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Collection And Characterization Of Particulate From The Tore Supra Tokamak (December 1999 Vent)

J. Phillip Sharpe

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Bechtel BWXT Idaho, LLC

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List of Acronyms

BET	Brunauer, Emmett, Teller
CFC	Carbon Fiber Composite
CMD	Count Median Diameter
EDX	Energy-Dispersive X-ray
GMD	Geometric Mean Diameter
GSD	Geometric Standard Deviation
INEEL	Idaho National Engineering and Environmental Laboratory
SEM	Scanning Electron Microscopy
SSA	Specific Surface Area
TEM	Tunneling Electron Microscopy

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1. Introduction

Particulate generated during the operation of a fusion device contributes to the radiological source term associated with accident scenarios in the device.[1,2] Understanding the mechanisms generating the particulate and correctly describing its physical and chemical behavior is essential for safety analyses of future fusion devices. Knowledge of these mechanisms is gained by collecting and characterizing particulate matter from operating fusion facilities.

Tokamak dust, the particulate matter generated during the operation of a tokamak fusion device, was collected from Tore Supra in December 1999, during the initial phase of the scheduled shutdown for installation of advanced plasma facing components. Tore Supra, located at CEA Cadarache, France, is presently the third largest operating tokamak with the capability of long-pulse operation. Eighteen super-conducting coils produce the 4.5 T magnetic field inside a vessel 2.4 m in major radius and 1.2 m in minor radius. Limiter and divertor regimes of operation are possible. In the divertor regime, the circular magnetic configuration is ergodized by six outboard resonant divertor modules that are covered with 12 m^2 of carbon fiber composite (CFC) tiles. In addition, some field lines are diverted to actively cooled neutralizing plates made of CuCrZr bars covered with B_4C. In the limiter regime, the plasma leans on the actively cooled inboard first wall or on a set of inertially cooled pumped limiters. The first wall area of 12 m^2 is covered with both polycrystalline graphite tiles (83%) and CFC tiles (17%). The single outboard limiter is constructed of pyrolitic graphite, and the four toroidally symmetric bottom limiters are constructed of CFC. Figure 1.1 displays the relative location of plasma facing components within the plasma chamber of Tore Supra.

In this report, we present in Section 2 the methods used to collect and analyze this dust and describe the selection of sampling locations. Section 3 includes a discussion of observed particle morphology, results from optical microscopy particle size analysis, and results of particle size measurements performed with a laser diffraction analysis system. The results from specific surface area analyses are given in Section 4, and particle composition analyses by SEM/EDX are discussed in Section 5. A discussion of the results and the implications of the Tore Supra dust are given in Section 6. Conclusions of this current work are summarized in Section 7.

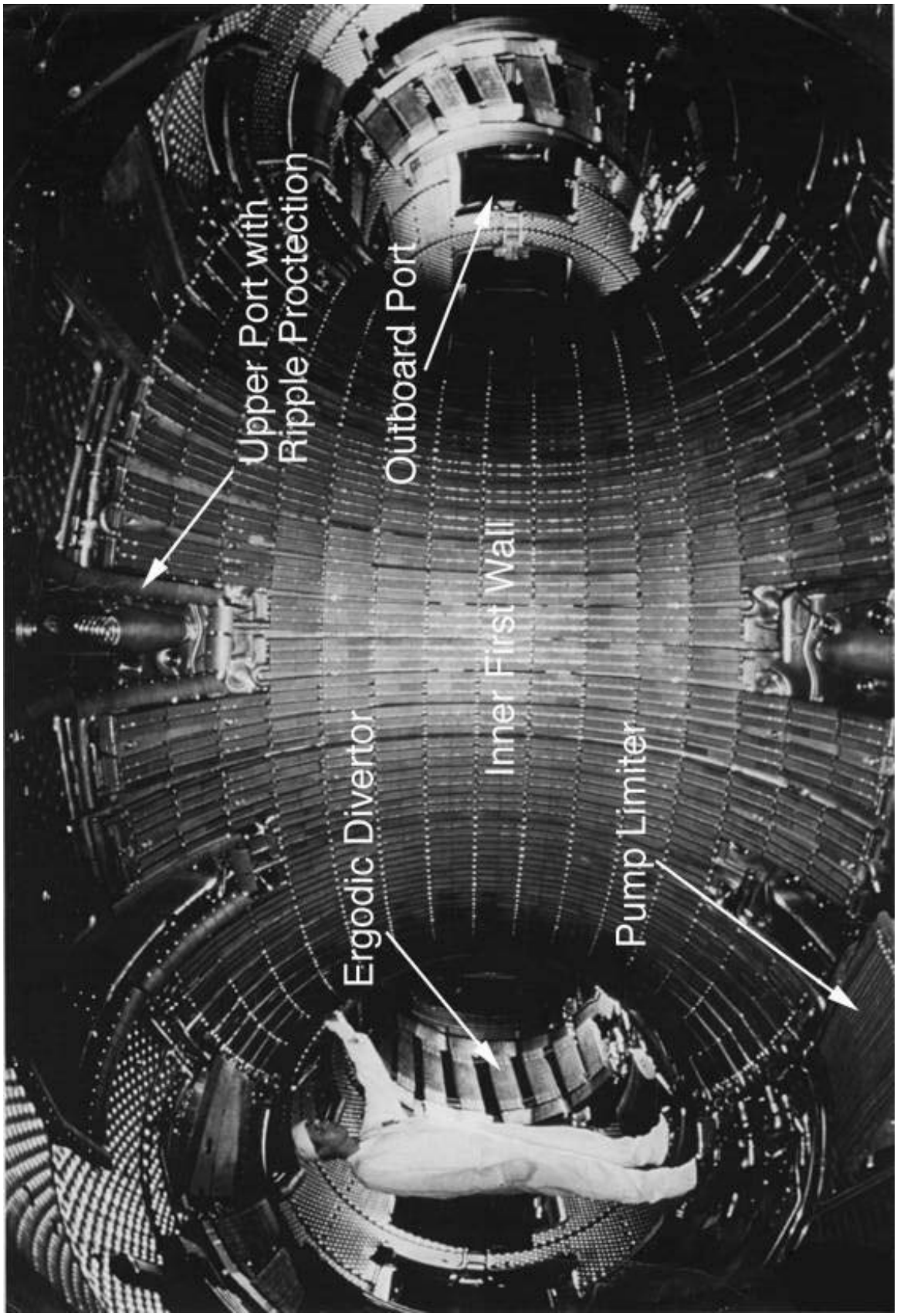


Figure 1.1 View of the Tore Supra plasma chamber with various components identified.

2. Collection of Particulate

Part 1 of this section describes the techniques used to sample dust from inner surfaces of the Tore Supra vacuum vessel and the initial preparation of these samples for analysis. In part 2, details of the sampling locations are given.

2.1. Methods of Collection

The primary method for collecting particulate from various locations in the Tore Supra vacuum vessel was the filtered vacuum technique used extensively in previous dust collection campaigns of other fusion devices.[3] Figure 2.1 demonstrates this simple and reliable technique. Particulate collection is achieved with the use of a small vacuum pump connected to a 50 mm filter housing. A filter of 0.02 μm pore size is placed within the housing, and a 0.25 in diameter probe tip is connected for sampling. Various probe lengths are available for surface or deep recess sampling. The volumetric flow rate of the vacuum filter system is 15 standard liters per minute (slpm), sufficient to entrain loosely bound particles into the flow stream as the probe tip is moved over the sample surface. Samples are acquired by placing the probe tip approximately 5 mm above the surface and sweeping with a velocity of 5 cm/s. The particles are deposited on the filter substrate, which is later removed for analysis. Upon disassembly in the laboratory, the filter substrate and any particle material not adherent to the substrate are removed from the filter housing, weighed for collected mass, and placed in metal storage tins. The filtered vacuum method has an estimated collection limit of 0.1 μm diameter for individual particles, as indicated by the absence of smaller particles when a filter substrate is observed via electron microscopy. Particles of size less than 0.1 μm have been observed only as a component to larger agglomerates.

Two additional collection techniques were used in this campaign. Swipe tests were taken at prescribed locations within the vessel using quartz fiber filter paper. Metallurgical replicating tape (acetate tape) was also used. These techniques allow collection of particulate with very small sizes, possibly demonstrating the existence of particulate at sizes beyond the collection

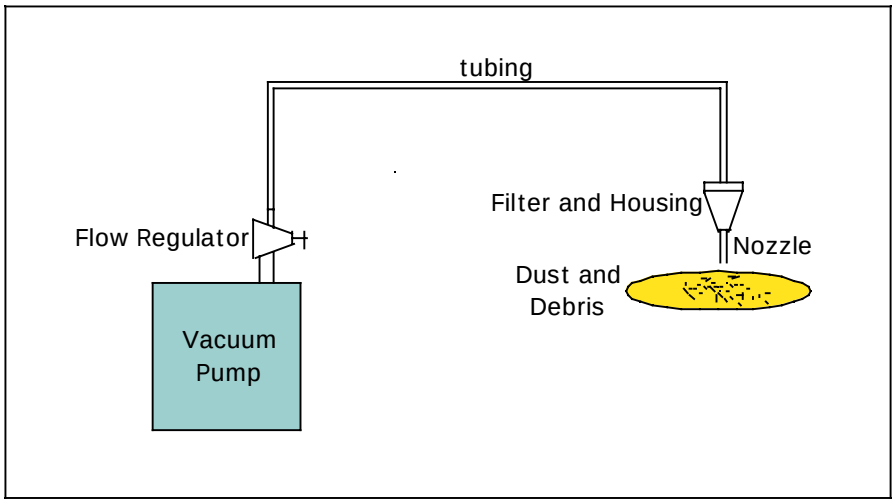


Figure 2.1 Schematic diagram of the filtered vacuum particle collection technique.

capability of the vacuum filter technique. Detailed analyses of samples obtained from swipe tests and replicating tape are, however, difficult due to the non-uniform structure of the collection substrate. Hence these methods of collection were used to investigate particle morphology (with SEM and TEM) and to examine particle size in a qualitative fashion.

2.2. Collection Locations in Tore Supra

Locations for dust sampling in the Tore Supra vessel were selected based on the objective of identifying position-dependent trends in particulate deposition. Collection was performed at 12 poloidal locations in each of the six toroidal modules that compose the vessel. Table 2.1 provides the details for each sampling location. Samples were also obtained at locations of certain structures exposed to plasma, specifically the horizontal pumped limiter, the electron cyclotron resonance heating antenna mirrors, the ion cyclotron resonance heating Faraday shield, and the lower hybrid heating launcher guides. Values for the sampled area of each location were determined from area measurements during collection in the first module. Corresponding poloidal locations in subsequent modules were sampled in a similar fashion such that the sampled areas are equivalent in each module.

Table 2.1 Sampling locations for dust collection in Tore Supra.

Location Number	Poloidal angle, ϕ		Toroidal angle*, θ	Sample Area (cm^2)	Description
Poloidal Locations- Sampled in each of the six modules.					
1	0	outboard positions	30	621.2	outboard chamber wall, short sweep ($\pm$ 15˚)
2	0		30	1,533	outboard vessel wall, long sweep ($\pm$ 90˚)
3	0		40	1,800	on ledge and around outboard observation port
4	0		0	689.0	on B_4C surface of divertor neutralizer
5	90	upper positions	20	1,200	on and between upper port ripple protection graphite tiles
6	90		20	658.0	around upper observation port
7	180	inboard positions	27	428.0	on inboard first wall protective tiles, long sweep ($\pm$ 90˚)
8	180		33	84.0	on inboard first wall protective tiles, short sweep ($\pm$ 15˚)
9	270	lower positions	20	294.0	on stainless steel wing on inner first wall
10	270		0	1,429	on lower electron collector protective tile surface
11	270		20	160.0	on lower vessel surface, left of module center
12	270		40	480.0	on lower vessel surface, right of module center
Other Locations.					
71	all outboard positions		Module 1	2,688	on lower hybrid heating launcher guides
72			Module 1	2,640	on ion cyclotron resonance heating Faraday shield
73			Module 3	5,520	electron cyclotron resonance heating antenna mirrors
74			Module 2	1,500	on horizontal pump limiter- ionic front face
75			Module 2	1,500	on horizontal pump limiter- electronic front face
76			Module 2	200.0	on horizontal pump limiter- ionic throat
77			Module 2	150.0	on horizontal pump limiter- electronic throat

- measured from the beginning position of each module, so that overall toroidal location of a sample position is determined by: (module number)(60˚)+ toroidal position angle indicated in the table.

Figure 2.2 through Figure 2.12 display detailed structures of the vessel chamber from which particulate samples were collected via the filtered vacuum technique. Numbered locations in the images correspond to the various poloidal sampling locations given in Table 2.1.

Figure 2.2 Poloidal sampling locations 1 and 2. Location 1 is on the outboard plasma chamber wall, and location 2 is the outboard vessel wall along the centerline groove.

Figure 2.4 Poloidal sampling location 4- surface of divertor neutralizer.

Figure 2.3 Poloidal sampling location 3- around outboard observation port.

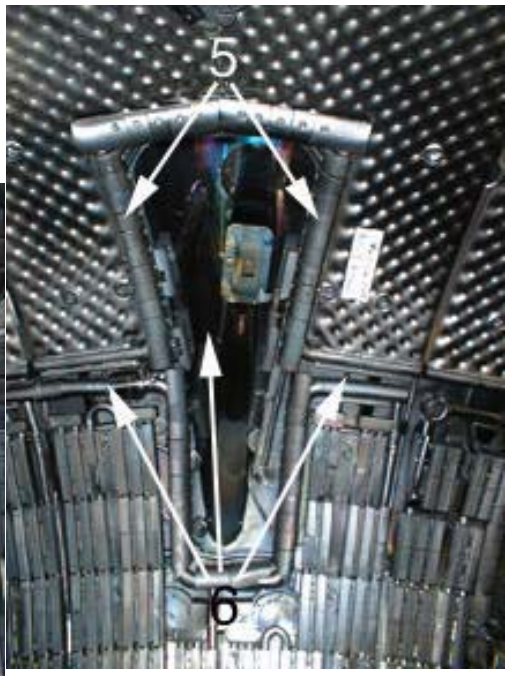


Figure 2.5 Poloidal sampling locations 5 and 6. Location 5 is on and between the port ripple protection, and location 6 is around and inside the port.

Figure 2.6 Poloidal sampling locations 7 and 8. Location 7 is a sweep along the entire column height, and location 8 is a short, midplane sweep.

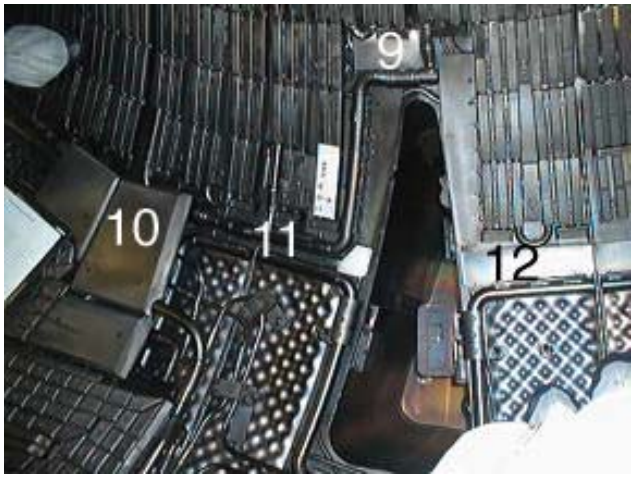


Figure 2.8 Poloidal sampling locations 9, 10, 11, and 12.

Figure 2.7 LHH launcher guides- sampling location 71.

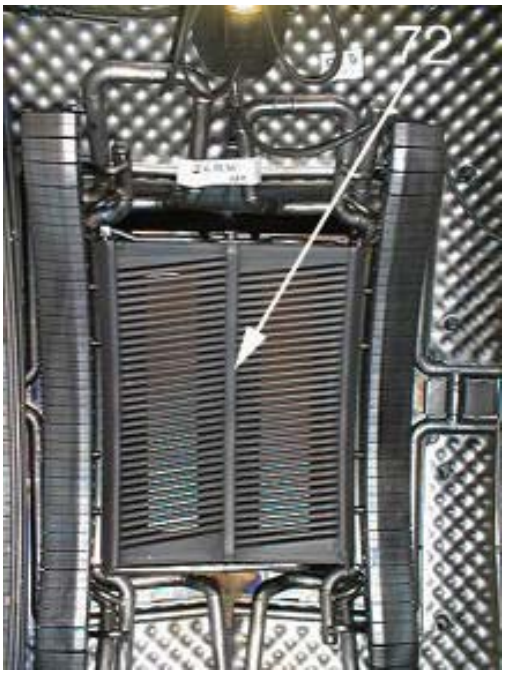


Figure 2.9 ICRH Faraday shield- sampling location 72.

Figure 2.10 ECRH antenna mirrors- sampling location 73.

Figure 2.12 Horizontal pump limiter. In this view, the right side of the limiter is the ionic face, and the left side is the electronic face.

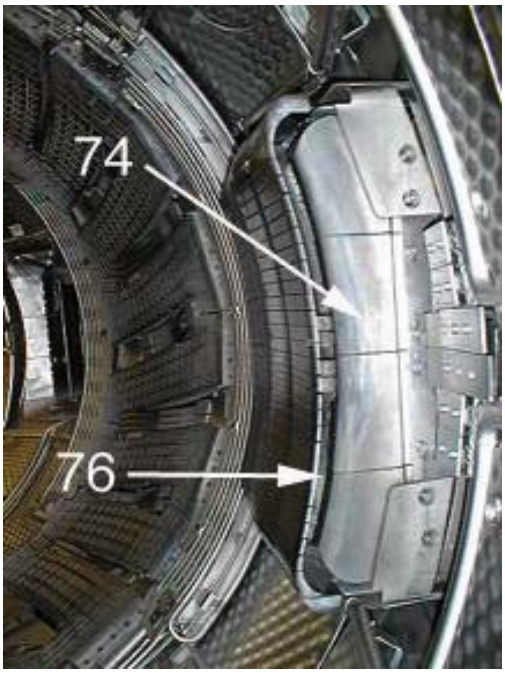


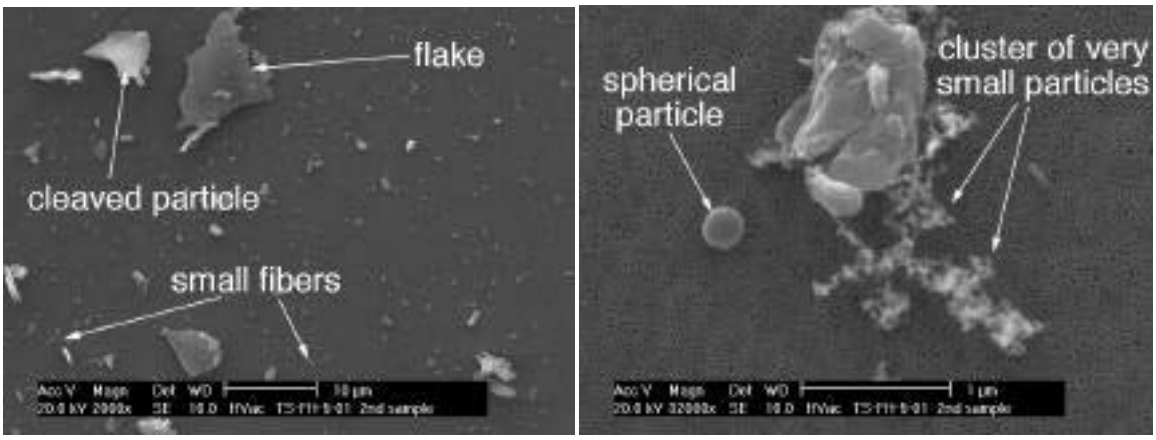
Figure 2.11 Detail of horizontal pump limiter ionic side- sampling locations 74 (throat) and 76 (face). Sampling locations 75 and 77 are the corresponding electronic positions on the opposite side.

3. Particle Size Analysis

Two different techniques were utilized in determining particle size distributions of material collected via the filter vacuum technique: optical microscopy imaging and particle counting, and laser diffraction particle analysis. Optical microscopy image and count analysis served as the primary technique, and each filter substrate used for collection in Tore Supra was analyzed in detail with this method. Laser diffraction analysis is a powerful tool, however difficulties were encountered in sample preparation due to the requirement of particle removal from the filter substrates. In addition to size distribution analyses, particulate morphology (shape, degree of agglomeration or clustering, cleaved surfaces, etc.) was examined for a qualitative description of the state of the particulate.

3.1. Particulate Morphology

Details of particle morphology were investigated by selective imaging of filter substrates with a scanning electron microscope (SEM). The SEM is capable of producing high resolution and very sharp images, as shown in the representative photomicrographs in Figure 3.1. Typical particles found in all filter vacuum samples are shown in the figure; the dust sample in the figure was collected from the area around the upper observation port ripple protection (poloidal location 5) in Module I. Figure 3.1(a) shows a moderate-sized carbon flake, small fibers or agglomerate chains (difficult to distinguish in this image), and a cleaved particle of alumina. Figure 3.1(b) displays a spherical copper particle and clusters with very small particles of undetermined composition. Variety of particle shapes indicates several mechanisms are responsible for the generation of dust in Tore Supra. Observations of dust from several samples collected at various locations in the vessel suggest that a predominant number of particles appear as small clusters of very small particles.



(a) (b)

Figure 3.1 Representative SEM photomicrographs demonstrating various particle morphologies observed in dust samples from Tore Supra.

Another qualitative imaging analysis of a dust sample was performed with a tunneling electron microscope (TEM). The TEM is capable of very high resolution, although image quality is sometimes poor due to inadequate methods of sample preparation. The dust sample analyzed with a TEM at the INEEL was collected from a graphite tile on the inner first wall, one row below the midplane in Module V. Metallurgical replicating tape (an acetate compound) was used to literally lift off particles adhered to the tile surface. This collection technique is useful for acquiring samples from small areas since all particle sizes are collected, particularly particles below the collection limit of the vacuum filter method (roughly 0.1 μm). Sample preparation for TEM analysis consisted of several steps:

1.0 dissolution of the acetate tape in a small vial containing acetone
2.0 capture of suspended particulate in the acetone solution onto a TEM analysis grid
3.0 drying of the grid and evaporation of the acetone/acetate solution
4.0 cleaning of the grid with acetone to remove trace amounts of acetate
5.0 grid mounting in the TEM

The presence of acetate compounds on the analysis grid severely deteriorates the imaging capability of the TEM at the INEEL. Step 4 in the preparation procedure was required to allow generation of reasonable images. Figure 3.2 gives two images acquired with the TEM. Although the quality is very poor, the images display discrete rounded structures. Similar structures have been observed by Chappuis, et al., in Tore Supra dust[4], along with extended filamentary structures reminiscent of carbon nanotubes. A more suitable particle collection technique must be used in future attempts to collect and characterize these tokamak nanostructures.

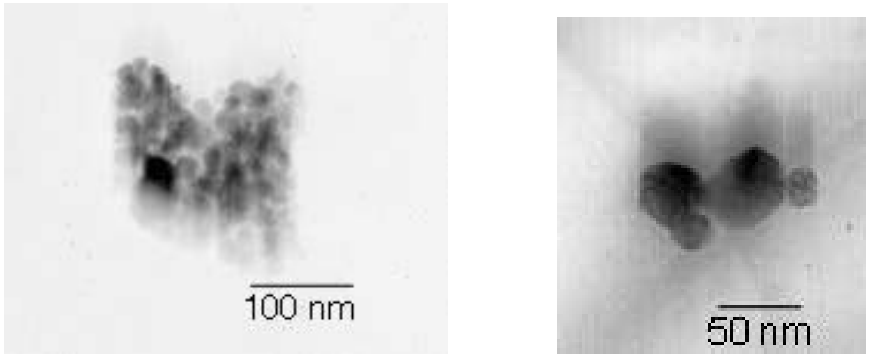


Figure 3.2 TEM photomicrographs of dust collected with replicating tape.

3.2. Size Analysis by Optical Microscopy

3.2.1. Technique

Dust collected from Tore Supra via the filtered vacuum method has been analyzed for count-based particle size distributions using the procedure described in Reference 3. The procedure requires photomicrographs of multiple, randomly selected sites on the filter substrate from each sampling location. Photomicrographs are obtained with an optical microscope at magnifications

of 50x, 100x, 200x, 500x, and 1000x. An automated sizing and counting routine, using the freeware image analysis program NIHImage[5], is used to develop the particle sample population. The reported size of each tallied particle is the equivalent diameter of the projected particle area as observed at the focal plane of the microscope. From this population, the data moments of geometric mean diameter (GMD) and geometric standard deviation (GSD) are acquired. Geometric moments are typically used because of the direct relation to the lognormal distribution. The measured population is compared to a lognormal distribution by use of a log-probability plot, on which a lognormal distribution is linear. If the sample distribution is truly lognormal, the particle size data count median diameter (CMD) is equivalent to the GMD. A measure of comparison is the linear correlation coefficient R^2 associated with a linear fit of the data. Departure from linearity, i.e. values of R^2 less than 0.99, indicates a sample population that is not best described by the unimodal lognormal distribution.

3.2.2. Results

This section presents the results of the optical microscopy analysis for each filter substrate from all collection locations in Tore Supra. A summary table for each toroidal module is presented in the following subsections, reporting the amount of mass collected on from each sample location, the area sampled, and the resulting count-based size distribution data moments (GMD and GSD). The total dust mass that was collected during this campaign is 439.2 mg.

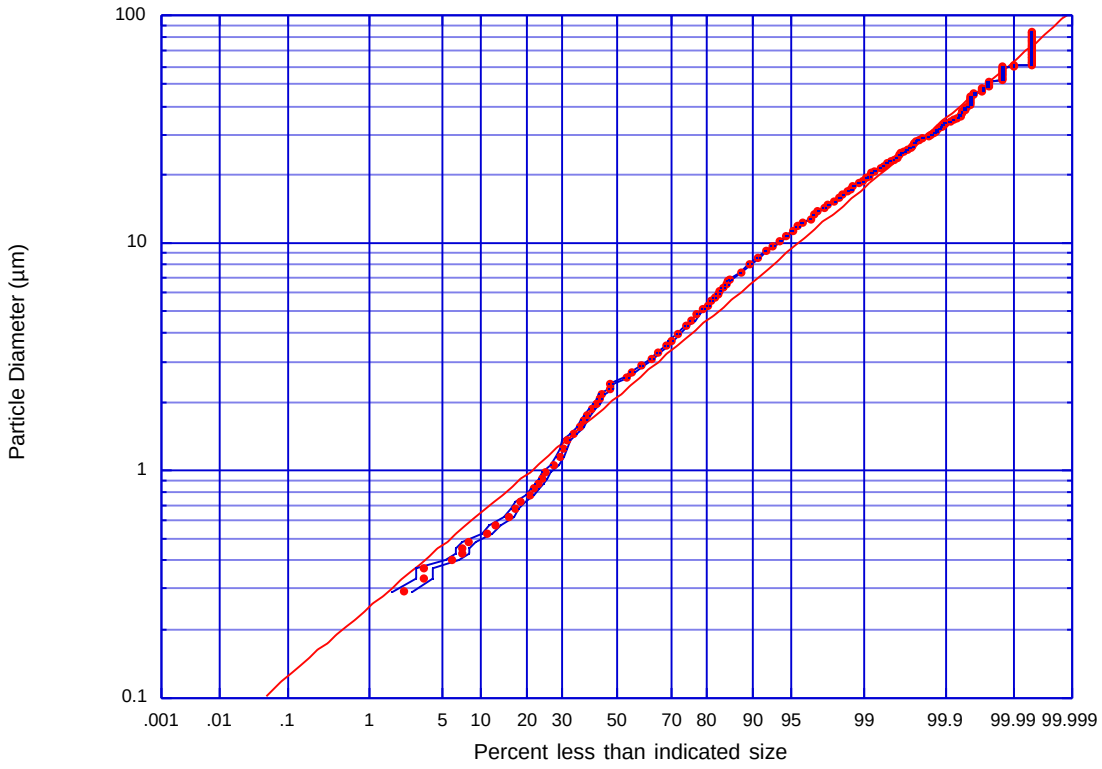
3.2.2.1. Module I Results

Figure 3.3 through Figure 3.14 display details of particle size distributions for corresponding collection locations of Module I. Table 3.1 gives a summary of Module I results.

Table 3.1 Summary of dust collected from locations in Tore Supra Module I.

Poloidal Location	Sample Number	Filter ID	Sampled Area (cm^2)	Collected Mass (mg)	Count-based Size Distribution Parameters	
					GMD (μm)	GSD
1	1	TSFH22-01	621.2	21.9	2.23	2.79
2	2	TSFH01-01	1,553	0.8	3.08	3.25
4	3	TSFH23-01	689.0	0.4	3.00	2.87
3	4	TSFH24-01	1,800	0.2	3.13	2.65
6	5	TSFH25-01	658.0	0.0	3.30	2.79
5	6	TSFH05-01	1,200	1.0	2.59	2.92
7	7	TSFH07-01	428.0	3.8	2.17	2.65
8	8	TSFH06-01	84.00	0.2	1.83	3.12
10	9	TSFH04-01	1,429	0.8	3.10	2.72
9	10	TSFH02-01	294.0	0.1*	3.13	2.67
11	10A	TSFH21-01	160.0	34.5	1.30	2.43
12	10B	TSFH03-01	480.0	13.9	2.02	2.83

*- filter partially broken



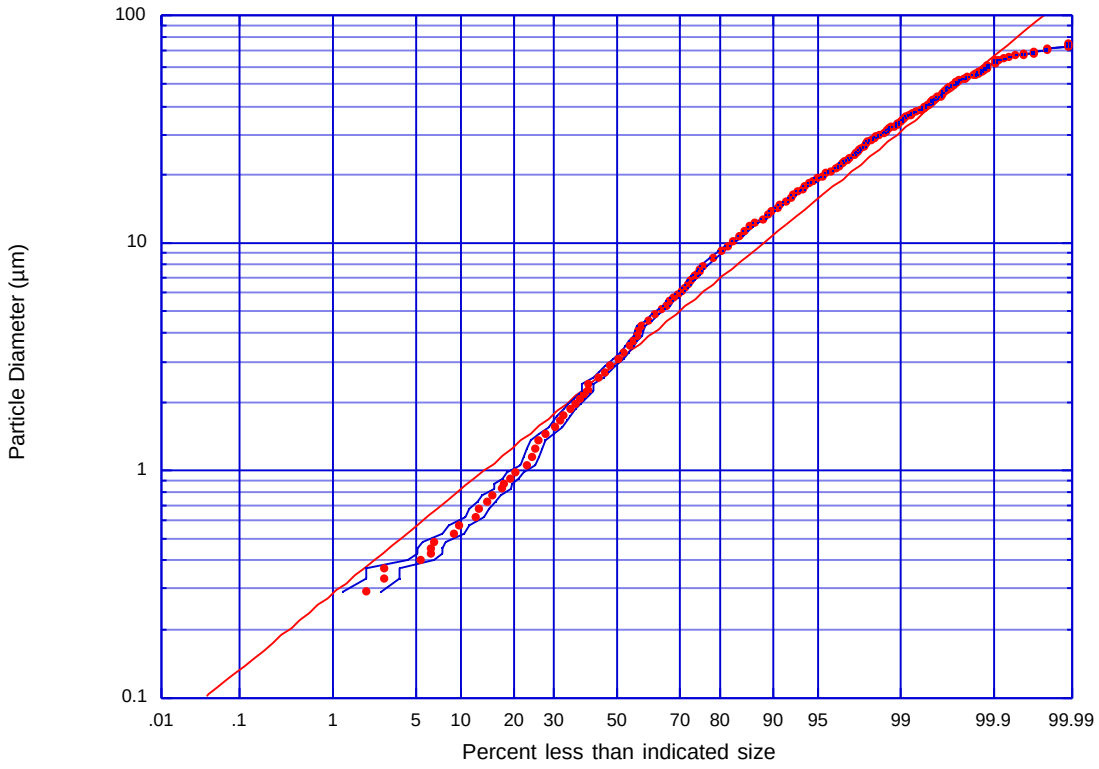
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.01$	4101
100x, 6	0.224	$3.82 < d_p < 7.01$	3574
200x, 6	0.0558	$2.29 < d_p < 3.82$	3398
500x, 6	0.00893	$1.40 < d_p < 2.29$	1105
1000x, 6	0.00217	$0.00 < d_p < 1.40$	450
Totals:	1.18%	-	12628

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.23	GMD (µm):	2.09
GSD:	2.79	GSD:	2.50
lower 95% (µm):	0.29	R^2:	0.99439
upper 95% (µm):	17.28	lower 95% (µm):	0.34
		upper 95% (µm):	13.07

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.3 Module I, Sample 1 (TSFH22-01) count-based particle size distribution.



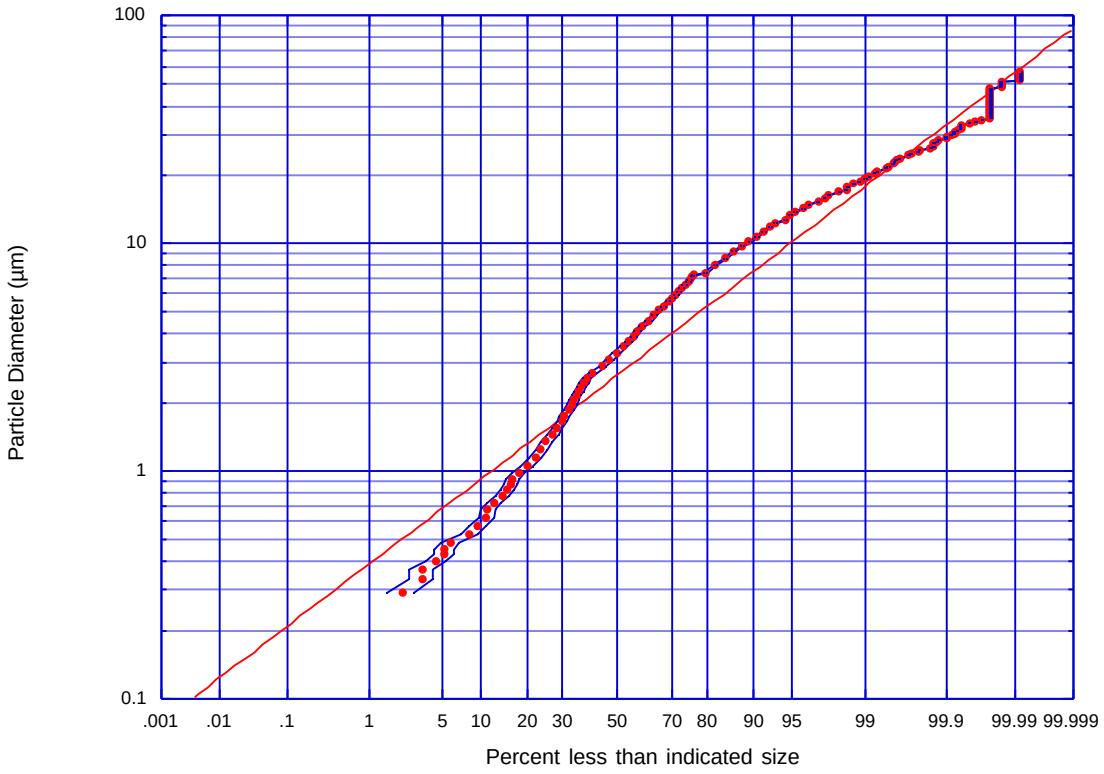
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.03$	3530
100x, 6	0.224	$4.27 < d_p < 8.03$	2100
200x, 6	0.0558	$2.34 < d_p < 4.27$	1031
500x, 6	0.00893	$1.39 < d_p < 2.34$	572
1000x, 6	0.00217	$0.00 < d_p < 1.39$	210
Totals:	1.18%	-	7443

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.08	GMD (µm):	2.97
GSD:	3.25	GSD:	2.74
lower 95% (µm):	0.29	R^2:	0.98148
upper 95% (µm):	32.56	lower 95% (µm):	0.36
		upper 95% (µm):	22.30

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.4 Module I, Sample 2 (TSFH01-01) count-based particle size distribution.



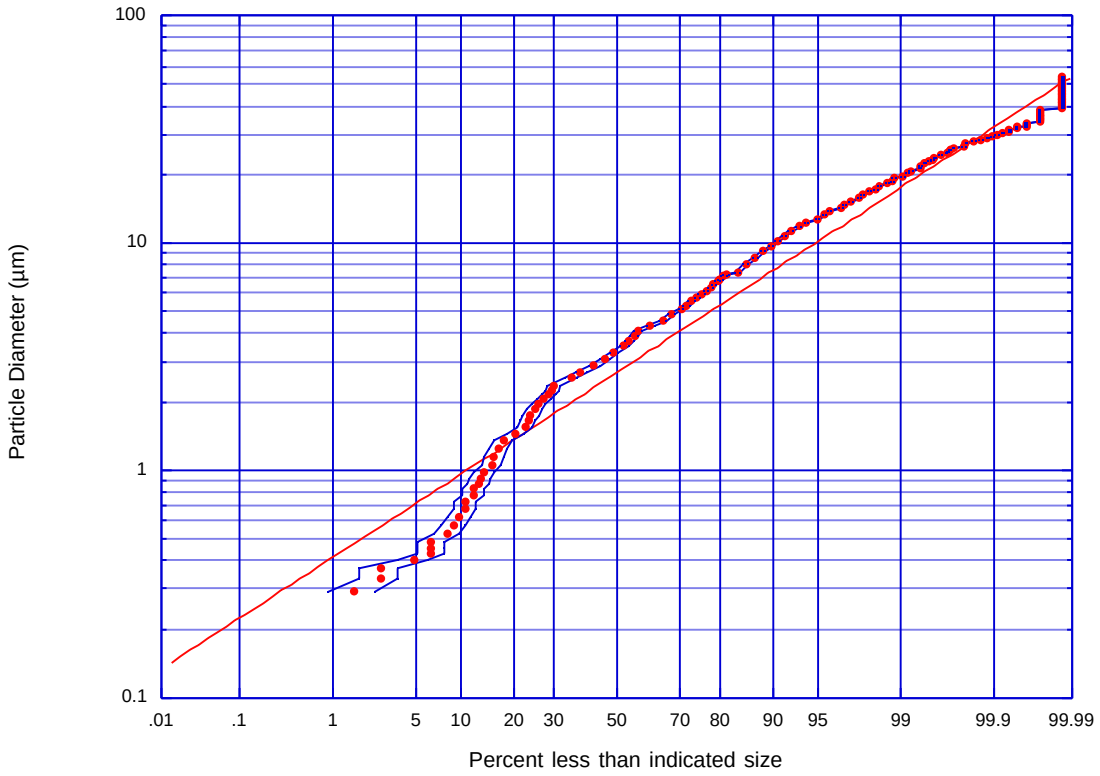
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.47$	3982
100x, 6	0.224	$4.50 < d_p < 7.47$	3107
200x, 6	0.0558	$2.66 < d_p < 4.50$	2080
500x, 6	0.00893	$1.61 < d_p < 2.66$	489
1000x, 6	0.00217	$0.00 < d_p < 1.61$	279
Totals:	1.18%	-	9937

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.00	GMD (µm):	2.64
GSD:	2.87	GSD:	2.27
lower 95% (µm):	0.37	R^2:	0.97507
upper 95% (µm):	24.65	lower 95% (µm):	0.51
		upper 95% (µm):	13.64

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.5 Module I, Sample 3 (TSFH23-01) count-based particle size distribution.



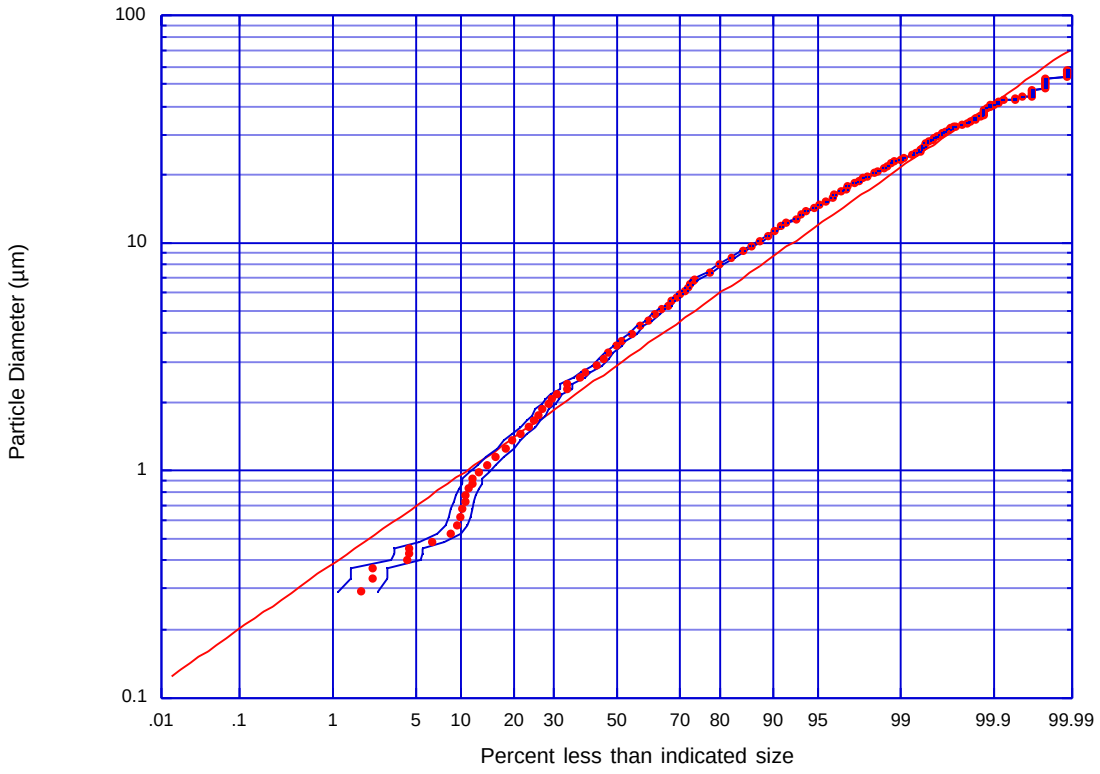
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.45$	1800
100x, 6	0.224	$4.22 < d_p < 7.45$	2354
200x, 6	0.0558	$2.48 < d_p < 4.22$	1252
500x, 6	0.00893	$1.44 < d_p < 2.48$	307
1000x, 6	0.00217	$0.00 < d_p < 1.44$	114
Totals:	1.18%	-	5827

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.13	GMD (µm):	2.70
GSD:	2.65	GSD:	2.24
lower 95% (µm):	0.45	R^2:	0.97778
upper 95% (µm):	21.88	lower 95% (µm):	0.54
		upper 95% (µm):	13.51

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.6 Module I, Sample 4 (TSFH24-01) count-based particle size distribution.



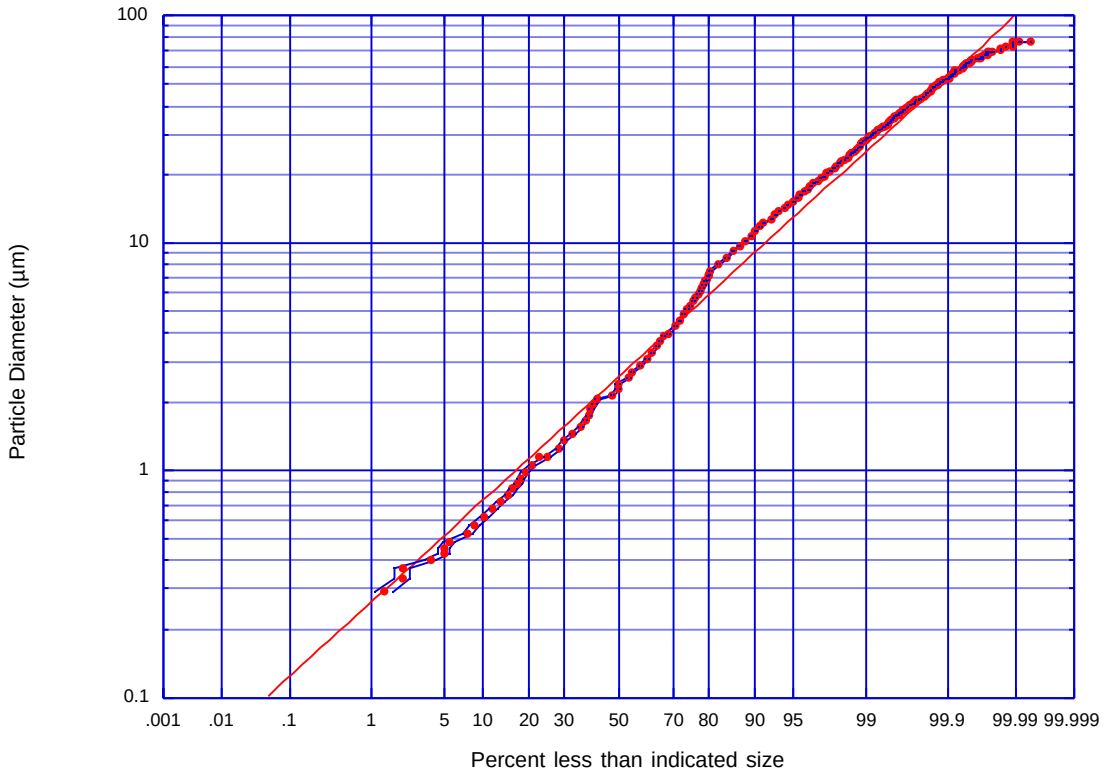
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.16$	3161
100x, 6	0.224	$3.90 < d_p < 7.16$	2056
200x, 6	0.0558	$2.22 < d_p < 3.90$	1139
500x, 6	0.00893	$1.28 < d_p < 2.22$	355
1000x, 6	0.00217	$0.00 < d_p < 1.28$	124
Totals:	1.18%	-	6835

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.30	GMD (µm):	2.89
GSD:	2.79	GSD:	2.37
lower 95% (µm):	0.42	R^2:	0.9821
upper 95% (µm):	25.70	lower 95% (µm):	0.51
		upper 95% (µm):	16.27

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.7 Module I, Sample 5 (TSFH25-01) count-based particle size distribution.



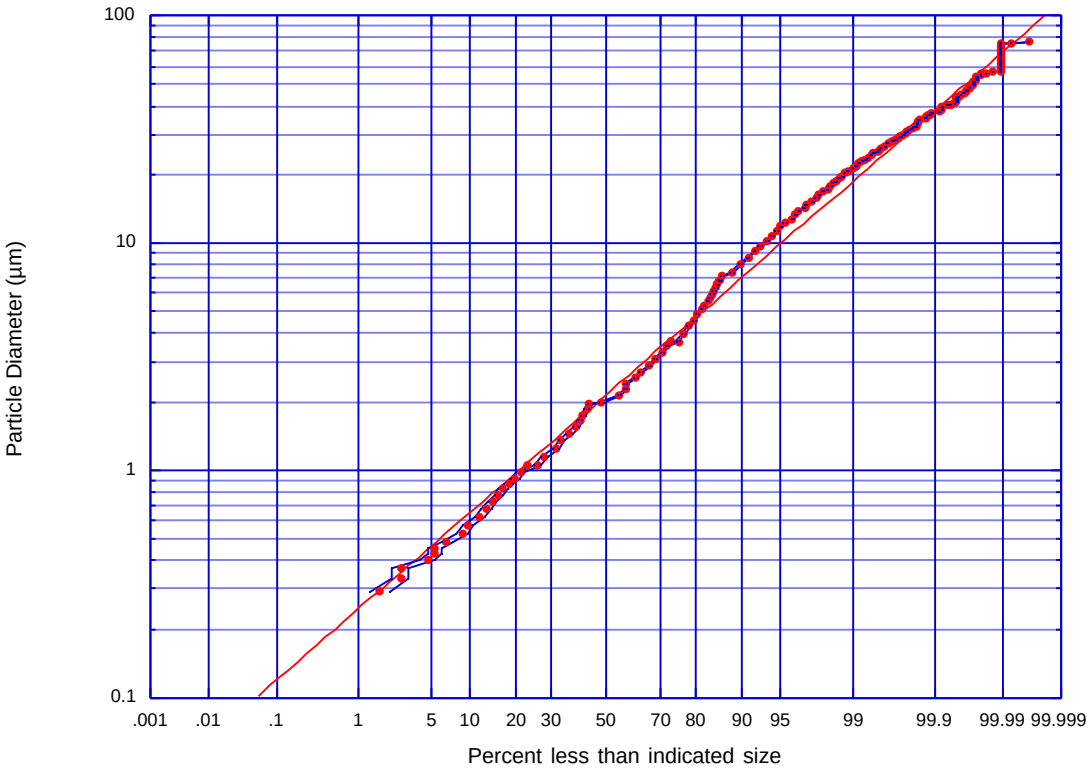
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.74$	10475
100x, 6	0.224	$4.11 < d_p < 7.74$	5374
200x, 6	0.0558	$2.17 < d_p < 4.11$	4252
500x, 6	0.00893	$1.21 < d_p < 2.17$	1828
1000x, 6	0.00217	$0.00 < d_p < 1.21$	621
Totals:	1.18%	-	22550

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.59	GMD (µm):	2.59
GSD:	2.92	GSD:	2.67
lower 95% (µm):	0.30	R^2:	0.99254
upper 95% (µm):	22.01	lower 95% (µm):	0.36
		upper 95% (µm):	18.47

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.8 Module I, Sample 6 (TSFH05-01) count-based particle size distribution.



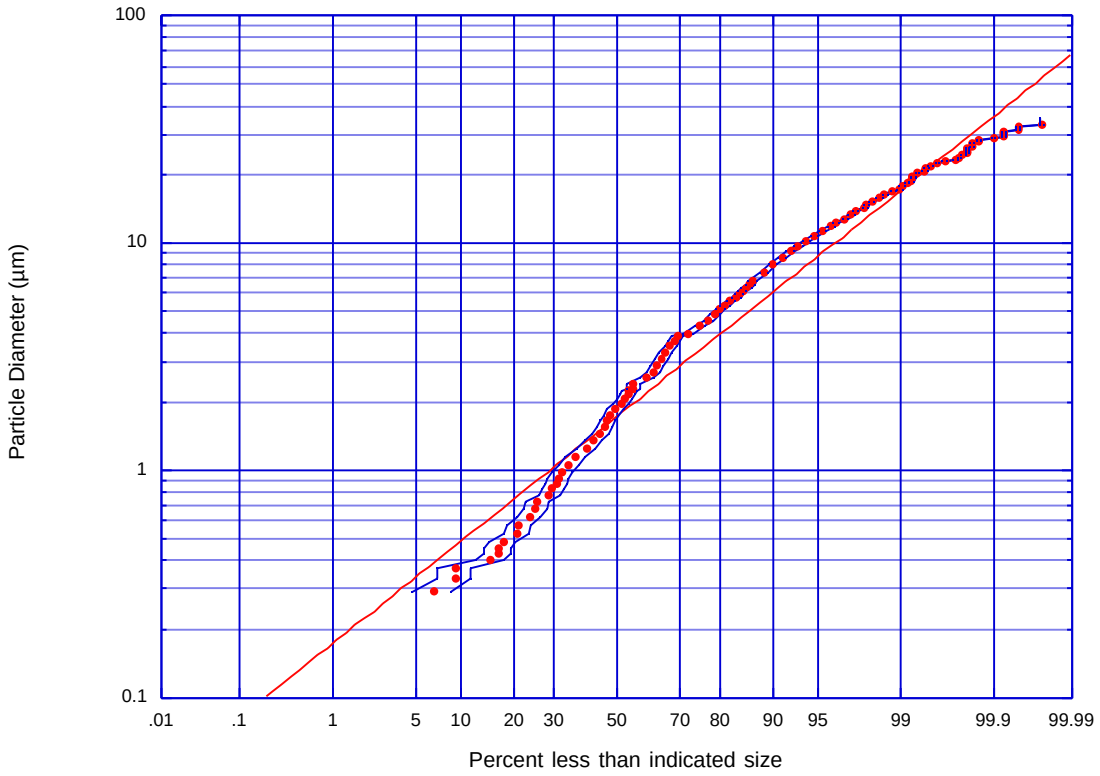
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.31$	5341
100x, 6	0.224	$3.88 < d_p < 7.31$	3463
200x, 6	0.0558	$2.03 < d_p < 3.88$	3458
500x, 6	0.00893	$1.18 < d_p < 2.03$	1321
1000x, 6	0.00217	$0.00 < d_p < 1.18$	526
Totals:	1.18%	-	14109

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.16	GMD (µm):	2.16
GSD:	2.65	GSD:	2.54
lower 95% (µm):	0.31	R^2:	0.99625
upper 95% (µm):	15.11	lower 95% (µm):	0.33
		upper 95% (µm):	13.88

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.9 Module I, Sample 7 (TSFH07-01) count-based particle size distribution.



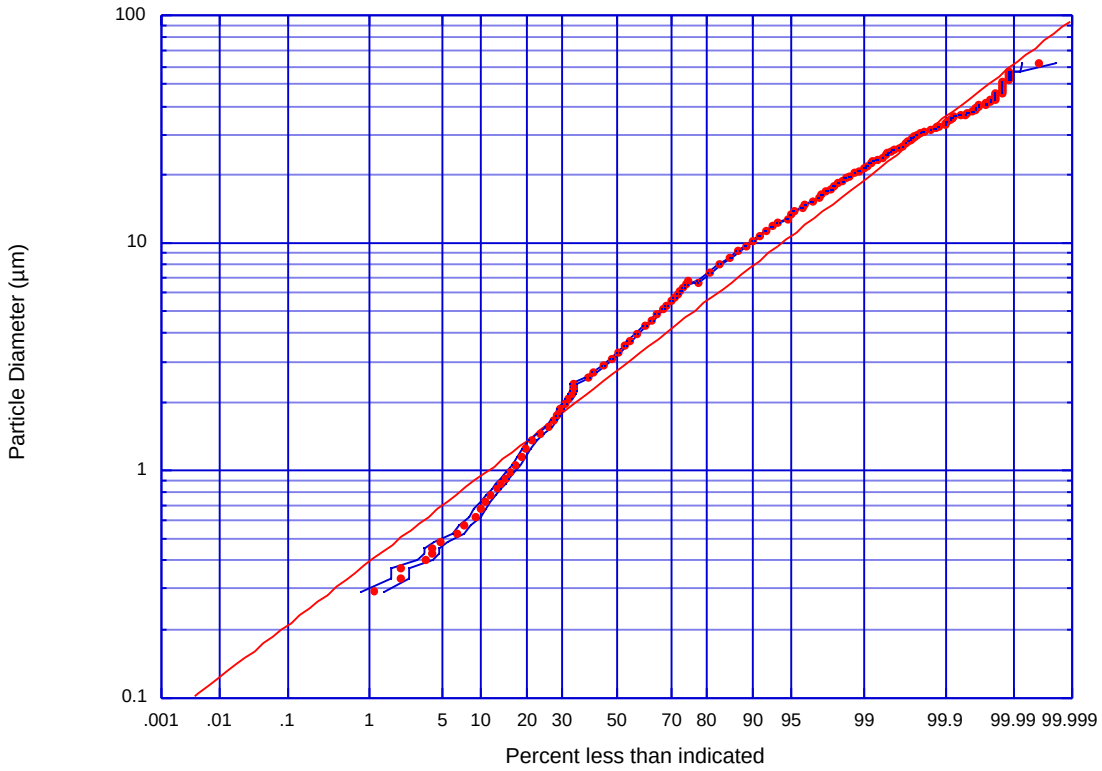
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.16$	706
100x, 6	0.224	$4.08 < d_p < 7.16$	780
200x, 6	0.0558	$2.34 < d_p < 4.08$	382
500x, 6	0.00893	$1.22 < d_p < 2.34$	175
1000x, 6	0.00217	$0.00 < d_p < 1.22$	105
Totals:	1.18%	-	2148

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.83	GMD (µm):	1.72
GSD:	3.12	GSD:	2.68
lower 95% (µm):	0.19	R^2:	0.97569
upper 95% (µm):	17.77	lower 95% (µm):	0.24
		upper 95% (µm):	12.39

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.10 Module I, Sample 8 (TSFH06-01) count-based particle size distribution.



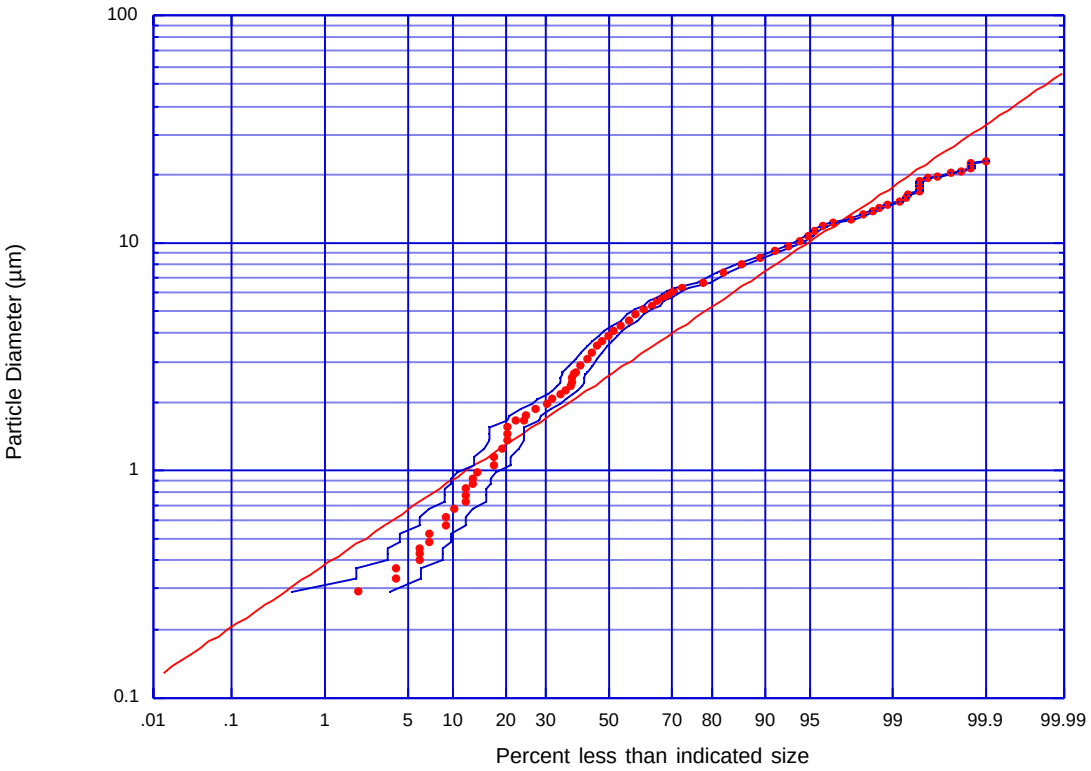
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.06$	8174
100x, 6	0.224	$3.95 < d_p < 7.06$	5837
200x, 6	0.0558	$2.30 < d_p < 3.95$	3936
500x, 6	0.00893	$1.34 < d_p < 2.30$	1262
1000x, 6	0.00217	$0.00 < d_p < 1.34$	396
Totals:	1.18%	-	19605

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.10	GMD (µm):	2.74
GSD:	2.72	GSD:	2.30
lower 95% (µm):	0.42	R^2:	0.98351
upper 95% (µm):	22.93	lower 95% (µm):	0.52
		upper 95% (µm):	14.51

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.11 Module I, Sample 9 (TSFH04-01) count-based particle size distribution.



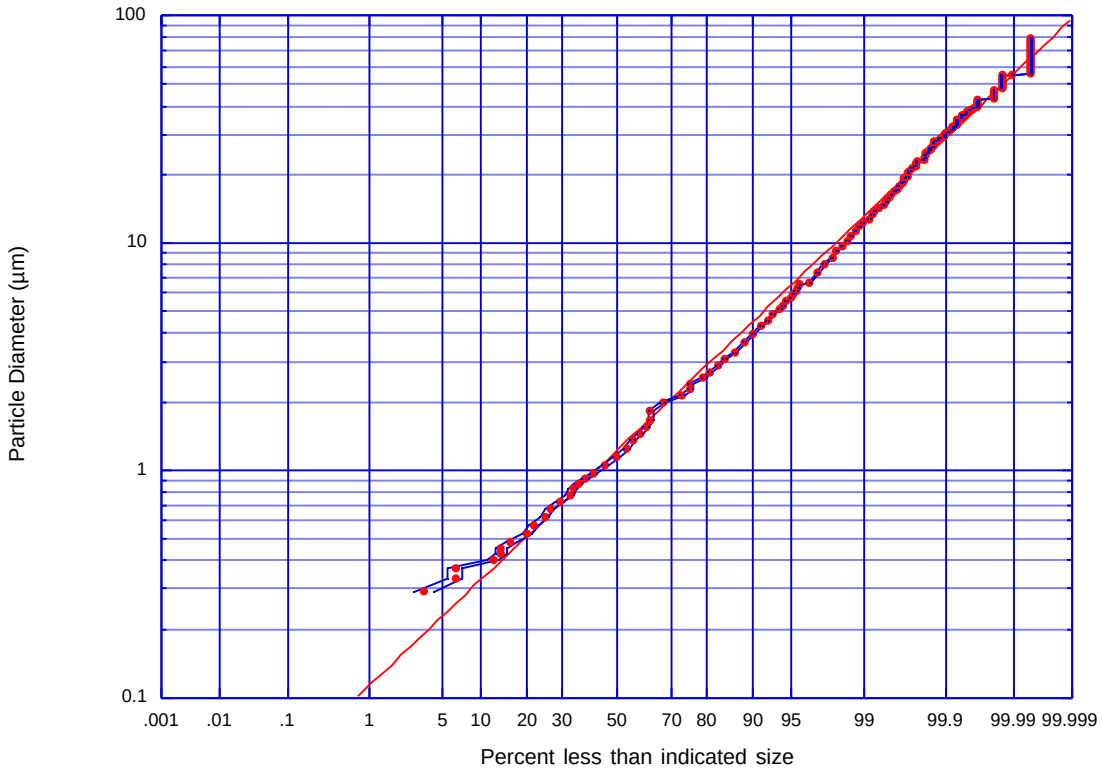
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 6.64$	709
100x, 6	0.224	$4.45 < d_p < 6.64$	469
200x, 6	0.0558	$2.76 < d_p < 4.45$	236
500x, 6	0.00893	$1.77 < d_p < 2.76$	155
1000x, 6	0.00217	$0.00 < d_p < 1.77$	51
Totals:	1.18%	-	1620

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.13	GMD (µm):	2.63
GSD:	2.67	GSD:	2.30
lower 95% (µm):	0.44	R^2:	0.94518
upper 95% (µm):	22.41	lower 95% (µm):	0.50
		upper 95% (µm):	13.86

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.12 Module I, Sample 10 (TSFH02-01) count-based particle size distribution.



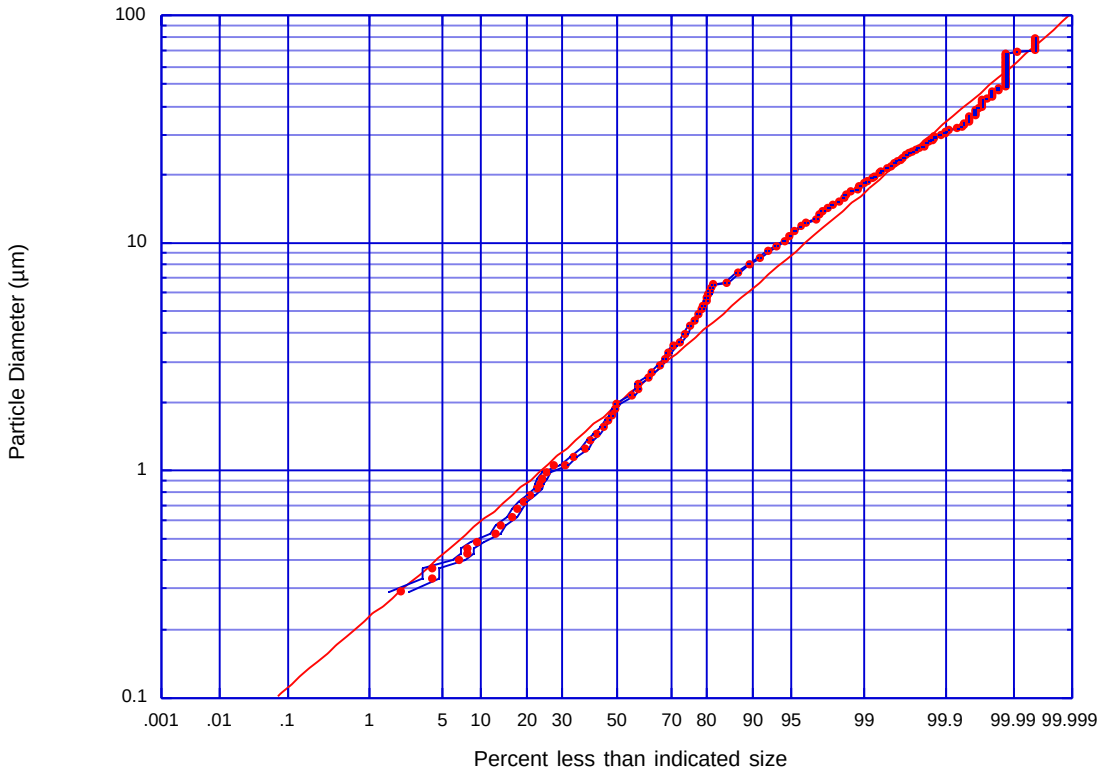
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 6.61$	1096
100x, 6	0.224	$3.32 < d_p < 6.61$	1714
200x, 6	0.0558	$1.73 < d_p < 3.32$	1979
500x, 6	0.00893	$0.92 < d_p < 1.73$	1186
1000x, 6	0.00217	$0.00 < d_p < 0.92$	503
Totals:	1.18%	-	6478

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.30	GMD (µm):	1.22
GSD:	2.43	GSD:	2.79
lower 95% (µm):	0.22	R^2:	0.99651
upper 95% (µm):	7.68	lower 95% (µm):	0.16
		upper 95% (µm):	9.49

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.13 Module I, Sample 10A (TSFH21-01) count-based particle size distribution.



Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 6.75$	5248
100x, 6	0.224	$3.70 < d_p < 6.75$	2512
200x, 6	0.0558	$1.99 < d_p < 3.70$	2406
500x, 6	0.00893	$1.13 < d_p < 1.99$	1233
1000x, 6	0.00217	$0.00 < d_p < 1.13$	480
Totals:	1.18%	-	11879

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.02	GMD (µm):	1.94
GSD:	2.83	GSD:	2.52
lower 95% (µm):	0.25	R^2:	0.99217
upper 95% (µm):	16.14	lower 95% (µm):	0.30
		upper 95% (µm):	12.39

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

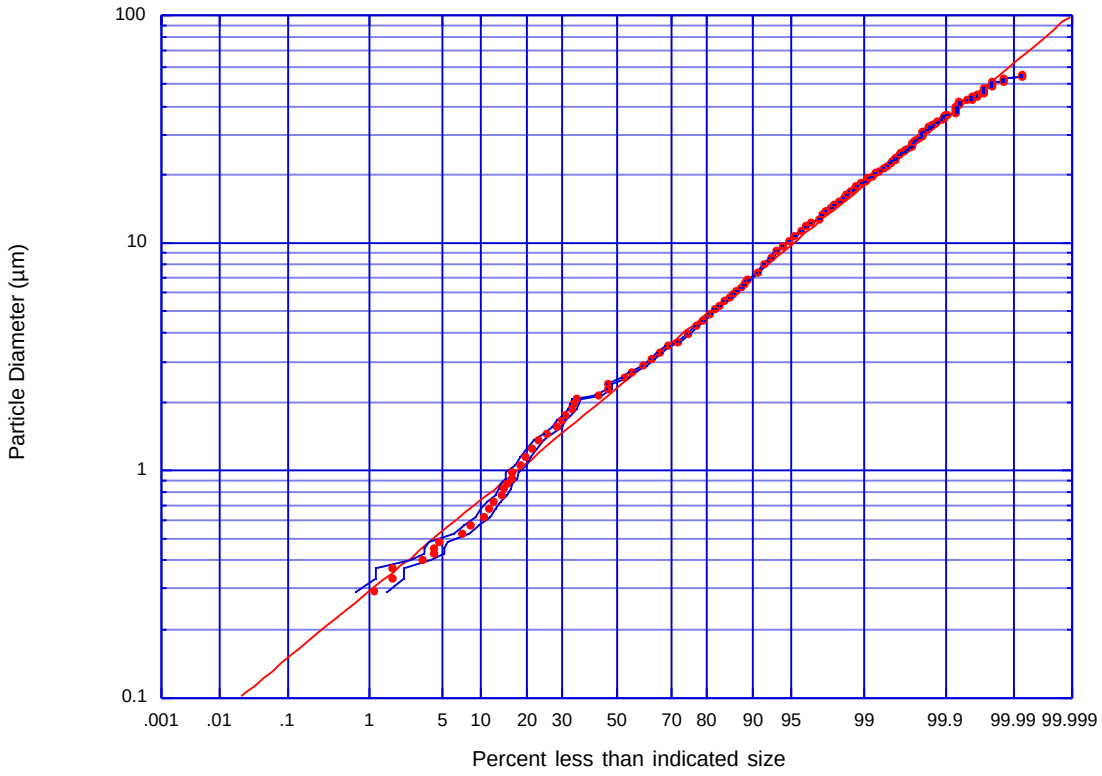
Figure 3.14 Module I, Sample 10B (TSFH03-01) count-based particle size distribution.

3.2.2.2. Module II Results

Figure 3.15 through Figure 3.26 display details of particle size distributions for corresponding collection locations of Module II. Table 3.2 gives a summary of Module II results.

Table 3.2 Summary of dust collected from locations in Tore Supra Module II.

Poloidal Location	Sample	Filter ID	Sampled Area (cm^2)	Collected Mass (mg)	Count-based Size Distribution Parameters	
					GMD (μm)	GSD
1	11	TSFH09-01	621.2	1.1	2.43	2.44
2	12	TSFH18-01	1,553	2.4	1.87	2.87
4	13	TSFH08-01	689.0	2.7	2.50	2.55
3	14	TSFH19-01	1,800	0.5	3.22	2.69
6	15	TSFH17-01	658.0	0.0	2.34	3.25
5	16	TSFH14-01	1,200	0.4	2.92	2.64
7	17	TSFH27-03	428.0	1.1	3.96	2.76
8	18	TSFH11-01	84.00	0.0	2.75	3.09
10	19	TSFH10-01	1,429	0.7	3.19	2.61
9	20	TSFH13-01	294.0	0.8	3.13	2.92
11	20A	TSFH15-01	160.0	3.5	4.65	2.72
12	20B	TSFH16-01	480.0	26.7	1.52	2.73



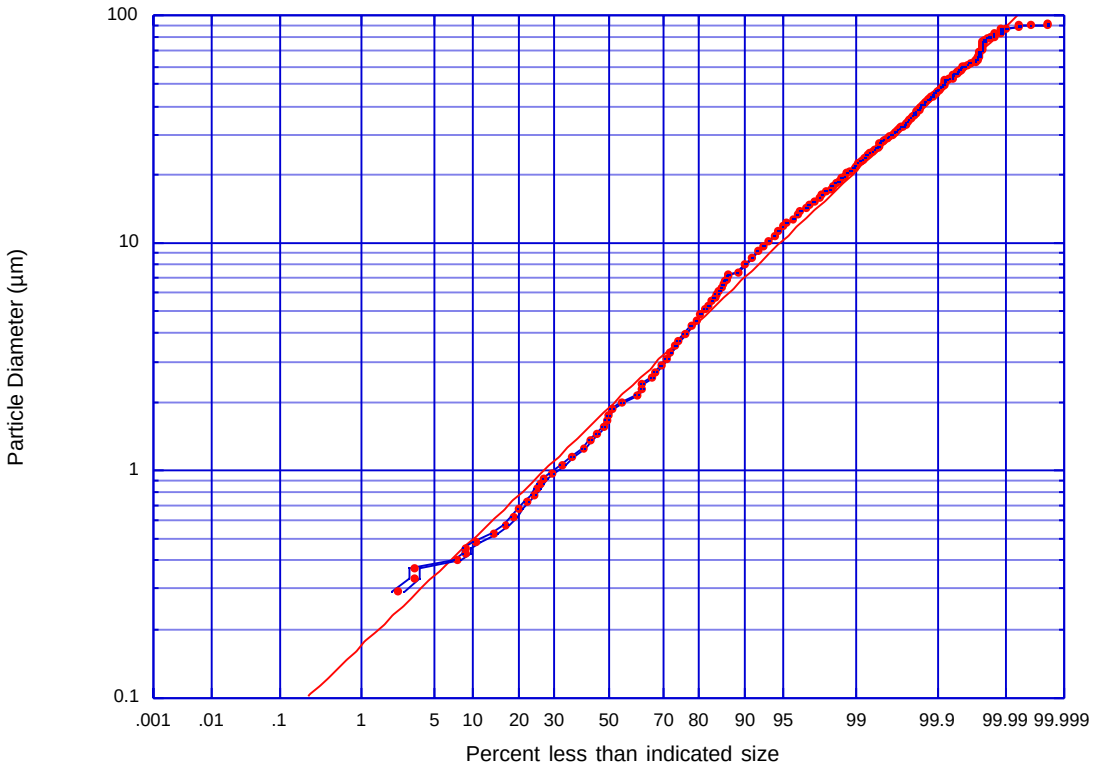
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.12$	2080
100x, 6	0.224	$3.78 < d_p < 7.12$	2597
200x, 6	0.0558	$2.12 < d_p < 3.78$	2269
500x, 6	0.00893	$1.32 < d_p < 2.12$	655
1000x, 6	0.00217	$0.00 < d_p < 1.32$	237
Totals:	1.18%	-	7838

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.43	GMD (µm):	230
GSD:	2.44	GSD:	2.42
lower 95% (µm):	0.41	R^2:	0.9977
upper 95% (µm):	14.42	lower 95% (µm):	0.39
		upper 95% (µm):	13.49

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.15 Module II, Sample 11 (TSFH09-01) count-based particle size distribution.



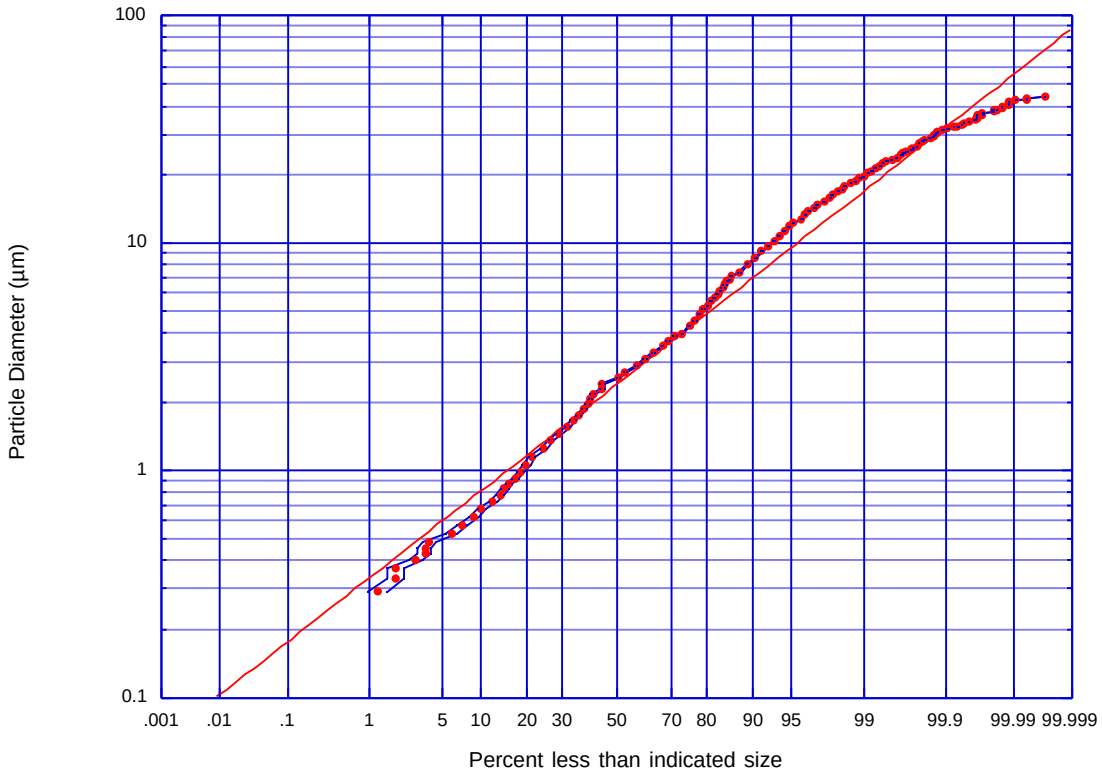
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.36$	9096
100x, 6	0.224	$4.41 < d_p < 8.36$	6873
200x, 6	0.0558	$2.07 < d_p < 4.41$	5171
500x, 6	0.00893	$1.40 < d_p < 2.07$	2935
1000x, 6	0.00217	$0.00 < d_p < 1.40$	1011
Totals:	1.18%	-	25086

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.87	GMD (µm):	1.88
GSD:	2.87	GSD:	2.82
lower 95% (µm):	0.23	R^2:	0.99634
upper 95% (µm):	15.41	lower 95% (µm):	0.24
		upper 95% (µm):	14.95

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.16 Module II, Sample 12 (TSFH18-01) count-based particle size distribution.



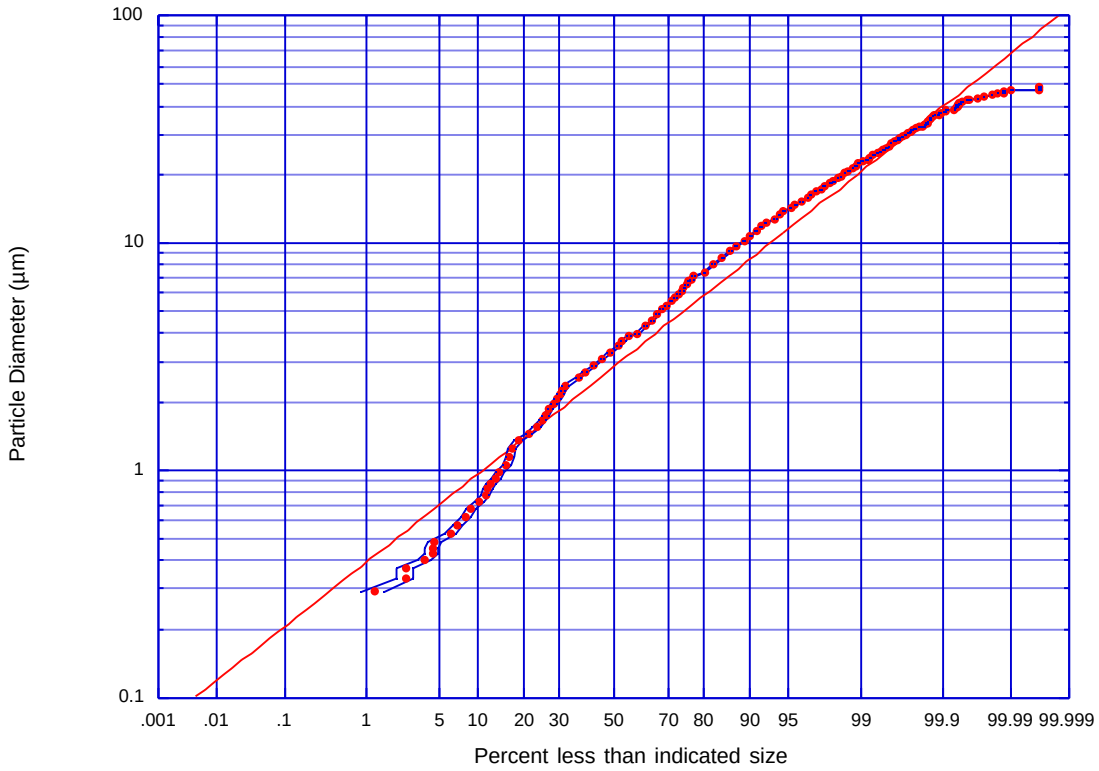
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.32$	6520
100x, 6	0.224	$4.03 < d_p < 7.32$	5462
200x, 6	0.0558	$2.27 < d_p < 4.03$	5908
500x, 6	0.00893	$1.38 < d_p < 2.27$	1766
1000x, 6	0.00217	$0.00 < d_p < 1.38$	624
Totals:	1.18%	-	20280

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.50	GMD (µm):	2.39
GSD:	2.55	GSD:	2.32
lower 95% (µm):	0.38	R^2:	0.9876
upper 95% (µm):	16.27	lower 95% (µm):	0.44
		upper 95% (µm):	12.93

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.17 Module II, Sample 13 (TSFH08-01) count-based particle size distribution.



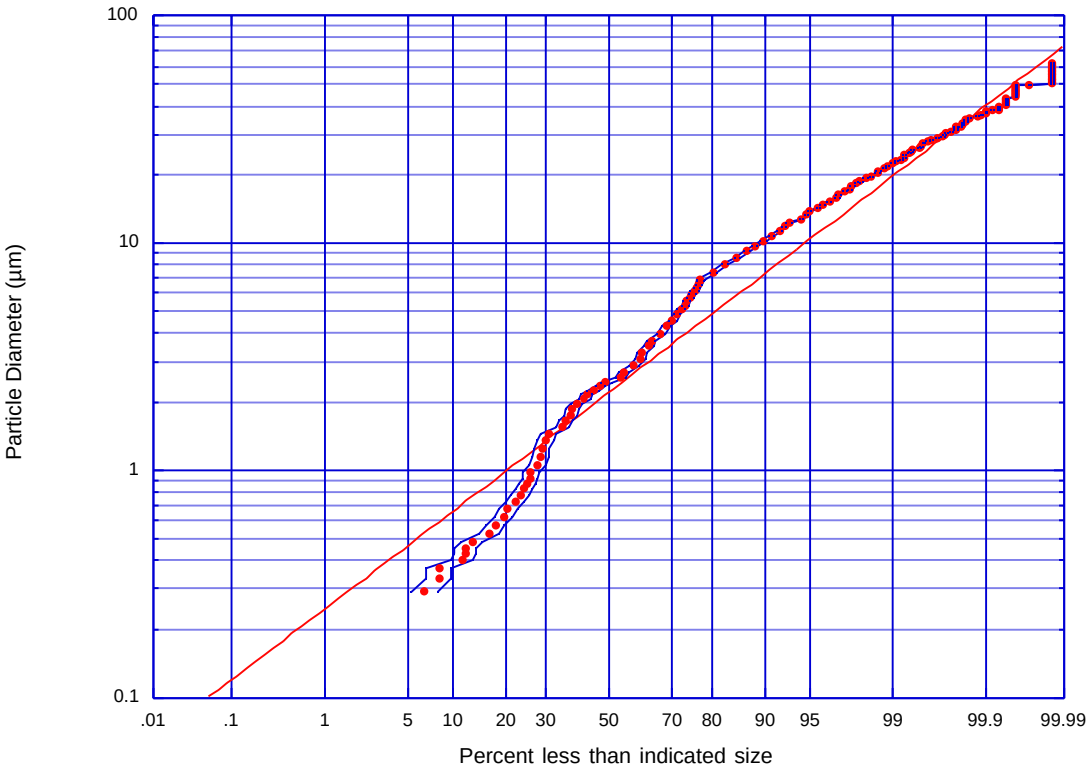
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.32$	9551
100x, 6	0.224	$4.13 < d_p < 7.32$	7080
200x, 6	0.0558	$2.41 < d_p < 4.13$	4834
500x, 6	0.00893	$1.36 < d_p < 2.41$	1398
1000x, 6	0.00217	$0.00 < d_p < 1.36$	431
Totals:	1.18%	-	23294

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.22	GMD (µm):	2.85
GSD:	2.69	GSD:	2.35
lower 95% (µm):	0.44	R^2:	0.97963
upper 95% (µm):	23.34	lower 95% (µm):	0.52
		upper 95% (µm):	15.70

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.18 Module II, Sample 14 (TSFH19-01) count-based particle size distribution.



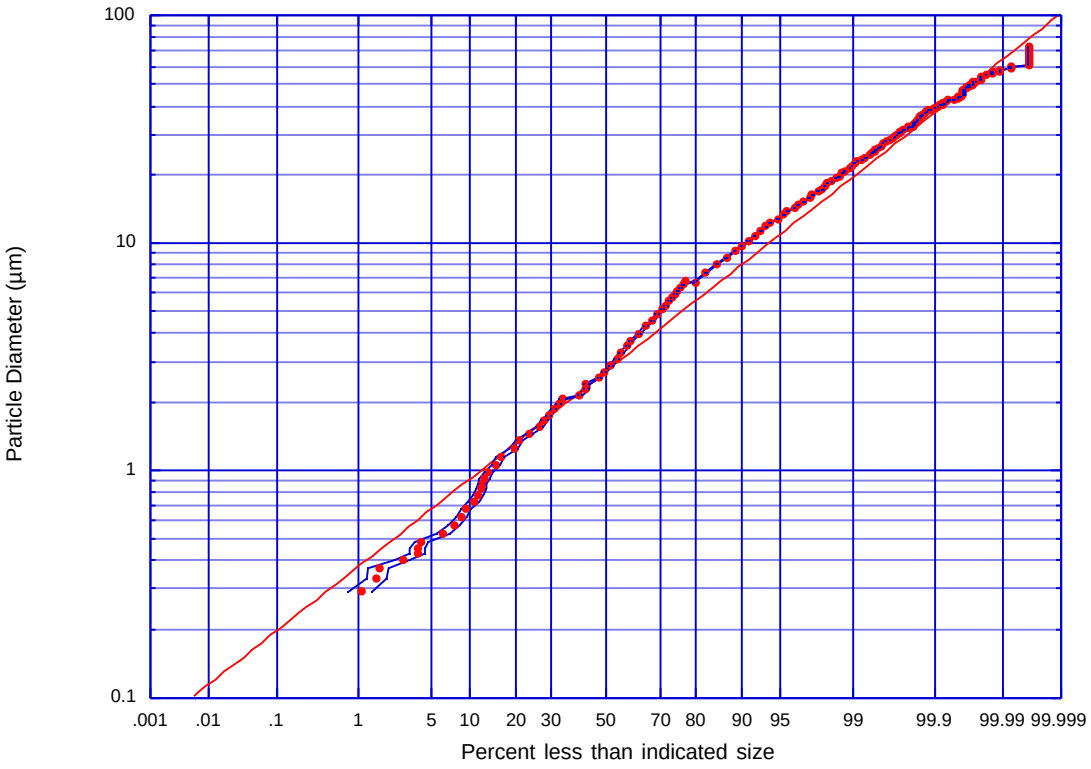
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.14$	2149
100x, 6	0.224	$3.92 < d_p < 7.14$	999
200x, 6	0.0558	$2.54 < d_p < 3.92$	761
500x, 6	0.00893	$1.47 < d_p < 2.54$	383
1000x, 6	0.00217	$0.00 < d_p < 1.47$	141
Totals:	1.18%	-	4433

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.34	GMD (µm):	2.20
GSD:	3.25	GSD:	2.57
lower 95% (µm):	0.22	R^2:	0.97613
upper 95% (µm):	24.79	lower 95% (µm):	0.33
		upper 95% (µm):	14.51

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.19 Module II, Sample 15 (TSFH17-01) count-based particle size distribution.



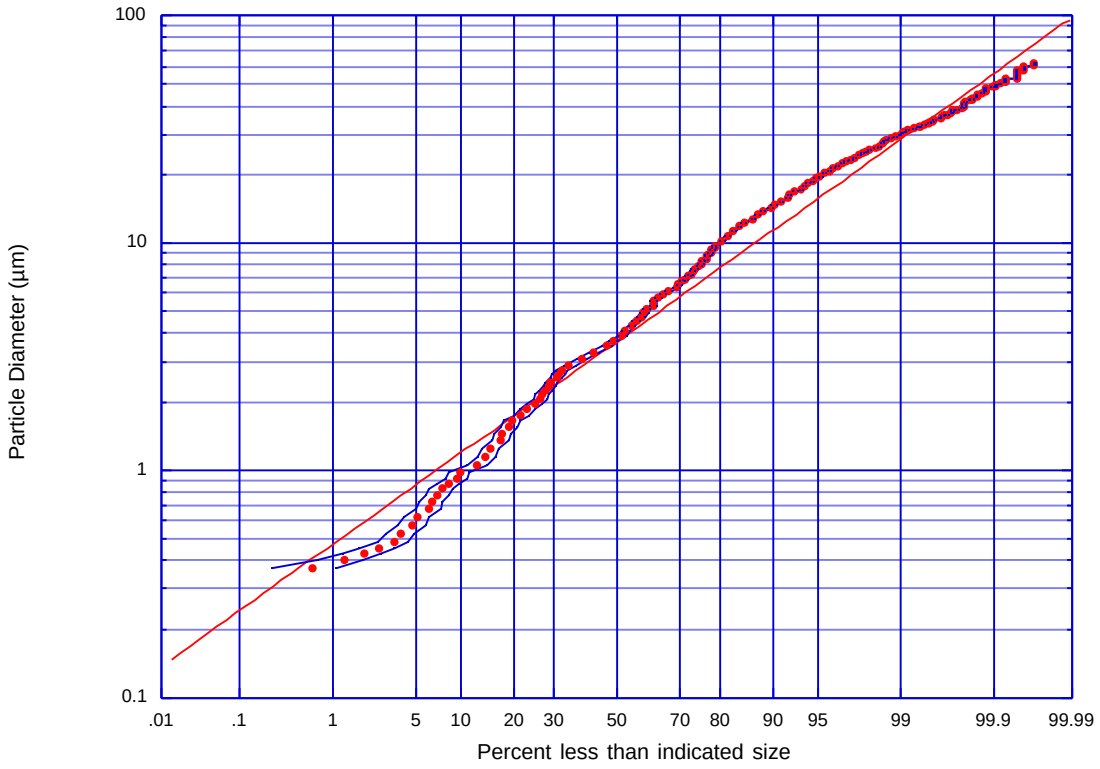
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.13$	7772
100x, 6	0.224	$3.91 < d_p < 7.13$	5440
200x, 6	0.0558	$2.16 < d_p < 3.91$	3463
500x, 6	0.00893	$1.29 < d_p < 2.16$	1312
1000x, 6	0.00217	$0.00 < d_p < 1.29$	376
Totals:	1.18%	-	18363

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.92	GMD (µm):	2.72
GSD:	2.64	GSD:	2.34
lower 95% (µm):	0.42	R^2:	0.99096
upper 95% (µm):	20.34	lower 95% (µm):	0.50
		upper 95% (µm):	14.86

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.20 Module II, Sample 16 (TSFH14-01) count-based particle size distribution.



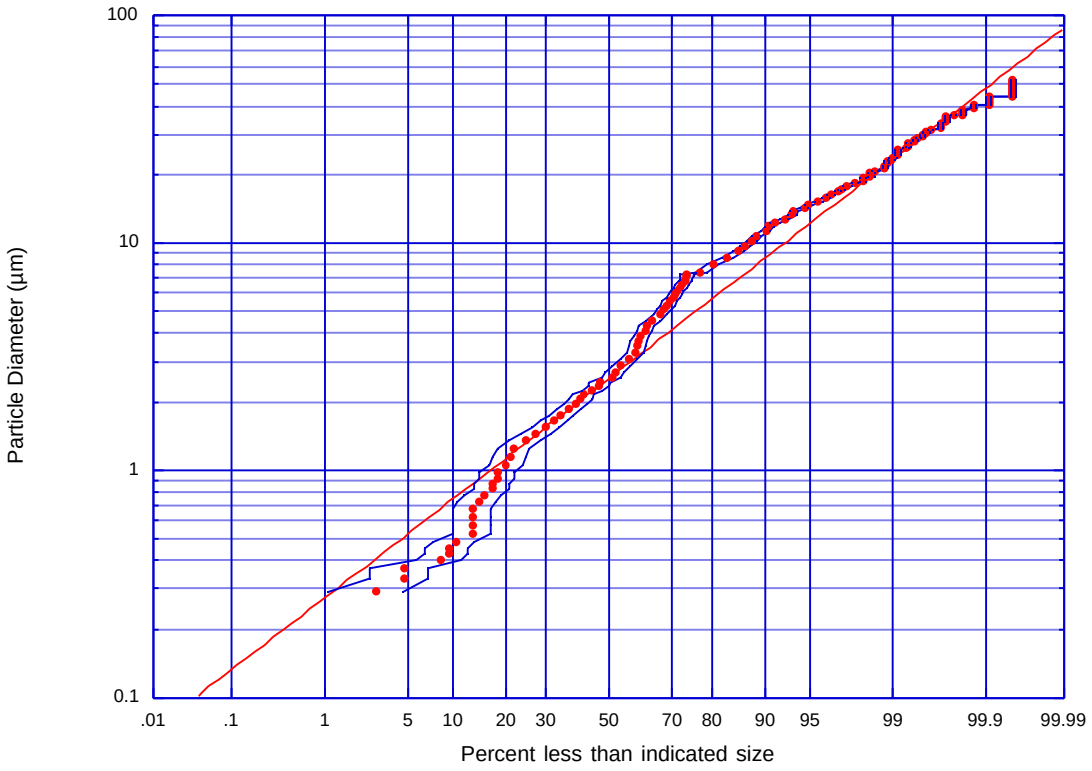
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.62$	3255
100x, 6	0.224	$5.25 < d_p < 9.62$	2179
200x, 6	0.0558	$2.78 < d_p < 5.25$	1795
500x, 6	0.00893	$1.70 < d_p < 2.78$	475
1000x, 6	0.00217	$0.00 < d_p < 1.70$	144
Totals:	1.18%	-	7848

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.96	GMD (µm):	3.68
GSD:	2.76	GSD:	2.41
lower 95% (µm):	0.52	R^2:	0.98536
upper 95% (µm):	30.04	lower 95% (µm):	0.63
		upper 95% (µm):	21.43

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.21 Module II, Sample 17 (TSFH27-03) count-based particle size distribution.



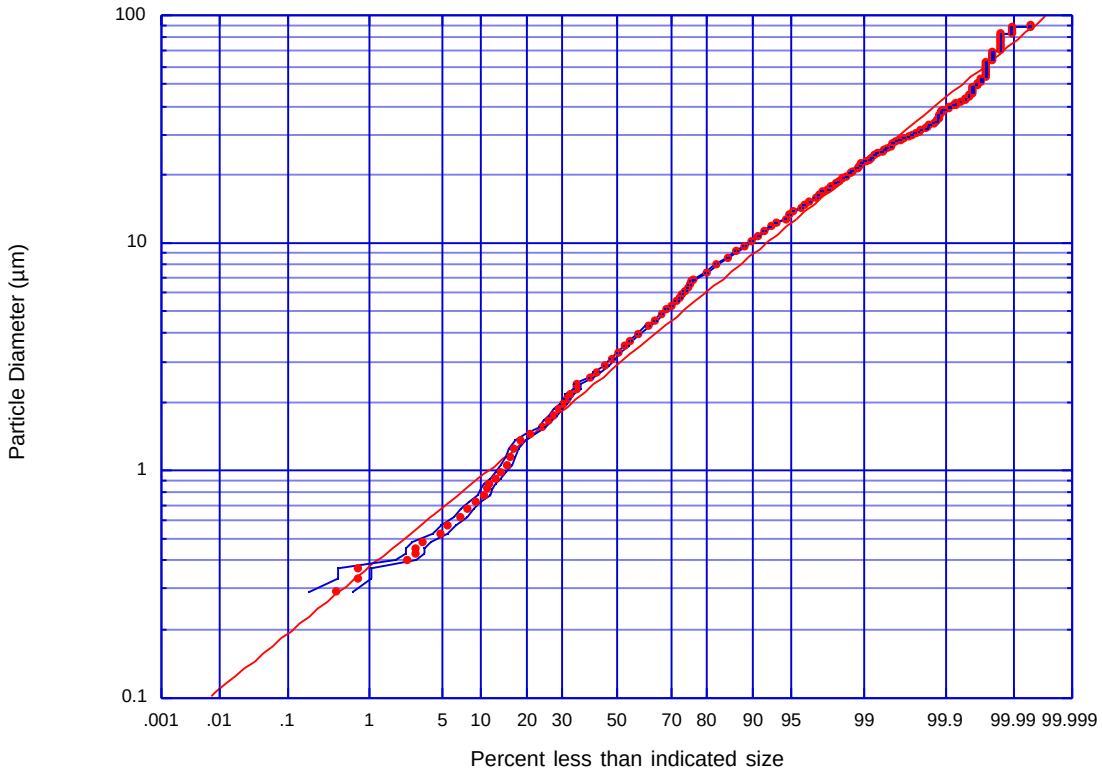
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.46$	752
100x, 6	0.224	$4.50 < d_p < 7.46$	348
200x, 6	0.0558	$2.57 < d_p < 4.50$	207
500x, 6	0.00893	$1.42 < d_p < 2.57$	123
1000x, 6	0.00217	$0.00 < d_p < 1.42$	46
Totals:	1.18%	-	

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.75	GMD (µm):	2.53
GSD:	3.09	GSD:	2.60
lower 95% (µm):	0.29	R^2:	0.98002
upper 95% (µm):	26.20	lower 95% (µm):	0.38
		upper 95% (µm):	17.07

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.22 Module II, Sample 18 (TSFH11-01) count-based particle size distribution.



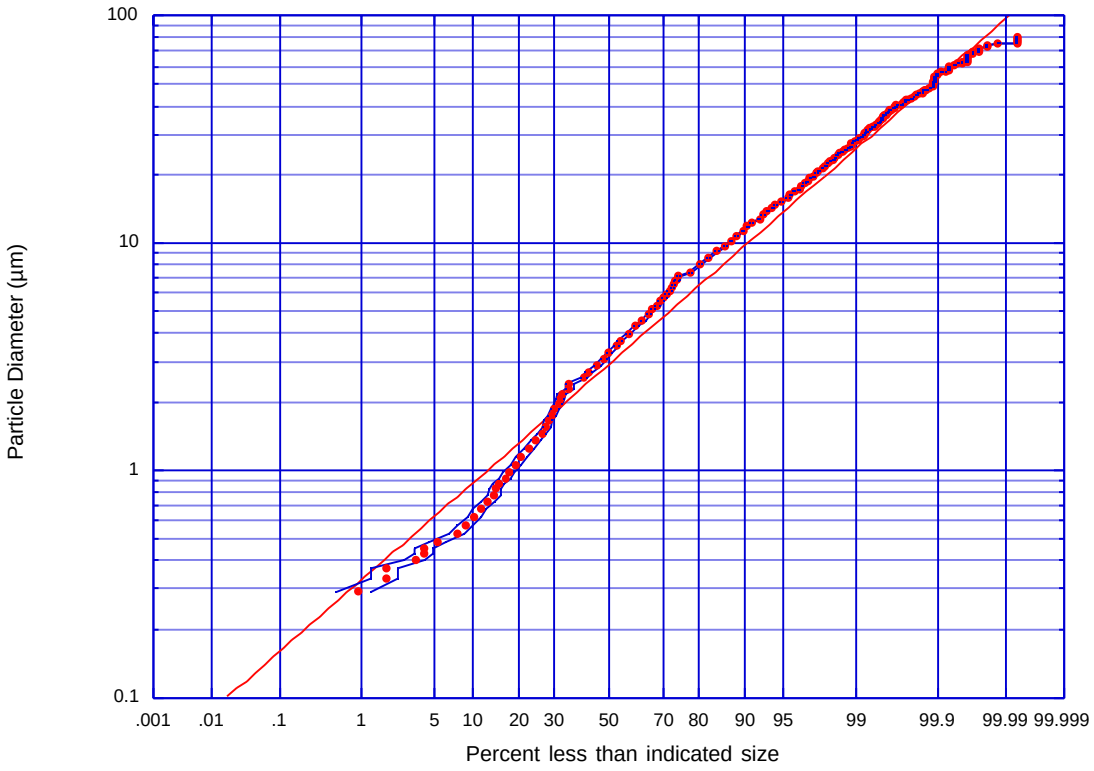
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.01$	5328
100x, 6	0.224	$3.88 < d_p < 7.01$	4319
200x, 6	0.0558	$2.20 < d_p < 3.88$	2641
500x, 6	0.00893	$1.35 < d_p < 2.20$	1001
1000x, 6	0.00217	$0.00 < d_p < 1.35$	257
Totals:	1.18%	-	13546

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.19	GMD (µm):	2.89
GSD:	2.61	GSD:	2.41
lower 95% (µm):	0.47	R^2:	0.99362
upper 95% (µm):	21.76	lower 95% (µm):	0.50
		upper 95% (µm):	16.82

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.23 Module II, Sample 19 (TSFH10-01) count-based particle size distribution.



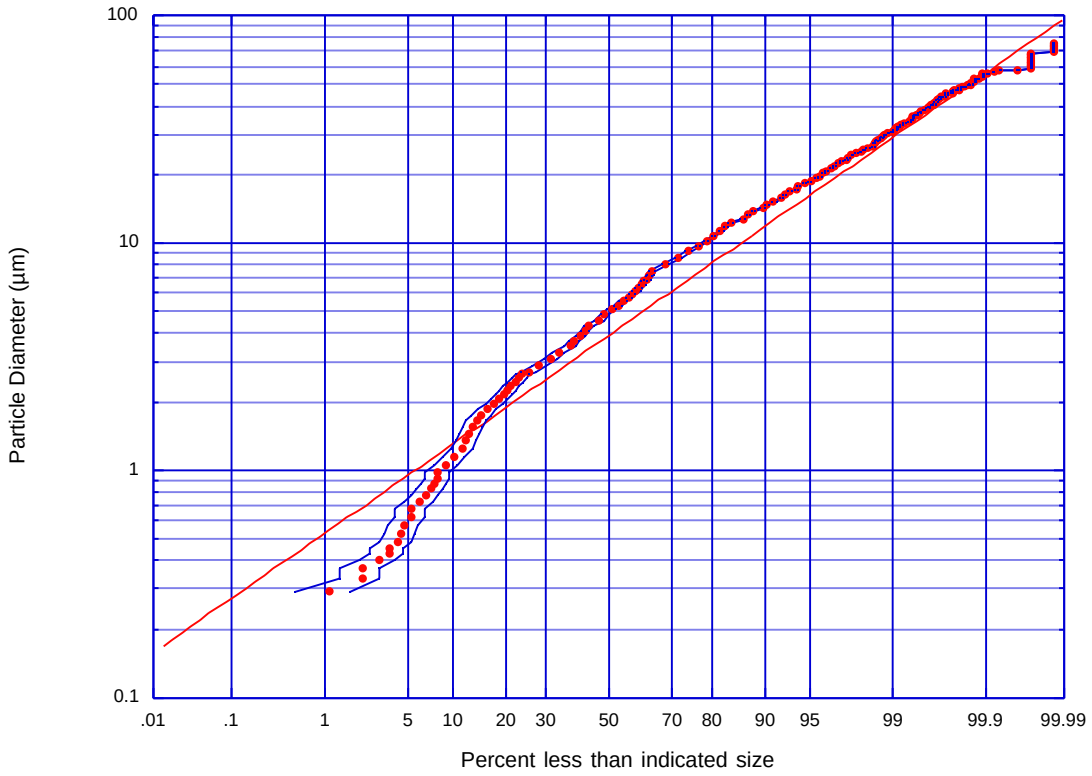
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.31$	5418
100x, 6	0.224	$3.93 < d_p < 7.31$	3172
200x, 6	0.0558	$2.27 < d_p < 3.93$	2189
500x, 6	0.00893	$1.28 < d_p < 2.27$	582
1000x, 6	0.00217	$0.00 < d_p < 1.28$	228
Totals:	1.18%	-	11589

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.13	GMD (µm):	2.93
GSD:	2.92	GSD:	2.56
lower 95% (µm):	0.37	R^2:	0.99069
upper 95% (µm):	26.64	lower 95% (µm):	0.45
		upper 95% (µm):	19.22

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.24 Module II, Sample 20 (TSFH13-01) count-based particle size distribution.



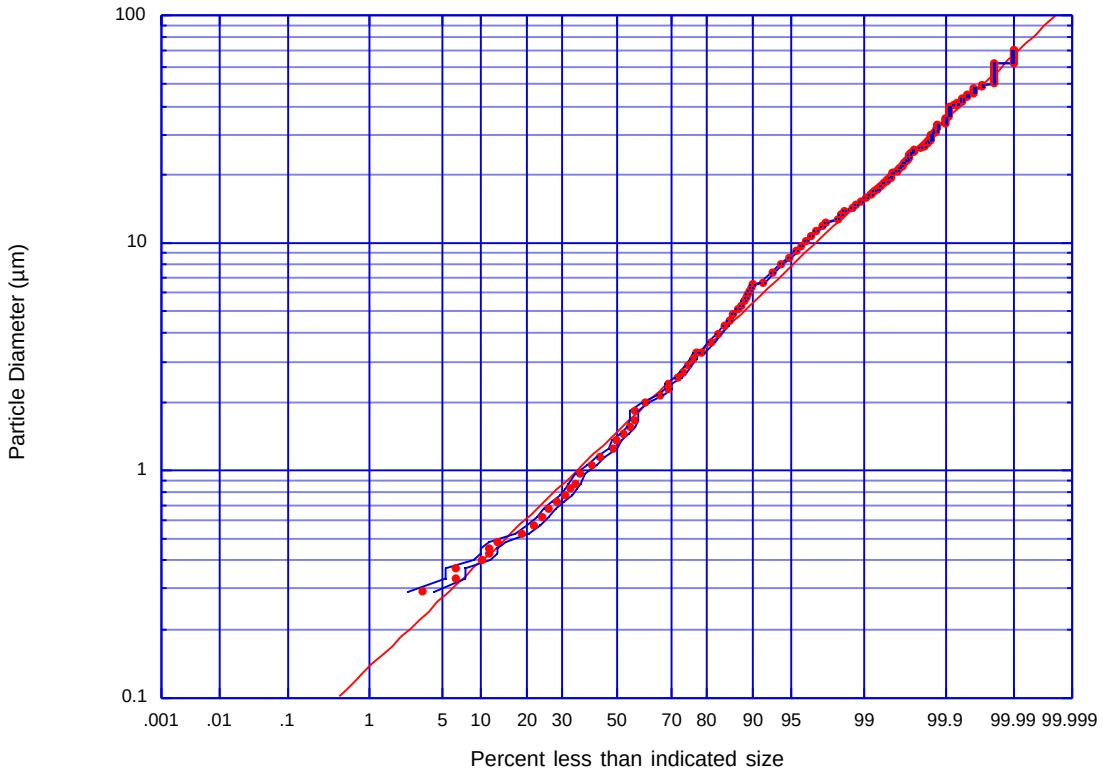
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.80$	3822
100x, 6	0.224	$4.48 < d_p < 7.80$	1939
200x, 6	0.0558	$2.72 < d_p < 4.48$	1043
500x, 6	0.00893	$1.63 < d_p < 2.72$	301
1000x, 6	0.00217	$0.00 < d_p < 1.63$	82
Totals:	1.18%	-	7187

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.65	GMD (µm):	3.92
GSD:	2.72	GSD:	2.37
lower 95% (µm):	0.63	R^2:	0.97932
upper 95% (µm):	34.49	lower 95% (µm):	0.70
		upper 95% (µm):	22.00

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.25 Module II, Sample 20A (TSFH15-01) count-based particle size distribution.



Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 6.72$	1330
100x, 6	0.224	$3.53 < d_p < 6.72$	1035
200x, 6	0.0558	$1.77 < d_p < 3.53$	912
500x, 6	0.00893	$0.91 < d_p < 1.77$	532
1000x, 6	0.00217	$0.00 < d_p < 0.91$	239
Totals:	1.18%	-	4048

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.52	GMD (µm):	1.47
GSD:	2.73	GSD:	2.79
lower 95% (µm):	0.20	R^2:	0.99787
upper 95% (µm):	11.38	lower 95% (µm):	0.19
		upper 95% (µm):	11.46

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.26 Module II, Sample 20B (TSFH16-01) count-based particle size distribution.

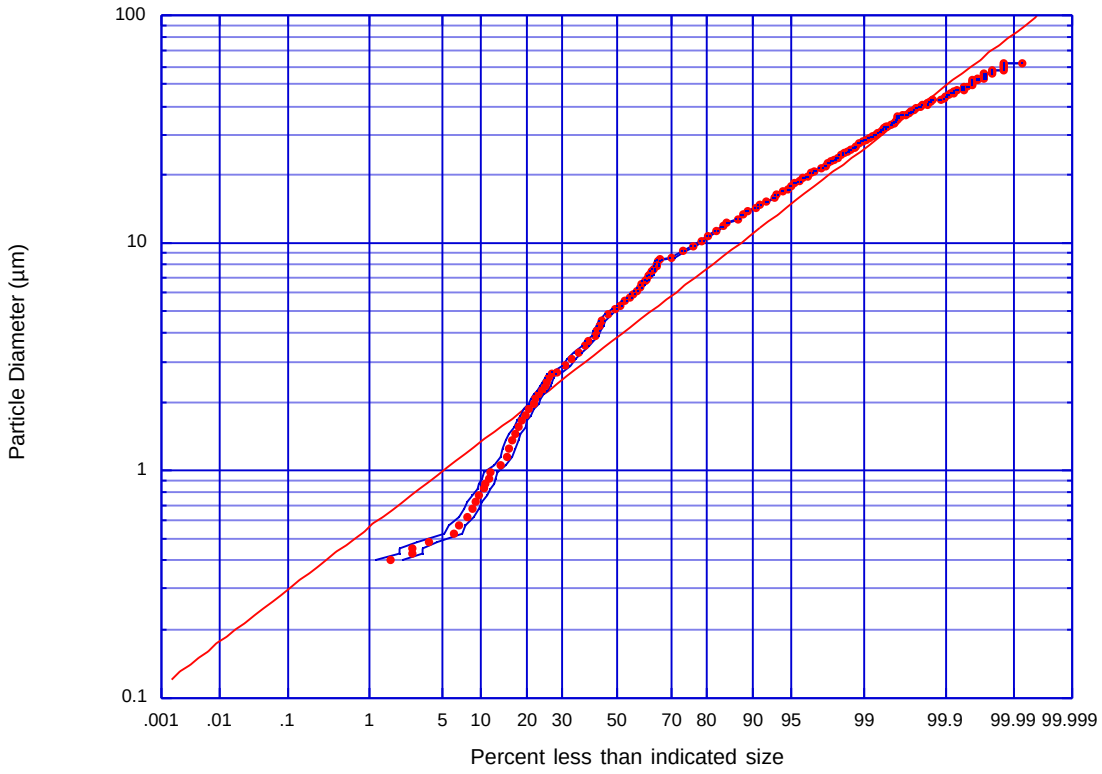
3.2.2.3. Module III Results

Figure 3.27 through Figure 3.38 display details of particle size distributions for corresponding collection locations of Module III. Table 3.3 gives a summary of Module III results.

Table 3.3 Summary of dust collected from locations in Tore Supra Module III.

Poloidal Location	Sample	Filter ID	Sampled Area (cm^2)	Collected Mass (mg)	Count-based Size Distribution Parameters	
					GMD (μm)	GSD
1	21	TSFH05-02	621.2	0.5	4.40	2.87
2	22	TSFH23-02	1,553	1.6	2.81	3.11
4	23	TSFH06-02	689.0	2.0	3.38	2.85
3	24	TSFH11-02	1,800	0.7	2.74	2.92
6	25	TSFH08-02	658.0	0.2	4.00	3.15
5	26	TSFH10-02	1,200	0.4	4.63	2.91
7	27	TSFH09-02	428.0	1.4	3.19	3.04
8	28	TSFH07-02	84.00	0.3	4.06	3.15
10	29	TSFH22-02	1,429	1.4	3.65	3.23
9	30	TSFH25-02	294.0	0.3*	3.28	2.63
11	30A	TSFH24-02	160.0	34.7*	1.96	2.94
12	30B	TSFH21-02	480.0	38.3	1.66	2.95

*- filter partially broken



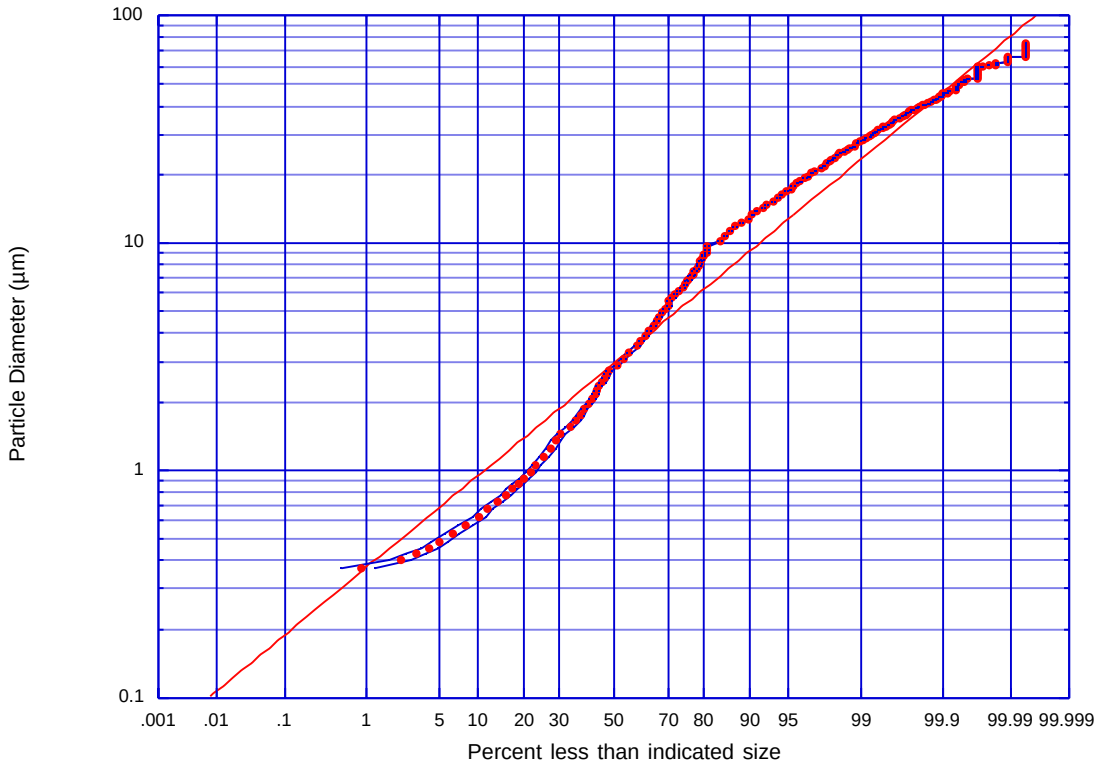
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.64$	6123
100x, 6	0.224	$4.75 < d_p < 8.64$	3111
200x, 6	0.0558	$2.77 < d_p < 4.75$	1432
500x, 6	0.00893	$1.62 < d_p < 2.77$	456
1000x, 6	0.00217	$0.00 < d_p < 1.62$	192
Totals:	1.18%	-	11314

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.40	GMD (µm):	3.83
GSD:	2.87	GSD:	2.29
lower 95% (µm):	0.53	R^2:	0.96637
upper 95% (µm):	36.15	lower 95% (µm):	0.73
		upper 95% (µm):	20.02

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.27 Module III, Sample 21 (TSFH05-02) count-based particle size distribution.



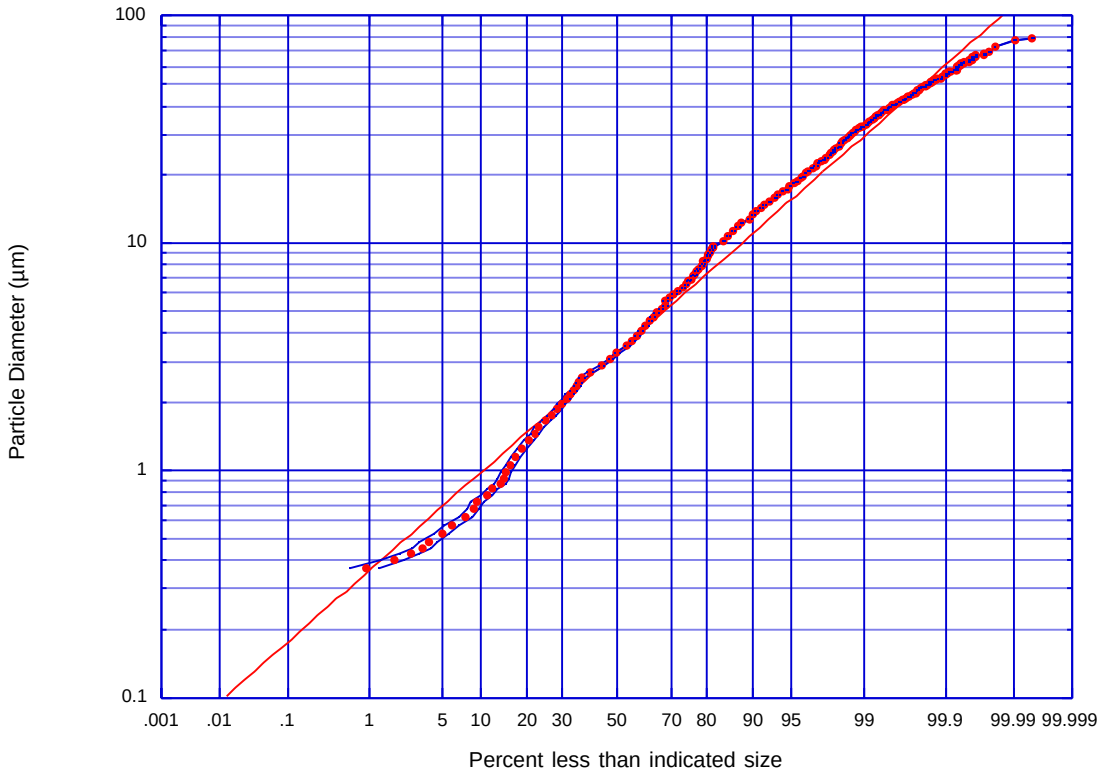
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.52$	5227
100x, 6	0.224	$5.34 < d_p < 9.52$	2929
200x, 6	0.0558	$2.80 < d_p < 5.34$	2475
500x, 6	0.00893	$1.52 < d_p < 2.80$	966
1000x, 6	0.00217	$0.00 < d_p < 1.52$	432
Totals:	1.18%	-	12029

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.81	GMD (µm):	2.89
GSD:	3.11	GSD:	2.52
lower 95% (µm):	0.29	R^2:	0.9746
upper 95% (µm):	27.20	lower 95% (µm):	0.46
		upper 95% (µm):	18.35

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.28 Module III, Sample 22 (TSFH23-02) count-based particle size distribution.



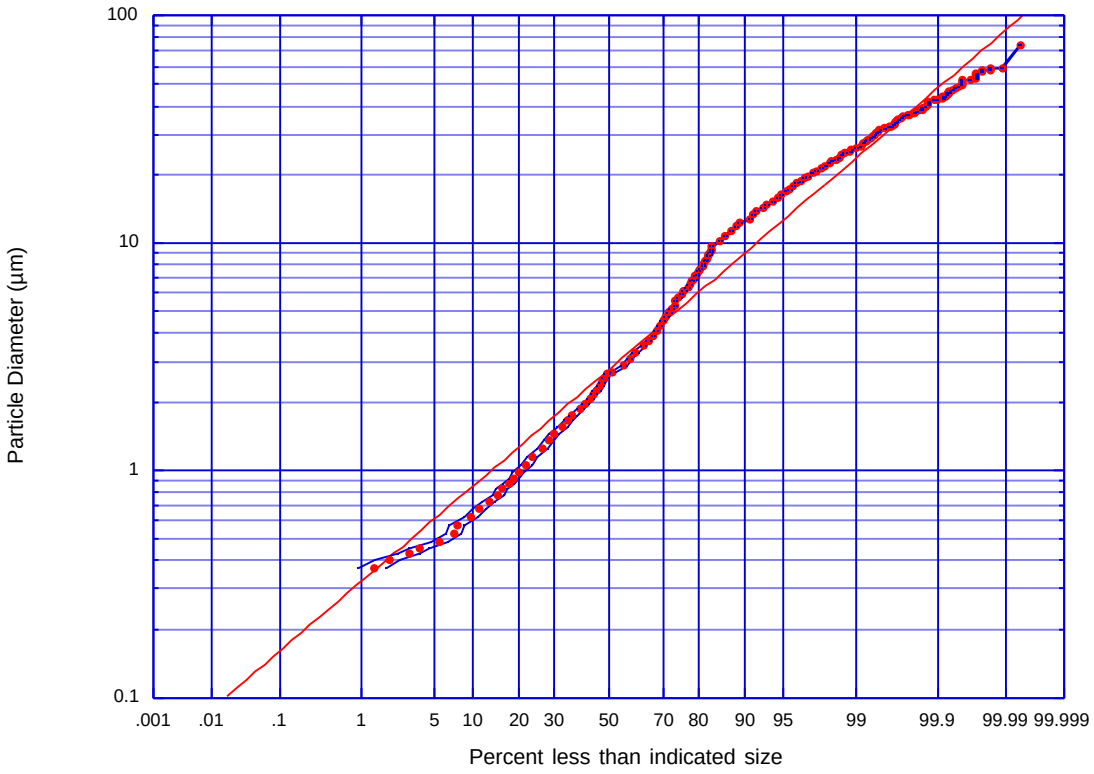
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.75$	5785
100x, 6	0.224	$5.16 < d_p < 9.75$	4162
200x, 6	0.0558	$2.67 < d_p < 5.16$	3257
500x, 6	0.00893	$1.62 < d_p < 2.67$	1237
1000x, 6	0.00217	$0.00 < d_p < 1.62$	425
Totals:	1.18%	-	14866

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.38	GMD (µm):	3.28
GSD:	2.85	GSD:	2.58
lower 95% (µm):	0.42	R^2:	0.98988
upper 95% (µm):	27.51	lower 95% (µm):	0.49
		upper 95% (µm):	21.80

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.29 Module III, Sample 23 (TSFH06-02) count-based particle size distribution.



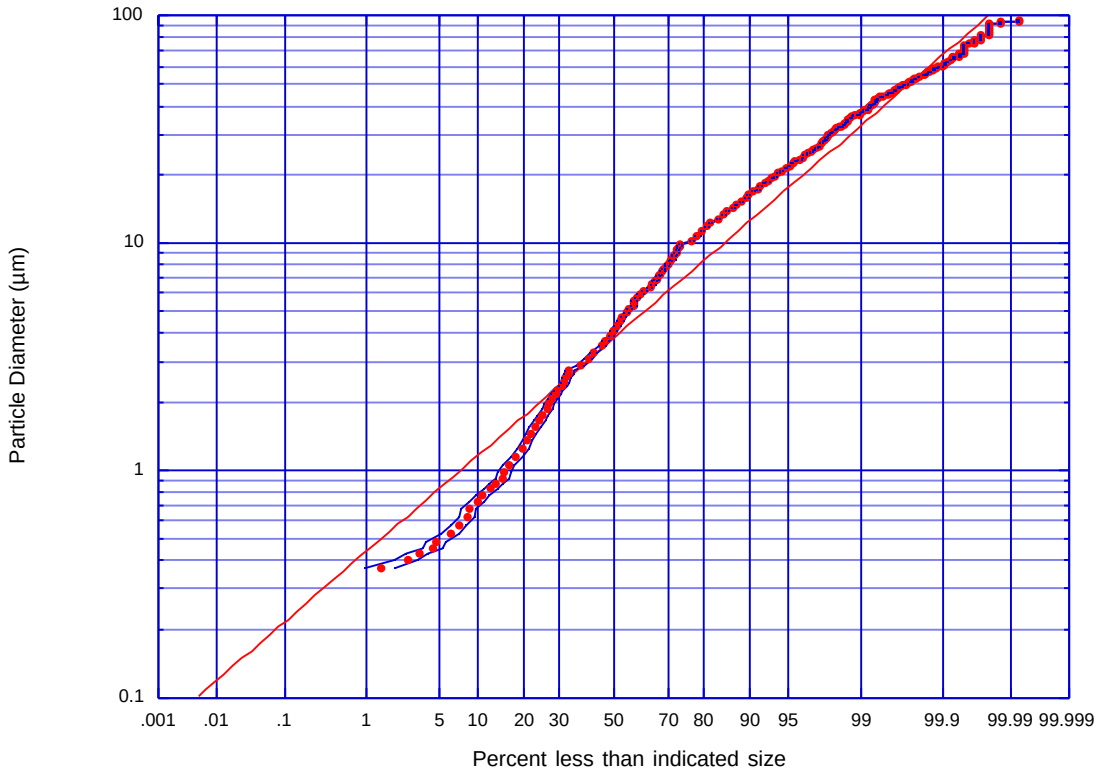
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.49$	4676
100x, 6	0.224	$5.24 < d_p < 9.49$	2474
200x, 6	0.0558	$2.73 < d_p < 5.24$	2324
500x, 6	0.00893	$1.54 < d_p < 2.73$	978
1000x, 6	0.00217	$0.00 < d_p < 1.54$	407
Totals:	1.18%	-	10859

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.74	GMD (µm):	2.78
GSD:	2.92	GSD:	2.52
lower 95% (µm):	0.32	R^2:	0.98184
upper 95% (µm):	23.46	lower 95% (µm):	0.44
		upper 95% (µm):	17.61

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.30 Module III, Sample 24 (TSFH11-02) count-based particle size distribution.



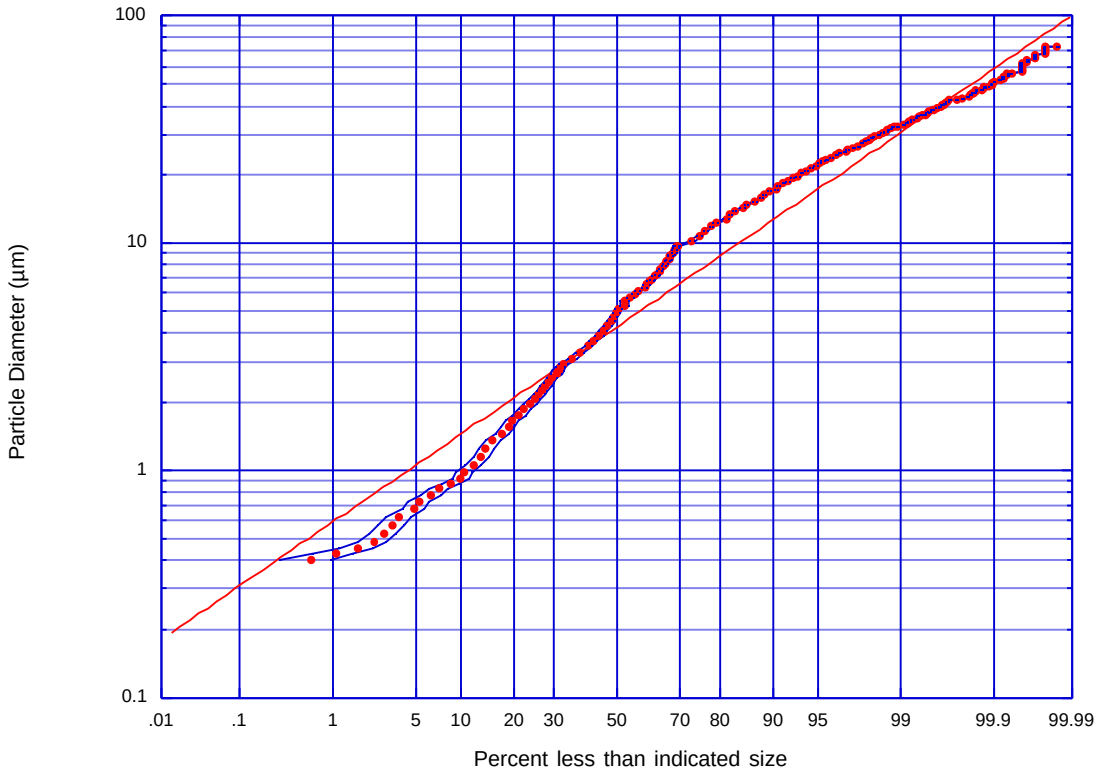
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 10.09$	5252
100x, 6	0.224	$5.35 < d_p < 10.09$	3025
200x, 6	0.0558	$2.87 < d_p < 5.35$	1926
500x, 6	0.00893	$1.67 < d_p < 2.87$	521
1000x, 6	0.00217	$0.00 < d_p < 1.67$	241
Totals:	1.18%	-	10965

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.00	GMD (µm):	3.81
GSD:	3.15	GSD:	2.53
lower 95% (µm):	0.40	R^2:	0.97966
upper 95% (µm):	39.80	lower 95% (µm):	0.59
		upper 95% (µm):	24.48

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.31 Module III, Sample 25 (TSFH08-02) count-based particle size distribution.



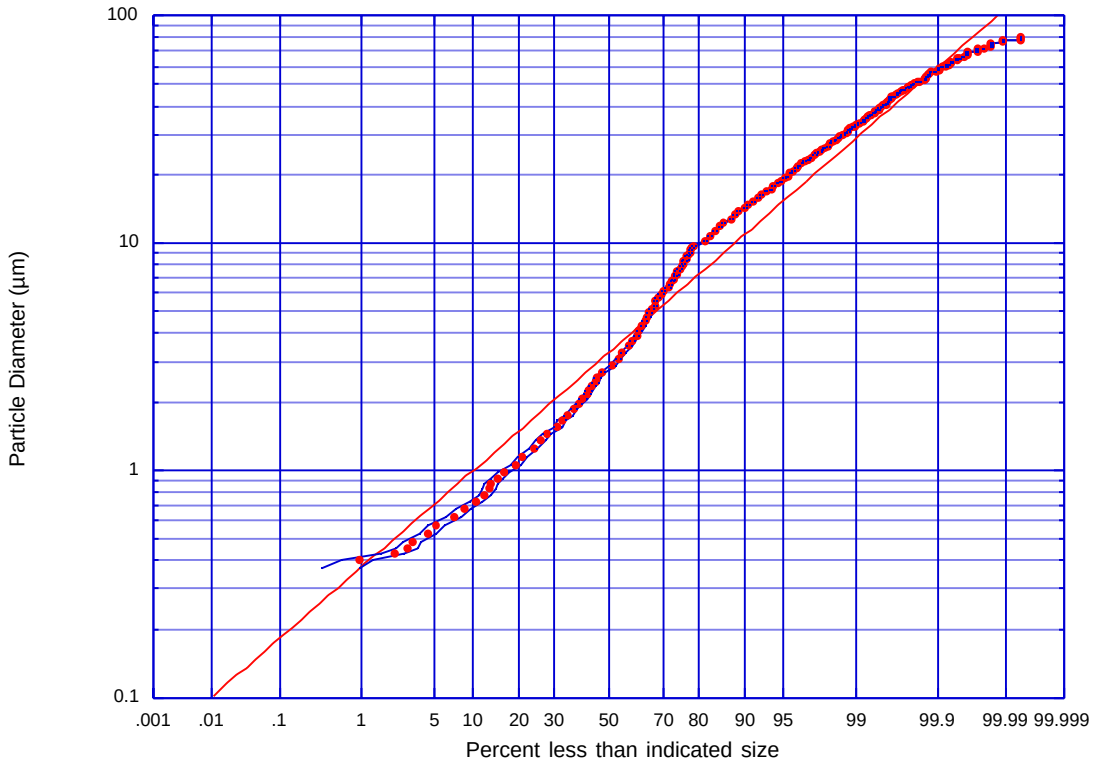
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.87$	5565
100x, 6	0.224	$5.26 < d_p < 9.87$	2940
200x, 6	0.0558	$3.00 < d_p < 5.26$	1630
500x, 6	0.00893	$1.88 < d_p < 3.00$	585
1000x, 6	0.00217	$0.00 < d_p < 1.88$	222
Totals:	1.18%	-	10942

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.63	GMD (µm):	4.26
GSD:	2.91	GSD:	2.34
lower 95% (µm):	0.54	R^2:	0.9745
upper 95% (µm):	39.28	lower 95% (µm):	0.78
		upper 95% (µm):	23.27

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.32 Module III, Sample 26 (TSFH10-02) count-based particle size distribution.



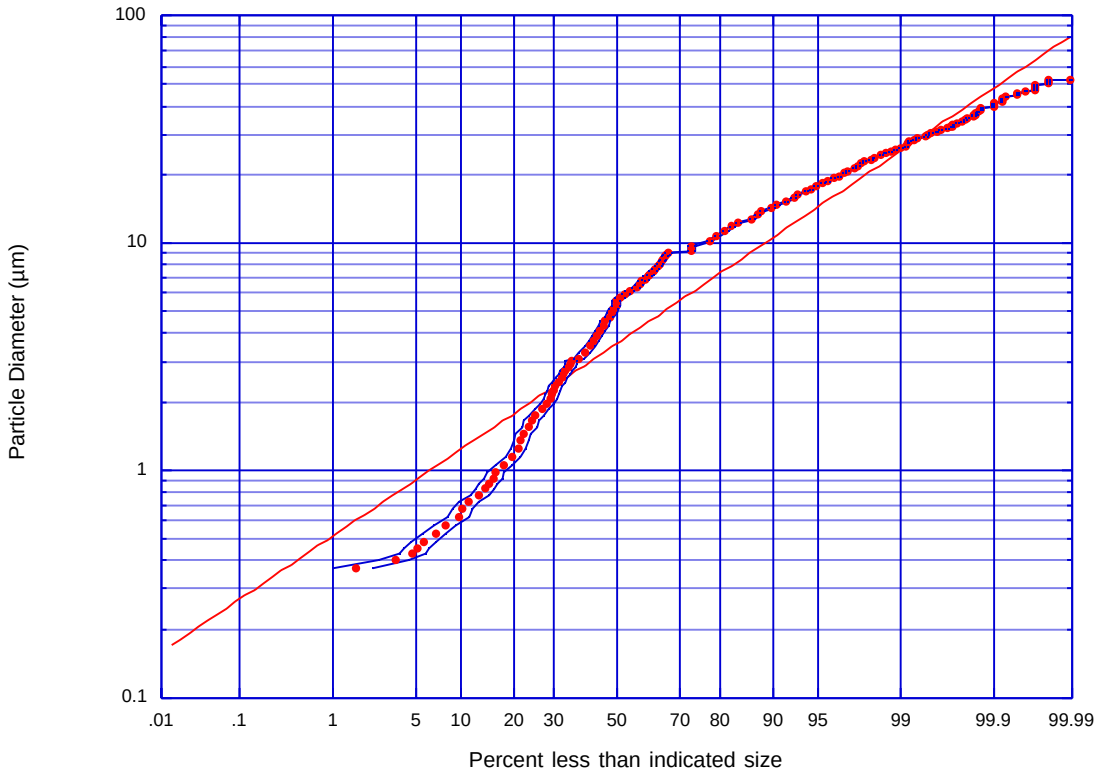
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.96$	5522
100x, 6	0.224	$5.27 < d_p < 9.96$	3085
200x, 6	0.0558	$2.68 < d_p < 5.27$	2125
500x, 6	0.00893	$1.56 < d_p < 2.68$	1016
1000x, 6	0.00217	$0.00 < d_p < 1.56$	411
Totals:	1.18%	-	12159

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.19	GMD (µm):	3.30
GSD:	3.04	GSD:	2.55
lower 95% (µm):	0.35	R^2:	0.9805
upper 95% (µm):	29.40	lower 95% (µm):	0.51
		upper 95% (µm):	21.47

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.33 Module III, Sample 27 (TSFH09-02) count-based particle size distribution.



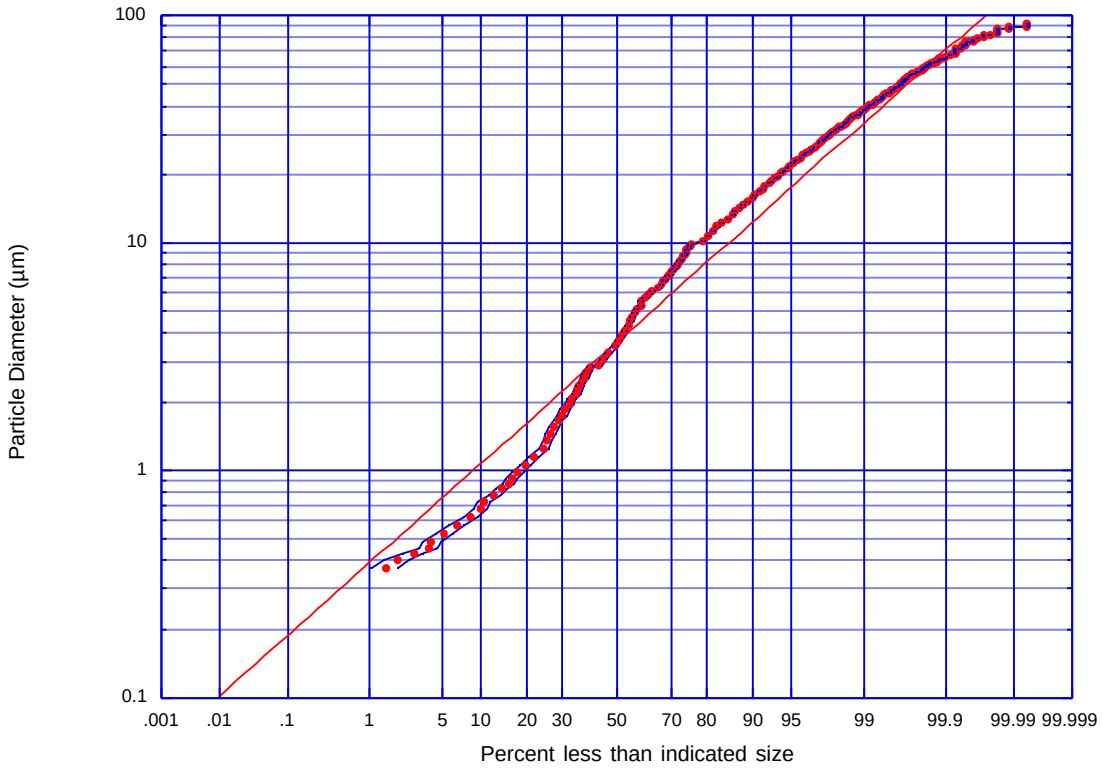
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.36$	4040
100x, 6	0.224	$5.48 < d_p < 9.36$	2129
200x, 6	0.0558	$3.12 < d_p < 5.48$	1170
500x, 6	0.00893	$1.74 < d_p < 3.12$	366
1000x, 6	0.00217	$0.00 < d_p < 1.74$	178
Totals:	1.18%	-	7883

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.06	GMD (µm):	3.62
GSD:	3.15	GSD:	2.31
lower 95% (µm):	0.41	R^2:	0.94493
upper 95% (µm):	40.27	lower 95% (µm):	0.68
		upper 95% (µm):	19.37

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.34 Module III, Sample 28 (TSFH07-02) count-based particle size distribution.



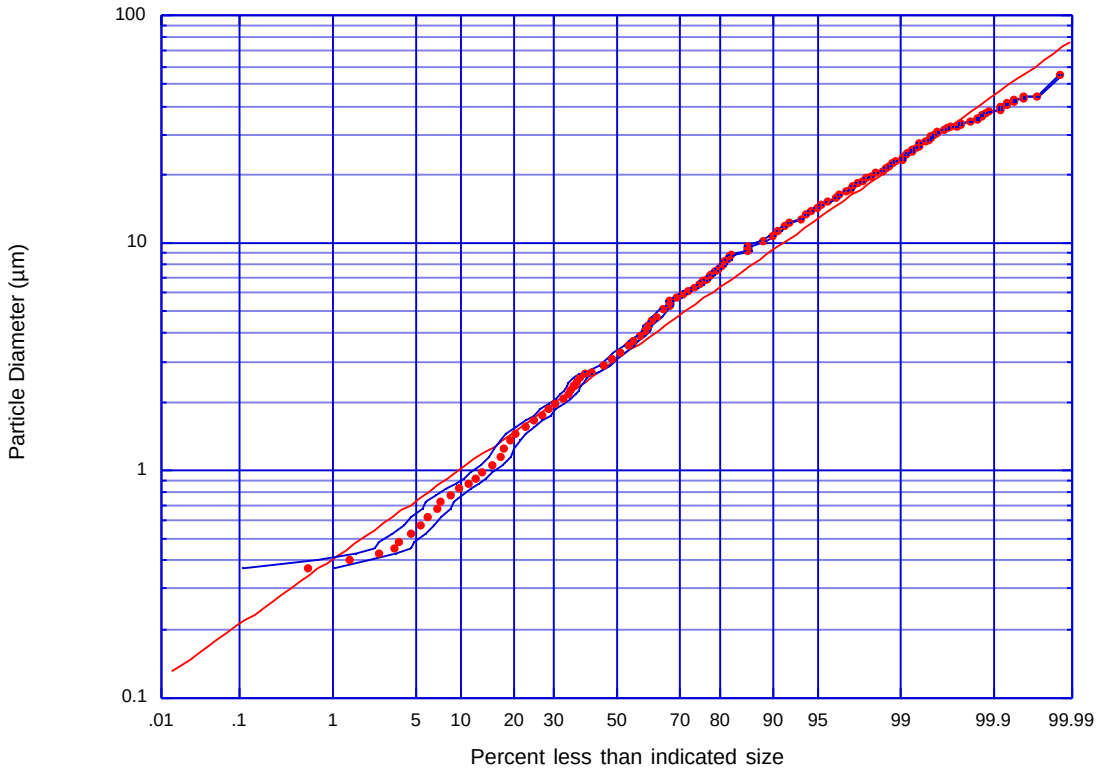
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 10.10$	5991
100x, 6	0.224	$5.37 < d_p < 10.10$	4056
200x, 6	0.0558	$2.90 < d_p < 5.37$	1880
500x, 6	0.00893	$1.64 < d_p < 2.90$	746
1000x, 6	0.00217	$0.00 < d_p < 1.64$	357
Totals:	1.18%	-	13030

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.65	GMD (µm):	3.65
GSD:	3.23	GSD:	2.61
lower 95% (µm):	0.35	R^2:	0.97837
upper 95% (µm):	38.05	lower 95% (µm):	0.53
		upper 95% (µm):	24.86

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.35 Module III, Sample 29 (TSFH22-02) count-based particle size distribution.



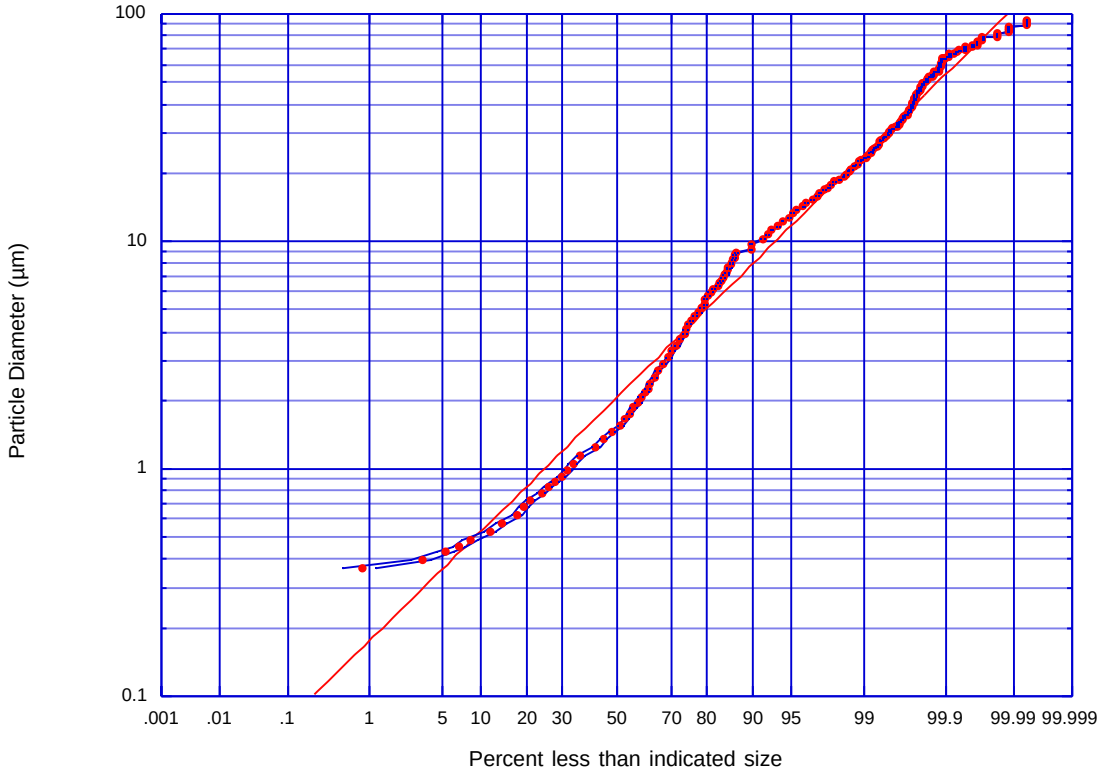
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.94$	1532
100x, 6	0.224	$4.92 < d_p < 8.94$	1583
200x, 6	0.0558	$2.78 < d_p < 4.92$	905
500x, 6	0.00893	$1.60 < d_p < 2.78$	436
1000x, 6	0.00217	$0.00 < d_p < 1.60$	124
Totals:	1.18%	-	4580

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.28	GMD (µm):	3.06
GSD:	2.63	GSD:	2.38
lower 95% (µm):	0.47	R^2:	0.98856
upper 95% (µm):	22.72	lower 95% (µm):	0.54
		upper 95% (µm):	17.40

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.36 Module III, Sample 30 (TSFH25-02) count-based particle size distribution.



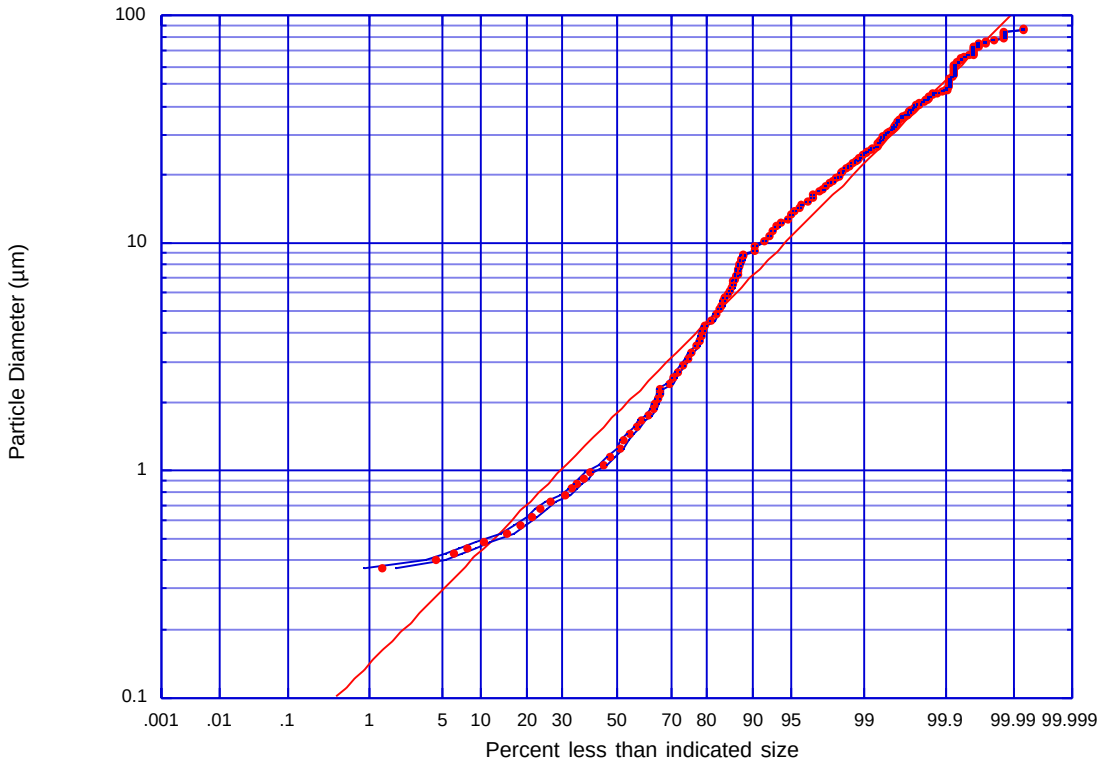
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.14$	2772
100x, 6	0.224	$4.87 < d_p < 9.14$	1781
200x, 6	0.0558	$2.43 < d_p < 4.87$	1371
500x, 6	0.00893	$1.25 < d_p < 2.43$	1037
1000x, 6	0.00217	$0.00 < d_p < 1.25$	465
Totals:	1.18%	-	7426

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.96	GMD (µm):	2.06
GSD:	2.94	GSD:	2.89
lower 95% (µm):	0.23	R^2:	0.98894
upper 95% (µm):	16.98	lower 95% (µm):	0.25
		upper 95% (µm):	17.18

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.37 Module III, Sample 30A (TSFH24-02) count-based particle size distribution.



Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.17$	2149
100x, 6	0.224	$4.50 < d_p < 9.17$	1018
200x, 6	0.0558	$2.20 < d_p < 4.50$	928
500x, 6	0.00893	$1.13 < d_p < 2.20$	712
1000x, 6	0.00217	$0.00 < d_p < 1.13$	460
Totals:	1.18%	-	5267

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.66	GMD (µm):	1.78
GSD:	2.95	GSD:	2.98
lower 95% (µm):	0.19	R^2:	0.98736
upper 95% (µm):	14.51	lower 95% (µm):	0.20
		upper 95% (µm):	15.82

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

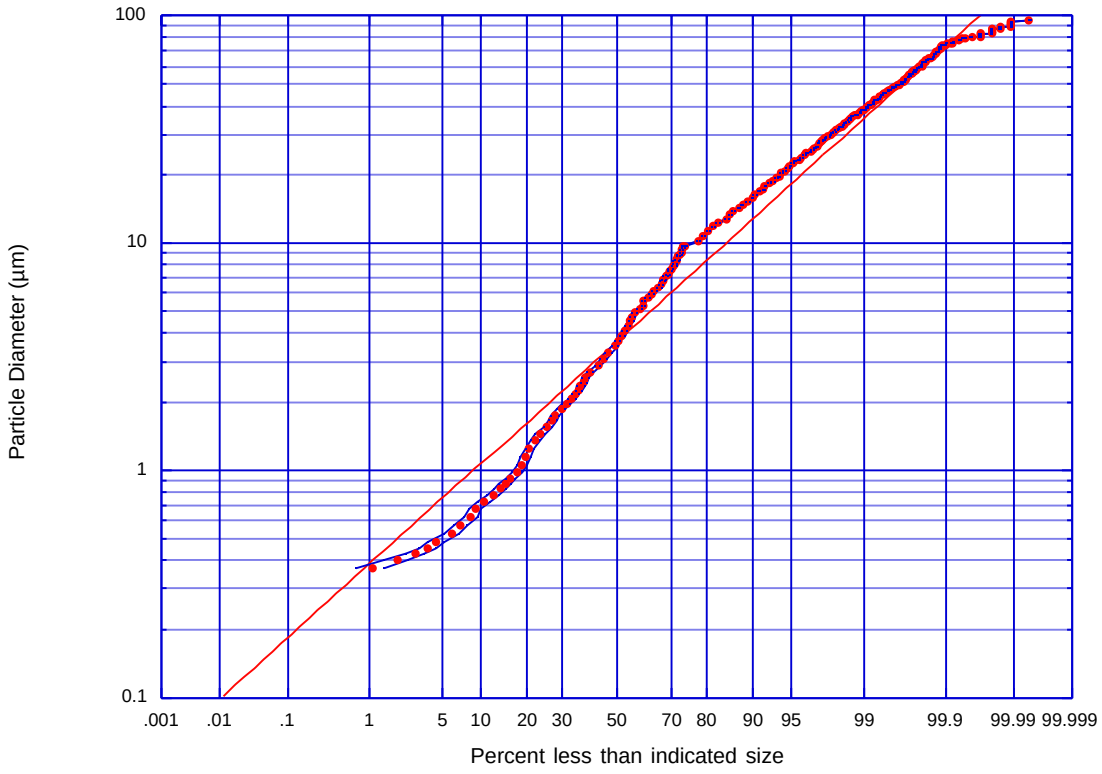
Figure 3.38 Module III, Sample 30B (TSFH21-02) count-based particle size distribution.

3.2.2.4. Module IV Results

Figure 3.39 through Figure 3.50 display details of particle size distributions for corresponding collection locations of Module IV. Table 3.4 gives a summary of Module IV results.

Table 3.4 Summary of dust collected from locations in Tore Supra Module IV.

Poloidal Location	Sample	Filter ID	Sampled Area (cm^2)	Collected Mass (mg)	Count-based Size Distribution Parameters	
					GMD (μm)	GSD
1	31	TSFH18-02	621.2	0.4	3.72	3.21
2	32	TSFH16-02	1,553	9.9	2.47	3.05
4	33	TSFH01-03	689.0	0.9	3.11	2.99
3	34	TSFH14-02	1,800	0.9	2.86	3.14
6	35	TSFH13-02	658.0	0.4	2.96	3.03
5	36	TSFH02-03	1,200	1.7	3.04	3.11
7	37	TSFH04-03	428.0	1.1	2.33	3.09
8	38	TSFH12-02	84.00	0.4	2.72	2.94
10	39	TSFH03-03	1,429	1.8	4.08	3.21
9	40	TSFH17-02	294.0	0.3	4.71	3.15
11	40A	TSFH19-02	160.0	31.9	1.54	2.67
12	40B	TSFH15-02	480.0	26.2	2.22	2.57



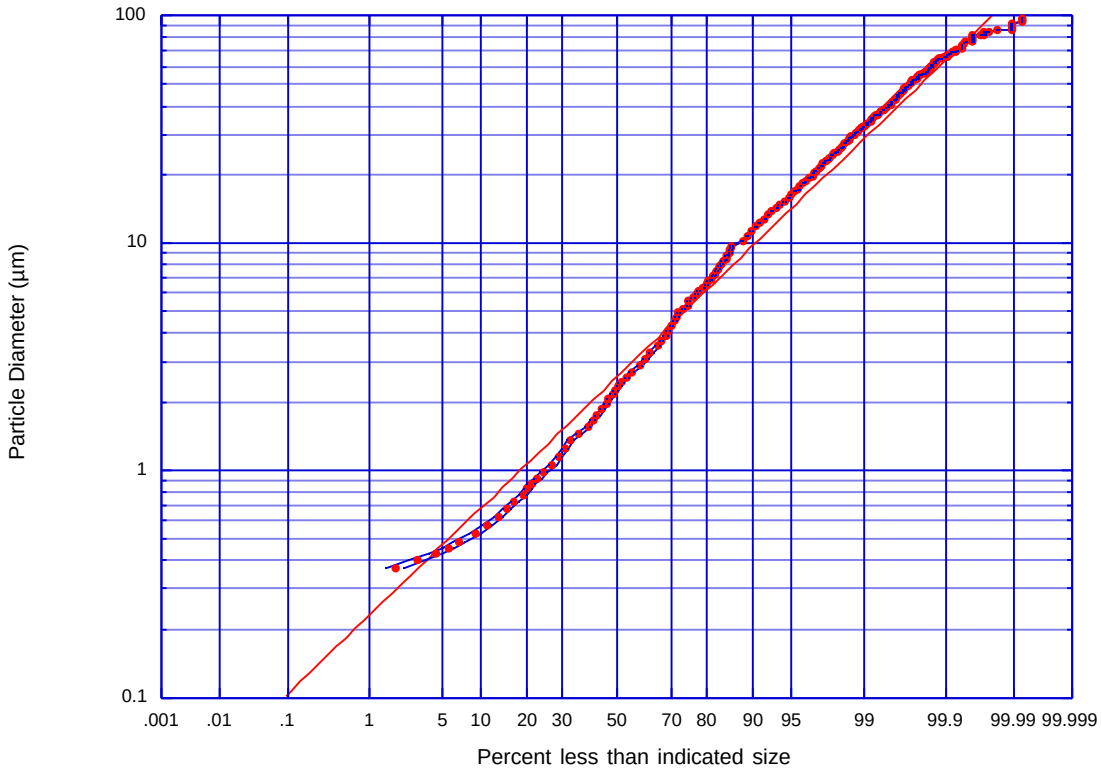
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.79$	6984
100x, 6	0.224	$4.97 < d_p < 9.79$	3567
200x, 6	0.0558	$2.63 < d_p < 4.97$	2134
500x, 6	0.00893	$1.49 < d_p < 2.63$	895
1000x, 6	0.00217	$0.00 < d_p < 1.49$	320
Totals:	1.18%	-	13900

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.72	GMD (µm):	3.69
GSD:	3.21	GSD:	2.64
lower 95% (µm):	0.36	R^2:	0.98074
upper 95% (µm):	38.37	lower 95% (µm):	0.53
		upper 95% (µm):	25.74

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.39 Module IV, Sample 31 (TSFH18-02) count-based particle size distribution.



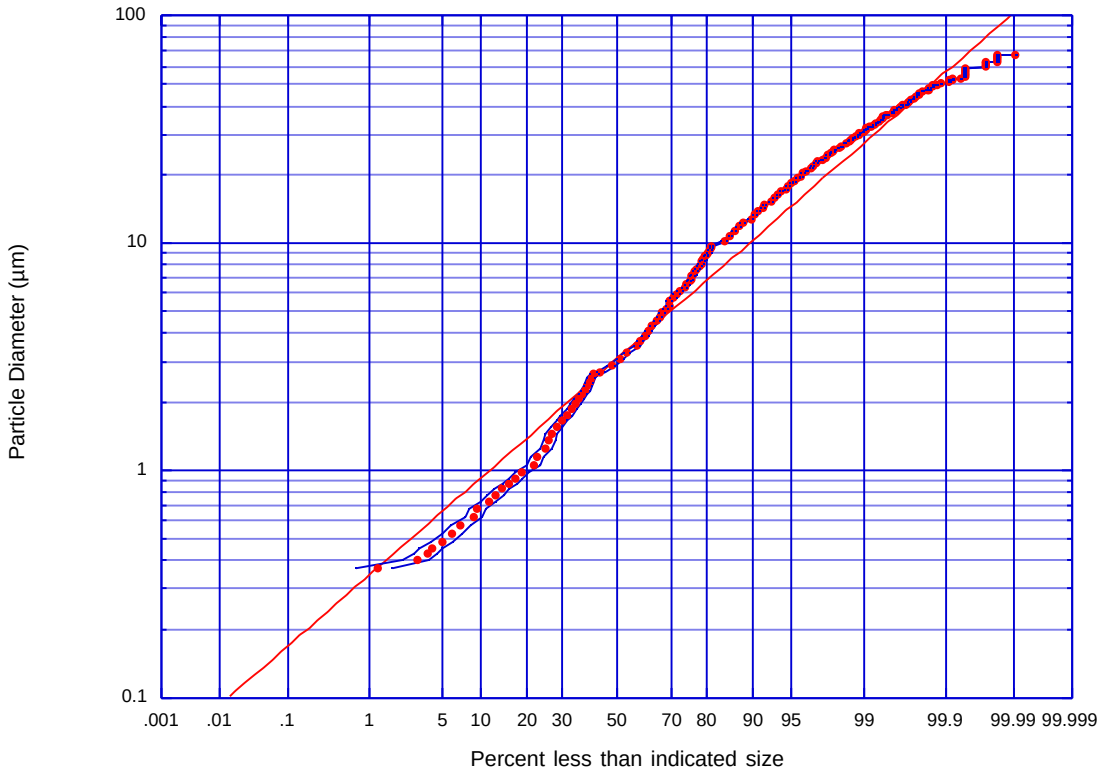
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.75$	5942
100x, 6	0.224	$5.03 < d_p < 9.75$	4424
200x, 6	0.0558	$2.56 < d_p < 5.03$	3311
500x, 6	0.00893	$1.41 < d_p < 2.56$	1613
1000x, 6	0.00217	$0.00 < d_p < 1.41$	715
Totals:	1.18%	-	16005

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.47	GMD (µm):	2.58
GSD:	3.05	GSD:	2.83
lower 95% (µm):	0.27	R^2:	0.98901
upper 95% (µm):	22.91	lower 95% (µm):	0.32
		upper 95% (µm):	20.59

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.40 Module IV, Sample 32 (TSFH16-02) count-based particle size distribution.



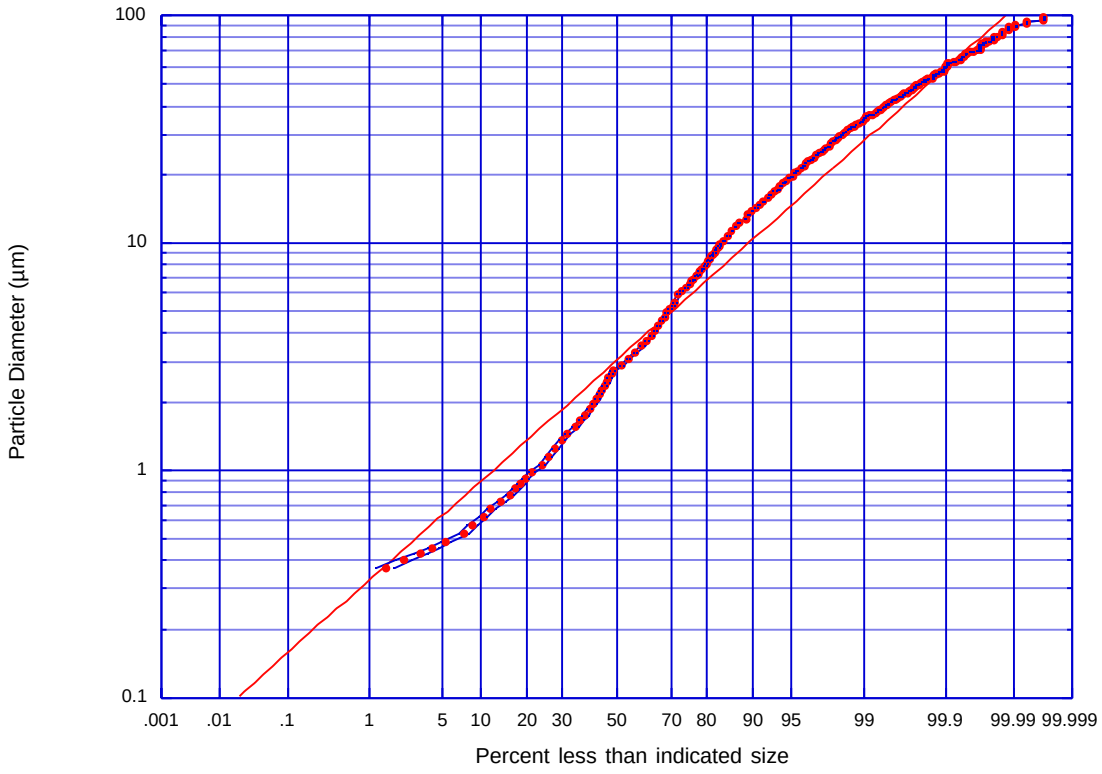
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.75$	3102
100x, 6	0.224	$5.24 < d_p < 9.75$	1989
200x, 6	0.0558	$2.69 < d_p < 5.24$	1726
500x, 6	0.00893	$1.62 < d_p < 2.69$	577
1000x, 6	0.00217	$0.00 < d_p < 1.62$	275
Totals:	1.18%	-	7669

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.11	GMD (µm):	3.09
GSD:	2.99	GSD:	2.57
lower 95% (µm):	0.35	R^2:	0.98152
upper 95% (µm):	27.86	lower 95% (µm):	0.47
		upper 95% (µm):	20.35

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.41 Module IV, Sample 33 (TSFH01-03) count-based particle size distribution.



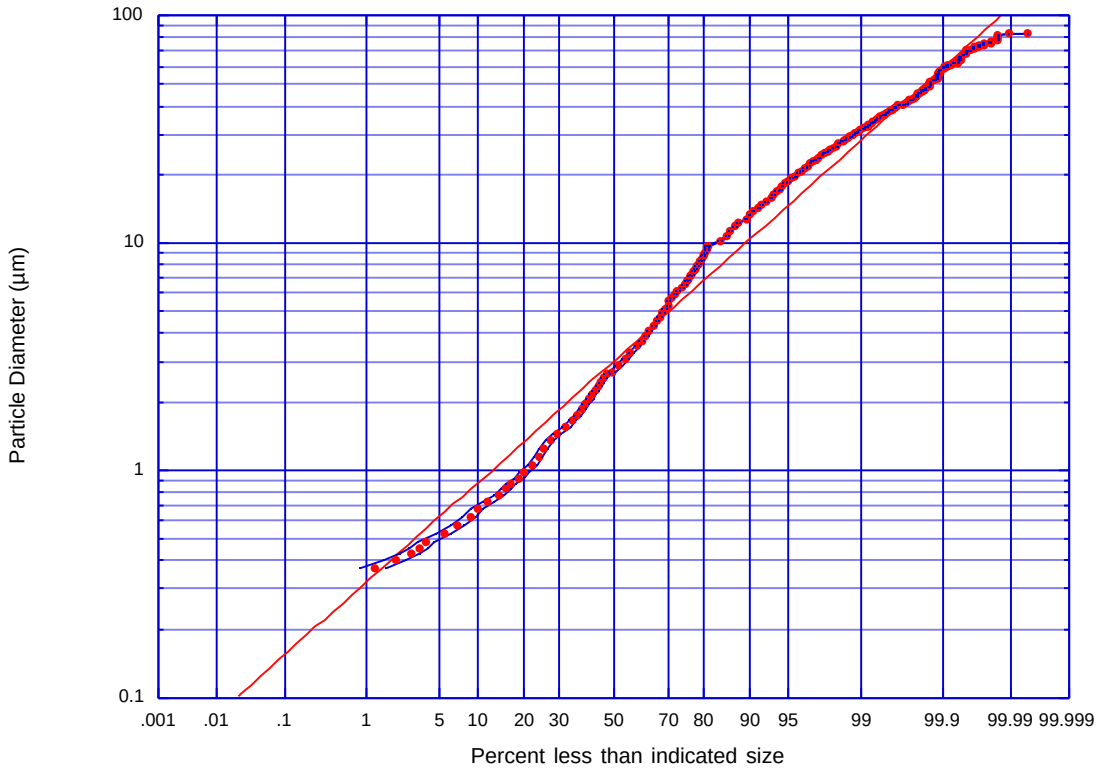
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 10.51$	8397
100x, 6	0.224	$5.58 < d_p < 10.51$	6469
200x, 6	0.0558	$2.82 < d_p < 5.58$	4356
500x, 6	0.00893	$1.58 < d_p < 2.82$	1788
1000x, 6	0.00217	$0.00 < d_p < 1.58$	867
Totals:	1.18%	-	21877

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.86	GMD (µm):	3.05
GSD:	3.14	GSD:	2.61
lower 95% (µm):	0.29	R^2:	0.98024
upper 95% (µm):	28.15	lower 95% (µm):	0.45
		upper 95% (µm):	20.76

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.42 Module IV, Sample 34 (TSFH14-02) count-based particle size distribution.



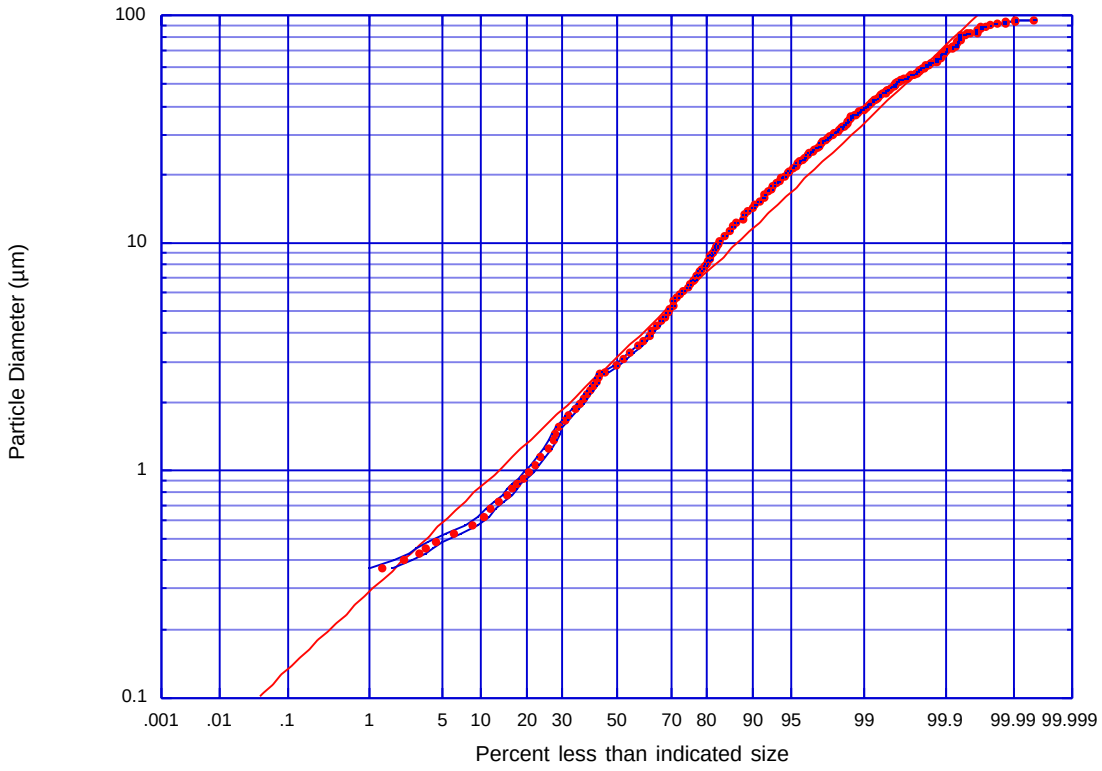
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.91$	5139
100x, 6	0.224	$5.25 < d_p < 9.91$	3229
200x, 6	0.0558	$2.71 < d_p < 5.25$	2334
500x, 6	0.00893	$1.59 < d_p < 2.71$	1035
1000x, 6	0.00217	$0.00 < d_p < 1.59$	480
Totals:	1.18%	-	12217

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.96	GMD (µm):	3.03
GSD:	3.03	GSD:	2.62
lower 95% (µm):	0.32	R^2:	0.98719
upper 95% (µm):	27.27	lower 95% (µm):	0.44
		upper 95% (µm):	20.79

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.43 Module IV, Sample 35 (TSFH13-02) count-based particle size distribution.



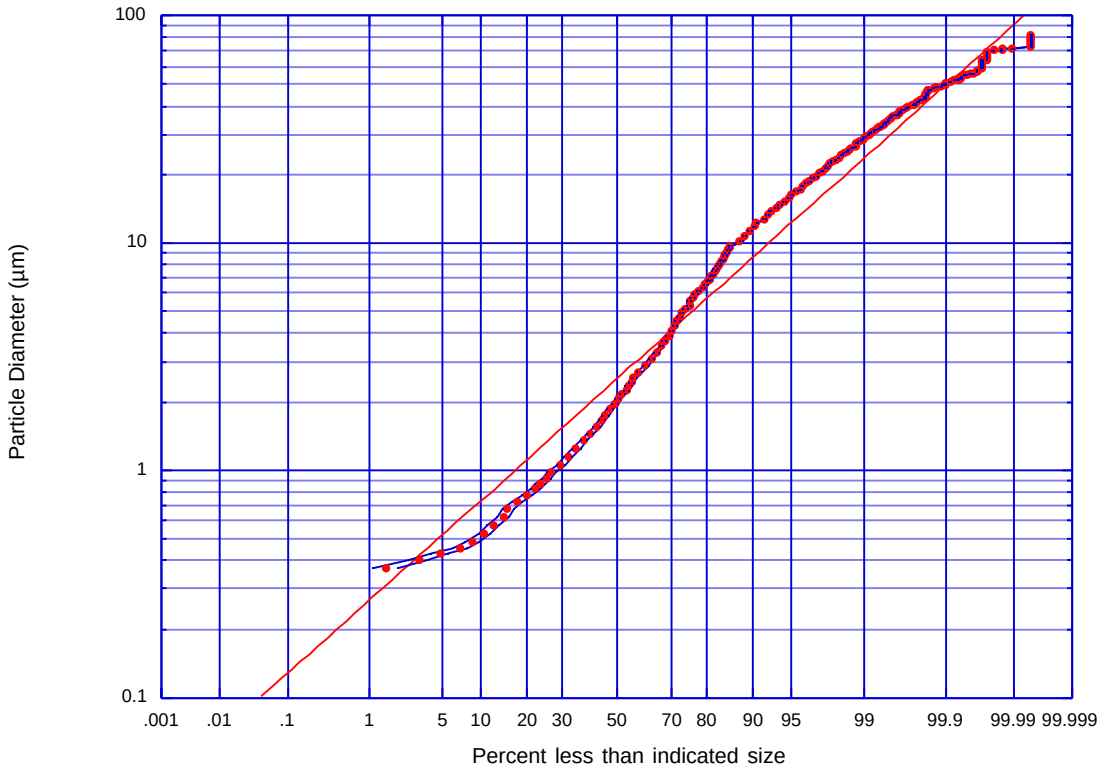
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 10.44$	5837
100x, 6	0.224	$5.38 < d_p < 10.44$	3956
200x, 6	0.0558	$2.73 < d_p < 5.38$	3183
500x, 6	0.00893	$1.57 < d_p < 2.73$	1218
1000x, 6	0.00217	$0.00 < d_p < 1.57$	497
Totals:	1.18%	-	14691

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.04	GMD (µm):	3.14
GSD:	3.11	GSD:	2.78
lower 95% (µm):	0.31	R^2:	0.9876
upper 95% (µm):	29.43	lower 95% (µm):	0.40
		upper 95% (µm):	24.30

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.44 Module IV, Sample 36 (TSFH02-03) count-based particle size distribution.



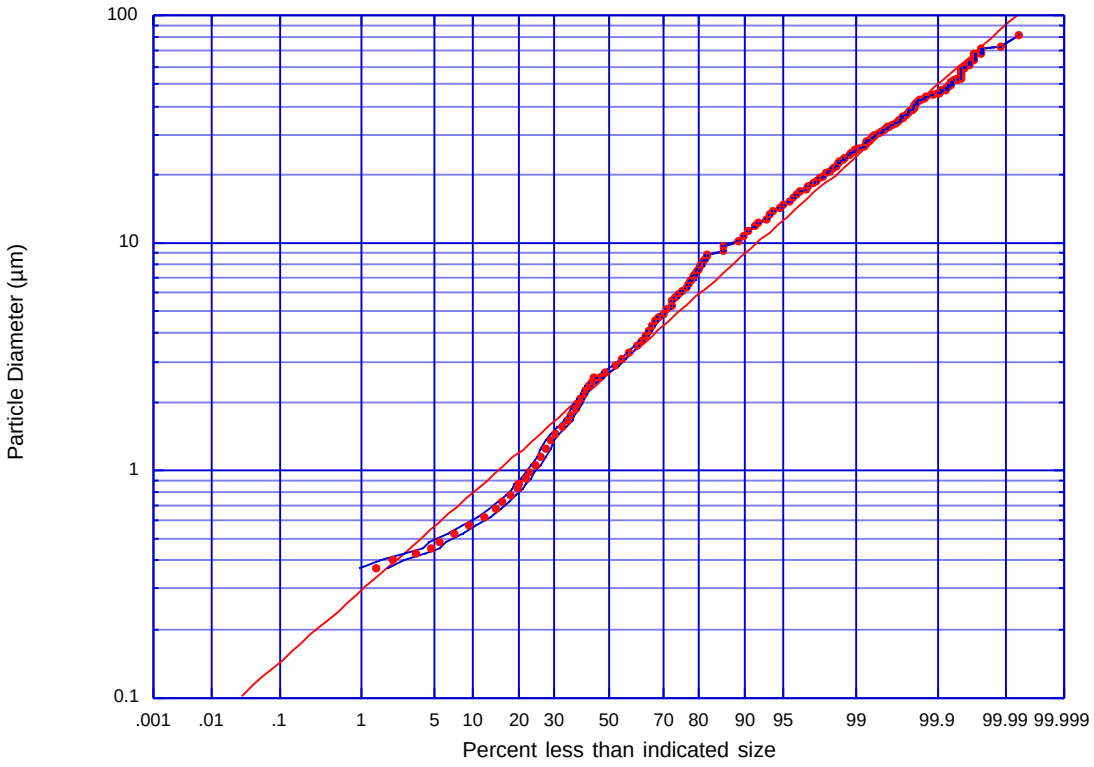
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.65$	4301
100x, 6	0.224	$5.13 < d_p < 9.65$	2871
200x, 6	0.0558	$2.58 < d_p < 5.13$	1958
500x, 6	0.00893	$1.44 < d_p < 2.58$	1084
1000x, 6	0.00217	$0.00 < d_p < 1.44$	570
Totals:	1.18%	-	10784

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.33	GMD (µm):	2.52
GSD:	3.09	GSD:	2.62
lower 95% (µm):	0.24	R^2:	0.97812
upper 95% (µm):	22.30	lower 95% (µm):	0.37
		upper 95% (µm):	17.34

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.45 Module IV, Sample 37 (TSFH04-03) count-based particle size distribution.



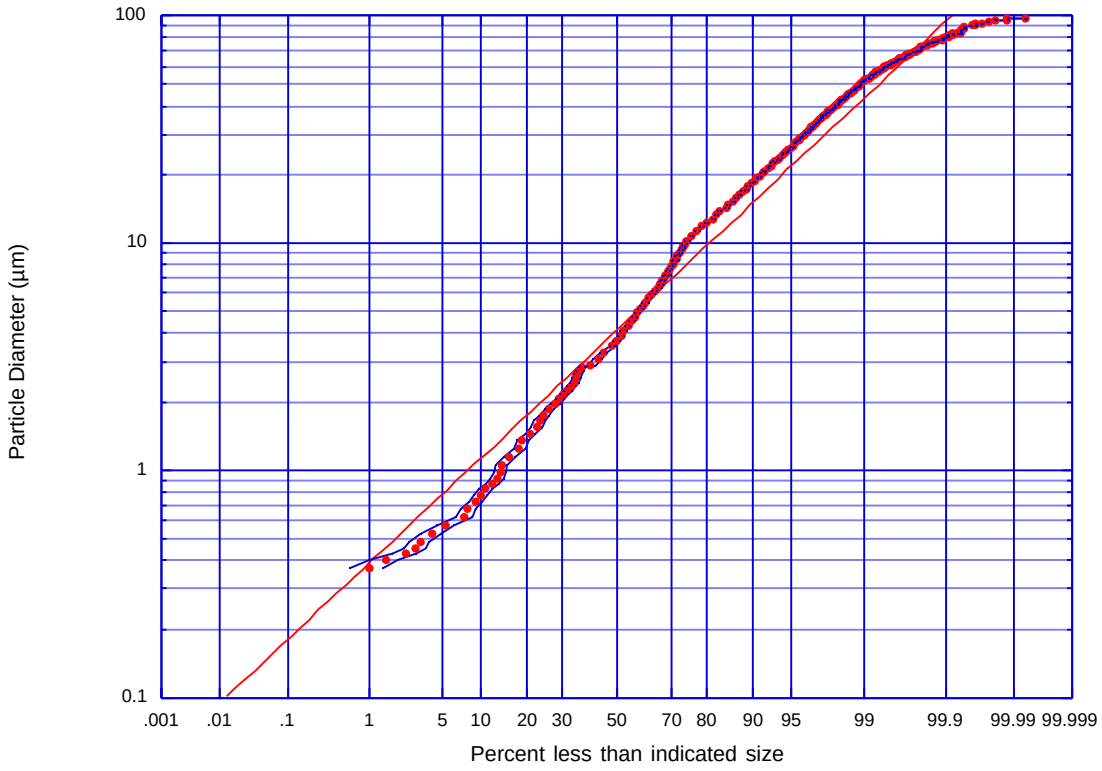
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.99$	3814
100x, 6	0.224	$4.85 < d_p < 8.99$	2530
200x, 6	0.0558	$2.63 < d_p < 4.85$	2121
500x, 6	0.00893	$1.49 < d_p < 2.63$	864
1000x, 6	0.00217	$0.00 < d_p < 1.49$	386
Totals:	1.18%	-	9715

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.72	GMD (µm):	2.67
GSD:	2.94	GSD:	2.56
lower 95% (µm):	0.31	R^2:	0.99074
upper 95% (µm):	23.47	lower 95% (µm):	0.40
		upper 95% (µm):	17.76

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.46 Module IV, Sample 38 (TSFH12-02) count-based particle size distribution.



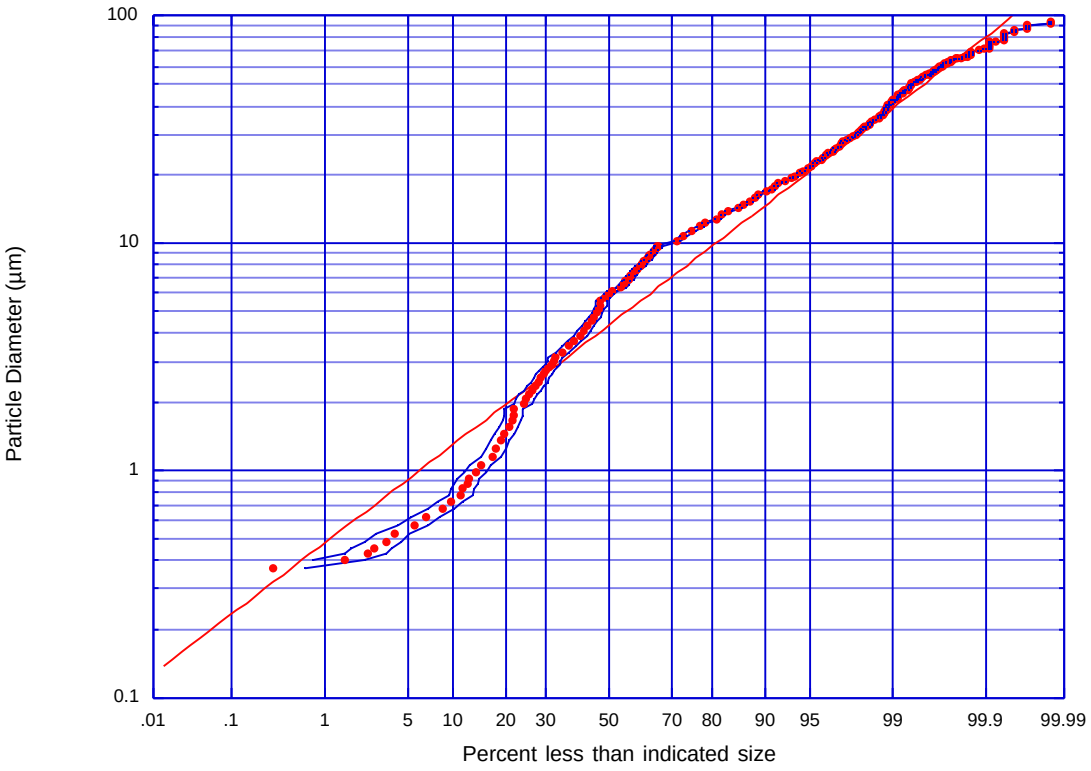
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 10.72$	6644
100x, 6	0.224	$5.74 < d_p < 10.72$	3098
200x, 6	0.0558	$2.95 < d_p < 5.74$	2304
500x, 6	0.00893	$1.75 < d_p < 2.95$	849
1000x, 6	0.00217	$0.00 < d_p < 1.75$	324
Totals:	1.18%	-	13219

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.08	GMD (µm):	4.13
GSD:	3.21	GSD:	2.76
lower 95% (µm):	0.40	R^2:	0.97927
upper 95% (µm):	42.17	lower 95% (µm):	0.54
		upper 95% (µm):	31.38

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.47 Module IV, Sample 39 (TSFH03-03) count-based particle size distribution.



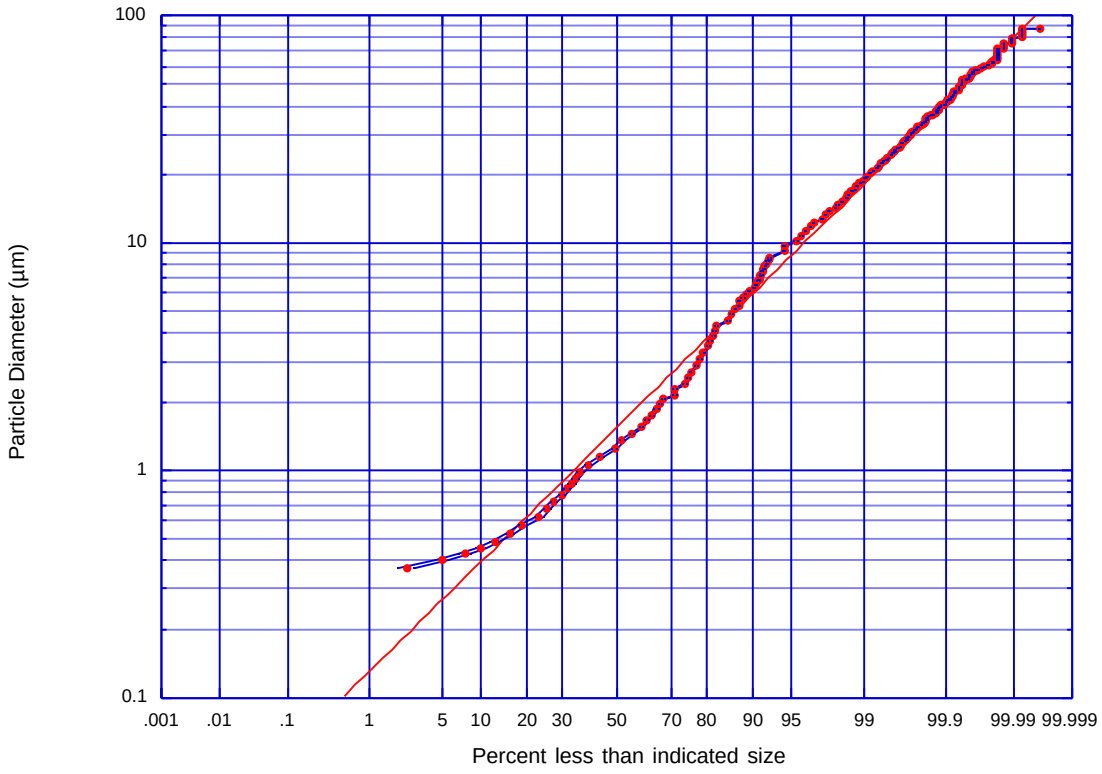
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.81$	3333
100x, 6	0.224	$5.56 < d_p < 9.81$	1558
200x, 6	0.0558	$3.24 < d_p < 5.56$	822
500x, 6	0.00893	$2.04 < d_p < 3.24$	255
1000x, 6	0.00217	$0.00 < d_p < 2.04$	123
Totals:	1.18%	-	6091

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.71	GMD (µm):	4.34
GSD:	3.15	GSD:	2.58
lower 95% (µm):	0.47	R^2:	0.98025
upper 95% (µm):	46.80	lower 95% (µm):	0.66
		upper 95% (µm):	28.84

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.48 Module IV, Sample 40 (TSFH17-02) count-based particle size distribution.



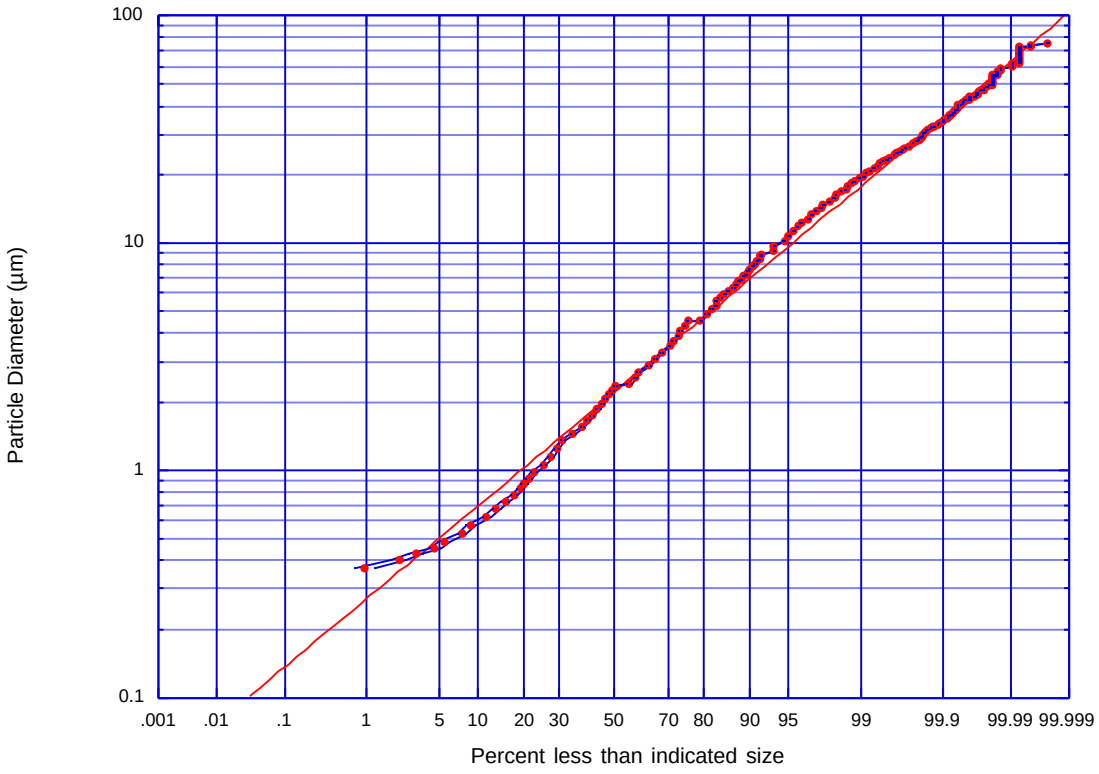
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.60$	2906
100x, 6	0.224	$4.41 < d_p < 8.60$	2261
200x, 6	0.0558	$2.17 < d_p < 4.41$	1522
500x, 6	0.00893	$1.10 < d_p < 2.17$	1836
1000x, 6	0.00217	$0.00 < d_p < 1.10$	821
Totals:	1.18%	-	9346

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.54	GMD (µm):	1.54
GSD:	2.67	GSD:	2.90
lower 95% (µm):	0.22	R^2:	0.99558
upper 95% (µm):	10.97	lower 95% (µm):	0.18
		upper 95% (µm):	12.93

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.49 Module IV, Sample 40A (TSFH19-02) count-based particle size distribution.



Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.99$	4503
100x, 6	0.224	$4.73 < d_p < 8.99$	5400
200x, 6	0.0558	$2.42 < d_p < 4.73$	4833
500x, 6	0.00893	$1.33 < d_p < 2.42$	2485
1000x, 6	0.00217	$0.00 < d_p < 1.33$	961
Totals:	1.18%	-	18182

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.22	GMD (µm):	2.20
GSD:	2.57	GSD:	2.46
lower 95% (µm):	0.34	R^2:	0.99724
upper 95% (µm):	14.58	lower 95% (µm):	0.36
		upper 95% (µm):	13.34

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

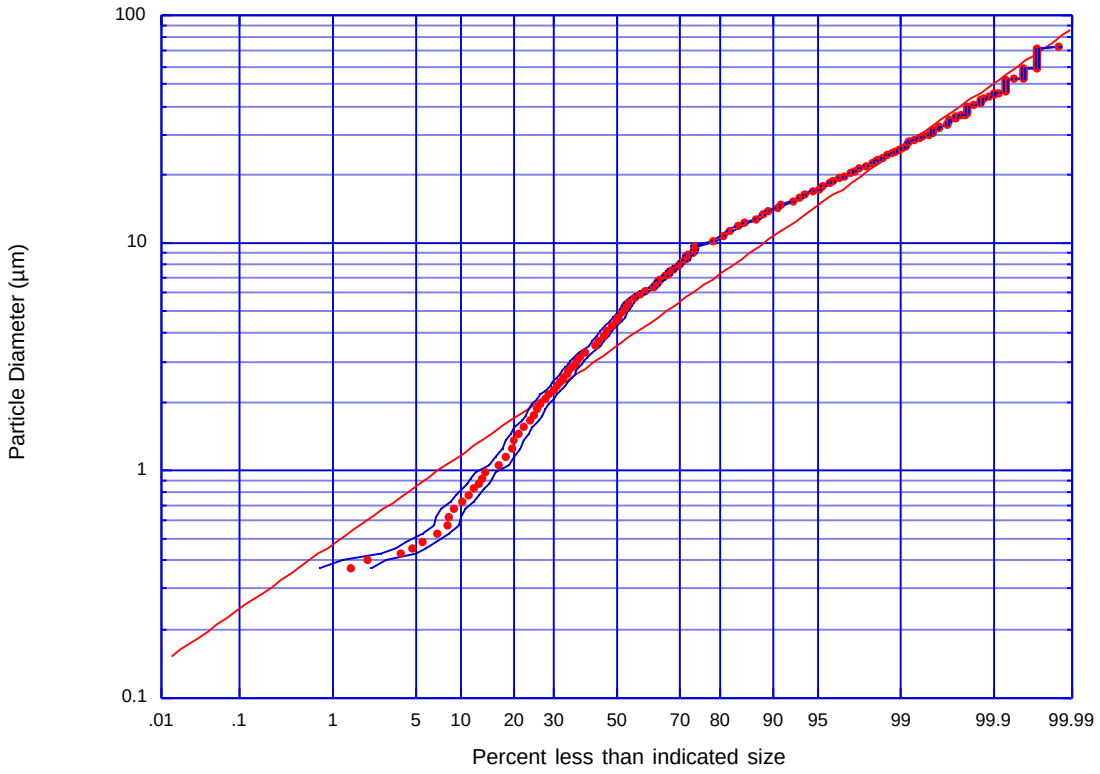
Figure 3.50 Module IV, Sample 40B (TSFH15-02) count-based particle size distribution.

3.2.2.5. Module V Results

Figure 3.51 through Figure 3.62 display details of particle size distributions for corresponding collection locations of Module V. Table 3.5 gives a summary of Module V results.

Table 3.5 Summary of dust collected from locations in Tore Supra Module V.

Poloidal Location	Sample	Filter ID	Sampled Area (cm^2)	Collected Mass (mg)	Count-based Size Distribution Parameters	
					GMD (μm)	GSD
1	41	TSFH08-03	621.2	3.7	3.95	3.01
2	42	TSFH24-03	1,553	1.8	2.76	3.01
4	43	TSFH11-03	689.0	2.2	3.56	3.39
3	44	TSFH21-03	1,800	0.9	5.13	2.86
6	45	TSFH09-03	658.0	0.7	4.17	2.77
5	46	TSFH07-03	1,200	0.2	3.74	3.10
7	47	TSFH23-03	428.0	1.3	2.49	2.91
8	48	TSFH06-03	84.00	0.5	3.50	3.03
10	49	TSFH05-03	1,429	0.7	4.00	3.19
9	50	TSFH10-03	294.0	0.3	2.72	2.96
11	50A	TSFH22-03	160.0	21.2	1.85	2.78
12	50B	TSFH25-03	480.0	15.6	1.92	2.72



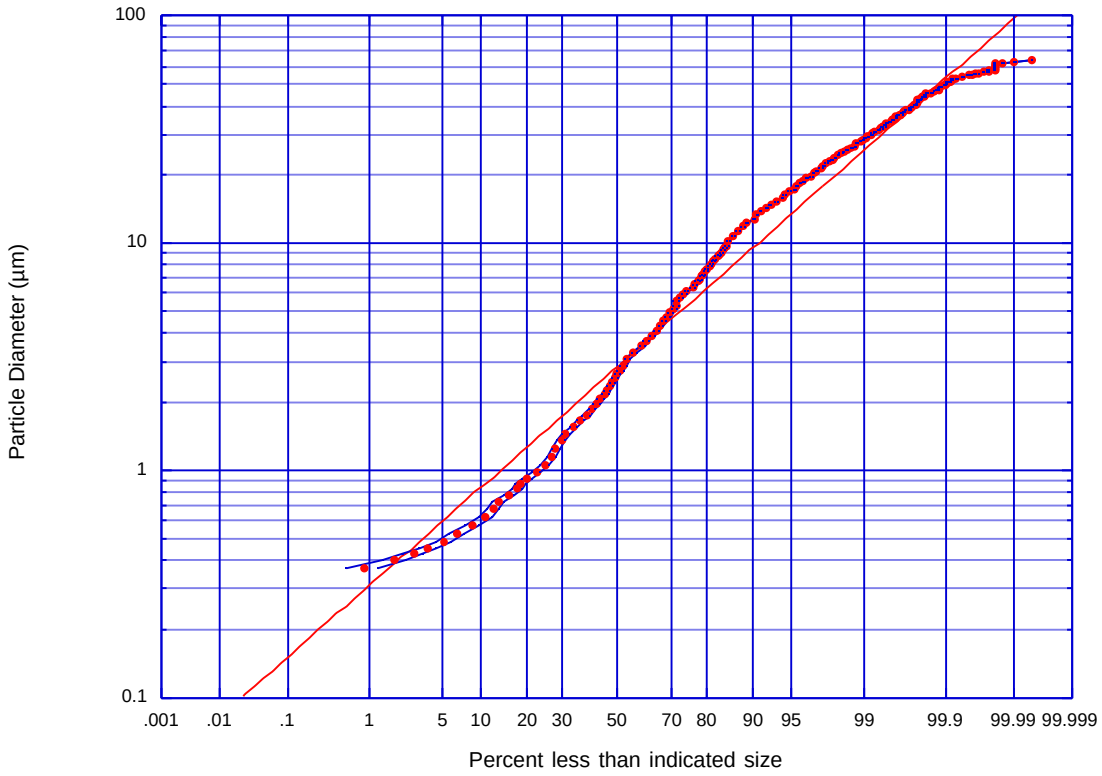
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.36$	2846
100x, 6	0.224	$5.62 < d_p < 9.36$	1726
200x, 6	0.0558	$3.19 < d_p < 5.62$	875
500x, 6	0.00893	$1.84 < d_p < 3.19$	290
1000x, 6	0.00217	$0.00 < d_p < 1.84$	130
Totals:	1.18%	-	5867

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.95	GMD (µm):	3.52
GSD:	3.01	GSD:	2.37
lower 95% (µm):	0.44	R^2:	0.97473
upper 95% (µm):	35.77	lower 95% (µm):	0.63
		upper 95% (µm):	19.80

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.51 Module V, Sample 41 (TSFH08-03) count-based particle size distribution.



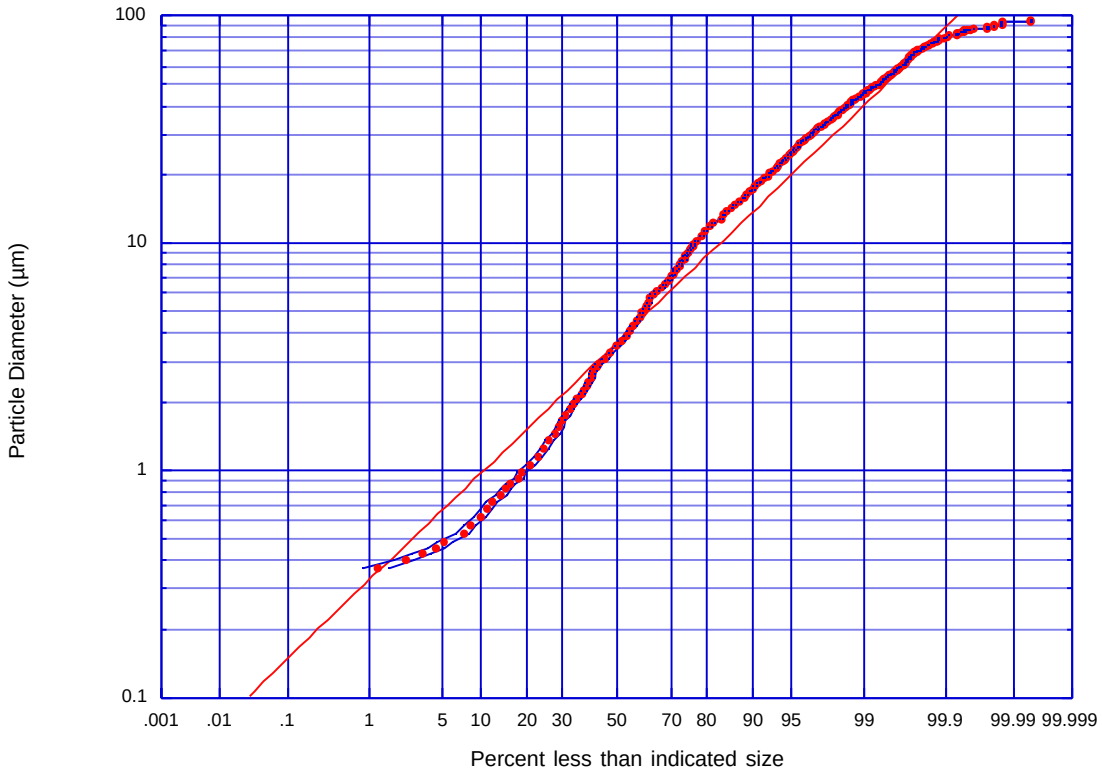
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.75$	5316
100x, 6	0.224	$5.40 < d_p < 9.75$	3807
200x, 6	0.0558	$2.80 < d_p < 5.40$	3036
500x, 6	0.00893	$1.54 < d_p < 2.80$	1313
1000x, 6	0.00217	$0.00 < d_p < 1.54$	508
Totals:	1.18%	-	13980

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.76	GMD (µm):	2.83
GSD:	3.01	GSD:	2.58
lower 95% (µm):	0.30	R^2:	0.98034
upper 95% (µm):	25.10	lower 95% (µm):	0.42
		upper 95% (µm):	18.91

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.52 Module V, Sample 42 (TSFH24-03) count-based particle size distribution.



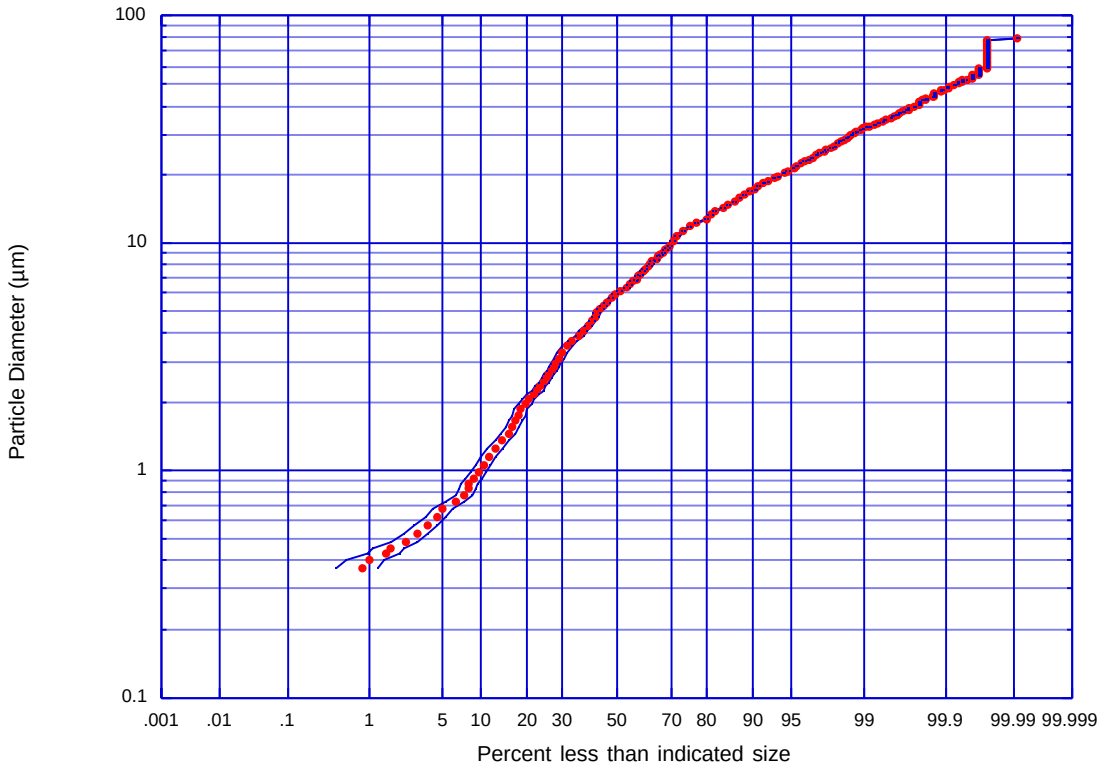
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 10.78$	7063
100x, 6	0.224	$5.79 < d_p < 10.78$	4262
200x, 6	0.0558	$3.10 < d_p < 5.79$	2530
500x, 6	0.00893	$1.81 < d_p < 3.10$	981
1000x, 6	0.00217	$0.00 < d_p < 1.81$	497
Totals:	1.18%	-	15333

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.56	GMD (µm):	3.65
GSD:	3.39	GSD:	2.82
lower 95% (µm):	0.31	R^2:	0.97621
upper 95% (µm):	41.03	lower 95% (µm):	0.46
		upper 95% (µm):	28.94

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.53 Module V, Sample 43 (TSFH11-03) count-based particle size distribution.



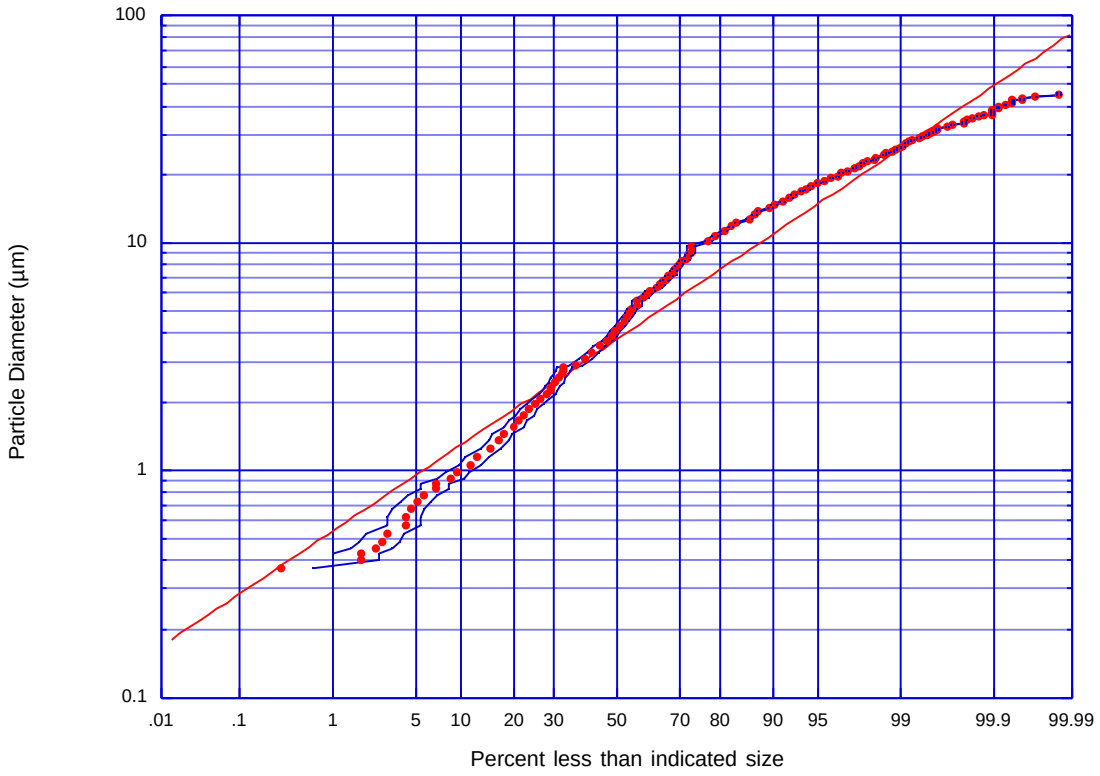
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.77$	6335
100x, 6	0.224	$5.61 < d_p < 9.77$	3489
200x, 6	0.0558	$3.06 < d_p < 5.61$	1980
500x, 6	0.00893	$1.86 < d_p < 3.06$	534
1000x, 6	0.00217	$0.00 < d_p < 1.86$	190
Totals:	1.18%	-	12528

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	5.13	GMD (µm):	4.40
GSD:	2.86	GSD:	2.26
lower 95% (µm):	0.63	R^2:	0.97004
upper 95% (µm):	41.95	lower 95% (µm):	0.86
		upper 95% (µm):	22.46

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.54 Module V, Sample 44 (TSFH21-03) count-based particle size distribution.



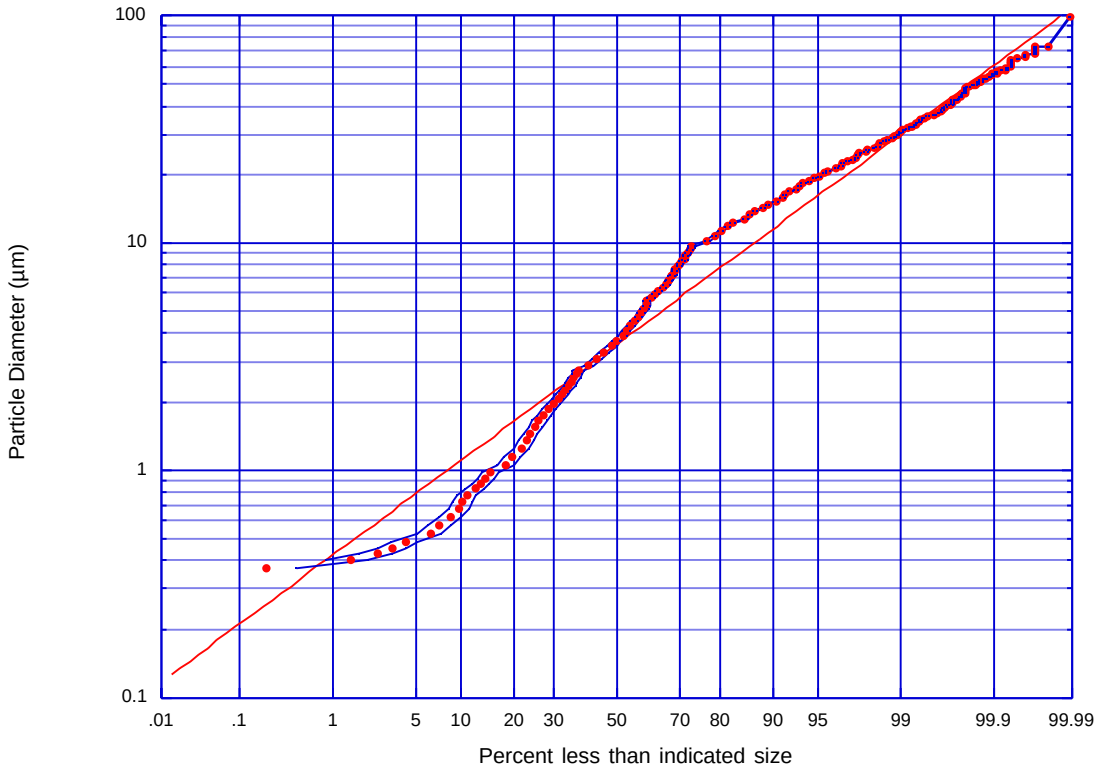
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.22$	2819
100x, 6	0.224	$5.21 < d_p < 9.22$	1538
200x, 6	0.0558	$2.95 < d_p < 5.21$	901
500x, 6	0.00893	$1.88 < d_p < 2.95$	272
1000x, 6	0.00217	$0.00 < d_p < 1.88$	116
Totals:	1.18%	-	5646

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.17	GMD (µm):	3.76
GSD:	2.77	GSD:	2.30
lower 95% (µm):	0.54	R^2:	0.96822
upper 95% (µm):	31.98	lower 95% (µm):	0.71
		upper 95% (µm):	19.95

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.55 Module V, Sample 45 (TSFH09-03) count-based particle size distribution.



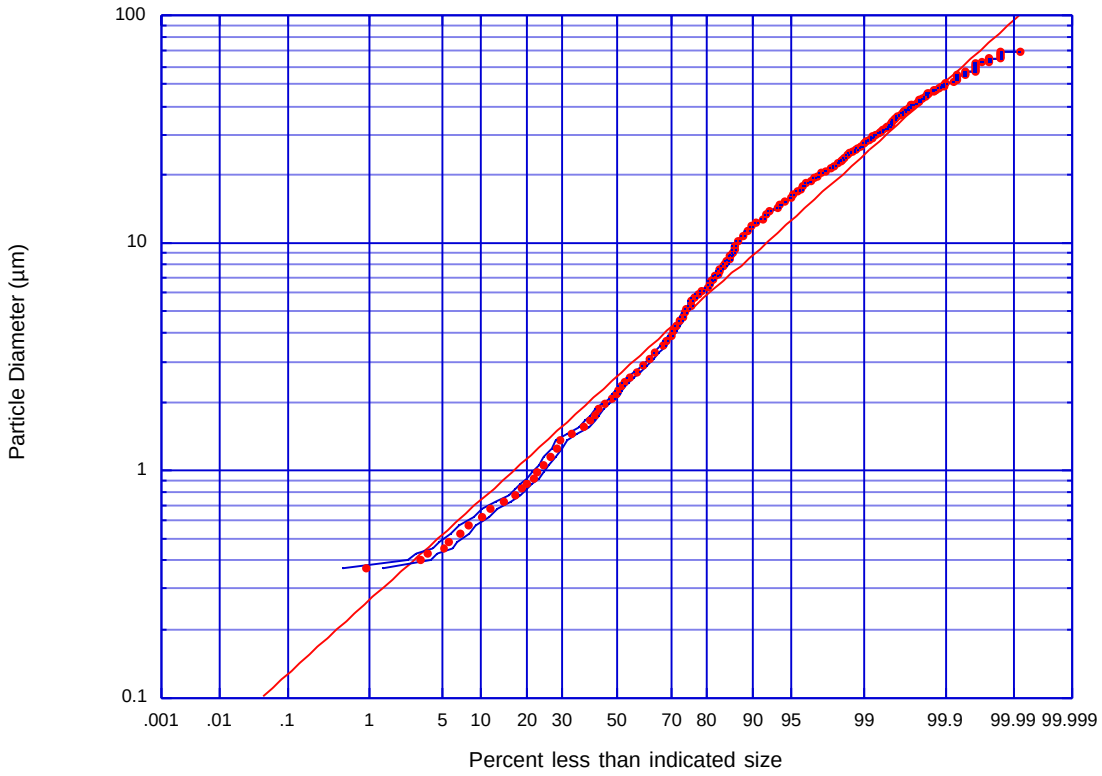
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.70$	3848
100x, 6	0.224	$5.39 < d_p < 9.70$	1761
200x, 6	0.0558	$2.86 < d_p < 5.39$	1351
500x, 6	0.00893	$1.69 < d_p < 2.86$	386
1000x, 6	0.00217	$0.00 < d_p < 1.69$	192
Totals:	1.18%	-	7538

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.74	GMD (µm):	3.57
GSD:	3.10	GSD:	2.50
lower 95% (µm):	0.39	R^2:	0.97976
upper 95% (µm):	36.05	lower 95% (µm):	0.57
		upper 95% (µm):	22.36

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.56 Module V, Sample 46 (TSFH07-03) count-based particle size distribution.



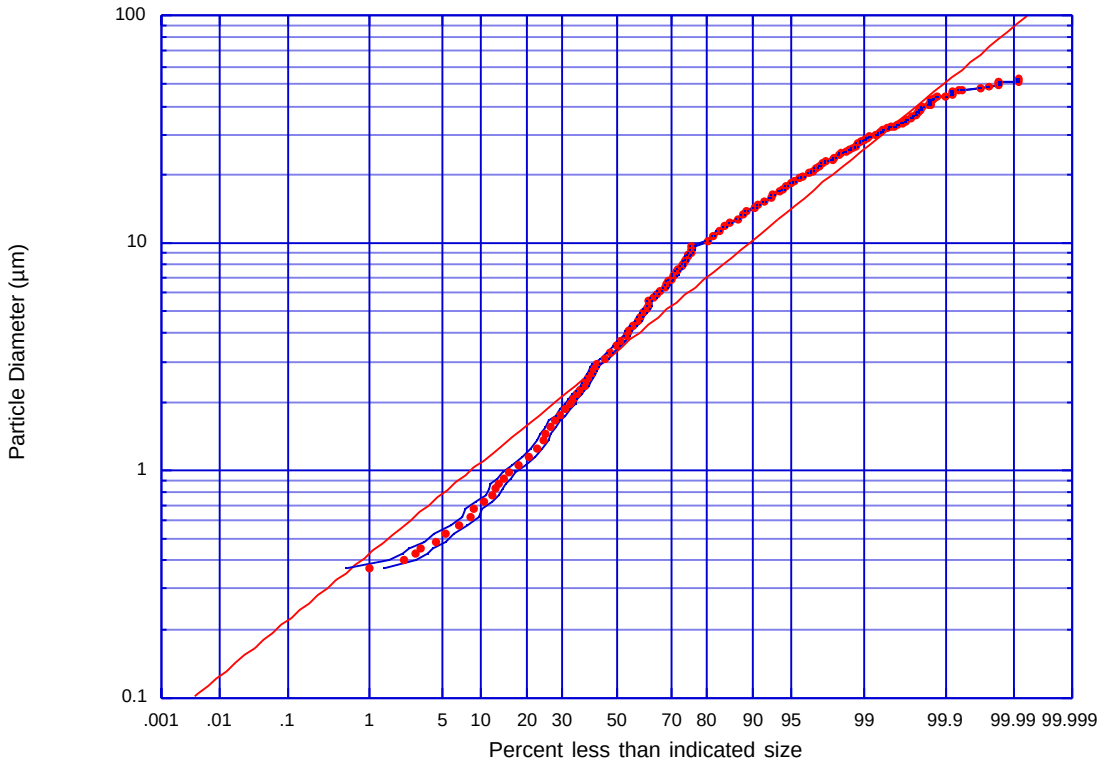
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.52$	2943
100x, 6	0.224	$5.08 < d_p < 9.52$	2068
200x, 6	0.0558	$2.58 < d_p < 5.08$	1527
500x, 6	0.00893	$1.40 < d_p < 2.58$	915
1000x, 6	0.00217	$0.00 < d_p < 1.40$	285
Totals:	1.18%	-	7738

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.49	GMD (µm):	2.56
GSD:	2.91	GSD:	2.65
lower 95% (µm):	0.29	R^2:	0.98798
upper 95% (µm):	21.02	lower 95% (µm):	0.37
		upper 95% (µm):	18.00

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.57 Module V, Sample 47 (TSFH23-03) count-based particle size distribution.



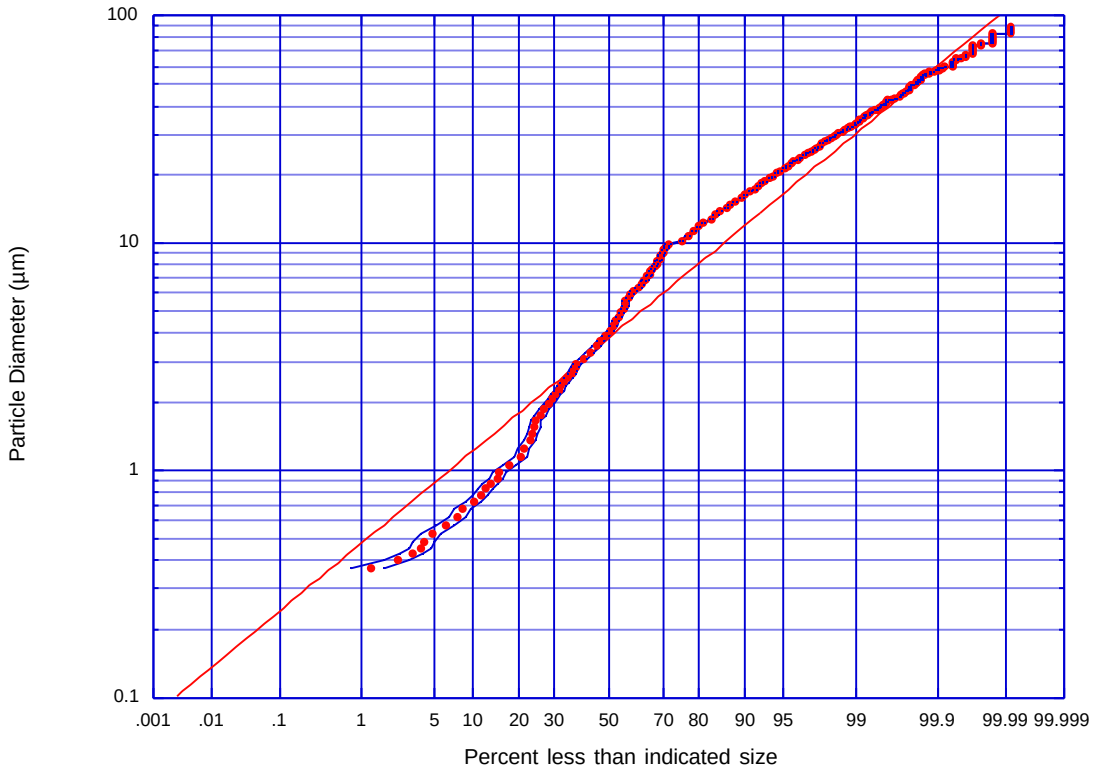
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.48$	4491
100x, 6	0.224	$5.49 < d_p < 9.48$	2393
200x, 6	0.0558	$3.07 < d_p < 5.49$	1680
500x, 6	0.00893	$1.85 < d_p < 3.07$	571
1000x, 6	0.00217	$0.00 < d_p < 1.85$	300
Totals:	1.18%	-	9435

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.50	GMD (µm):	3.34
GSD:	3.03	GSD:	2.42
lower 95% (µm):	0.38	R^2:	0.96461
upper 95% (µm):	32.17	lower 95% (µm):	0.57
		upper 95% (µm):	19.52

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.58 Module V, Sample 48 (TSFH06-03) count-based particle size distribution.



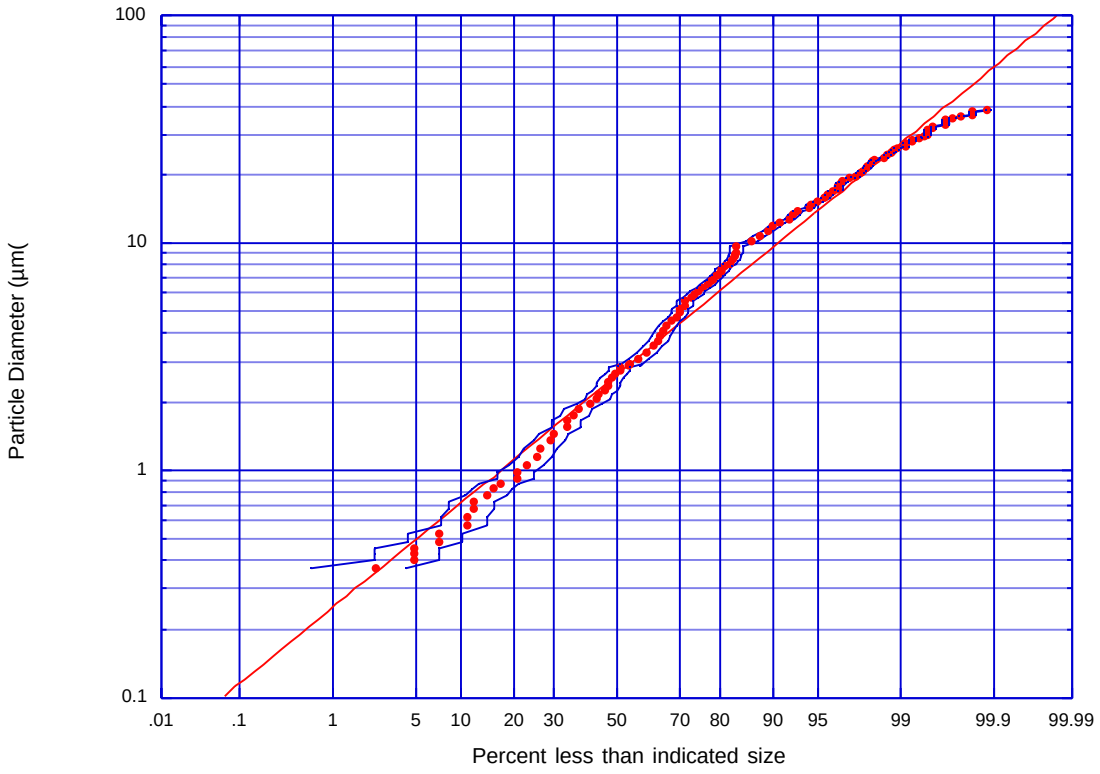
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 10.00$	5160
100x, 6	0.224	$5.57 < d_p < 10.00$	2518
200x, 6	0.0558	$3.03 < d_p < 5.57$	1614
500x, 6	0.00893	$1.78 < d_p < 3.03$	594
1000x, 6	0.00217	$0.00 < d_p < 1.78$	245
Totals:	1.18%	-	10131

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.00	GMD (µm):	3.81
GSD:	3.19	GSD:	2.45
lower 95% (µm):	0.39	R^2:	0.97381
upper 95% (µm):	40.53	lower 95% (µm):	0.64
		upper 95% (µm):	22.80

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.59 Module V, Sample 49 (TSFH05-03) count-based particle size distribution.



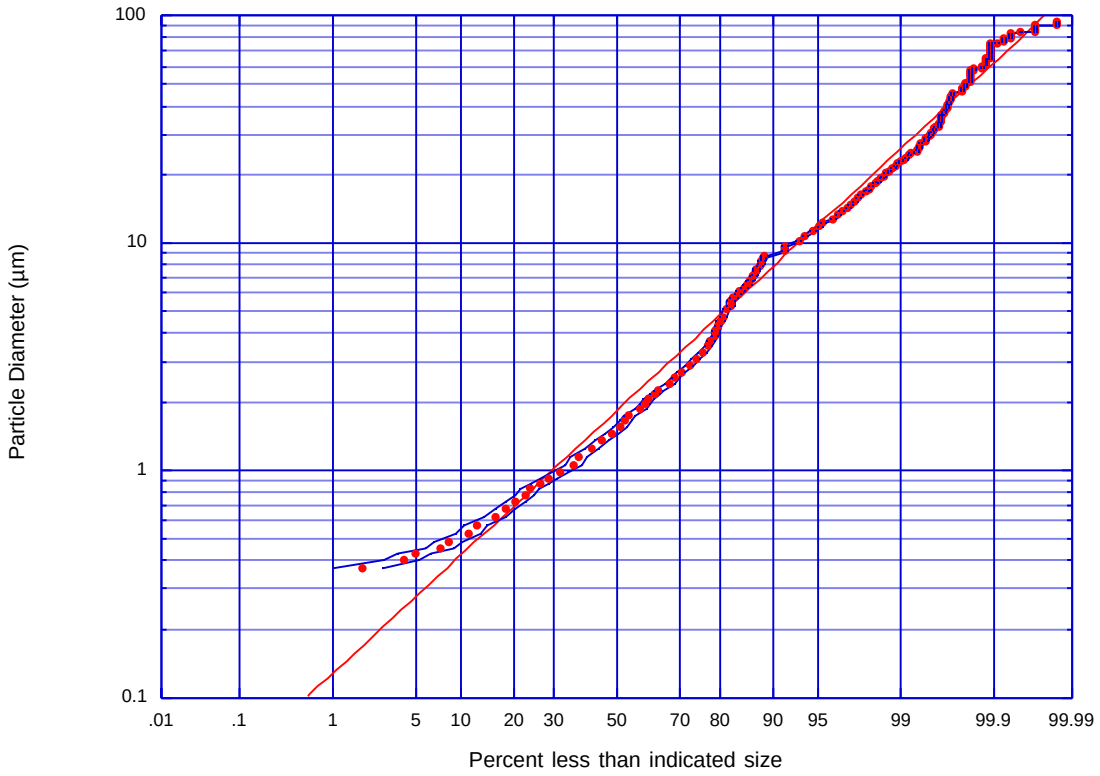
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.24$	434
100x, 6	0.224	$5.30 < d_p < 9.24$	307
200x, 6	0.0558	$2.98 < d_p < 5.30$	223
500x, 6	0.00893	$1.71 < d_p < 2.98$	90
1000x, 6	0.00217	$0.00 < d_p < 1.71$	42
Totals:	1.18%	-	1096

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.72	GMD (µm):	2.62
GSD:	2.96	GSD:	2.75
lower 95% (µm):	0.31	R^2:	0.98763
upper 95% (µm):	23.90	lower 95% (µm):	0.35
		upper 95% (µm):	19.85

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.60 Module V, Sample 50 (TSFH10-03) count-based particle size distribution.



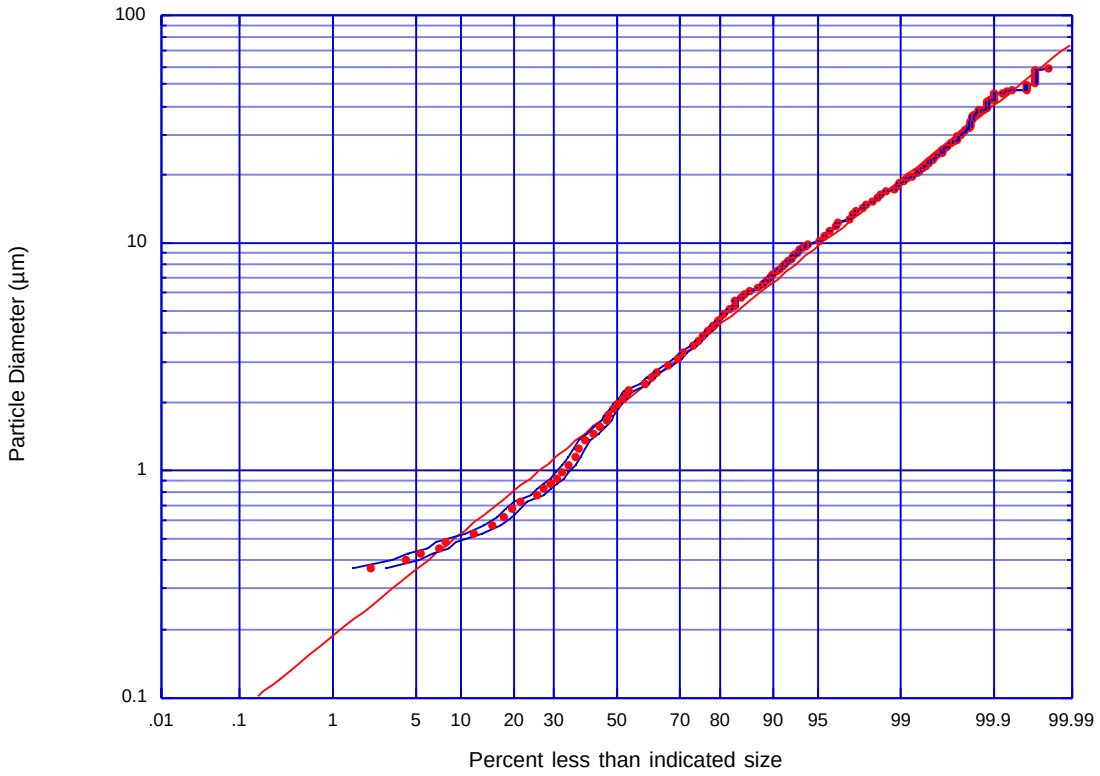
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.83$	1010
100x, 6	0.224	$4.78 < d_p < 8.83$	647
200x, 6	0.0558	$2.34 < d_p < 4.78$	546
500x, 6	0.00893	$1.27 < d_p < 2.34$	447
1000x, 6	0.00217	$0.00 < d_p < 1.27$	191
Totals:	1.18%	-	2841

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.85	GMD (µm):	1.83
GSD:	2.78	GSD:	3.14
lower 95% (µm):	0.24	R^2:	0.99167
upper 95% (µm):	14.31	lower 95% (µm):	0.19
		upper 95% (µm):	18.01

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.61 Module V, Sample 50A (TSFH22-03) count-based particle size distribution.



Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.94$	986
100x, 6	0.224	$4.74 < d_p < 8.94$	1401
200x, 6	0.0558	$2.34 < d_p < 4.74$	1126
500x, 6	0.00893	$1.27 < d_p < 2.34$	529
1000x, 6	0.00217	$0.00 < d_p < 1.27$	276
Totals:	1.18%	-	4318

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.92	GMD (µm):	1.88
GSD:	2.72	GSD:	2.70
lower 95% (µm):	0.26	R^2:	0.99629
upper 95% (µm):	14.26	lower 95% (µm):	0.26
		upper 95% (µm):	13.72

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.62 Module V, Sample 50B (TSFH25-03) count-based particle size distribution.

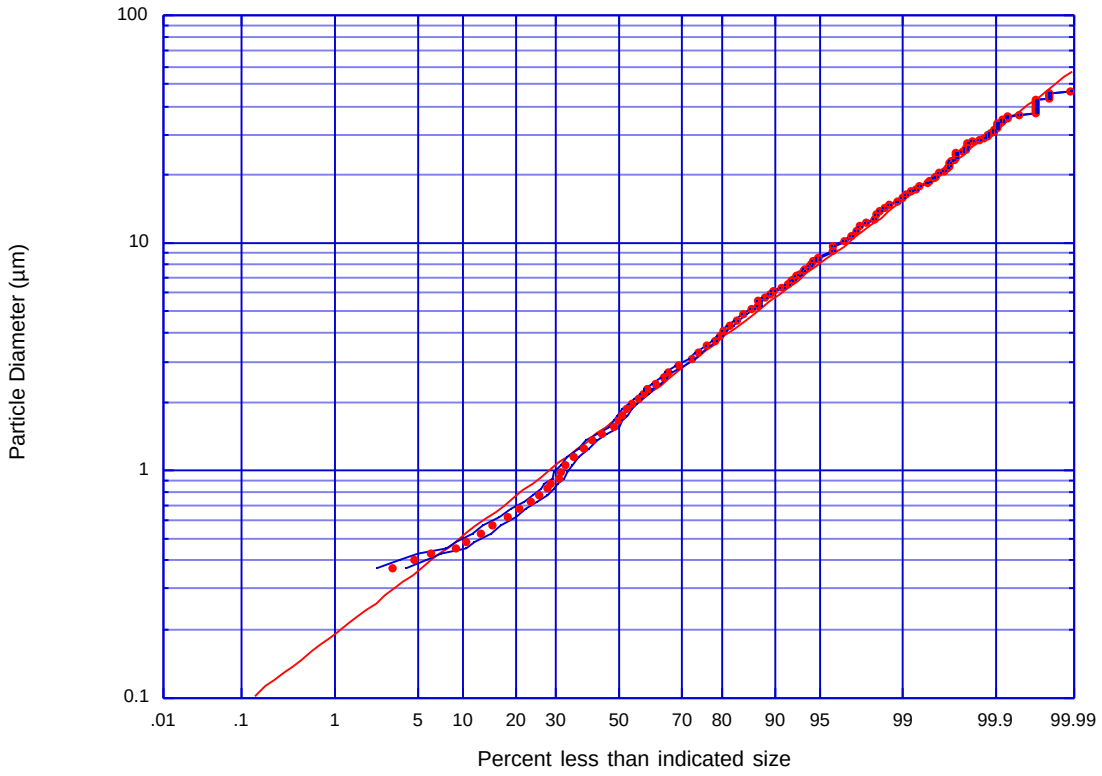
3.2.2.6. Module VI Results

Figure 3.63 through Figure 3.74 display details of particle size distributions for corresponding collection locations of Module VI. Table 3.6 gives a summary of Module VI results.

Table 3.6 Summary of dust collected from locations in Tore Supra Module VI.

Poloidal Location	Sample	Filter ID	Sampled Area (cm^2)	Collected Mass (mg)	Count-based Size Distribution Parameters	
					GMD (μm)	GSD
1	51	TSFH12-03	621.2	0.3	1.77	2.58
2	52	TSFH17-03	1,553	1.9*	2.72	2.99
4	53	TSFH13-03	689.0	1.0*	2.69	2.99
3	54	TSFH27-02	1,800	0.6	2.66	2.78
6	55	TSFH26-03	658.0	0.0	2.39	2.85
5	56	TSFH27-01	1,200	1.6	3.71	2.75
7	57	TSFH14-03	428.0	1.4	2.69	3.23
8	58	TSFH26-02	84.00	0.2	3.53	2.84
10	59	TSFH19-03	1,429	0.1*	2.52	3.00
9	60	TSFH15-03	294.0	0.1	2.35	4.03
11	60A	TSFH16-03	160.0	46.9*	1.54	2.79
12	60B	TSFH18-03	480.0	41.4*	2.25	3.02

*- filter partially broken



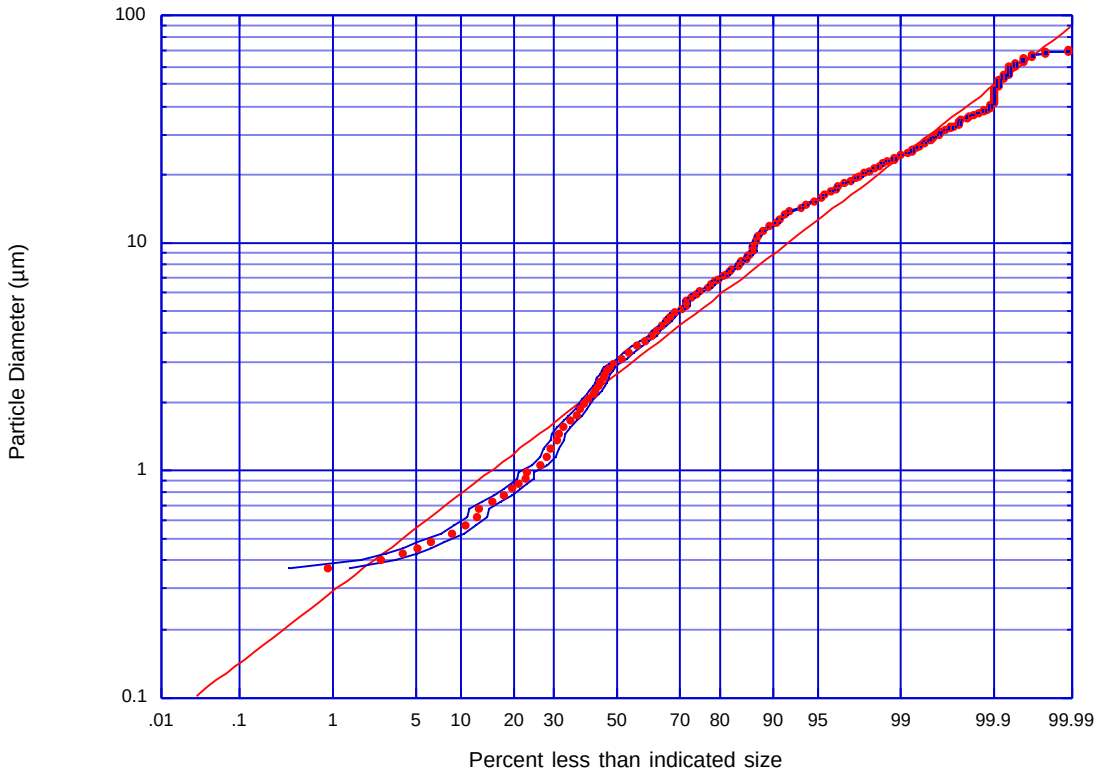
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.46$	672
100x, 6	0.224	$4.44 < d_p < 8.46$	1145
200x, 6	0.0558	$2.32 < d_p < 4.44$	1023
500x, 6	0.00893	$1.21 < d_p < 2.32$	584
1000x, 6	0.00217	$0.00 < d_p < 1.21$	227
Totals:	1.18%	-	3651

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.77	GMD (µm):	1.71
GSD:	2.58	GSD:	2.57
lower 95% (µm):	0.27	R^2:	0.99738
upper 95% (µm):	11.80	lower 95% (µm):	0.26
		upper 95% (µm):	11.33

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.63 Module VI, Sample 51 (TSFH12-03) count-based particle size distribution.



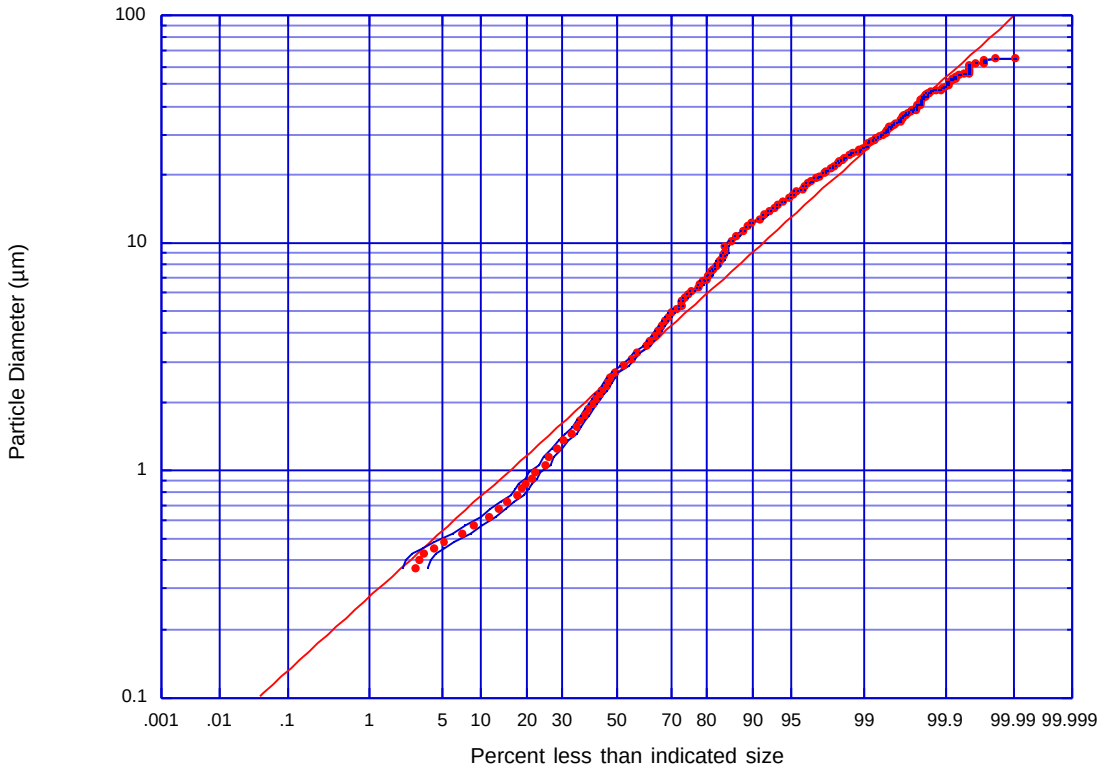
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.93$	2958
100x, 6	0.224	$5.17 < d_p < 8.93$	1828
200x, 6	0.0558	$2.99 < d_p < 5.17$	1348
500x, 6	0.00893	$1.78 < d_p < 2.99$	425
1000x, 6	0.00217	$0.00 < d_p < 1.78$	259
Totals:	1.18%	-	6818

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.72	GMD (µm):	2.65
GSD:	2.99	GSD:	2.58
lower 95% (µm):	0.30	R^2:	0.98804
upper 95% (µm):	24.29	lower 95% (µm):	0.40
		upper 95% (µm):	17.63

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.64 Module VI, Sample 52 (TSFH17-03) count-based particle size distribution.



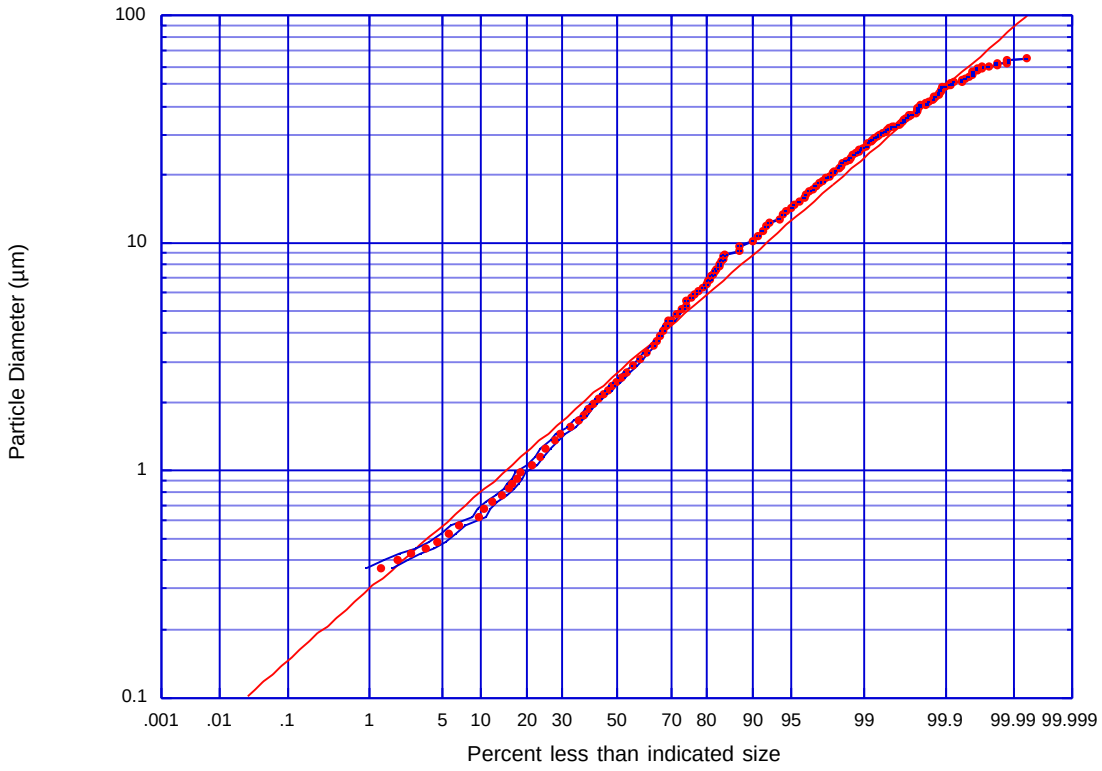
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.15$	2959
100x, 6	0.224	$4.98 < d_p < 9.15$	1825
200x, 6	0.0558	$2.67 < d_p < 4.98$	1467
500x, 6	0.00893	$1.56 < d_p < 2.67$	475
1000x, 6	0.00217	$0.00 < d_p < 1.56$	283
Totals:	1.18%	-	7009

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.69	GMD (µm):	2.65
GSD:	2.99	GSD:	2.64
lower 95% (µm):	0.30	R^2:	0.98883
upper 95% (µm):	24.10	lower 95% (µm):	0.38
		upper 95% (µm):	18.54

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.65 Module VI, Sample 53 (TSFH13-03) count-based particle size distribution.



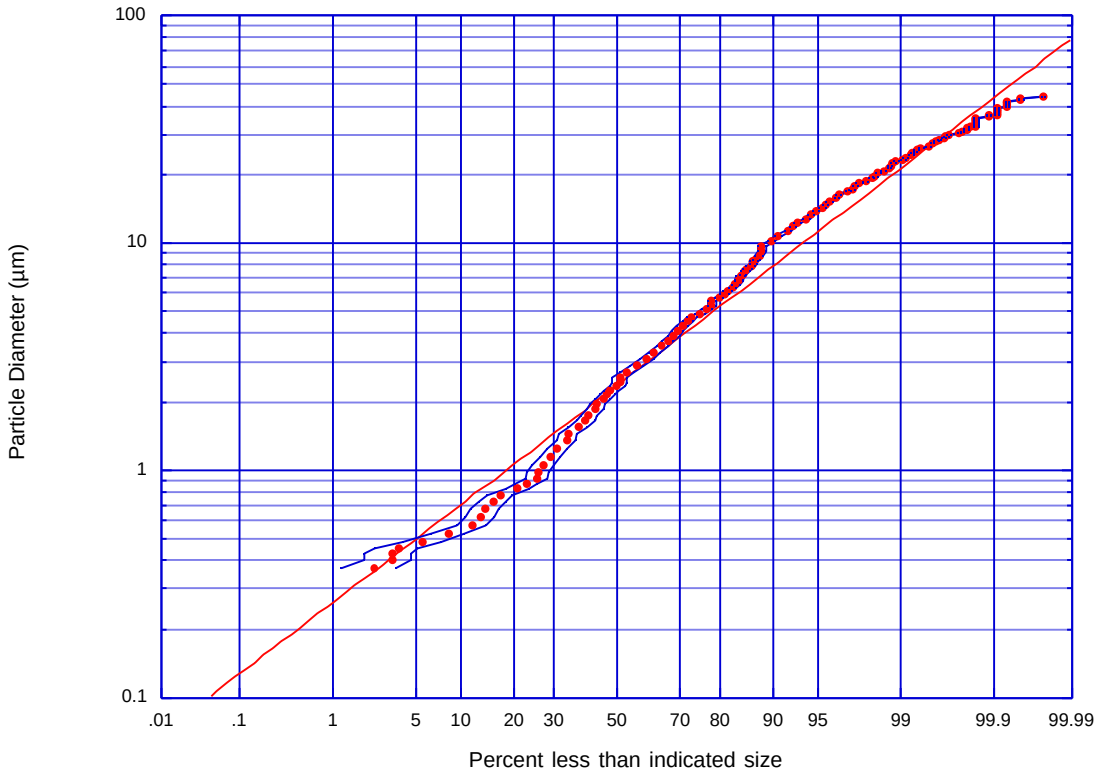
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.04$	3325
100x, 6	0.224	$4.76 < d_p < 9.04$	2542
200x, 6	0.0558	$2.55 < d_p < 4.76$	1820
500x, 6	0.00893	$1.53 < d_p < 2.55$	1007
1000x, 6	0.00217	$0.00 < d_p < 1.53$	380
Totals:	1.18%	-	9074

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.66	GMD (µm):	2.67
GSD:	2.78	GSD:	2.56
lower 95% (µm):	0.35	R^2:	0.99168
upper 95% (µm):	20.55	lower 95% (µm):	0.41
		upper 95% (µm):	17.58

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.66 Module VI, Sample 54 (TSFH27-02) count-based particle size distribution.



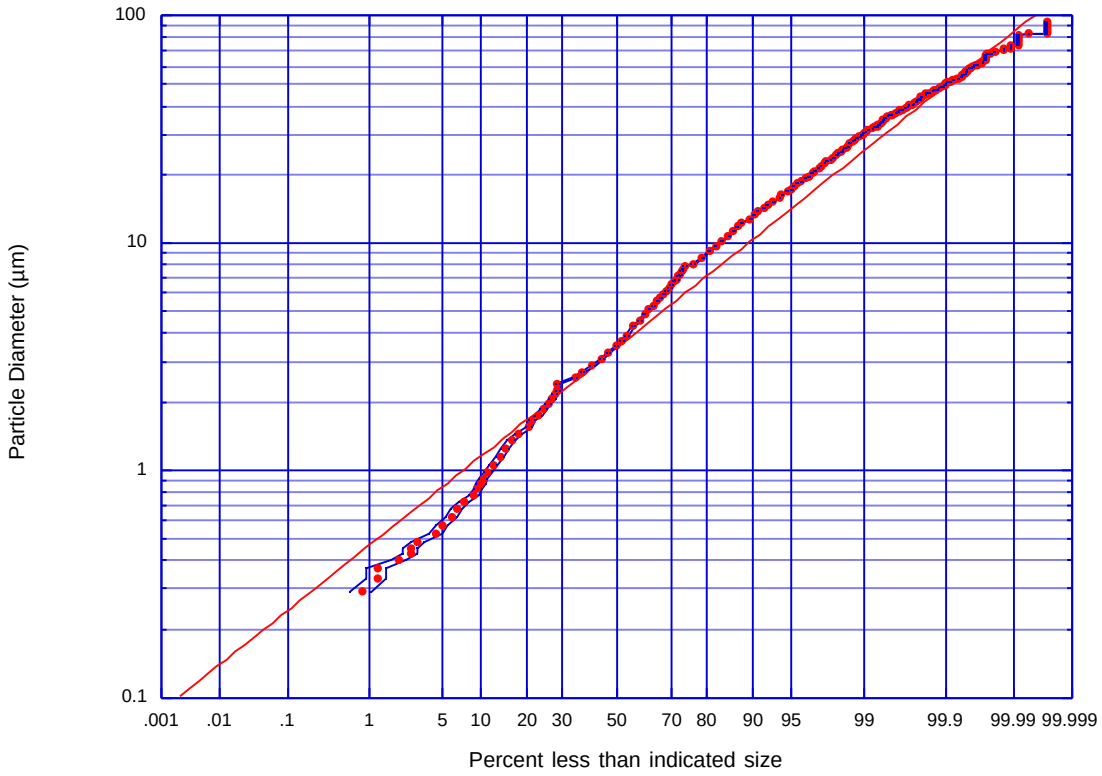
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.85$	902
100x, 6	0.224	$4.81 < d_p < 8.85$	666
200x, 6	0.0558	$2.64 < d_p < 4.81$	572
500x, 6	0.00893	$1.51 < d_p < 2.64$	293
1000x, 6	0.00217	$0.00 < d_p < 1.51$	109
Totals:	1.18%	-	2542

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.39	GMD (µm):	2.36
GSD:	2.85	GSD:	2.58
lower 95% (µm):	0.30	R^2:	0.98625
upper 95% (µm):	19.37	lower 95% (µm):	0.36
		upper 95% (µm):	15.66

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.67 Module VI, Sample 55 (TSFH26-03) count-based particle size distribution.



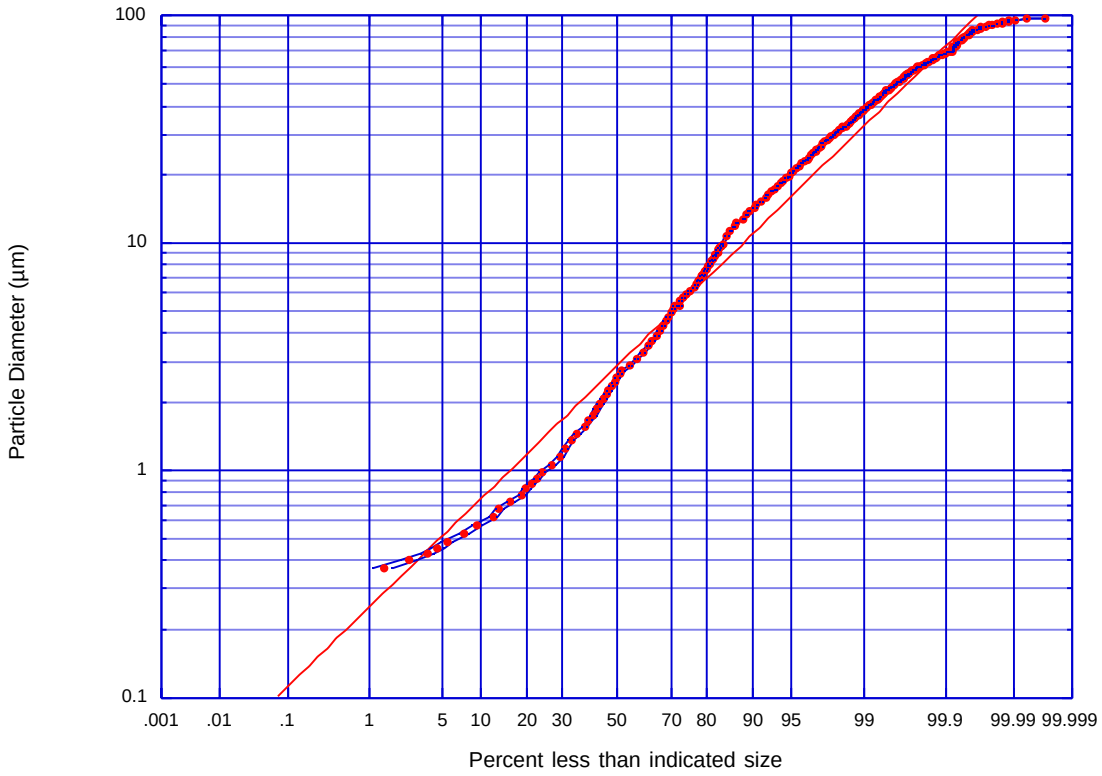
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.91$	13622
100x, 6	0.224	$4.25 < d_p < 7.91$	8158
200x, 6	0.0558	$2.30 < d_p < 4.25$	6069
500x, 6	0.00893	$1.37 < d_p < 2.30$	1635
1000x, 6	0.00217	$0.00 < d_p < 1.37$	448
Totals:	1.18%	-	29932

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.71	GMD (µm):	3.46
GSD:	2.75	GSD:	2.36
lower 95% (µm):	0.49	R^2:	0.98707
upper 95% (µm):	28.01	lower 95% (µm):	0.62
		upper 95% (µm):	19.33

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.68 Module VI, Sample 56 (TSFH27-01) count-based particle size distribution.



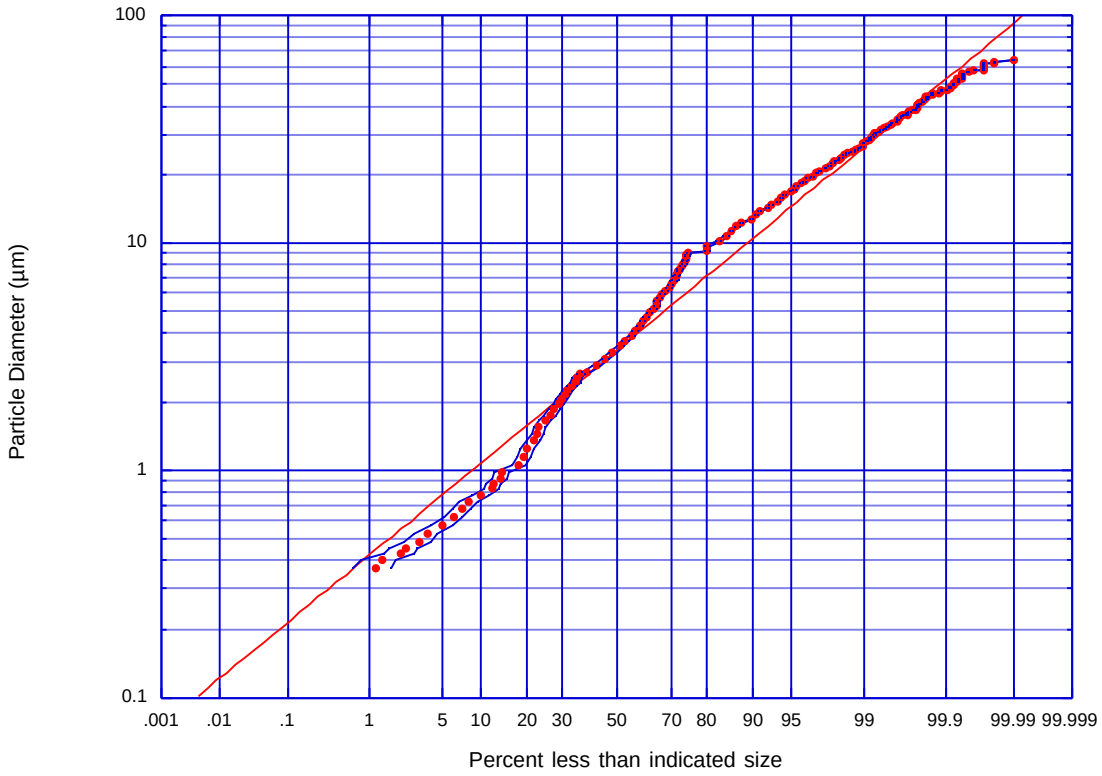
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 10.50$	8590
100x, 6	0.224	$5.44 < d_p < 10.50$	5468
200x, 6	0.0558	$2.81 < d_p < 5.44$	4041
500x, 6	0.00893	$1.56 < d_p < 2.81$	1775
1000x, 6	0.00217	$0.00 < d_p < 1.56$	870
Totals:	1.18%	-	20744

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.69	GMD (µm):	2.87
GSD:	3.23	GSD:	2.86
lower 95% (µm):	0.26	R^2:	0.98367
upper 95% (µm):	28.06	lower 95% (µm):	0.35
		upper 95% (µm):	23.50

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.69 Module VI, Sample 57 (TSFH14-03) count-based particle size distribution.



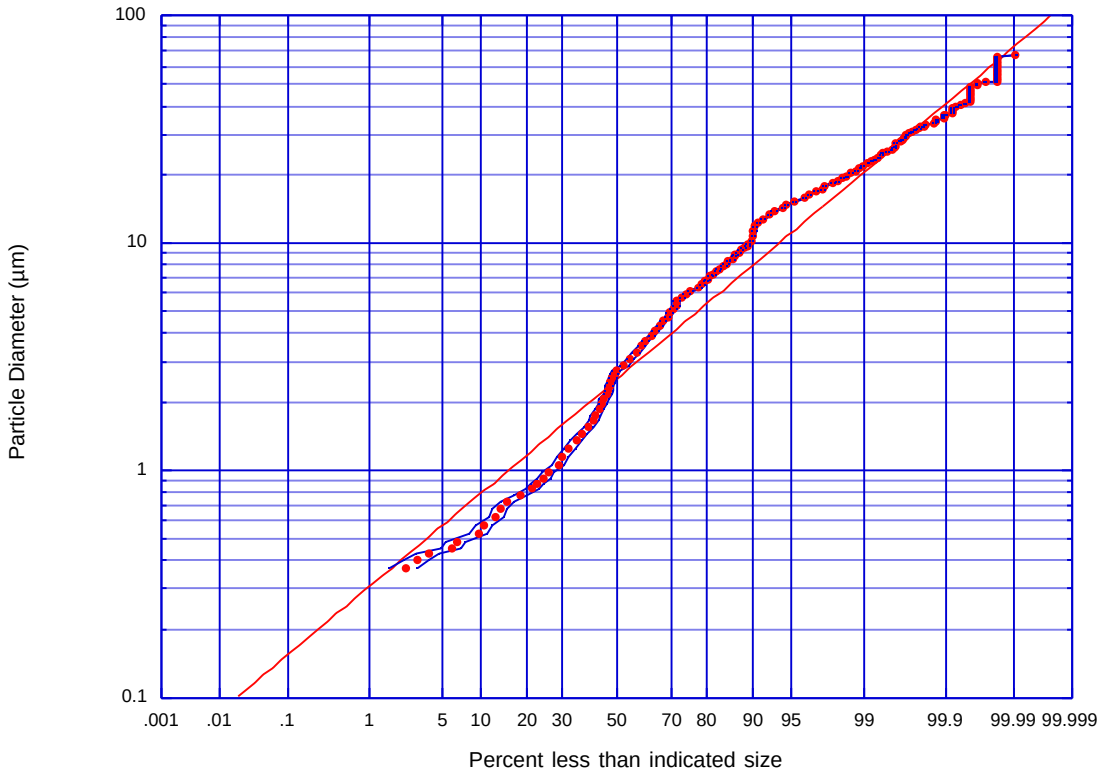
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.19$	3220
100x, 6	0.224	$5.07 < d_p < 9.19$	1563
200x, 6	0.0558	$2.78 < d_p < 5.07$	1568
500x, 6	0.00893	$1.69 < d_p < 2.78$	554
1000x, 6	0.00217	$0.00 < d_p < 1.69$	203
Totals:	1.18%	-	7108

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.53	GMD (µm):	3.36
GSD:	2.84	GSD:	2.44
lower 95% (µm):	0.44	R^2:	0.98551
upper 95% (µm):	28.57	lower 95% (µm):	0.57
		upper 95% (µm):	19.94

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.70 Module VI, Sample 58 (TSFH26-02) count-based particle size distribution.



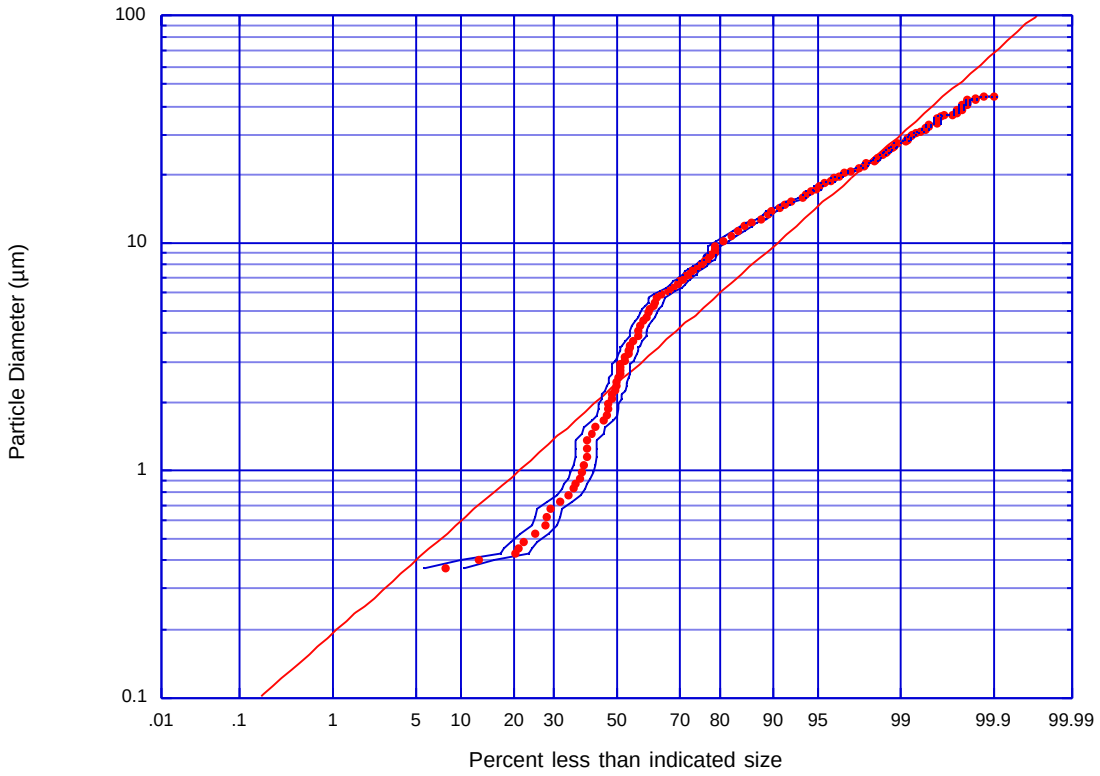
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.60$	3959
100x, 6	0.224	$4.97 < d_p < 8.60$	2263
200x, 6	0.0558	$2.80 < d_p < 4.97$	1397
500x, 6	0.00893	$1.53 < d_p < 2.80$	509
1000x, 6	0.00217	$0.00 < d_p < 1.53$	289
Totals:	1.18%	-	8417

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.52	GMD (µm):	2.52
GSD:	3.00	GSD:	2.47
lower 95% (µm):	0.28	R^2:	0.98526
upper 95% (µm):	22.67	lower 95% (µm):	0.41
		upper 95% (µm):	15.35

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.71 Module VI, Sample 59 (TSFH19-03) count-based particle size distribution.



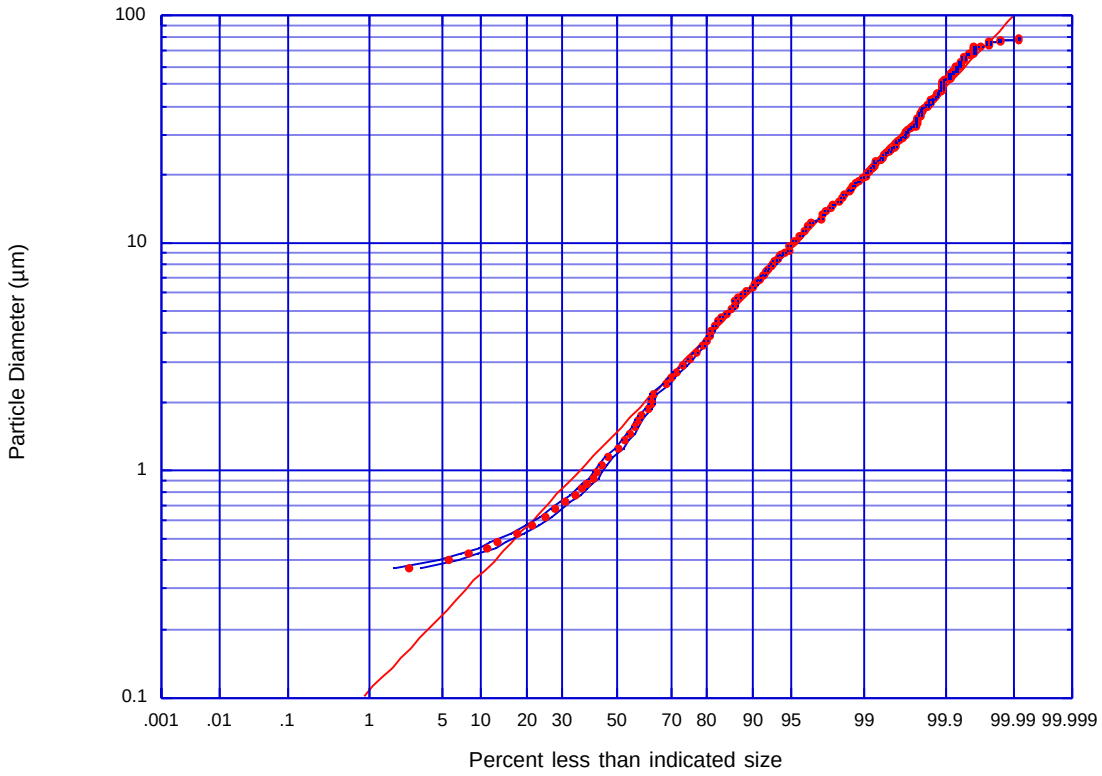
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.41$	1082
100x, 6	0.224	$5.70 < d_p < 9.41$	621
200x, 6	0.0558	$3.63 < d_p < 5.70$	237
500x, 6	0.00893	$1.96 < d_p < 3.63$	84
1000x, 6	0.00217	$0.00 < d_p < 1.96$	94
Totals:	1.18%	-	2118

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.35	GMD (µm):	2.40
GSD:	4.03	GSD:	2.97
lower 95% (µm):	0.14	R^2:	0.92636
upper 95% (µm):	38.19	lower 95% (µm):	0.27
		upper 95% (µm):	21.15

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.72 Module VI, Sample 60 (TSFH15-03) count-based particle size distribution.



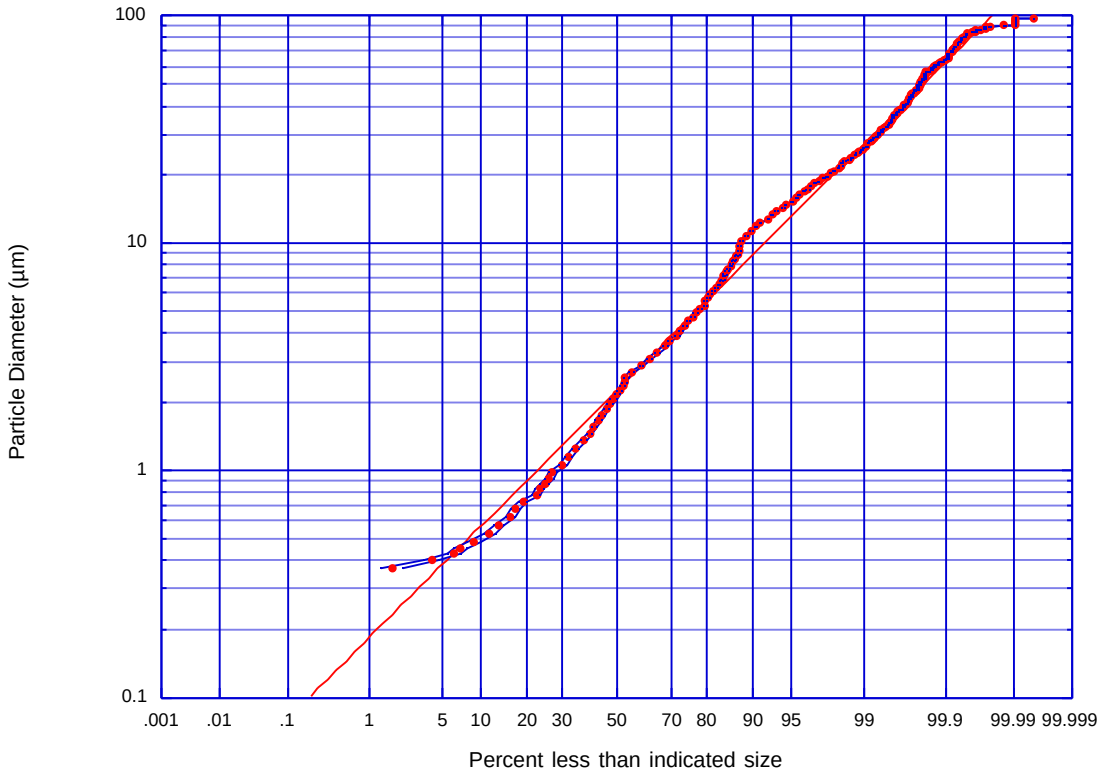
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.13$	1177
100x, 6	0.224	$4.84 < d_p < 9.13$	1354
200x, 6	0.0558	$2.34 < d_p < 4.84$	1091
500x, 6	0.00893	$1.15 < d_p < 2.34$	548
1000x, 6	0.00217	$0.00 < d_p < 1.15$	416
Totals:	1.18%	-	4586

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	1.54	GMD (µm):	1.48
GSD:	2.79	GSD:	3.10
lower 95% (µm):	0.20	R^2:	0.99461
upper 95% (µm):	11.93	lower 95% (µm):	0.15
		upper 95% (µm):	14.23

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.73 Module VI, Sample 60A (TSFH16-03) count-based particle size distribution.



Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 9.43$	4826
100x, 6	0.224	$5.18 < d_p < 9.43$	2675
200x, 6	0.0558	$2.64 < d_p < 5.18$	3119
500x, 6	0.00893	$1.40 < d_p < 2.64$	1053
1000x, 6	0.00217	$0.00 < d_p < 1.40$	599
Totals:	1.18%	-	12272

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	2.25	GMD (µm):	2.25
GSD:	3.02	GSD:	2.94
lower 95% (µm):	0.25	R^2:	0.99347
upper 95% (µm):	20.52	lower 95% (µm):	0.26
		upper 95% (µm):	19.35

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.74 Module VI, Sample 60B (TSFH18-03) count-based particle size distribution.

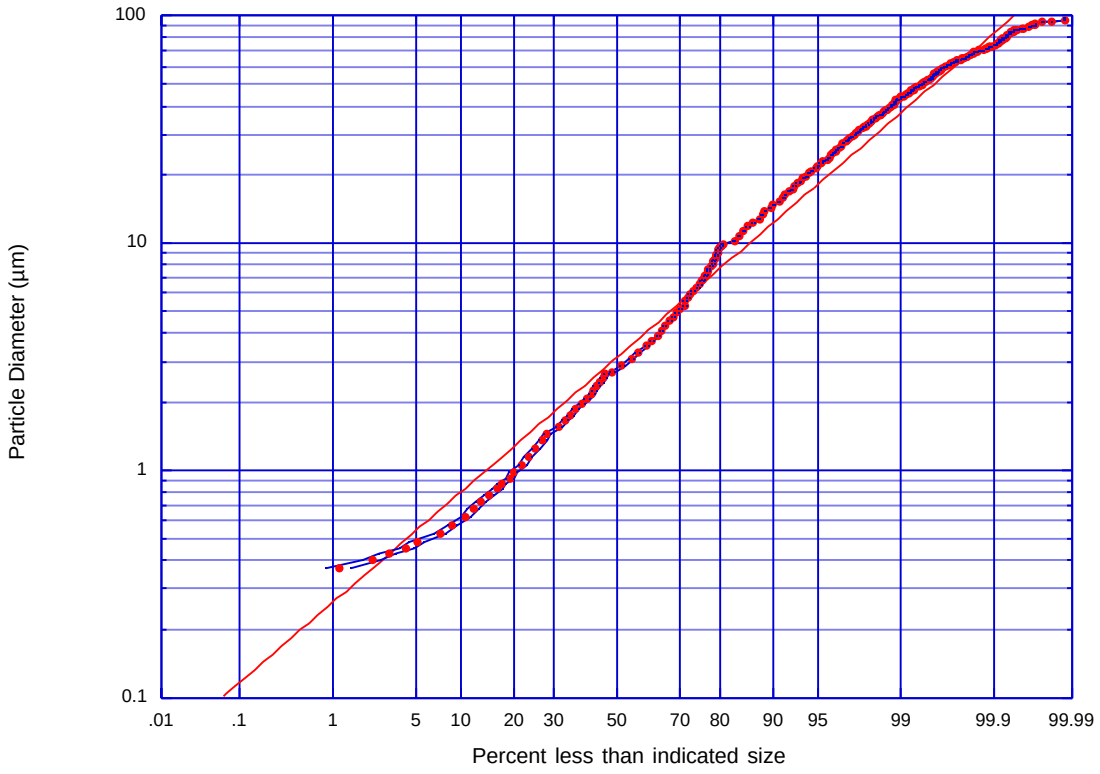
3.2.2.7. Other Locations Results

Figure 3.75 through Figure 3.81 display details of particle size distributions for corresponding collection special locations. Table 3.7 gives a summary of the results for special locations.

Table 3.7 Summary of dust collected from specific singular locations.

Reference Location	Sample	Filter ID	Sampled Area (cm^2)	Collected Mass (mg)	Count-based Size Distribution Parameters	
					GMD (μm)	GSD
71	71	TSFH20-02	2,688	1.5	3.00	3.18
72	72	TSFH20-01	2,640	2.6	3.16	3.14
73	73	TSFH26-01	5,520	1.1	3.68	2.89
74	74	TSFH04-02	1,500	5.8	4.23	2.88
75	75	TSFH01-02	1,500	6.6	3.21	2.81
76	76	TSFH02-02	200.0	-0.3*	0.98	1.93
77	77	TSFH03-02	150.0	1.9	4.33	2.86

*- filter partially broken



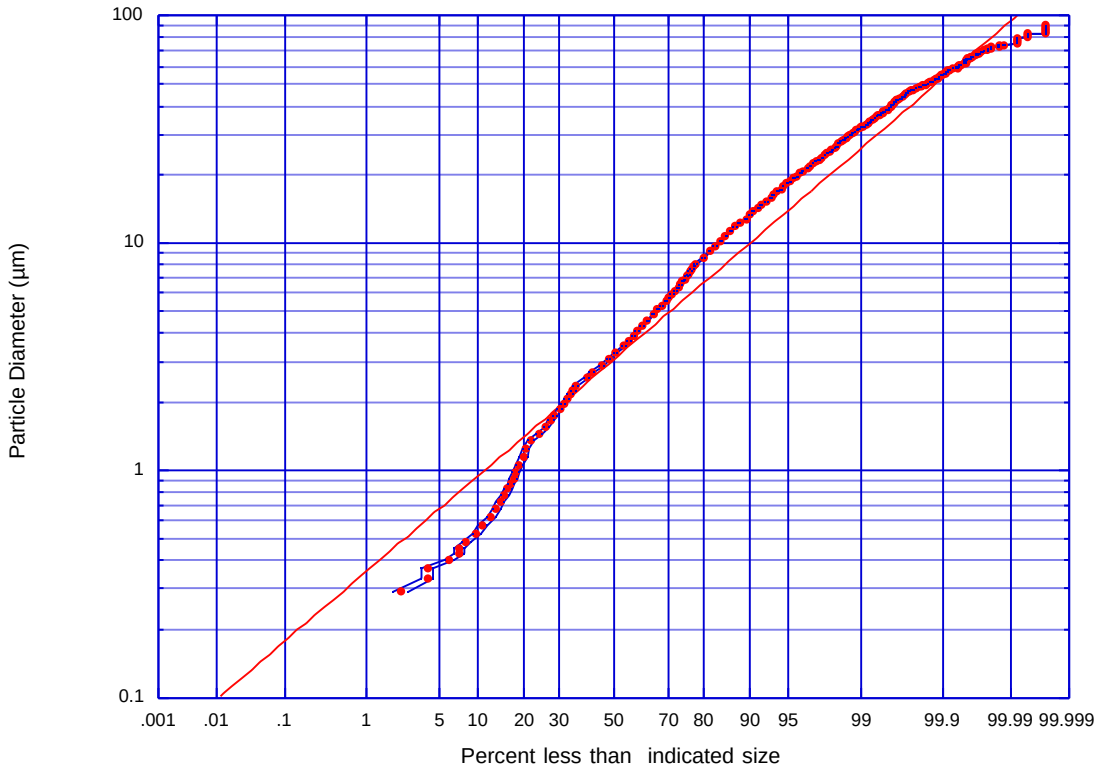
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 10.40$	8830
100x, 6	0.224	$5.22 < d_p < 10.40$	4362
200x, 6	0.0558	$2.73 < d_p < 5.22$	4241
500x, 6	0.00893	$1.56 < d_p < 2.73$	1842
1000x, 6	0.00217	$0.00 < d_p < 1.56$	748
Totals:	1.18%	-	20023

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.00	GMD (µm):	3.13
GSD:	3.18	GSD:	2.90
lower 95% (µm):	0.28	R^2:	0.98688
upper 95% (µm):	30.28	lower 95% (µm):	0.37
		upper 95% (µm):	26.43

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.75 Sample 71 (TSFH20-02) count-based particle size distribution.



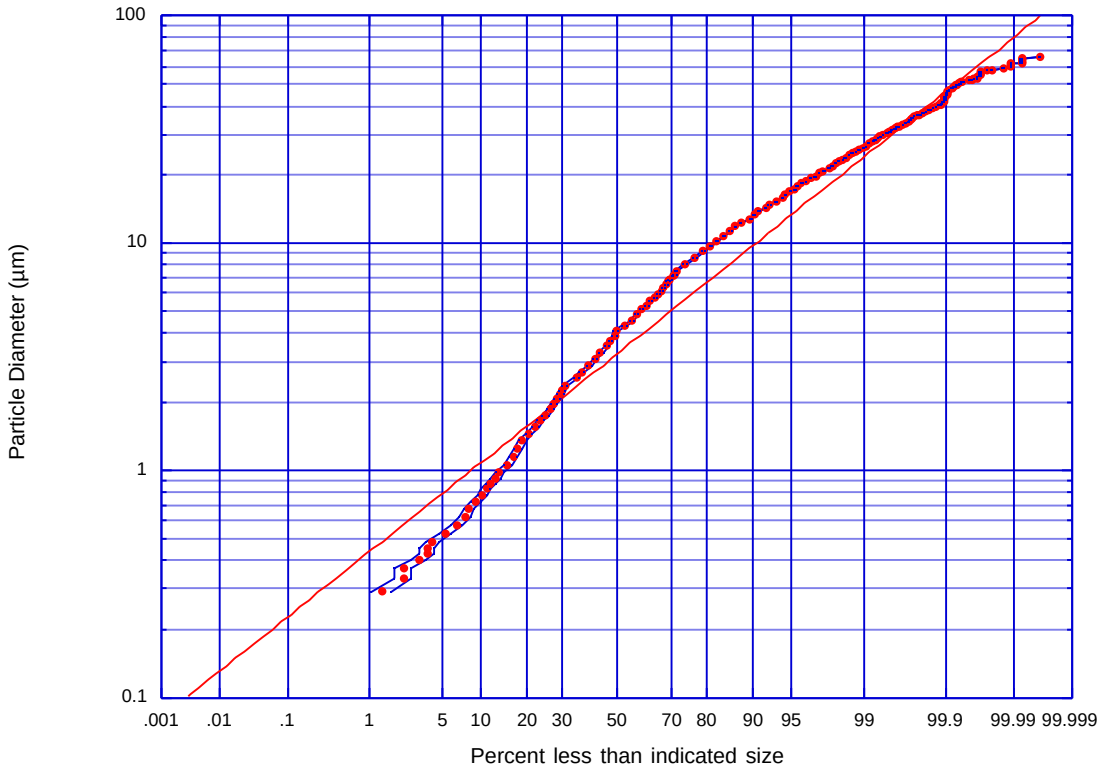
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.25$	13377
100x, 6	0.224	$4.39 < d_p < 8.25$	8853
200x, 6	0.0558	$2.45 < d_p < 4.39$	5682
500x, 6	0.00893	$1.37 < d_p < 2.45$	1843
1000x, 6	0.00217	$0.00 < d_p < 1.37$	622
Totals:	1.18%	-	30377

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.16	GMD (µm):	3.07
GSD:	3.14	GSD:	2.52
lower 95% (µm):	0.32	R^2:	0.97403
upper 95% (µm):	31.10	lower 95% (µm):	0.48
		upper 95% (µm):	19.42

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.76 Sample 72 (TSFH20-01) count-based particle size distribution.



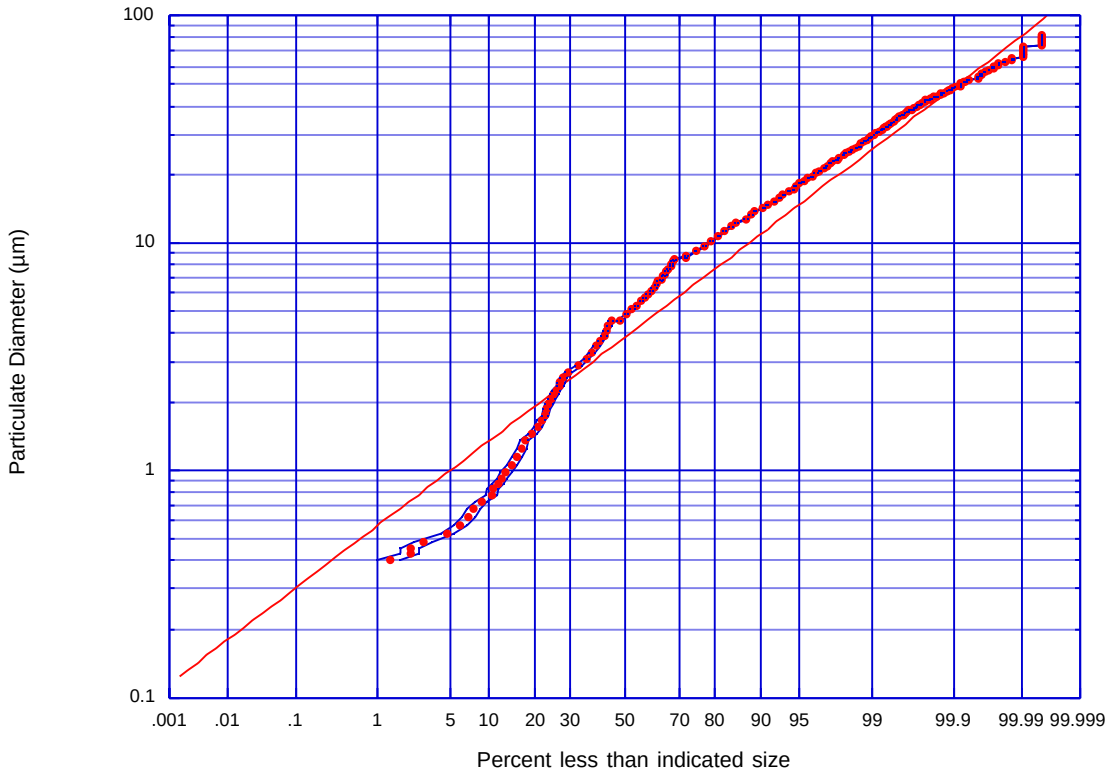
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 7.75$	11424
100x, 6	0.224	$4.25 < d_p < 7.75$	6880
200x, 6	0.0558	$2.43 < d_p < 4.25$	3450
500x, 6	0.00893	$1.46 < d_p < 2.43$	1168
1000x, 6	0.00217	$0.00 < d_p < 1.46$	413
Totals:	1.18%	-	23335

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.68	GMD (µm):	3.24
GSD:	2.89	GSD:	2.37
lower 95% (µm):	0.44	R^2:	0.978
upper 95% (µm):	30.67	lower 95% (µm):	0.58
		upper 95% (µm):	18.18

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.77 Sample 73 (TSFH26-01) count-based particle size distribution.



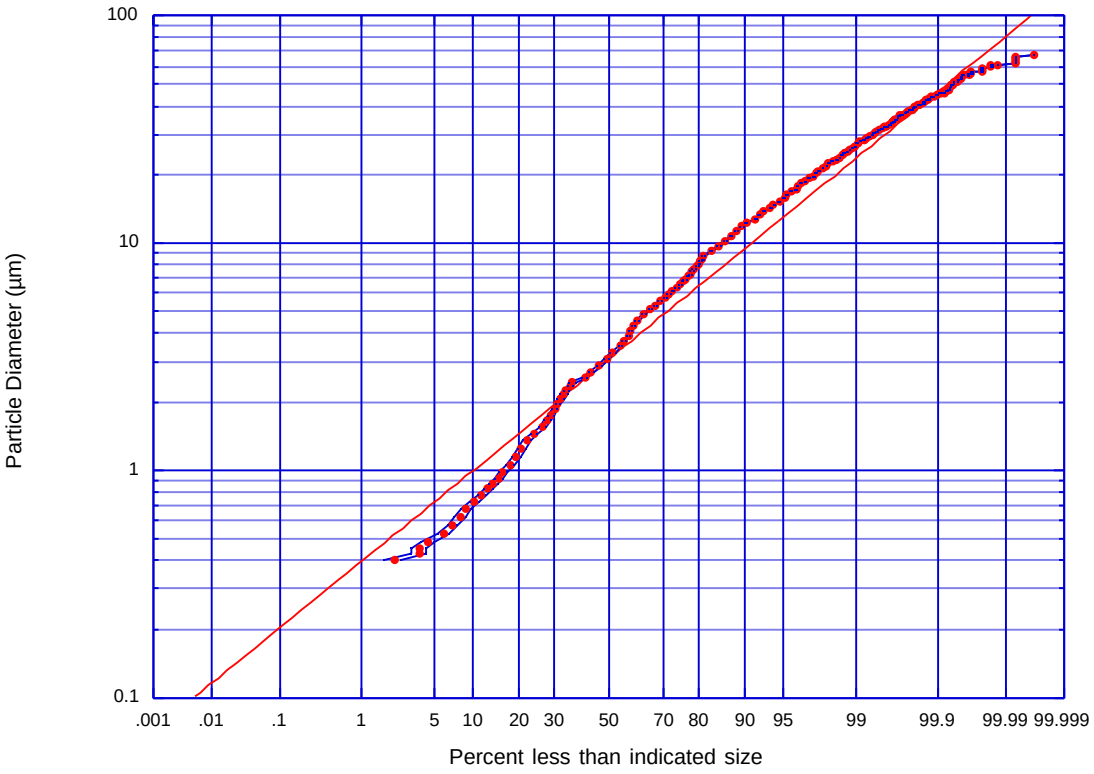
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.83$	8579
100x, 6	0.224	$4.74 < d_p < 8.83$	4567
200x, 6	0.0558	$2.62 < d_p < 4.74$	2256
500x, 6	0.00893	$1.42 < d_p < 2.62$	701
1000x, 6	0.00217	$0.00 < d_p < 1.42$	263
Totals:	1.18%	-	16366

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.23	GMD (µm):	3.84
GSD:	2.88	GSD:	2.27
lower 95% (µm):	0.51	R^2:	0.97446
upper 95% (µm):	35.09	lower 95% (µm):	0.74
		upper 95% (µm):	19.85

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.78 Sample 74 (TSFH04-02) count-based particle size distribution.



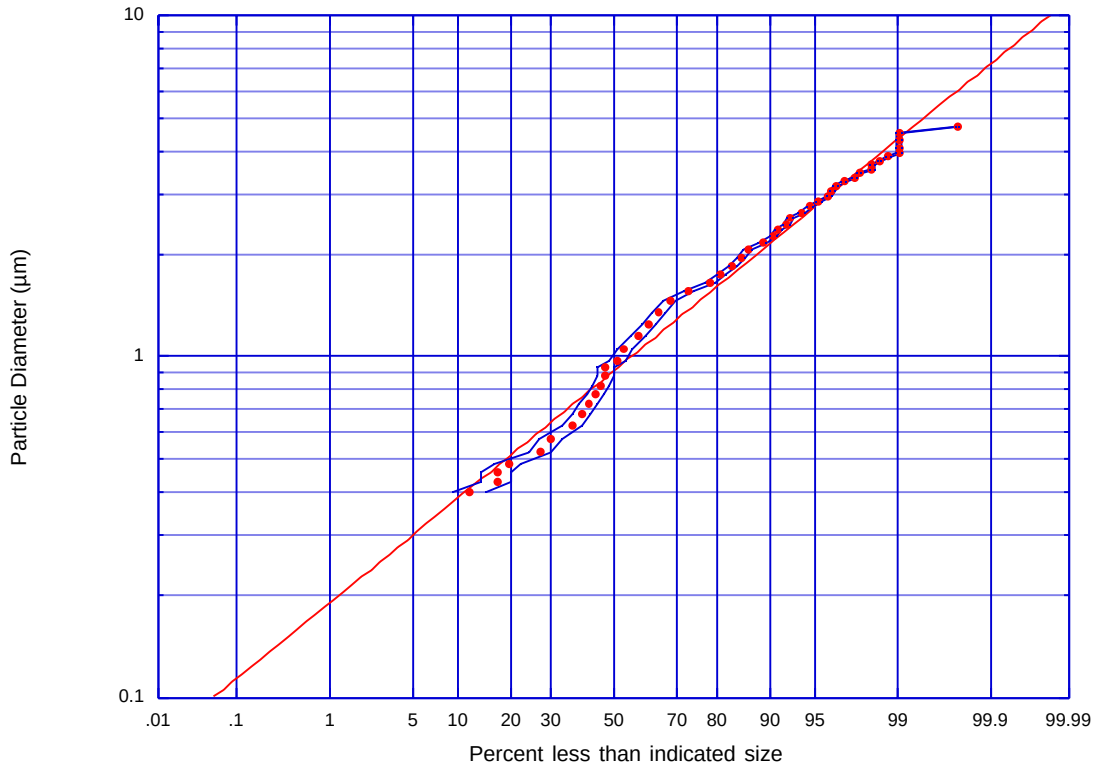
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.83$	8146
100x, 6	0.224	$4.70 < d_p < 8.83$	6488
200x, 6	0.0558	$2.52 < d_p < 4.70$	3624
500x, 6	0.00893	$1.40 < d_p < 2.52$	1189
1000x, 6	0.00217	$0.00 < d_p < 1.40$	460
Totals:	1.18%	-	19907

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	3.21	GMD (µm):	3.07
GSD:	2.81	GSD:	2.41
lower 95% (µm):	0.41	R^2:	0.98351
upper 95% (µm):	25.41	lower 95% (µm):	0.53
		upper 95% (µm):	17.86

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.79 Sample 75 (TSFH01-02) count-based particle size distribution.



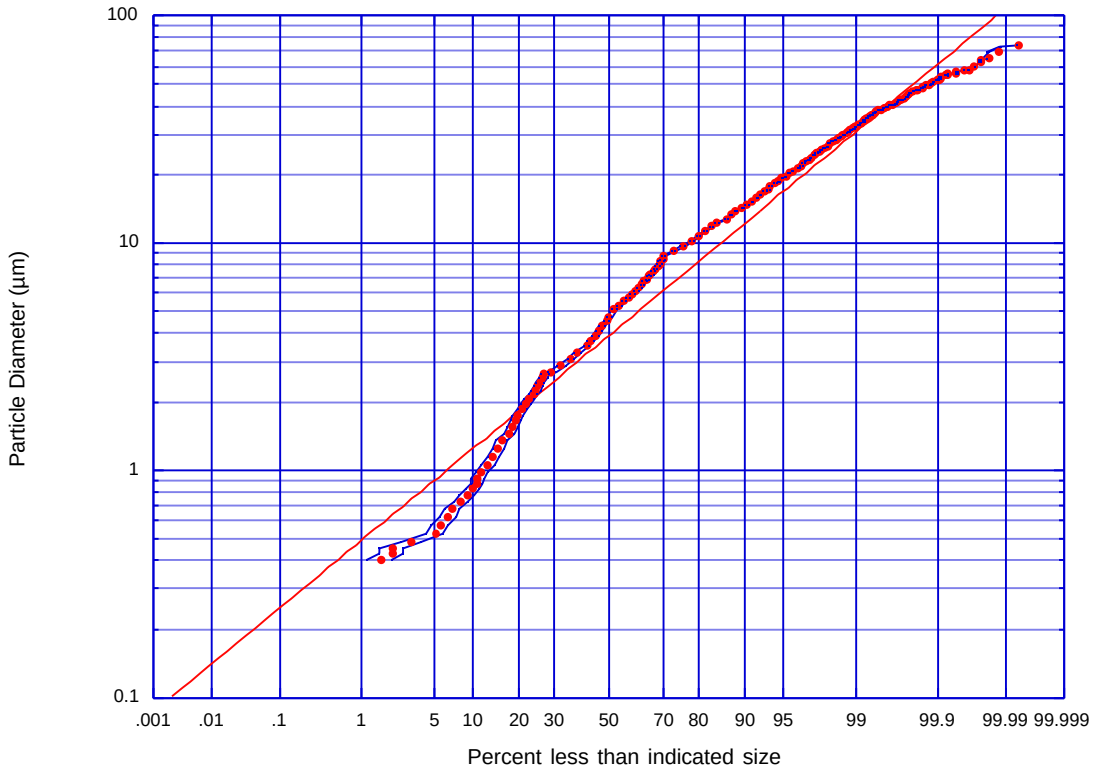
Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.0	NA	NA
100x, 6	0.0	NA	NA
200x, 6	0.0	NA	NA
500x, 6	0.00893	$d_p > 1.16$	173
1000x, 6	0.00217	$0.00 < d_p < 1.16$	268
Totals:	0.01%	-	441

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	0.98	GMD (µm):	0.91
GSD:	1.93	GSD:	1.96
lower 95% (µm):	0.26	R^2:	0.98738
upper 95% (µm):	3.63	lower 95% (µm):	0.24
		upper 95% (µm):	3.49

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.80 Sample 76 (TSFH02-02) count-based particle size distribution.



Analysis Summary Table:

magnification, number of images	area analyzed[1] (%)	counted size range (µm)	total number of particles (not scaled)
50x, 6	0.894	$d_p > 8.98$	7054
100x, 6	0.224	$4.95 < d_p < 8.98$	3837
200x, 6	0.0558	$2.74 < d_p < 4.95$	2099
500x, 6	0.00893	$1.62 < d_p < 2.74$	600
1000x, 6	0.00217	$0.00 < d_p < 1.62$	244
Totals:	1.18%	-	13834

data moments[2]:		log-normal fit moments[2]:	
GMD (µm):	4.33	GMD (µm):	3.90
GSD:	2.86	GSD:	2.44
lower 95% (µm):	0.53	R^2:	0.9783
upper 95% (µm):	35.35	lower 95% (µm):	0.66
		upper 95% (µm):	23.23

1. based on overall filter area of 1.59×10^9 µm^2
2. GMD = geometric mean diameter, GSD = geometric standard deviation, R = linear correlation coefficient

Figure 3.81 Sample 77 (TSFH03-02) count-based particle size distribution.

3.3. Size Analysis with the Coulter LS130 Particle Analysis System

3.3.1. Technique

The Coulter LS130 Particle Size Analysis System is an instrument that uses the diffraction of laser light by particles suspended in a transparent liquid medium. Mie scattering theory is used to deconvolve a time-averaged measurement (obtained via photodiode detectors displaced in angle about the beam centerline) of the diffraction pattern generated by the particulate population exposed to the collimated laser beam. Resulting from the measurement and deconvolution algorithm is the volume-based size distribution of the particulate in the measurement cell. Such a measurement is useful because it provides information regarding the mass distribution of the particulate if the sample is composed of particles with equal-density. When compared to the count-based distribution (obtained by the method described in Section 3.2) of the same particulate, the measured volume-based distribution may be used to indicate shape of the average particle, even when all particles are not equally dense. The Coulter LS130 has a manufacturer-specified size measurement range of 0.4 –1000 μm.

Size analysis with this instrument requires the particulate sample (often milligrams in quantity) to be added to the diluent as a dry powder. Only samples collected in the lower regions of the Tore Supra vessel provided sufficient quantity for analysis. An additional requirement involves efficient removal of the smallest particulate (> ~5 μm) from the filter substrate. Difficulties were encountered in fulfilling this requirement because the small particles strongly adhere to the filter substrate. Repeated washing of the filters with pure water and/or ethanol did remove some of the smaller particulate, as indicated upon microscopy inspection following the wash. Because of these difficulties, only one dust sample from Tore Supra was successfully analyzed with the Coulter LS130. It is recommended that in the future a significant effort is made to collect vastly greater quantities of dust (provided they exist) with an alternative collection technique, such as mechanically removing the particulate, i.e. sweeping with a fine brush into a collection bin. Note however that all collection techniques display size-range bias in collection efficiency.

3.3.2. Results

Particulate collected from the Tore Supra vessel bottom in Module V has been successfully analyzed with the Coulter LS130 particle size analysis system. Shown in Figure 3.83 is the resulting volume-based size distribution of particulate removed from the filter substrate (TSFH23-02) via repeated washing in pure water followed by ethanol. The analysis medium was also ethanol. Results from two rinsing trials are shown on the figure. Trial 1 was performed and two independent measurements were taken with the LS130. Samples for each measurement were obtained from the same particle-ethanol mixture from Trial 1. Effluent from the next rinsing trial (Trial 2) was then added to that of Trial 1, and three separate measurements were obtained with the LS130. As indicated by the larger differential volume (y-axis in the figure) values at lower particle sizes (~0.5-2 μm) from Trial 2 and nearly equivalent values at larger sizes (~10-100 μm) from both trials, several additional small particles were removed during the second rinse cycle. Hence the distributions measured from the Trial 2 measurements are believed to most likely represent the volume-based distribution of this Tore Supra dust sample.

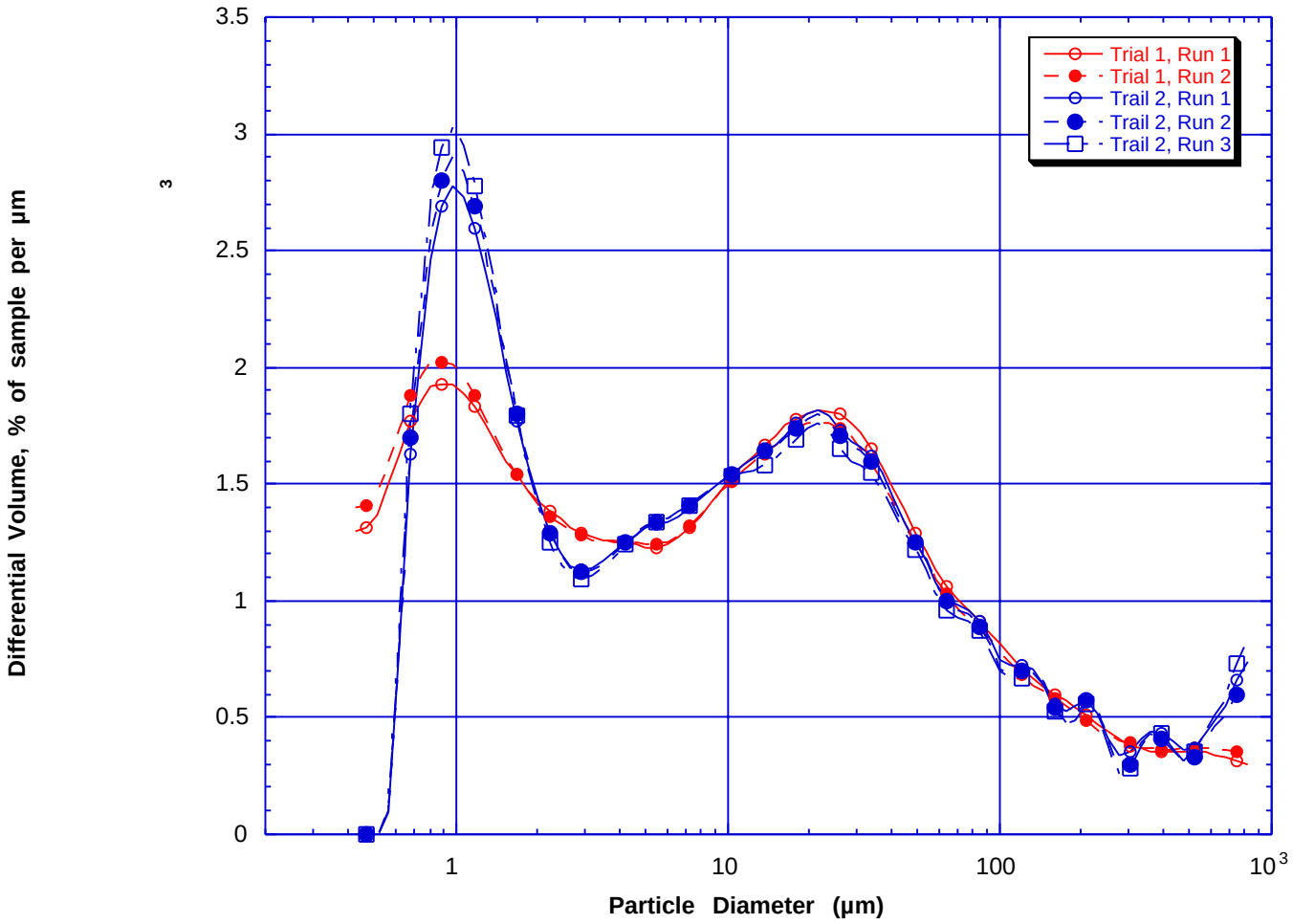


Figure 3.82 Volume-based size distribution of Module V, Sample 50A (TSFH22-03).

An inference may be drawn from the volume-based size distribution shown in Figure 3.82. Two distinct maxima are observed, one centered about 1 µm and the other centered about 23 µm. A large population of particulate exists in the 1-2 µm range, and they are roughly spherical in shape since this measurement agrees with the count-based measurement (GMD of 1.85 µm) given in Figure 3.61 of Section 3.2. Another population with a much larger variance appears in this dust sample. This subset does not correspond to spherical particulate and agrees with the observed bi-modality found in Figure 3.61. The inference regarding the existence of varying particle in this dust sample is not unexpected since many particle shapes were found, as discussed in Section 3.1.

4. Specific Surface Area Analysis

The total effective surface area of dust in a fusion device is an important factor in understanding the consequences of postulated accidents considered in safety analyses. For example, reactive dust may yield explosive concentrations of H_2 when exposed to steam or moist air in loss of vacuum ingress accidents. Measurements of the specific surface area (m^2 per gram) of dust from operating fusion experiments can provide fundamental data for such safety analyses.

4.1. Technique

Measurement of specific surface area of dust collected from Tore Supra was performed with the Micromeritics Model ASAP 2010 accelerated surface area and porosity system. The system is designed to use a static volumetric method for determining the volume of gas adsorbed on a sample at constant temperature (77 K). Measurements of high accuracy are obtained for the adsorptive gas pressure and required volume that fills a control manifold, the sample container, and that adsorbed on the sample surface. Pressures used for this measurement are varied from 0 (vacuum) to approximately 50% of the vapor saturation pressure at the analysis temperature. The molar quantity of adsorbate is computed from the measured pressure *P* and adsorbed volume *V* (normalized to sample mass) by utilizing the BET multilayer physisorption isotherm[6]:

$$\frac{1}{V\left(P_o/P - 1\right)} = \frac{(c-1)P}{cV_m P_o} + \frac{1}{cV_m} \tag{1}$$

where P_o is the vapor pressure at the analysis temperature, V_m is the monlayer volume of adsorbate per unit sample mass, and c is a constant. As V, P, and P_o are known, a linear fit of this equation in P/P_o will yield values of c and V_m. The sample's specific surface area (SSA, m^2/g) at STP (273 K and 1.0 atm) is then found by:

$$SSA = \frac{V_m m_s N_A \sigma_o}{0.0224} \tag{2}$$

where m_s is the sample mass in grams, N_A is Avagadro's number, and σ_o is the molecular diameter (m^2) of the adsorbate (e.g. 0.21E-19 m^2 for Kr). The constant in the denominator of Equation 2 is the volume in m^3 of 1 mole of an ideal gas at STP (T = 300 K, P = 101325 Pa). Due to the small quantities of sample mass available for testing, special procedures have been developed[7] to enhance the sensitivity of the ASAP 2010. These procedures include the use of Kr as the analysis gas and a novel background volume subtraction technique.

4.2. Results

The specific surface area measurements were performed on dust samples taken from the following locations:

i. bottom Location 12 of Module III (TSFH21-02, Sample 30B)
ii. outboard Location 2 of Module IV (TSFH16-02, Sample 32)

iii. bottom Location 11 of Module IV (TSFH15-02, Sample 40B)
iv. bottom Location 12 of Module IV (TSFH19-02, Sample 40A)

These locations were selected because the total sample mass collected from each position was sufficiently large to provide sufficient surface area for measurement. Particulate composition of the samples from these locations included carbon and metal with unknown weight proportions, thereby rendering unknown the components' relative contribution to surface area.

Figure 4.1 through Figure 4.4 show the measured values of (a) adsorbed volume and (b) adsorption isotherms for each sample. Two runs in the ASAP2100 were made for each sample, with a bakeout period between runs. A linear fit of the entire data range on some of the isotherm plots (e.g. Figure 4.2(b) and Figure 4.4(b)) yielded poor linear correlation coefficients (R^2), such that another fit was performed over a reduced range with an improved linear trend. Fits that gives R^2 >0.99 where used to determine averaged sample *SSA* results. Table 4.1 summarizes the measurements and the resulting *SSA* values for the dust samples.

Table 4.1 Summary of results from BET SSA measurements.

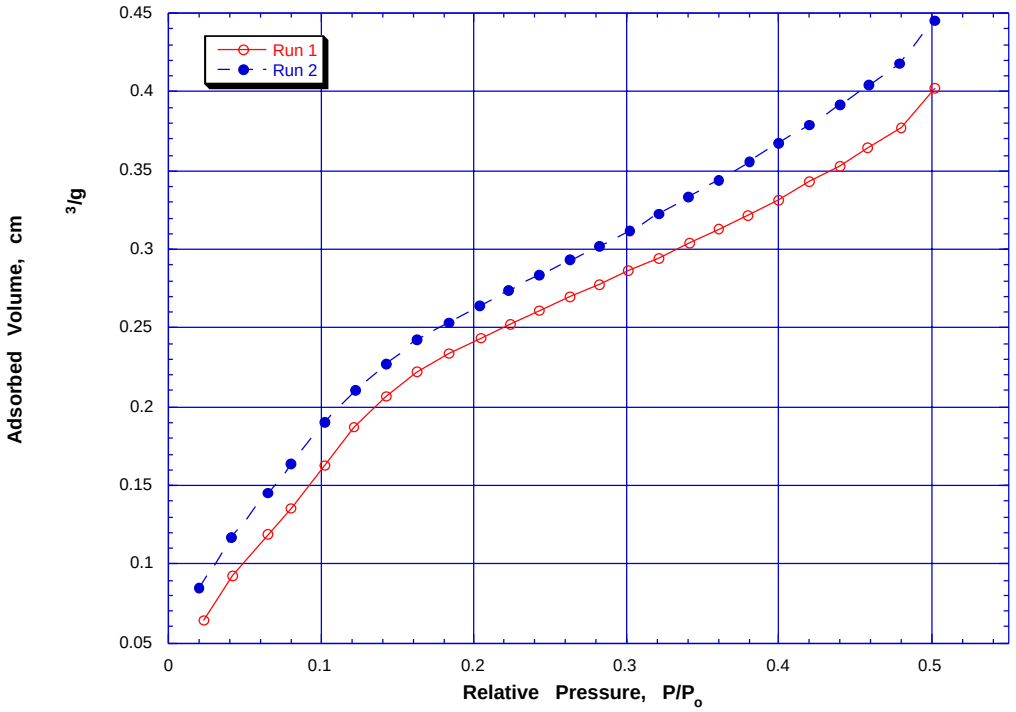
Sample 1.			
Location 12 of Module III (TSFH21-02, Sample 30B)			
Fitted Range		*SSA*, m^2/g	R^2
Run 1:	Full	1.2009 ± 0.0215	0.99633
	Partial:	1.1307 ± 0.0104	0.99950
Run 2:	Full:	1.3075 ± 0.0134	0.99881
	Partial:	1.2806 ± 0.0073	0.99980
Sample average *SSA*: 1.230 ± 0.013 m^2/g			

Sample 2.			
Location 2 of Module IV (TSFH16-02, Sample 32)			
Fitted Range		*SSA*, m^2/g	R^2
Run 1:	Full	2.2780 ± 0.9969	0.29159
	Partial:	1.2109 ± 0.1313	0.99731
Run 2:	Full:	2.0203 ± 0.6310	0.46248
	Partial:	1.3025 ± 0.0337	0.99777
Sample average *SSA*: 1.257 ± 0.083 m^2/g			

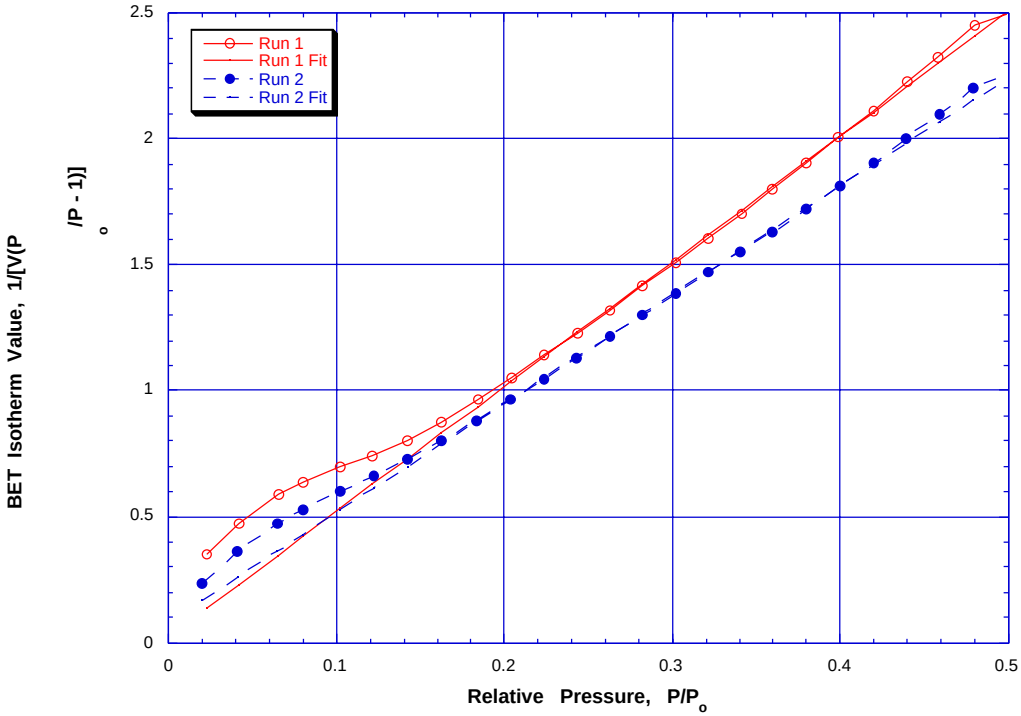
Sample 3.			
Location 11 of Module IV (TSFH15-02, Sample 40B)			
Fitted Range		*SSA*, m^2/g	R^2
Run 1:	Full	NA	NA
	Partial:	1.1990 ± 0.0081	0.99976
Run 2:	Full:	1.5945 ± 0.0680	0.99980
	Partial:	1.5987 ± 0.0038	0.99996
Sample average *SSA*: 1.464 ± 0.026 m^2/g			

Sample 4.			
Location 12 of Module IV (TSFH19-02, Sample 40A)			
Fitted Range		*SSA*, m^2/g	R^2
Run 1:	Full	0.4473 ± 0.0315	0.94629
	Partial:	0.3923 ± 0.0950	0.99781
Run 2:	Full:	0.2683 ± 0.0221	0.93495
	Partial:	0.2400 ± 0.0084	0.99720
Sample average *SSA*: 0.316 ± 0.052` m^2/g			

The value obtained for the outboard sample (ii) was comparable to the values obtained for vessel bottom samples. The value for the bottom sample (iv), however, is lower than the measurements from other bottom locations, possibly due to a greater contribution of metals. Continued investigation is underway to determine the degree of influence of dust composition on specific surface area. The specific surface area measurements for dust in Tore Supra are consistent in magnitude with the average values obtained from other fusion experiments[7]: 2.44 m^2/g in DIII-D, 0.77 m^2/g in Alcator C-Mod, and 0.82 m^2/g in TFTR (vacuum filter analysis with Kr gas).

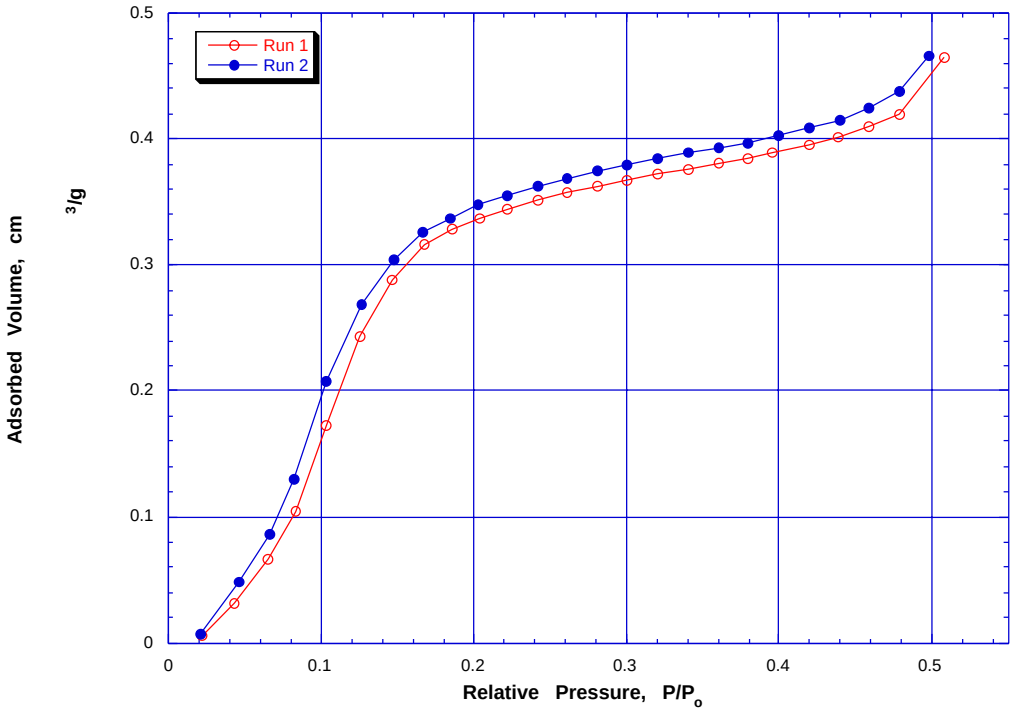


(a) Adsorbed Volume

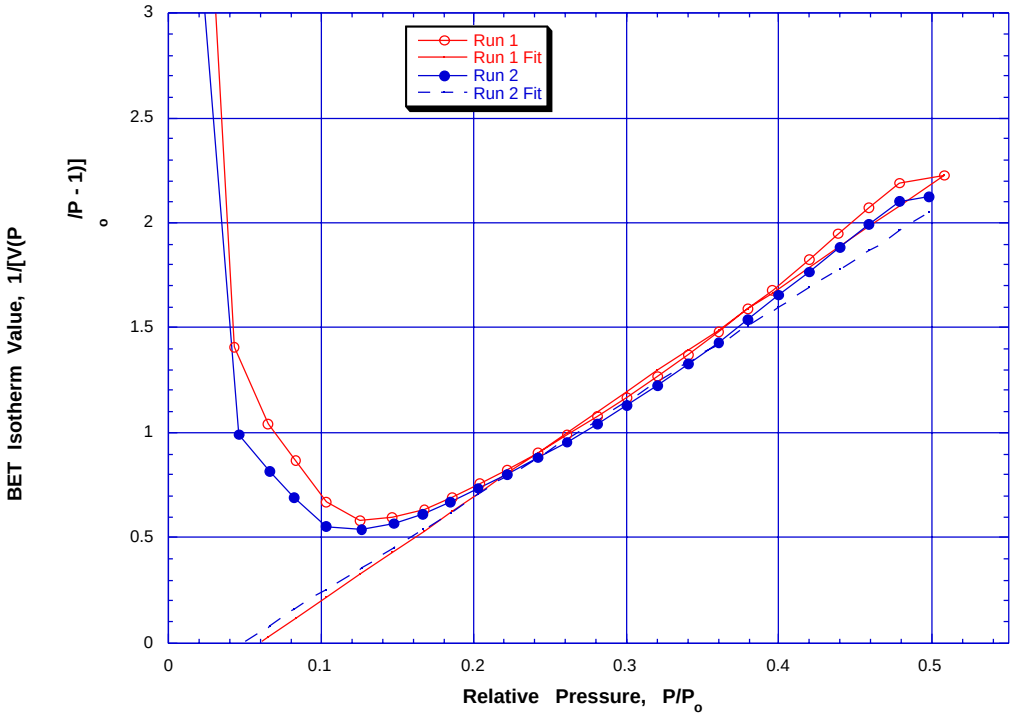


(b) Isotherm

Figure 4.1 Adsorbed Volume (a) and adsorption isotherm (b) for (iv) TSFH21-02, Sample 30B.

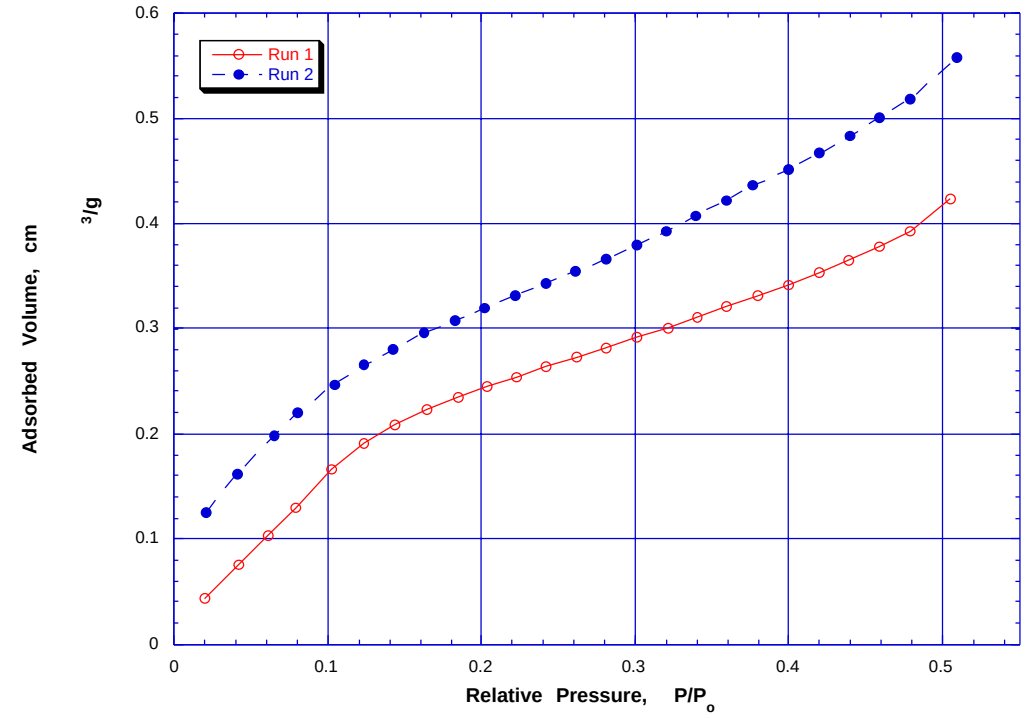


(a) Adsorbed Volume

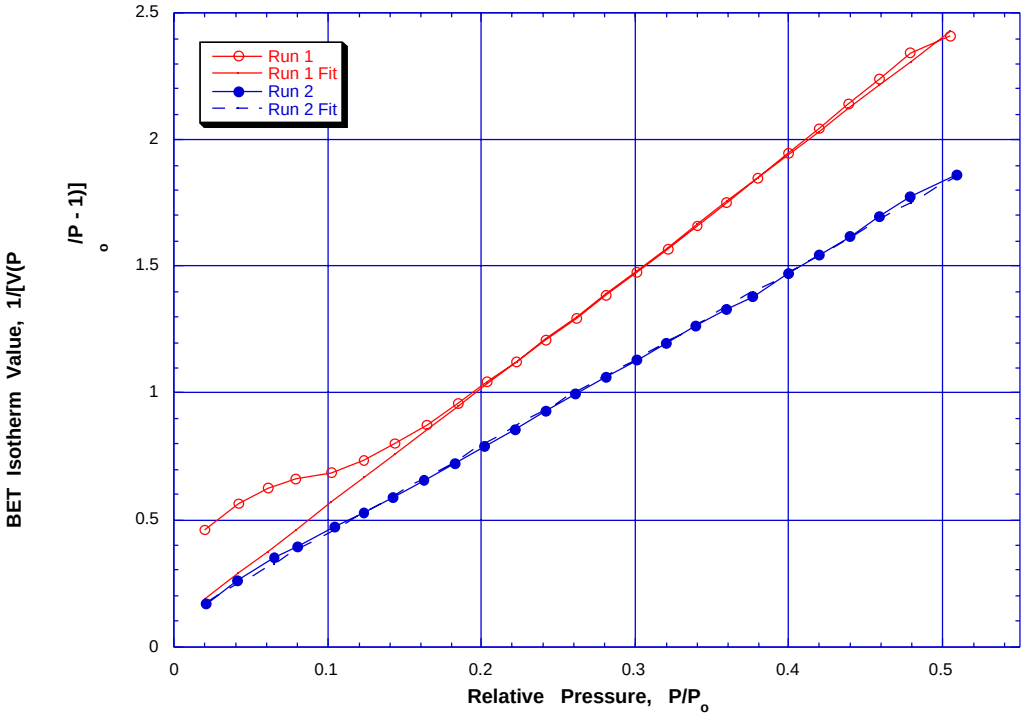


(b) Isotherm

Figure 4.2 Adsorbed Volume (a) and adsorption isotherm (b) for (iii) TSFH16-02, Sample 32.

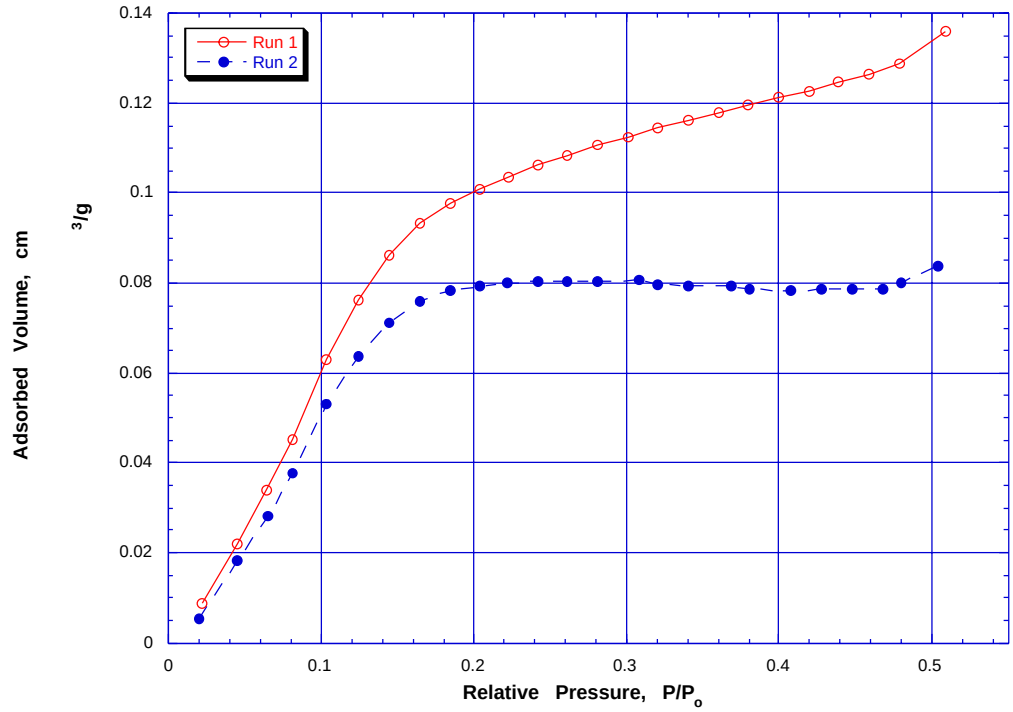


(a) Adsorbed Volume

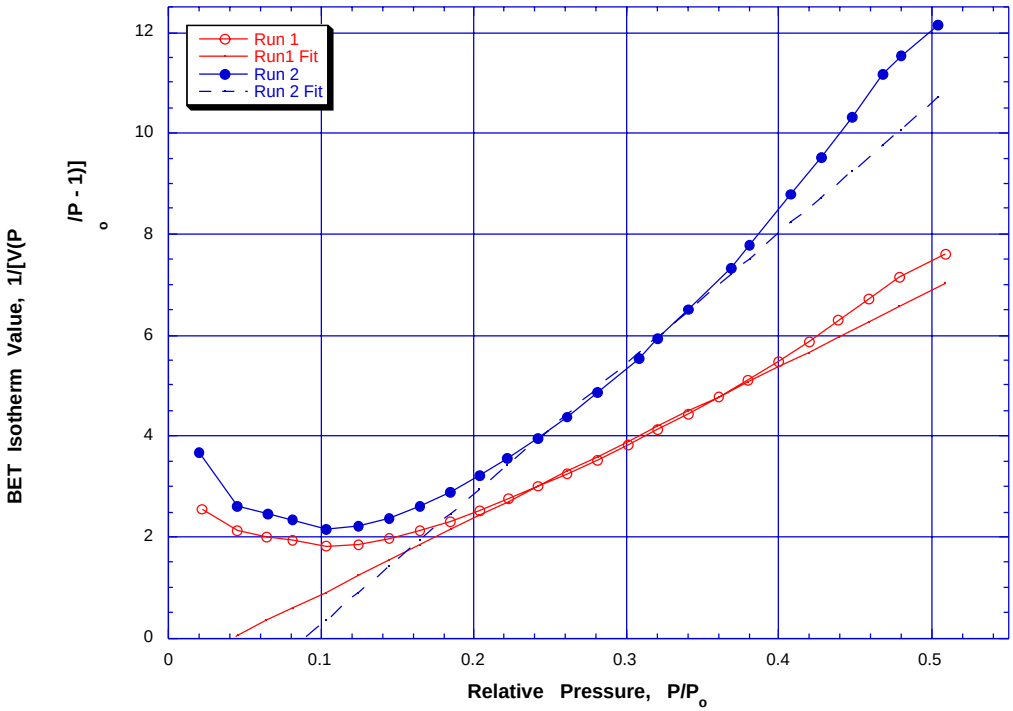


(b) Isotherm

Figure 4.3 Adsorbed Volume (a) and adsorption isotherm (b) for (i) TSFH15-02, Sample 40B.



(a) Adsorbed Volume



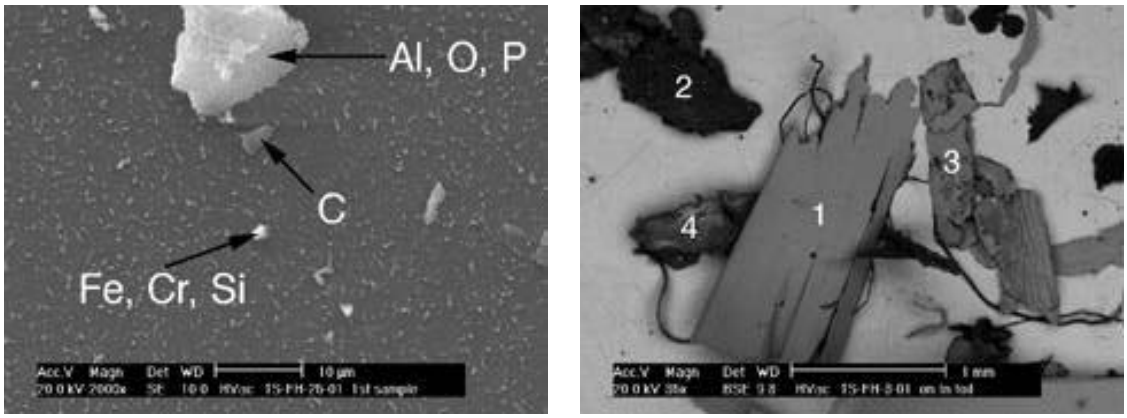
(b) Isotherm

Figure 4.4 Adsorbed Volume (a) and adsorption isotherm (b) for (ii) TSFH19-02, Sample 40A.

5. Particulate Composition Analysis by SEM/EDX Analysis

Qualitative elemental composition analysis of dust collected from Tore Supra was obtained via energy dispersive X-ray analysis. Figure 5.1 shows (a) smaller particulate collected from the upper region of the vessel, and (b) larger particulate collected from the bottom. As indicated in part (a) of the figure, X-ray spot analysis indicated the presence of particles composed of pure carbon, as well as particles containing various quantities of Fe, Cr, Al, Si, and O. The locations identified in part (b) of the figure contain the following:

(1) Fe (67.8 at.%), Cr (18.7 at.%), and Ni (13.5 at.%)
(2) C (65.0 at.%), O (17.0 at.%), Ca (9.00 at%), and Cl (9.00 at.%)
(3) Fe (44.3 at.%), C (20.0 at.%), Cr (14.3 at.%), Ni (10.0 at.%), and O (10.0 at.%)
(4) C (72.5 at.%), Cl (14.7 at.%), and O (12.8 at.%)



(a) Location 6, Module 1 (b) Location 12, Module1

Figure 5.1 SEM images of (a) smaller dust collected from Location 6 and (b) larger debris from Location 12 of Module I.

Quantities of elements such as Al, Zn, Cr, and Fe were also found in particles collected from nearly all locations. Figure 5.2 displays the composition of particles with intermediate sizes (5 – 10 μm) collected from Location 6, of Module I (Sample 5).

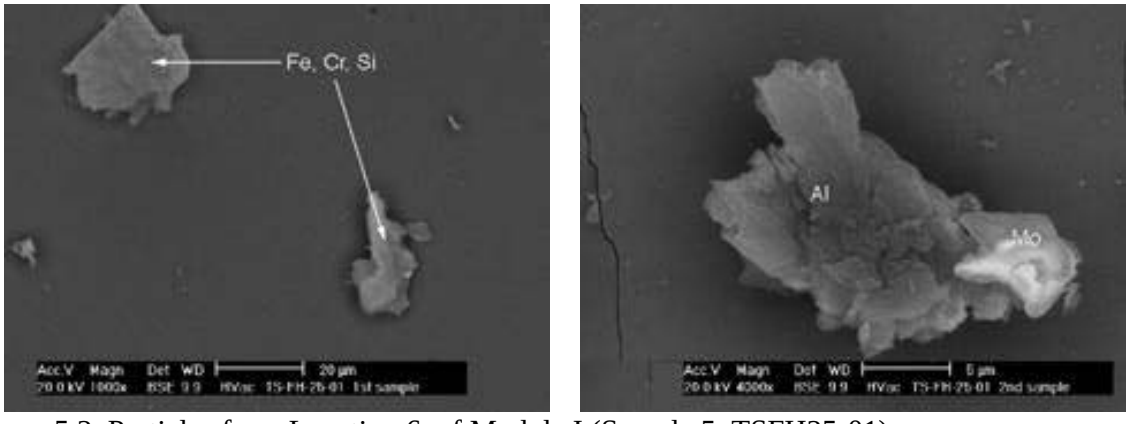


Figure 5.2 Particles from Location 6, of Module I (Sample 5, TSFH25-01).

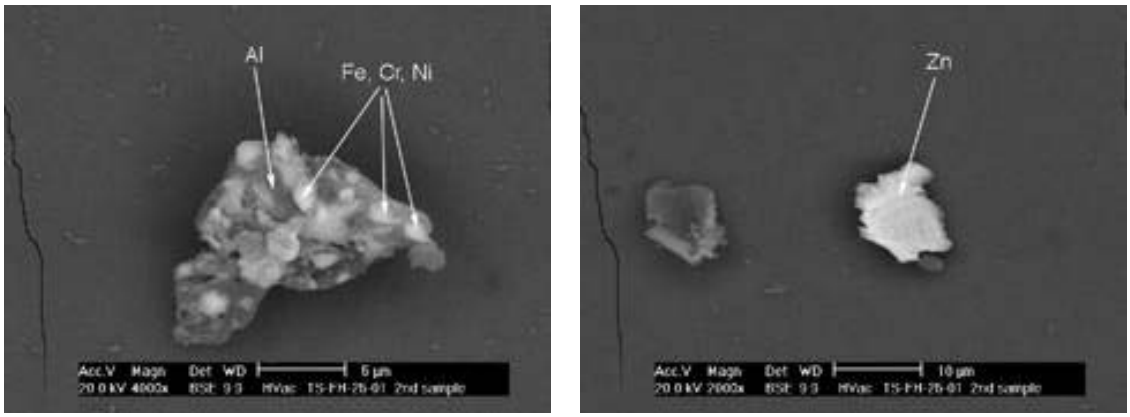


Figure 5.2 continued

6. Discussion

6.1. Distribution of Dust Surface Mass Density

The total mass of dust collected by each filter is divided by the sampled area to give the surface mass density at each sampling location. Figure 6.1 shows the distribution of surface mass density for all poloidal locations in each toroidal module. With the exception of the sample taken from location 1 in module 1, outboard collection locations have an average surface mass density of 20 mg/m^2. The value for location 1 in module 1 is abnormally large (350 mg/m^2) because of the presence and collection of melted copper from a lower hybrid heating antenna in the neighboring port. Particulate collected from inboard locations has an average surface mass density of 35 mg/m^2, slightly greater than that of the outboard locations. Greater deposition on the inboard first wall tiles is expected because of the local plasma contact during inboard limiter operation. Mass surface density of dust collected from upper surfaces has the lowest value relative to all other poloidal positions, having an average of 5.0 mg/m^2. Dust collected at locations 9 and 10 have average surface mass densities of 10.8 mg/m^2 and 6.4 mg/m^2, respectively. The somewhat larger value that is observed on the stainless steel wing is a result of the proximity of the wing to carbon protective tiles on the lower section of the inner first wall. Each of these surface mass density values contrasts greatly with the values obtained from sampling the vessel floor at locations 11 and 12. The average value for location 11 is 1800 mg/m^{2,} and for location 12 the value is 560 mg/m^2. A significant quantity of the dust's mass inventory therefore resides on the vessel bottom. Of the total dust mass collected in this campaign (440 mg), 76% (335 mg) was obtained from the lower reaches of the vessel.

An estimation of the total dust mass inventory has been shown[4] to be 31 g. This estimate was derived by assuming a surface mass distribution of 2000 mg/m^2 on 15 m^2 of the vessel bottom, and an average of 15 mg/m^2 on the remaining 85 m^2 of the vessel surface. A different estimation has been performed based on sputtering of plasma facing components.[4] An integration of all representative plasma discharges for a full experiment campaign (986 discharges) gives 27 g of eroded carbon. This estimation compares remarkably well with the estimated amount total dust mass in the vessel.

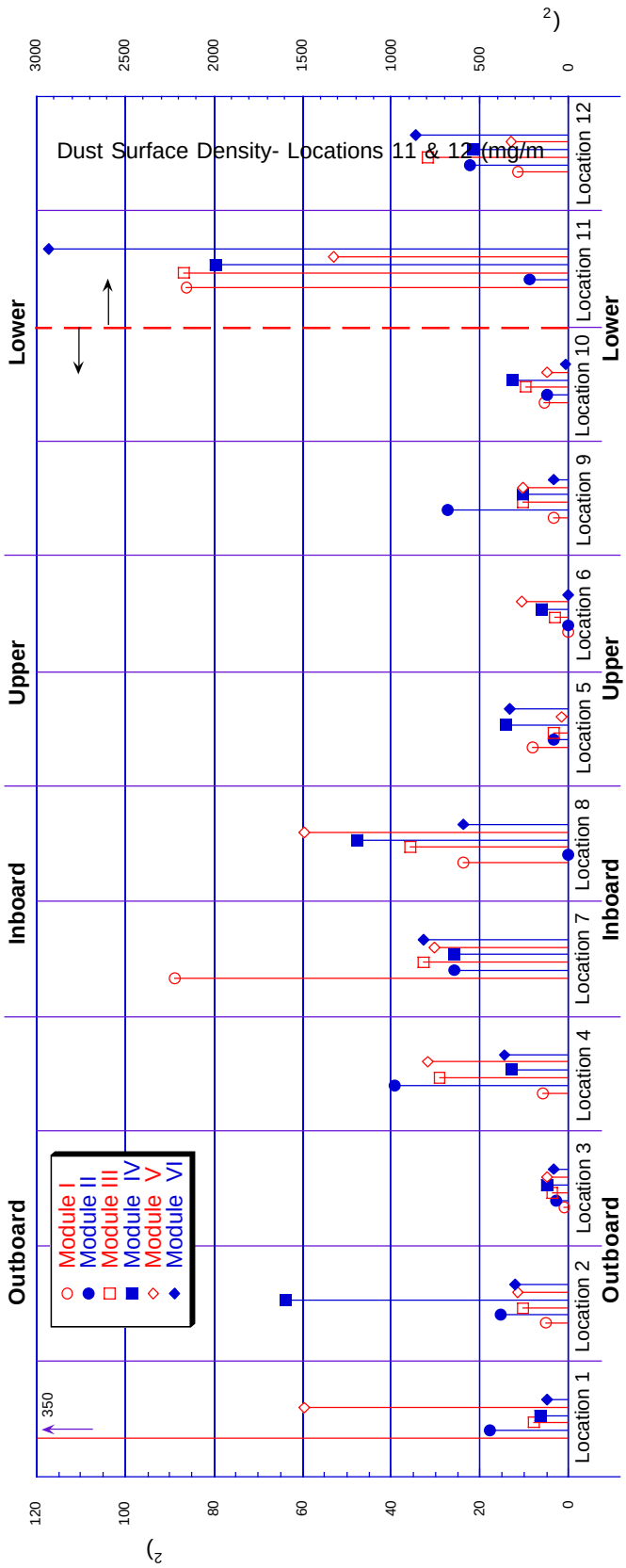


Figure 6.1 Distribution of dust surface mass density in Tore Supra.

6.2. Distribution of Dust Size

Variations of GMD and GSD among all sampled locations are shown in Figure 6.2. Measured GMDs ranged from 0.98 μm to 5.3 μm with an average value of 3.0 μm, and the measured GSDs ranged from 1.93 to 4.03. There are no distinguishable position-dependent trends of the data moments at locations other than vessel bottom Locations 11 and 12. These two sample locations were found to have lower than average GMDs and GSDs, even though most of the collected mass came from these positions. Nearly all the mass from these samples is held in the larger particles of the distribution. Smaller particles, however, significantly outnumber the larger ones, and thereby dominate the count-based distribution. This observation has important safety implications because of the difficulty to efficiently control and remove the smaller particulate.

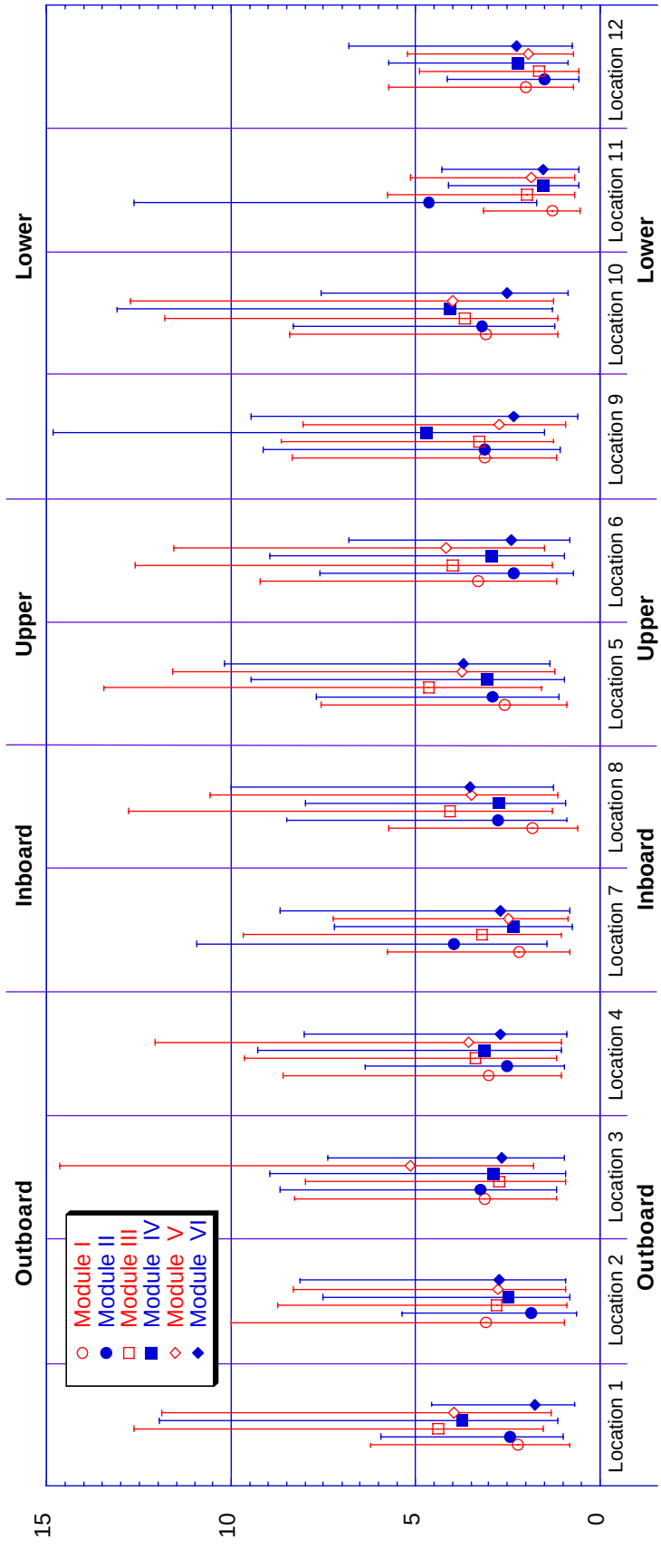


Figure 6.2 Distribution of dust size in Tore Supra.

7. Conclusion

Tokamak dust collected from various locations within the Tore Supra vessel has been characterized in terms of surface mass density distribution, specific surface area, count-based particle size distribution, and particulate composition. Of the 440 mg of dust collected in this campaign, 76% was found at locations on the bottom of the vessel. An average of 1100 mg/m^2 was collected at these locations, whereas an average of 15 mg/m^2 was collected at all other locations. Specific surface area of dust collected from vessel bottom and outboard locations was found to be 1.32 m^2/g. Average particle size from all locations was 3.0 μm, and the particles were composed of several elements that constitute various components within the vessel.

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