0.00	100.00	2.750	10.00	75.48
1184	0.00	100.00	2.313	9.96	65.48
995.6	0.00	100.00	1.945	8.89	55.52
837.2	0.00	100.00	1.635	7.57	46.63
704.0	0.00	100.00	1.375	6.46	39.06
592.0	0.00	100.00	1.156	5.72	32.60
497.8	0.00	100.00	0.972	5.39	26.88
418.6	0.00	100.00	0.818	5.42	21.49
352.0	0.00	100.00	0.688	5.48	16.07
296.0	0.00	100.00	0.578	4.91	10.59
248.9	0.00	100.00	0.486	3.39	5.68
209.3	0.00	100.00	0.409	1.67	2.29
176.0	0.00	100.00	0.344	0.62	0.62
148.0	0.00	100.00	0.2890	0.00	0.00
124.5	0.00	100.00	0.2430	0.00	0.00
104.7	0.00	100.00	0.2040	0.00	0.00
88.00	0.00	100.00	0.1720	0.00	0.00
74.00	0.00	100.00	0.1450	0.00	0.00
62.23	0.00	100.00	0.1220	0.00	0.00
52.33	0.00	100.00	0.1020	0.00	0.00
44.00	0.00	100.00	0.0860	0.00	0.00
37.00	0.00	100.00	0.0720	0.00	0.00
31.11	0.00	100.00	0.0610	0.00	0.00
26.16	0.00	100.00	0.0510	0.00	0.00
22.00	0.00	100.00	0.0430	0.00	0.00
18.50	0.00	100.00	0.0360	0.00	0.00
15.56	0.00	100.00	0.0300	0.00	0.00
13.08	0.00	100.00	0.02550	0.00	0.00
11.00	0.00	100.00			
9.25	0.35	100.00			
7.78	0.69	99.65			
6.54	1.34	98.96			
5.50	2.48	97.62			
4.63	4.26	95.14			

WARNING: NONE



Measurement Info

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Identifiers	
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-	
Database Record	2
Run Number	1 of 1
Date	9/16/2020
Time	8:54 AM
Acquired Date	9/16/2020
Acquired Time	8:54 AM
Serial Number	H0045
Sample Cell ID	20039
Calculated Data	
Above Residual	0
Below Residual	0
Loading Factor	0.0080
Transmission	0.924
RMS Residual	2.017%
Calc SW Ver	12.0.1.0
User Defined Calculations	
Name	Value
Recalculation Status	
Live-Meas : : Original :	

SOP Info

21367_CARBON(*)	
Timing	
Setzero Time	20 (sec)
Run Time	20 (sec)
Number of Runs	1
Analysis	
21367_Carbon	
Refractive Index	1.85
Transparency	Transp
Shape	Irregular
Isopropyl alcohol	
Refractive Index	1.38
Options:	
Filter	Enabled
Analysis Gain	Default(2)
Analysis Mode	3R/Img L
Analysis Type	Diff Only
Enhanced Imaging	Disabled
Img Cor File:	Default
Perspective	
Progression	Standard
Distribution	Volume
Upper Edge(um)	2000
Lower Edge(um)	0.0215
Residuals	Disabled

Summary	
Data	Value
MV(um):	2.012
MN(um):	0.582
MA(um):	1.234
CS:	4.86
SD:	1.281
Mz:	1.896
si:	1.266
Ski:	0.2743
Kg:	0.934

Percentiles	
%Tile	Size(um)
90.00	3.78
50.00	1.752
10.00	0.567

Peaks Summary		
Dia(um)	Vol%	Width
1.752	100	2.563

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Notes

PM100 + 500 ml jar of ZrO2 + 1 kg 3 mm balls + 125 ml sample + 200 ml IPA_480rpm

Sample System(Wet)	
Number of Rinses	2
Flow Rate (%)	55%
Deaeration Cycles	2
Ultrasonic Power (W)	100 %
Ultrasonic Time (sec)	60 S

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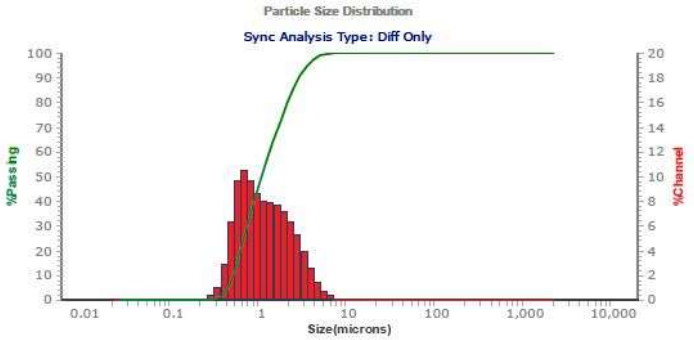
- Particle Size Analysis -

60 minutes grinding time

Tabular Data

Size(um)	%Chan	%Pass	Size(um)	%Chan	%Pass
2000	0.00	100.00	3.89	2.55	97.55
1674	0.00	100.00	3.27	3.92	95.00
1408	0.00	100.00	2.750	5.23	91.08
1184	0.00	100.00	2.313	6.29	85.85
995.6	0.00	100.00	1.945	7.12	79.56
837.2	0.00	100.00	1.635	7.66	72.44
704.0	0.00	100.00	1.375	7.89	64.78
592.0	0.00	100.00	1.156	8.05	56.89
497.8	0.00	100.00	0.972	8.58	48.84
418.6	0.00	100.00	0.818	9.68	40.26
352.0	0.00	100.00	0.688	10.52	30.58
296.0	0.00	100.00	0.578	9.62	20.06
248.9	0.00	100.00	0.486	6.26	10.44
209.3	0.00	100.00	0.409	2.85	4.18
176.0	0.00	100.00	0.344	1.01	1.33
148.0	0.00	100.00	0.2890	0.32	0.32
124.5	0.00	100.00	0.2430	0.00	0.00
104.7	0.00	100.00	0.2040	0.00	0.00
88.00	0.00	100.00	0.1720	0.00	0.00
74.00	0.00	100.00	0.1450	0.00	0.00
62.23	0.00	100.00	0.1220	0.00	0.00
52.33	0.00	100.00	0.1020	0.00	0.00
44.00	0.00	100.00	0.0860	0.00	0.00
37.00	0.00	100.00	0.0720	0.00	0.00
31.11	0.00	100.00	0.0610	0.00	0.00
26.16	0.00	100.00	0.0510	0.00	0.00
22.00	0.00	100.00	0.0430	0.00	0.00
18.50	0.00	100.00	0.0360	0.00	0.00
15.56	0.00	100.00	0.0300	0.00	0.00
13.08	0.00	100.00	0.02550	0.00	0.00
11.00	0.00	100.00			
9.25	0.00	100.00			
7.78	0.00	100.00			
6.54	0.33	100.00			
5.50	0.70	99.67			
4.63	1.42	98.97			

WARNING: NONE



Measurement Info

Title	
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Identifiers	
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-	
Database Record	4
Run Number	1 of 1
Date	9/16/2020
Time	10:21 AM
Acquired Date	9/16/2020
Acquired Time	10:21 AM
Serial Number	H0045
Sample Cell ID	20039
Calculated Data	
Above Residual	0
Below Residual	0
Loading Factor	0.0027
Transmission	0.968
RMS Residual	1.884%
Calc SW Ver	12.0.1.0
User Defined Calculations	
Name	Value
Recalculation Status	
Live-Meas : : Original :	

SOP Info

21367_CARBON(*)	
Timing	
Setzero Time	20 (sec)
Run Time	20 (sec)
Number of Runs	1
Analysis	
21367_Carbon	
Refractive Index	1.85
Transparency	Transp
Shape	Irregular
Isopropyl alcohol	
Refractive Index	1.38
Options:	
Filter	Enabled
Analysis Gain	Default(2)
Analysis Mode	3R/Img L
Analysis Type	Diff Only
Enhanced Imaging	Disabled
Img Cor File:	Default
Perspective	
Progression	Standard
Distribution	Volume
Upper Edge(um)	2000
Lower Edge(um)	0.0215
Residuals	Disabled

Summary	
Data	Value
MV(um):	1.323
MN(um):	0.534
MA(um):	0.878
CS:	6.83
SD:	0.826
Mz:	1.243
si:	0.845
Ski:	0.522
Kg:	1.051

Percentiles	
%Tile	Size(um)
90.00	2.644
50.00	0.996
10.00	0.481

Peaks Summary		
Dia(um)	Vol%	Width
0.996	100	1.652

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9/16/2020 10:21 AM

Notes

PM100 + 500 ml jar of ZrO2 + 1 kg 3 mm balls + 125 ml sample + 200 ml IPA_480rpm

Sample System(Wet)	
Number of Rinses	2
Flow Rate (%)	55%
Deaeration Cycles	2
Ultrasonic Power (W)	100 %
Ultrasonic Time (sec)	60 S

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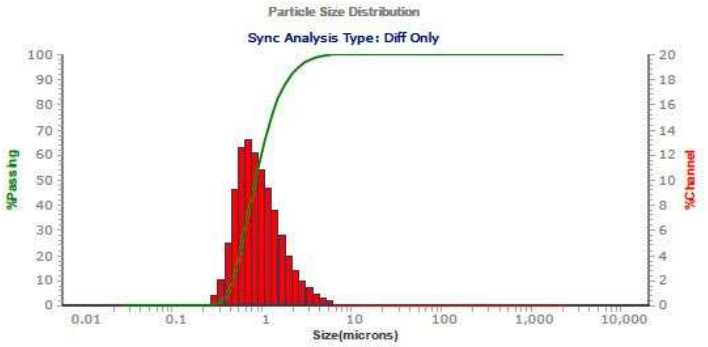
- Particle Size Analysis -

105 minutes grinding time

Tabular Data

Size(um)	%Chan	%Pass	Size(um)	%Chan	%Pass
2000	0.00	100.00	3.89	0.92	99.09
1674	0.00	100.00	3.27	1.36	98.17
1408	0.00	100.00	2.750	1.93	96.81
1184	0.00	100.00	2.313	2.72	94.88
995.6	0.00	100.00	1.945	3.92	92.16
837.2	0.00	100.00	1.635	5.61	88.24
704.0	0.00	100.00	1.375	7.56	82.63
592.0	0.00	100.00	1.156	9.30	75.07
497.8	0.00	100.00	0.972	10.75	65.77
418.6	0.00	100.00	0.818	12.17	55.02
352.0	0.00	100.00	0.688	13.16	42.85
296.0	0.00	100.00	0.578	12.59	29.69
248.9	0.00	100.00	0.486	9.25	17.10
209.3	0.00	100.00	0.409	5.00	7.85
176.0	0.00	100.00	0.344	2.09	2.85
148.0	0.00	100.00	0.2890	0.76	0.76
124.5	0.00	100.00	0.2430	0.00	0.00
104.7	0.00	100.00	0.2040	0.00	0.00
88.00	0.00	100.00	0.1720	0.00	0.00
74.00	0.00	100.00	0.1450	0.00	0.00
62.23	0.00	100.00	0.1220	0.00	0.00
52.33	0.00	100.00	0.1020	0.00	0.00
44.00	0.00	100.00	0.0860	0.00	0.00
37.00	0.00	100.00	0.0720	0.00	0.00
31.11	0.00	100.00	0.0610	0.00	0.00
26.16	0.00	100.00	0.0510	0.00	0.00
22.00	0.00	100.00	0.0430	0.00	0.00
18.50	0.00	100.00	0.0360	0.00	0.00
15.56	0.00	100.00	0.0300	0.00	0.00
13.08	0.00	100.00	0.02550	0.00	0.00
11.00	0.00	100.00			
9.25	0.00	100.00			
7.78	0.00	100.00			
6.54	0.00	100.00			
5.50	0.34	100.00			
4.63	0.57	99.66			

WARNING: NONE



Measurement Info

Title	
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Identifiers	
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Database Record	3
Run Number	1 of 1
Date	9/16/2020
Time	1:22 PM
Acquired Date	9/16/2020
Acquired Time	1:22 PM
Serial Number	H0045
Sample Cell ID	20039
Calculated Data	
Above Residual	0
Below Residual	0
Loading Factor	0.0017
Transmission	0.979
RMS Residual	1.191%
Calc SW Ver	12.0.1.0
User Defined Calculations	
Name	Value
Recalculation Status	
Live-Meas : : Original :	

SOP Info

21367_CARBON(*)	
Timing	
Setzero Time	20 (sec)
Run Time	20 (sec)
Number of Runs	1
Analysis	
21367_Carbon	
Refractive Index	1.85
Transparency	Transp
Shape	Irregular
Isopropyl alcohol	
Refractive Index	1.38
Options:	
Filter	Enabled
Analysis Gain	Default(2)
Analysis Mode	3R/Img L
Analysis Type	Diff Only
Enhanced Imaging	Disabled
Img Cor File:	Default
Perspective	
Progression	Standard
Distribution	Volume
Upper Edge(um)	2000
Lower Edge(um)	0.0215
Residuals	Disabled

Summary	
Data	Value
MV(um):	0.974
MN(um):	0.490
MA(um):	0.714
CS:	8.40
SD:	0.475
Mz:	0.889
si:	0.534
Ski:	0.507
Kg:	1.315

Percentiles	
%Tile	Size(um)
90.00	1.755
50.00	0.760
10.00	0.429

Peaks Summary		
Dia(um)	Vol%	Width
0.76	100	0.95

9/16/2020 1:33 PM

FLEX

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Notes

PM100 + 500 ml jar of ZrO2 + 1 kg 3 mm balls + 125 ml sample + 200 ml IPA_480rpm

Sample System(Wet)	
Number of Rinses	2
Flow Rate (%)	55%
Deaeration Cycles	2
Ultrasonic Power (W)	100 %
Ultrasonic Time (sec)	60 S

MICROTRAC MRB

MICROTRAC MRB

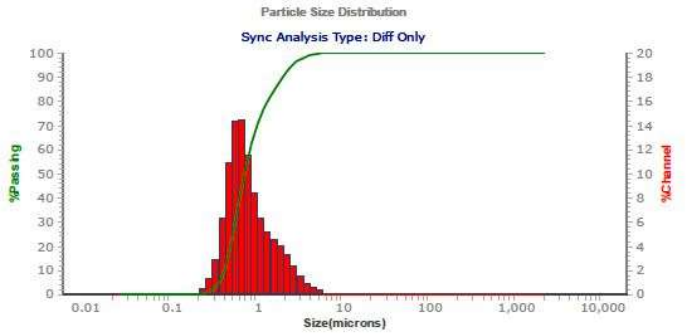
- Particle Size Analysis -

150 minutes grinding time

Tabular Data

Size(um)	%Chan	%Pass	Size(um)	%Chan	%Pass
2000	0.00	100.00	3.89	0.98	99.02
1674	0.00	100.00	3.27	1.59	98.04
1408	0.00	100.00	2.750	2.42	96.45
1184	0.00	100.00	2.313	3.31	94.03
995.6	0.00	100.00	1.945	4.04	90.72
837.2	0.00	100.00	1.635	4.57	86.68
704.0	0.00	100.00	1.375	5.17	82.11
592.0	0.00	100.00	1.156	6.28	76.94
497.8	0.00	100.00	0.972	8.37	70.66
418.6	0.00	100.00	0.818	11.51	62.29
352.0	0.00	100.00	0.688	14.44	50.78
296.0	0.00	100.00	0.578	14.43	36.34
248.9	0.00	100.00	0.486	10.95	21.91
209.3	0.00	100.00	0.409	6.27	10.96
176.0	0.00	100.00	0.344	2.95	4.69
148.0	0.00	100.00	0.2890	1.25	1.74
124.5	0.00	100.00	0.2430	0.49	0.49
104.7	0.00	100.00	0.2040	0.00	0.00
88.00	0.00	100.00	0.1720	0.00	0.00
74.00	0.00	100.00	0.1450	0.00	0.00
62.23	0.00	100.00	0.1220	0.00	0.00
52.33	0.00	100.00	0.1020	0.00	0.00
44.00	0.00	100.00	0.0860	0.00	0.00
37.00	0.00	100.00	0.0720	0.00	0.00
31.11	0.00	100.00	0.0610	0.00	0.00
26.16	0.00	100.00	0.0510	0.00	0.00
22.00	0.00	100.00	0.0430	0.00	0.00
18.50	0.00	100.00	0.0360	0.00	0.00
15.56	0.00	100.00	0.0300	0.00	0.00
13.08	0.00	100.00	0.02550	0.00	0.00
11.00	0.00	100.00			
9.25	0.00	100.00			
7.78	0.00	100.00			
6.54	0.00	100.00			
5.50	0.38	100.00			
4.63	0.60	99.62			

WARNING: NONE



Measurement Info

Title	
PM100_3mmballs_480rpm_2h30min-	
Identifiers	
-	
-	
Database Record	9
Run Number	1 of 1
Date	9/16/2020
Time	3:23 PM
Acquired Date	9/16/2020
Acquired Time	3:23 PM
Serial Number	H0045
Sample Cell ID	20039
Calculated Data	
Above Residual	0
Below Residual	0
Loading Factor	0.0016
Transmission	0.974
RMS Residual	1.403%
Calc SW Ver	12.0.1.0
User Defined Calculations	
Name	Value
Recalculation Status	
Live-Meas : : Original :	

SOP Info

21367_CARBON(*)	
Timing	
Setzero Time	20 (sec)
Run Time	20 (sec)
Number of Runs	1
Analysis	
21367_Carbon	
Refractive Index	1.85
Transparency	Transp
Shape	Irregular
Isopropyl alcohol	
Refractive Index	1.38
Options:	
Filter	Enabled
Analysis Gain	Default(2)
Analysis Mode	3R/Img L
Analysis Type	Diff Only
Enhanced Imaging	Disabled
Img Cor File:	Default
Perspective	
Progression	Standard
Distribution	Volume
Upper Edge(um)	2000
Lower Edge(um)	0.0215
Residuals	Disabled

Summary	
Data	Value
MV(um):	0.944
MN(um):	0.446
MA(um):	0.662
CS:	9.07
SD:	0.514
Mz:	0.867
si:	0.577
Ski:	0.614
Kg:	1.481

Percentiles	
%Tile	Size(um)
90.00	1.882
50.00	0.681
10.00	0.400

Peaks Summary		
Dia(um)	Vol%	Width
0.681	100	1.027

9/16/2020 3:24 PM

FLEX

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Notes

PM100 + 500 ml jar of ZrO2 + 1 kg 3 mm balls + 125 ml sample + 200 ml IPA_480rpm

Sample System(Wet)	
Number of Rinses	2
Flow Rate (%)	55%
Deaeration Cycles	2
Ultrasonic Power (W)	100 %
Ultrasonic Time (sec)	60 S