

Implementing infrared determination of quartz particulates on novel filters for a prototype dust monitor

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Appendix A. Extended data tables

Table A-1: P-7 analysis of ashed candidate filter assembly materials

Table A-1 reports the results for P-7 sample analysis of candidate materials. Integrated absorbances are recorded for peaks at ~915 (930-900) and ~800 (815-770) cm^{-1} , used for quantifying kaolin and quartz. Presumed (false) masses of these minerals are also recorded, resulting from calculations with the integrated absorbances. Estimates are given for bias, calculated as the mean of false quartz masses, and limit of quantitation (LOQ), calculated as ten times the root mean square of false quartz masses.

Table A-2: Open-face sample gravimetric and P-7 comparison analyses

Table A-2 records the results of the open-face PDM filter tests. The table reports gravimetrically assessed sample masses and the expected P-7 quartz results, using the 0.942 correction factor. Actual P-7 quartz measurements are also reported for both variations of reference spectra employed, as well as percent deviation of P-7 results from expected values. Data are pooled for each PDM filter type.

Table A-3: P-7 comparison analyses for PDM-collected and PVC filters

Table A-3 records the spectrometric results for the PDM-collection tests. The table reports P-7 measured quartz masses for the prototype PDM filters, the related PVC reference samples, and the percent difference between them. Data are grouped by test run for each PDM filter type. Individual PDM filter results are compared to mean reference filter results.

Tables A-4 and A-5: Gravimetric comparisons for polyester- or cellulose-back and PVC filters from PDM-collection tests

Tables A-4 and A-5 report the sample masses for the PDM-collection tests, based on gravimetric assessment of PVC filters and PDM filters of each type. Again, data are grouped by test run and individual PDM filter results are compared to mean PVC filter results. The tables also report PDM-assessed end-of-file (EOF) dust masses, the final instrument mass reading for each test file. Individual EOF results are compared to mean PVC filter and mean PDM filter gravimetric results. These tables address PDM dust measurement accuracy with the new prototype filters. Results are reported as mass measurements and percent differences for the comparisons made.

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Table A-1 P-7 analysis of ashed candidate filter assembly materials

Material tested	Integrated absorbance		Mass/ μg		Bias est. ^c	LOQ est. ^d
	$\sim 915\text{ cm}^{-1}$	$\sim 800\text{ cm}^{-1}$	Kaolin ^a	Quartz ^b		
PVC-acrylic membrane ^e	0.0117	0.0323	0.5	0.6	0.3	4.2
	0.0061	0.0195	0.3	0.4		
	0.0045	-0.0013	0.2	-0.1		
PVC membrane ^e	0.0079	0.0158	0.3	0.3	0.6	6.7
	0.0045	0.0170	0.2	0.3		
	0.0050	0.0613	0.2	1.2		
	0.0010	0.0208	0.0	0.4		
White PP ring/base sets with TiO ₂	-0.0422	-0.7812	-1.8	-15.4	-22.5	243.9
	-0.0468	-0.8371	-2.0	-16.5		
	-0.0509	-1.7969	-2.2	-35.7		
Clear PP ring/base sets	0.0091	0.0048	0.4	0.0	0.3	3.3
	0.0121	0.0249	0.5	0.4		
	-0.0056	0.0174	-0.2	0.4		
High wt. PP electret blown melt fiber	-0.0057	-0.0096	-0.2	-0.2	0.0	1.4
	0.0053	0.0061	0.2	0.1		
	0.0073	0.0058	0.3	0.1		
Med. wt. PP electret blown melt fiber	0.0129	-0.0057	0.6	-0.2	0.2	3.1
	0.0088	0.0156	0.4	0.3		
	0.0147	0.0233	0.6	0.4		
Spun bound cover for electret with TiO ₂	0.0191	-0.1744	0.8	-3.6	-2.9	29.9
	0.0052	-0.1607	0.2	-3.2		
	0.0067	-0.0921	0.3	-1.9		
Non-woven cover for electret	0.0112	0.0045	0.5	0.0	0.0	0.6
	0.0343	0.0119	1.5	0.0		
	0.0021	-0.0025	0.1	-0.1		
All-nylon fibrous filter	-0.0108	0.0482	-0.5	1.0	1.3	13.7
	-0.0102	0.0368	-0.4	0.8		
	-0.0133	0.0973	-0.6	2.0		
HEPA all-nylon fibrous filter ^f	-0.0299	-0.0124	-1.3	-0.1	0.5	6.5
	0.0460	0.0378	2.0	0.5		
	0.0021	0.0502	0.1	1.0		
Cellulose with melamine binder	0.0084	0.0221	0.4	0.4	0.5	4.8
	0.0086	0.0310	0.4	0.6		
	0.0064	0.0227	0.3	0.4		
High strength cellulose	-0.0012	0.0251	-0.1	0.5	0.2	3.1
	0.0040	0.0096	0.2	0.2		
	-0.0008	0.0000	0.0	0.0		

^a (Kaolin mass in μg) = (915 cm^{-1} integr. abs.)/0.023

^b (Quartz mass in μg) = {(800 cm^{-1} integr. abs.) - [(915 cm^{-1} integr. abs.)/3.62]}/0.050

^c Calculated as mean of quartz mass values. ^d Calculated as 10 x root mean square of quartz mass values.

^e Reference filter materials. ^f Most promising new filter material.

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Table A-2 Open-face sample gravimetric and P-7 comparison analyses

Sample type	Grav.	0.942 x Grav.	Reference = PVC-acrylic filter		Reference = PVC-acrylic + PDM filters	
	mass/ μg	mass/ μg	P-7 mass/ μg	P-7/Grav. diff. (%)	P-7 mass/ μg	P-7/Grav. diff. (%)
Polyester-back	529	498	495	-0.7	489	-1.9
	514	484	495	2.2	485	0.2
	514	484	485	0.2	482	-0.5
	512	482	474	-1.7	472	-2.1
	524	494	491	-0.5	489	-0.9
	517	487	496	1.8	492	1.0
	495	466	492	5.5	487	4.4
	498	469	466	-0.7	457	-2.6
	501	472	482	2.1	483	2.3
	513	483	495	2.4	495	2.4
	Pooled mean =	511.7	482.0	487.1	1.1	483.1
Pooled SD =	10.9	10.3	10.3	2.2	11.1	2.3
Cellulose-back	497	468	465	-0.7	467	-0.3
	498	469	461	-1.7	462	-1.5
	491	463	456	-1.4	456	-1.4
	487	459	461	0.5	461	0.5
	539	508	499	-1.7	501	-1.3
	488	460	448	-2.5	449	-2.3
	487	459	460	0.3	459	0.1
	484	456	458	0.5	458	0.5
	490	462	483	4.6	486	5.3
	539	508	504	-0.7	503	-0.9
	Pooled mean =	500.0	471.0	469.5	-0.3	470.2
Pooled SD =	21.0	19.8	19.1	2.0	19.3	2.1

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Table A-3 P-7 comparison analyses for PDM-collected and PVC filters^a

PDM no.	Polyester-back filters			Cellulose-back filters		
	PDM filter P-7 mass/ μ g	PVC filter P-7 mass/ μ g	PDM/PVC _M diff. (%)	PDM filter P-7 mass/ μ g	PVC filter P-7 mass/ μ g	PDM/PVC _M diff. (%)
		453			445	
1	451	448	0.6	451	434	1.6
2	452	443	0.8	451	441	1.6
3	418	449	-6.7	435	455	-2.0
Mean =	440.3	448.3	-1.8	445.7	443.8	0.4
		458			489	
1	433	474	-5.1	448	476	-4.8
2	462	438	1.2	466	475	-1.0
3	420	456	-8.0	460	443	-2.3
Mean =	438.3	456.5	-4.0	458.0	470.8	-2.7
		454			402	
1	422	448	-6.5	408	419	-0.5
2	447	451	-0.9	417	408	1.6
3	444	452	-1.6	413	412	0.7
Mean =	437.7	451.3	-3.0	412.7	410.3	0.6
		463			430	
1	467	447	3.0	422	452	-3.5
2	466	457	2.8	436	430	-0.3
3	-	447	-	432	438	-1.3
Mean =	466.5	453.5	2.9	430.0	437.5	-1.7
		439			446	
1	413	431	-4.0	443	450	-2.5
2	428	422	-0.5	449	471	-1.2
3	417	428	-3.0	428	450	-5.8
Mean =	419.3	430.0	-2.5	440.0	454.3	-3.1
		431			447	
1	460	469	2.4	432	449	-2.5
2	449	451	0.0	442	440	-0.3
3	445	445	-0.9	446	437	0.6
Mean =	451.3	449.0	0.5	440.0	443.3	-0.7
		Pooled mean =	-1.6		Pooled mean =	-1.2
		Pooled SD =	3.5		Pooled SD =	2.1

^a Subscript M denotes the mean of the sample type indicated.

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Table A-4 Gravimetric comparisons for polyester-back and PVC filters from PDM-collection tests^{a,b}

PDM no.	Mass/ μ g			Difference (%)		
	PDM filter grav.	EOF value	PVC filter grav.	PDM/PVC _M	EOF/PVC _M	EOF/PDM _M
			475			
1	495	512	462	5.4	9.1	5.1
2	494	513	467	5.2	9.3	5.3
3	473	-	474	0.7	-	-
Mean =	487.3	512.5	469.5	3.8	9.2	5.2
			482			
1	484	494	491	1.1	3.2	1.5
2	509	533	463	6.3	11.3	9.5
3	467	-	479	-2.5	-	-
Mean =	486.7	513.5	478.8	1.7	7.3	5.5
			471			
1	472	496	456	0.7	5.9	3.3
2	479	499	479	2.2	6.5	3.9
3	490	-	468	4.6	-	-
Mean =	480.3	497.5	468.5	2.5	6.2	3.6
			487			
1	510	521	472	4.7	7.0	2.9
2	503	519	490	3.3	6.6	2.5
3	-	-	499	-	-	-
Mean =	506.5	520.0	487.0	4.0	6.8	2.7
			457			
1	457	463	448	1.0	2.3	1.5
2	463	485	448	2.3	7.2	6.4
3	448	-	457	-1.0	-	-
Mean =	456.0	474.0	452.5	0.8	4.8	3.9
			481			
1	503	510	484	4.5	6.0	3.8
2	491	503	486	2.0	4.5	2.4
3	480	-	474	-0.3	-	-
Mean =	491.3	506.5	481.3	2.1	5.2	3.1
			Pooled mean =	2.4	6.6	4.0
			Pooled SD =	2.5	2.5	2.3

^a Subscript M denotes the mean of the sample type indicated. ^b PDM no. 3 EOF data was not included.

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Table A-5 Gravimetric comparisons for cellulose-back and PVC filters from PDM-collection tests^{a,b}

PDM no.	Mass/ μ g			Difference (%)		
	PDM filter grav.	EOF value	PVC filter grav.	PDM/PVC _M	EOF/PVC _M	EOF/PDM _M
			482			
1	469	517	460	-1.6	8.5	9.2
2	476	529	490	-0.1	11.0	11.8
3	475	-	474	-0.3	-	-
Mean =	473.3	523.0	476.5	-0.7	9.8	10.5
			518			
1	468	537	507	-6.1	7.7	12.4
2	489	548	498	-1.9	9.9	14.7
3	476	-	471	-4.5	-	-
Mean =	477.7	542.5	498.5	-4.2	8.8	13.6
			432			
1	426	459	463	-3.9	3.6	7.7
2	426	467	434	-3.9	5.4	9.5
3	427	-	444	-3.7	-	-
Mean =	426.3	463.0	443.3	-3.8	4.5	8.6
			463			
1	455	458	468	-2.0	-1.4	-1.4
2	472	487	458	1.6	4.8	4.8
3	467	-	469	0.5	-	-
Mean =	464.7	472.5	464.5	0.0	1.7	1.7
			475			
1	496	501	469	4.3	5.3	4.1
2	483	495	485	1.5	4.0	2.8
3	465	-	474	-2.3	-	-
Mean =	481.3	498.0	475.8	1.2	4.7	3.5
			477			
1	443	486	464	-5.4	3.8	8.8
2	447	500	467	-4.5	6.8	11.9
3	450	-	465	-3.9	-	-
Mean =	446.7	493.0	468.3	-4.6	5.3	10.4
			Pooled mean =	-2.0	5.8	8.0
			Pooled SD =	2.8	3.3	4.7

^a Subscript M denotes the mean of the sample type indicated. ^b PDM no. 3 EOF data was not included.