Particle Size Analysis: Solids Degradation and WSM

Thomas Freeman, CEO, President, & Founder
Synergy Fluid Services

- Introduction to Particle Size Analysis
- PSA measurement methods
- Particle size data quality
- Impact of drilled solids on PSD
- Solids Degradation and its impact on PSD

Questions? Contact us at:
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24 hr. Laboratory: 713.230.8828

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Contact Us

Drilling Fluid Automation

Particle Sizing and drilling Fluid testing

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Ship Samples to:

Synergy Fluid Services

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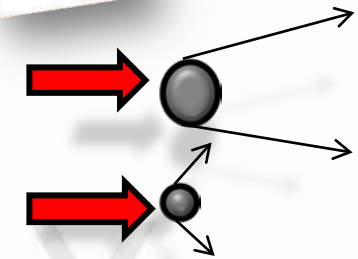
PSA Measurement Methods

Which method to choose depends largely on the application…



I. SIEVE ANALYSIS

- **Practical Range**: > 74 µm
- Used for decades to monitor material quality based on particle size

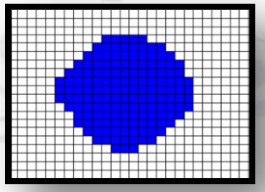


II. Laser Diffraction

- **Approximate Range**: 0.2 µm to 2000 µm
- Irregularly Shaped Particles > Equivalent Spherical Diameter

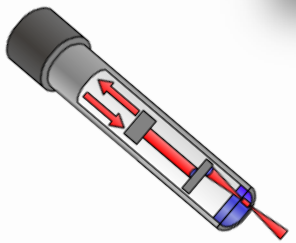
III. Image Analysis

- **Approximate Range**: Size Ranges
- Captures image of <u>each individual particle</u>
- **Length** x **Width** (2D)
- **Length** x **Width** x **Thickness** (3D)



IV. Focused Beam Reflectance Measurement (FBRM®)

- **Approximate Range**: 0.5 µm to 2000 µm
- Chord Length Distribution



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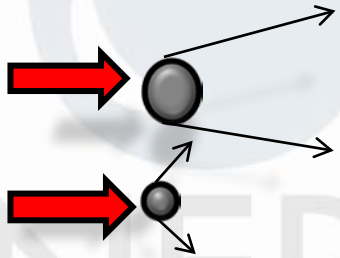
Particle Size Data Quality

Sieve Analysis



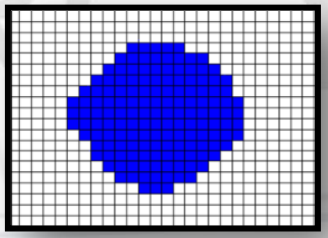
- Measurement intended for singe material
- Limited to coarse particles
- Sieving can potentially degrade particles during measurement

Laser Diffraction



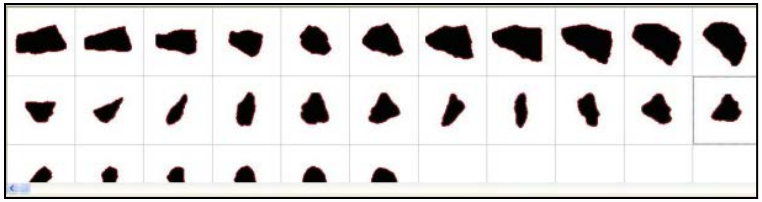
- Fast & Reproducible Results
- Irregularly shaped particles
- Particles < 2000 µm

Image Analysis

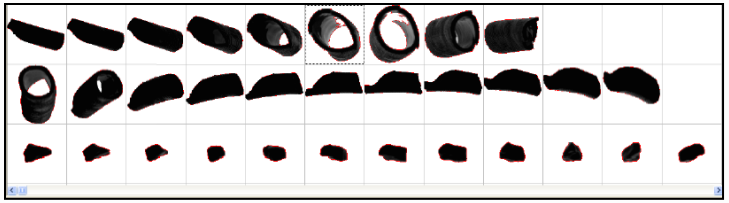


- Measures each particle individually
- Depth of Field or Depth of Focus

2D Imaging: Length x Width

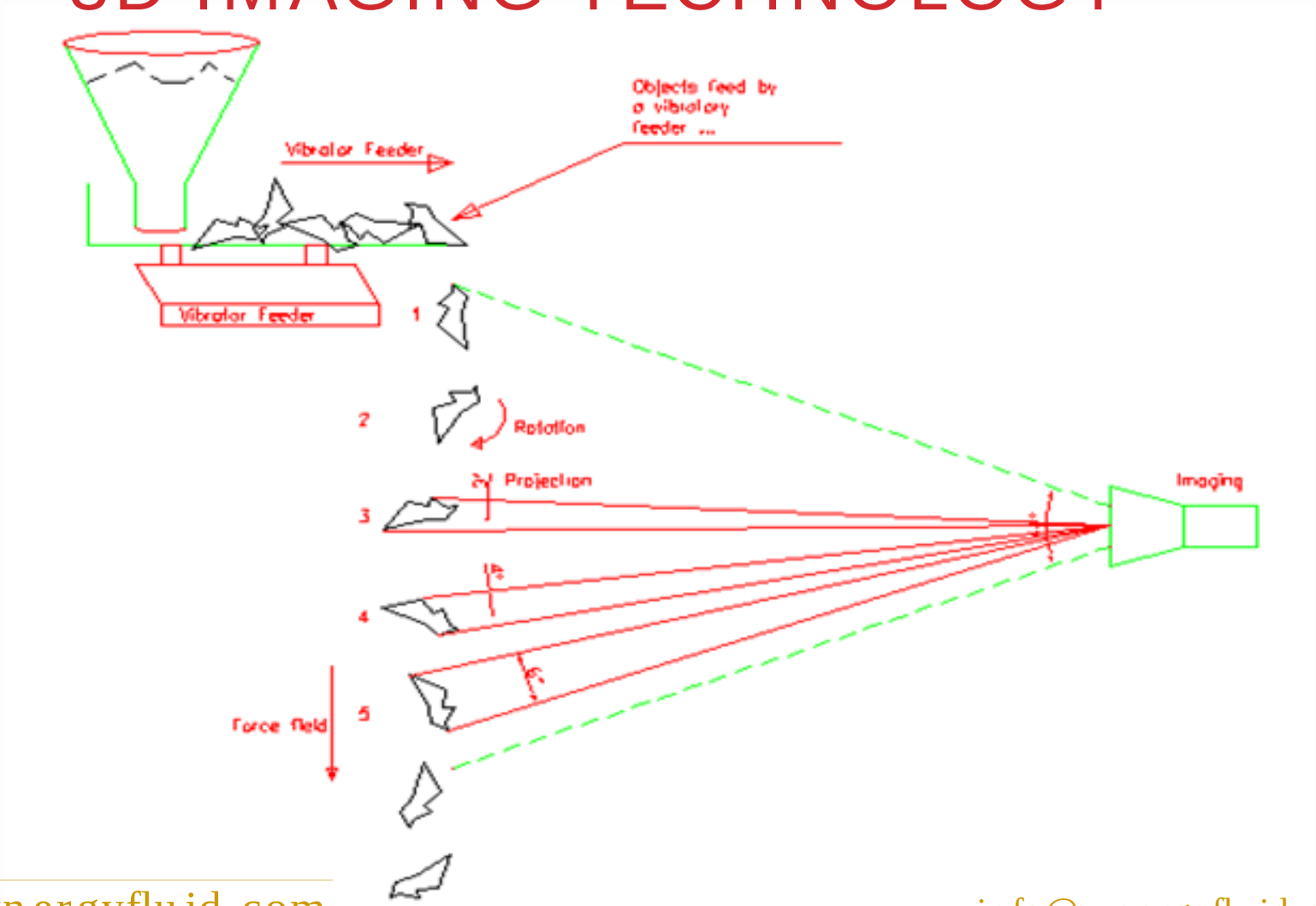


3D Imaging: Length x Width x Thickness



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SIZING CUTTINGS
3D IMAGING TECHNOLOGY



Interpreting the PSD: Volume Distribution

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Summary Data

Peak Summary

Percentiles

Vol.% of particles in specified channel

Vol.% of particles smaller than specified size

Data	Value
MV(um):	4.81
MN(um):	0.787
MA(um):	2.227
CS:	2.694
SD:	2.660
Mz:	3.72
σι:	3.58
Ski:	0.533
Kg:	1.880

Size(um)	%Tile
250.0	100.00
200.0	100.00
150.0	100.00
125.0	100.00
100.0	100.00
74.00	100.00
44.00	99.63
20.00	96.43
10.00	91.15
6.00	80.87

%Tile	Size(um)
95.00	15.59
90.00	9.16
80.00	5.83
60.00	3.67
50.00	3.05
40.00	2.537
30.00	2.065
20.00	1.591
10.00	1.070
5.00	0.760

Dia(um)	Vol%	Width
3.05	100.0	5.32

UDefName	UDefData

D90 (90th %tile)
90% of particles are smaller than 9.16 um

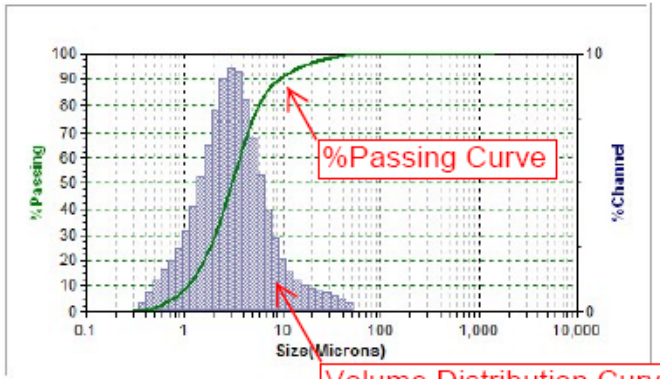
D50 (50th %tile)
50% of the particles are smaller than 3.05 um

Size(um)	%Chan	% Pass	Size(um)	%Chan	% Pass
1408	0.00	100.00	3.89	9.29	63.05
1184	0.00	100.00	3.27	9.45	53.76
995.6	0.00	100.00	2.750	9.02	44.31
837.2	0.00	100.00	2.312	7.85	35.29
704.0	0.00	100.00	1.945	6.53	27.44
592.0	0.00	100.00	1.635	5.27	20.91
497.8	0.00	100.00	1.375	4.13	15.64
418.6	0.00	100.00	1.156	3.17	11.51
352.0	0.00	100.00	0.972	2.46	8.34
296.0	0.00	100.00	0.818	1.98	5.88
	0.00	100.00	0.688	1.63	3.90
	0.00	100.00	0.578	1.20	2.27
	0.00	100.00	0.486	0.72	1.07
148.0	0.00	100.00	0.409	0.35	0.35
124.5	0.00	100.00	0.344	0.00	0.00
104.7	0.00	100.00	0.2890	0.00	0.00
88.00	0.00	100.00			
74.00	0.00	100.00			
44.00	0.52	99.63			
37.00	0.64	99.11			
31.11	0.74	98.47			
26.16	0.82	97.73			
22.00	0.90	96.91			
18.50	1.02	96.01			
15.56	1.22	94.99			
13.08					
11.00					
9.25	2.86	90.15			
7.78	3.95	87.29			

0.9% of particles are between 22 um to 18.5 um

Channel
22 um to 18.5 um

96.91% of particles are smaller than 22 um



%Passing Curve

Volume Distribution Curve

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INTERPRETING THE DATA

Summary

Data	Value
MV(um):	5.54
MN(um):	0.763
MA(um):	3.41
CS:	1.761
SD:	2.841
Mz:	5.29
σι:	2.978
Ski:	0.1798
Kg:	1.123

%Tile

%Tile	Size(um)
100.00	207.7
90.00	48.60
80.00	33.17
70.00	24.29
60.00	17.71
50.00	12.33
40.00	8.46
30.00	5.99
20.00	4.23
10.00	2.701

Peak Summary

Dia(um)	Vol%	Width
23.43	62.4	37.40
4.05	37.6	4.29

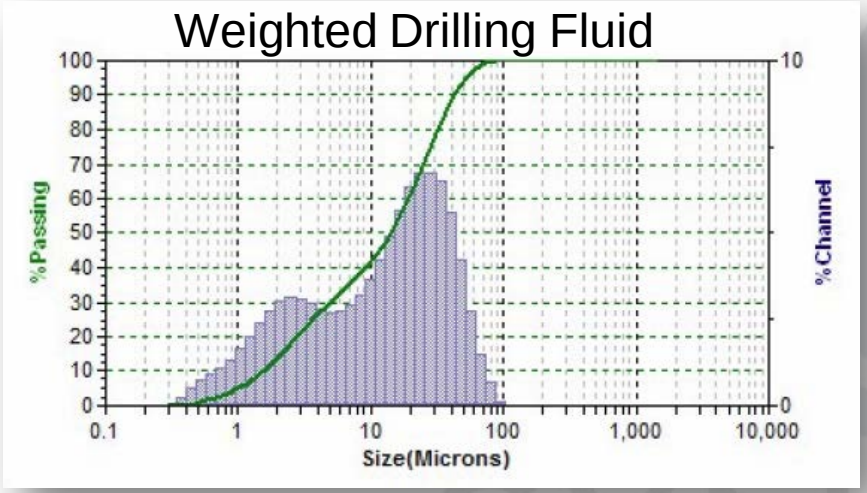
d90
- 90th Percentile
- 90% of the particles are smaller than…

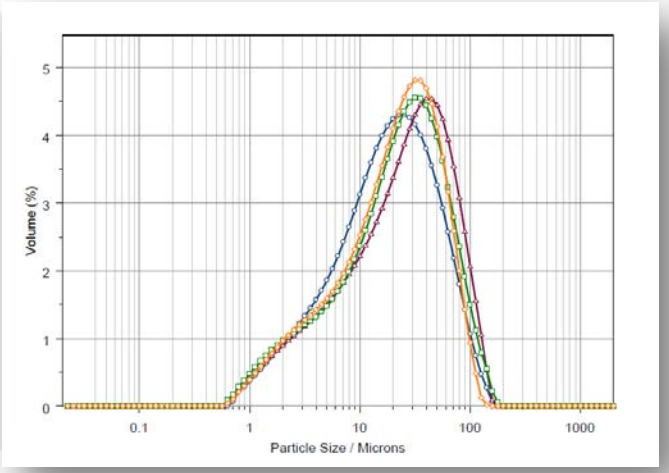
d50
- Median Particle Size, NOT average
- 50% of particles are larger and 50% smaller

d10
- 10th Percentile
- 90% of the particles are larger than…

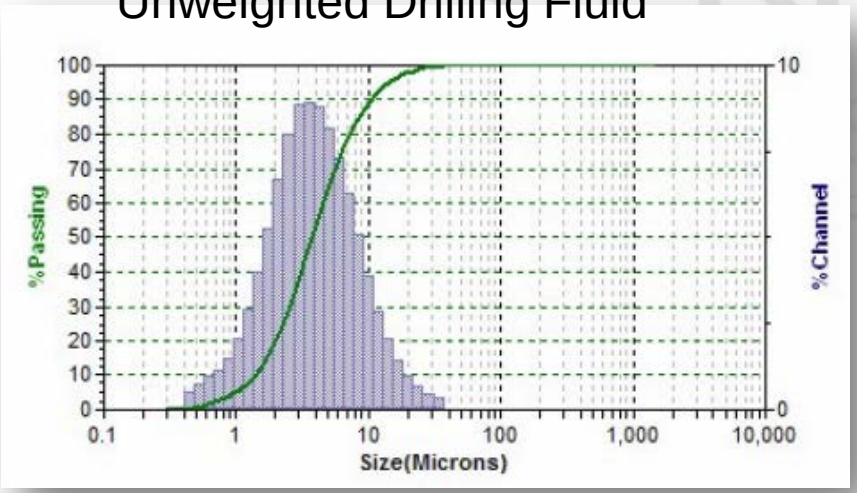
Weighted Mud vs Unweighted Mud

Weighted Drilling Fluid





Unweighted Drilling Fluid



API Standards for BARITE:

- 30% by wt. < 7 µm
- 3% by wt. > 74 µm

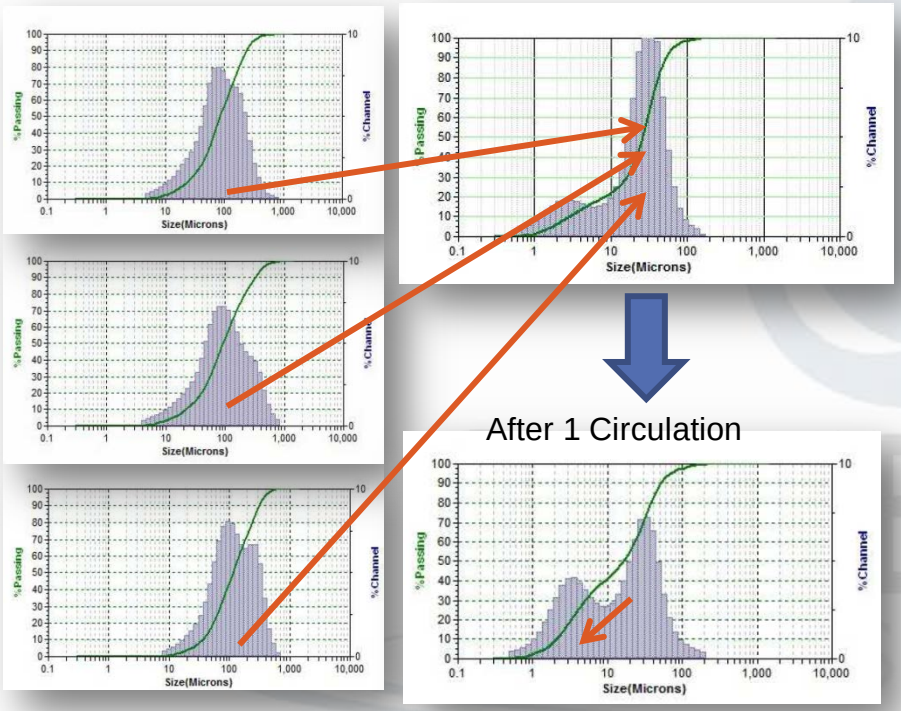
Specific Channels: Barite

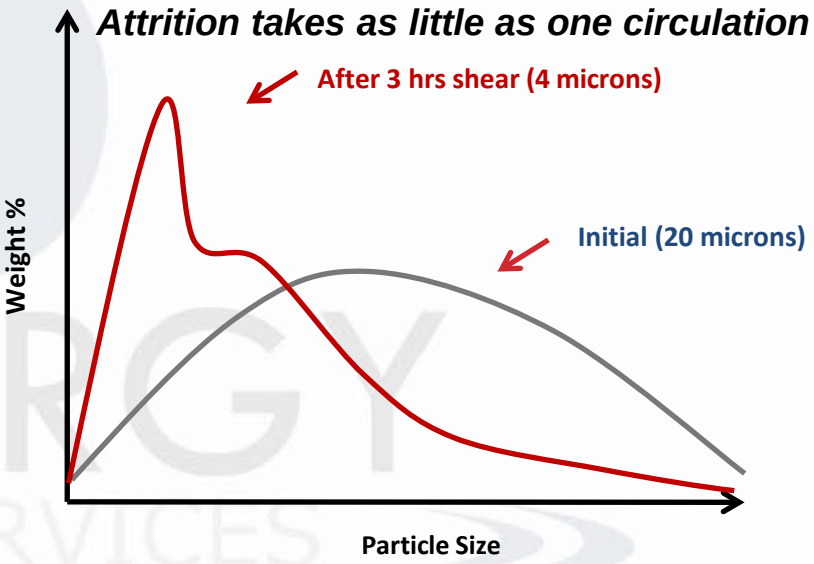
- With mechanical degradation
- Without mechanical degradation

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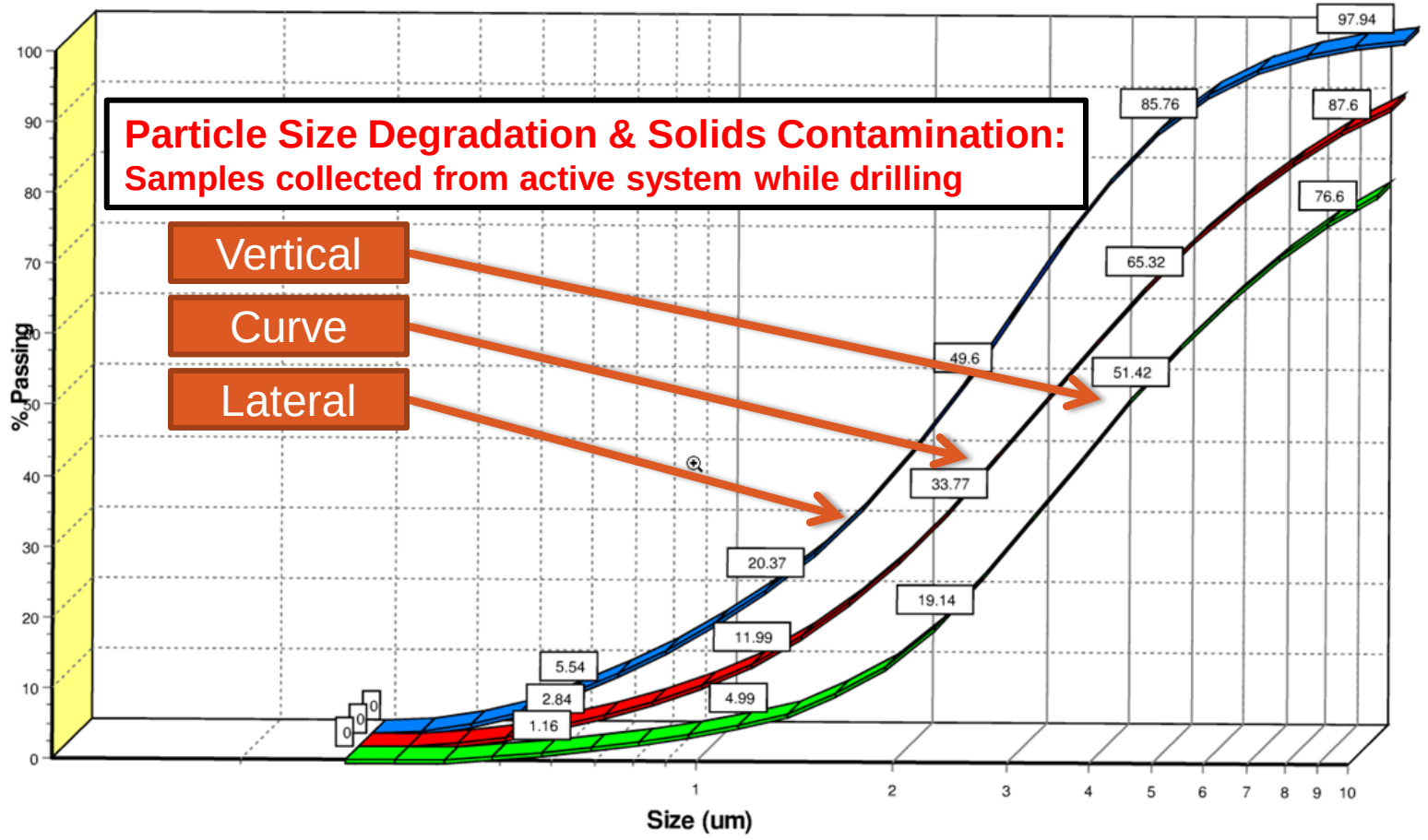
IMPACT OF DRILLED SOLIDS ON PSD





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IMPACT OF DRILLED SOLIDS ON PSD



References

- Microtrac: www.microtrac.com
- Malvern: www.malvern.com
- Canty Process Technology: www.jmcanty.com
- RGS Scientific: www.rgsscientific
- Synergy Fluid Services: www.synergyfluid.com