



TECHNICAL MEMORANDUM

TO: Dennis Crumpler / OAQPS
FROM: Eric Boswell / NAREL
COPY: Mike Poore / CARB
Ken Stroud / CARB
AUTHOR: Jewell Smiley / NAREL
DATE: November 12, 2008
SUBJECT: CARB Laboratory Audit

Introduction

On September 25, 2008, a Technical Systems Audit (TSA) was conducted at the Northern Laboratory Branch of the California Air Resources Board (CARB) facilities located in Sacramento. The TSA was conducted as part of the US EPA's quality assurance oversight for the PM_{2.5} Chemical Speciation Network (CSN). CARB has elected to use their own laboratory facilities to analyze many of the speciation samples collected within the state rather than use other laboratories which are available to perform this function under a federal contract.

This audit was performed by Steve Taylor and Jewell Smiley from EPA's National Air and Radiation Environmental Laboratory (NAREL) located in Montgomery, AL. This TSA was a routine inspection of specific laboratory systems and operations at CARB that are required for the analysis of PM_{2.5} Speciation samples. The last TSA performed by NAREL was conducted in June of 2006 [see reference 1].

Summary of Audit Proceedings

After a brief meeting with some of the CARB staff and supervisors, the audit team visited specific areas of the laboratory to interview those technical staff actually performing the analyses. At least one member of the CARB staff was always available to escort and assist the auditors. The following specific areas at the CARB facilities were visited and inspected.

- Sample Receiving and Handling Laboratory – George Dunstan
- Carbon Thermal Optical Analysis (TOA) Laboratory – Peter Samra
- Gravimetric Laboratory – Debbie Moreno-Thornsberry
- X-Ray Fluorescence (XRF) Laboratory – Mike Humenny
- Ion Chromatography (IC) Laboratory – George Dunstan

Besides the areas mentioned above, interviews were also conducted with the following CARB staff.

- Michael Poore – Chief, Northern Laboratory Branch
- Ken Stroud – Chief, Air Quality Surveillance Branch

- Merrin Wright – Quality Assurance Manager
- Samantha Scola – Air Pollution Specialist
- Dan Tackett – LIMS Specialist

CARB’s Northern Laboratory Branch provides a large number of chemical analyses using many different analytical methods. However, this TSA focused exclusively on the techniques listed above which are used to analyze PM_{2.5} filters collected at seven speciation sites and thirty mass sites. All seven of the speciation field sites use Met One SASS units for most sample collections. Three of the sites have recently added a URG 3000N unit to collect PM_{2.5} for subsequent carbon analysis. CARB has been analyzing speciation samples since January of 2002.

The auditors were familiar with CARB’s Quality Assurance Project Plan (QAPP) and pertinent SOPs. A few months before the TSA was scheduled, a set of single-blind Performance Evaluation (PE) samples were prepared at NAREL and submitted to CARB for analysis. All of the results from these PE samples were available to discuss with CARB staff during the audit.

Sample Receiving and Handling Laboratory

George Dunstan is currently responsible for shipping clean filters to the field sites and receiving the loaded filters back at the lab. An SOP is available on the web that describes this critical process [see reference 2].

Sample receiving was the first area inspected, and both auditors were present to observe how samples were processed and handled. New clean filters are prepared for shipment to the supported field sites by placing the new Teflon® and Nylon® filters into SASS canisters, and the new quartz filters are first placed into cassettes which are then assembled into URG3000N cartridges. Each new filter is protected to minimize any unwanted contamination during shipment and at the field site. After the sampling event, the loaded filters are returned to the laboratory still mounted in the canisters and the cartridge, but are cooled to approximately 4 °C for preservation during transit. Upon receipt at the laboratory, the samples are removed from the shipping cooler, and the temperature is recorded. The canisters and cartridge are disassembled, and each recovered filter is placed into a new container. The Nylon® filter is transferred to an extraction tube. The Teflon® and the quartz filters are transferred to Petri slides to await analysis. Canisters and filter holder cassettes are expensive and must be cleaned for reuse. A dishwasher was used to clean these items. Field blanks were used to monitor for accidental contamination of the filter media. A request was made to query the Laboratory Information Management System (LIMS) for the field blank results. A summary of those results is presented in the following table.

Table 1. Field Blank Summary Results

Parameter	Instrument	Concentration (µg/filter)					Number of Values
		Average	Max	Min	Std. Dev.	LOD*	
PM _{2.5} Mass	Balance	7.657	27	-10	7.554	1	102
EC by TOT	Carbon Anal. – SASS	0.000	0.000	0.000	0.000	9	35
OC by TOT	Carbon Anal. – SASS	7.039	14.980	2.740	2.433	9	35
Ammonium	IC	0.115	0.400	-0.110	0.121	0.500	102
Nitrate	IC	0.453	2.260	0.210	0.243	0.500	102

Table 1. Field Blank Summary Results

Parameter	Instrument	Concentration (µg/filter)					Number of Values
		Average	Max	Min	Std. Dev.	LOD*	
Potassium	IC	0.056	0.410	0.000	0.098	1.250	102
Sodium	IC	0.272	1.730	-0.290	0.409	0.750	102
Sulfate	IC	0.078	2.340	0.000	0.244	1.750	102
Aluminum	XRF	-0.026	0.650	-0.280	0.130	0.092	106
Antimony	XRF	0.070	0.290	0.000	0.087	0.129	106
Arsenic	XRF	0.001	0.010	0.000	0.002	0.009	106
Barium	XRF	0.091	0.130	0.050	0.015	0.054	106
Bromine	XRF	0.001	0.010	0.000	0.003	0.006	106
Calcium	XRF	0.047	0.390	0.010	0.042	0.049	106
Chlorine	XRF	0.028	0.120	0.010	0.015	0.028	106
Chromium	XRF	0.005	0.030	0.000	0.006	0.016	106
Cobalt	XRF	0.001	0.010	0.000	0.002	0.019	106
Copper	XRF	0.022	0.040	0.010	0.008	0.012	106
Iron	XRF	0.031	0.150	0.010	0.020	0.015	106
Lead	XRF	0.003	0.020	0.000	0.005	0.020	106
Manganese	XRF	0.004	0.010	0.000	0.005	0.018	106
Mercury	XRF	0.002	0.020	0.000	0.004	0.017	106
Molybdenum	XRF	0.000	0.000	0.000	0.000	0.044	106
Nickel	XRF	0.000	0.010	0.000	0.002	0.021	106
Phosphorus	XRF	0.000	0.010	0.000	0.002	0.027	106
Potassium	XRF	0.053	0.130	0.030	0.013	0.055	106
Rubidium	XRF	0.002	0.010	0.000	0.004	0.007	106
Selenium	XRF	0.002	0.010	0.000	0.004	0.009	106
Silicon	XRF	0.061	0.250	0.010	0.038	0.042	106
Strontium	XRF	0.008	0.020	0.000	0.007	0.014	106
Sulfur	XRF	0.002	0.040	0.000	0.006	0.033	106
Tin	XRF	0.046	0.200	0.000	0.057	0.095	106
Titanium	XRF	0.007	0.050	0.000	0.009	0.024	106
Vanadium	XRF	0.002	0.010	0.000	0.004	0.021	106
Yttrium	XRF	0.002	0.020	0.000	0.005	0.016	106
Zinc	XRF	0.006	0.020	0.000	0.006	0.010	106

*LOD = *Limit of Detection*

The field blanks summarized in Table 1 were from several different sampling periods. Blanks for gravimetric mass and IC analysis were from a sampling period that ran from April 2006 to July 2008. The XRF blanks were from sampling dates between August 2005 and January 2008. The thirty-five carbon field blanks described in Table 1 were scheduled for the Met One SASS samplers and cover a period between April and December of 2006. After December of 2006, the traditional 47-mm quartz filter blanks were discontinued and replaced with 25-mm quartz backup filters that are installed into the URG 3000N samplers. Table 2 summarizes all of the results from quartz backup filters installed at the three field sites that were converted to URG 3000N sampling. The twenty-four quartz backup filters cover a period between May 2007 and July 2008.

Table 2. Quartz Backup Filter Summary Results

Parameter	Instrument	Concentration (µg/filter)					Number of Values
		Average	Max	Min	Std. Dev.	LOD*	
EC by TOR	Carbon Anal. – 3000N	0.157	1.480	0.000	0.346	2	24
OC by TOR	Carbon Anal. – 3000N	5.639	27.130	3.030	4.952	2	24
PyroC by TOR	Carbon Anal. – 3000N	0.042	1.010	0.000	0.206	2	24
OC1	Carbon Anal. – 3000N	0.194	0.810	0.000	0.295	2	24
OC2	Carbon Anal. – 3000N	1.994	6.840	1.110	1.223	2	24
OC3	Carbon Anal. – 3000N	3.005	18.840	1.580	3.445	2	24
OC4	Carbon Anal. – 3000N	0.406	4.350	0.000	0.888	2	24
EC1	Carbon Anal. – 3000N	0.176	2.290	0.000	0.491	2	24
EC2	Carbon Anal. – 3000N	0.023	0.200	0.000	0.061	2	24
EC3	Carbon Anal. – 3000N	0.000	0.000	0.000	0.000	2	24
EC by TOT	Carbon Anal. – 3000N	0.000	0.000	0.000	0.000	2	24
OC by TOT	Carbon Anal. – 3000N	5.793	28.610	3.030	5.251	2	24
PyroC by TOT	Carbon Anal. – 3000N	0.199	2.490	0.000	0.528	2	24

*LOD = Limit of Detection

A simple experiment was performed during the audit to measure the level of contamination that a filter may receive during canister assembly followed immediately by canister disassembly to retrieve the filter. Four sets of clean filters (four Teflon®, four Nylon®, and four quartz filters) were hand-carried from NAREL to the audit and were available for the experiment. Half of the filters (two sets) were assembled into “clean” canisters provided by CARB, and the remaining filters were treated as experimental control blanks since they were not removed from their containers during the TSA. George performed the experiment during the audit after which all of the filters were carried back to NAREL for analysis. Results from the canister assembly experiment are presented in Table 3, and no significant contamination was observed for any of the test filters.

Table 3. Results from Canister Assembly & Filter Retrieval Experiment

Filter ID	Filter Description	Parameter	Instrument	Concentration (µg/filter)
T08-12536	Teflon® test filter #1	PM2.5 Mass	Balance	1
T08-12537	Teflon® test filter #2	PM2.5 Mass	Balance	1
T08-12540	Teflon® control filter #1	PM2.5 Mass	Balance	2
T08-12541	Teflon® control filter #2	PM2.5 Mass	Balance	2
Q08-12560	Quartz test filter #1	Elemental Carbon	Carbon Anal.	not detected
Q08-12561	Quartz test filter #2	Elemental Carbon	Carbon Anal.	not detected
Q08-12562	Quartz control filter #1	Elemental Carbon	Carbon Anal.	not detected
Q08-12563	Quartz control filter #2	Elemental Carbon	Carbon Anal.	not detected
Q08-12560	Quartz test filter #1	Organic Carbon	Carbon Anal.	2.1
Q08-12561	Quartz test filter #2	Organic Carbon	Carbon Anal.	1.6
Q08-12562	Quartz control filter #1	Organic Carbon	Carbon Anal.	1.7
Q08-12563	Quartz control filter #2	Organic Carbon	Carbon Anal.	2.0

Table 3. Results from Canister Assembly & Filter Retrieval Experiment

Filter ID	Filter Description	Parameter	Instrument	Concentration (µg/filter)
N08-12552	Nylon® test filter #1	Nitrate	IC	not detected
N08-12553	Nylon® test filter #2	Nitrate	IC	not detected
N08-12554	Nylon® control filter #1	Nitrate	IC	not detected
N08-12555	Nylon® control filter #2	Nitrate	IC	not detected
N08-12552	Nylon® test filter #1	Sulfate	IC	not detected
N08-12553	Nylon® test filter #2	Sulfate	IC	not detected
N08-12554	Nylon® control filter #1	Sulfate	IC	not detected
N08-12555	Nylon® control filter #2	Sulfate	IC	not detected
N08-12552	Nylon® test filter #1	Ammonium	IC	not detected
N08-12553	Nylon® test filter #2	Ammonium	IC	not detected
N08-12554	Nylon® control filter #1	Ammonium	IC	not detected
N08-12555	Nylon® control filter #2	Ammonium	IC	not detected
N08-12552	Nylon® test filter #1	Potassium	IC	not detected
N08-12553	Nylon® test filter #2	Potassium	IC	not detected
N08-12554	Nylon® control filter #1	Potassium	IC	not detected
N08-12555	Nylon® control filter #2	Potassium	IC	not detected
N08-12552	Nylon® test filter #1	Sodium	IC	not detected
N08-12553	Nylon® test filter #2	Sodium	IC	not detected
N08-12554	Nylon® control filter #1	Sodium	IC	not detected
N08-12555	Nylon® control filter #2	Sodium	IC	not detected

CARB maintains a stock of ready-to-go filters, and during the audit, a request was made to remove two of each filter type from their stock. These six stock filters were carried back to NAREL for analysis, and the results are presented in Table 4.

Table 4. Results from Clean Filters Removed from CARB's Stock

Filter ID	Filter Description	Parameter	Instrument	Concentration (µg/filter)
T08-12568	Teflon® (CARB# PFS03509)	PM2.5 Mass	Balance	0
T08-12569	Teflon® (CARB# PFS03510)	PM2.5 Mass	Balance	0
Q08-12576	Quartz test filter #1	Elemental Carbon	Carbon Anal.	not detected
Q08-12577	Quartz test filter #2	Elemental Carbon	Carbon Anal.	not detected
Q08-12576	Quartz test filter #1	Organic Carbon	Carbon Anal.	3.1
Q08-12577	Quartz test filter #2	Organic Carbon	Carbon Anal.	1.0
N08-12572	Nylon® test filter #1	Nitrate	IC	not detected
N08-12573	Nylon® test filter #2	Nitrate	IC	not detected
N08-12572	Nylon® test filter #1	Sulfate	IC	not detected
N08-12573	Nylon® test filter #2	Sulfate	IC	not detected

Table 4. Results from Clean Filters Removed from CARB's Stock

Filter ID	Filter Description	Parameter	Instrument	Concentration (µg/filter)
N08-12572	Nylon® test filter #1	Ammonium	IC	not detected
N08-12573	Nylon® test filter #2	Ammonium	IC	not detected
N08-12572	Nylon® test filter #1	Potassium	IC	not detected
N08-12573	Nylon® test filter #2	Potassium	IC	not detected
N08-12572	Nylon® test filter #1	Sodium	IC	not detected
N08-12573	Nylon® test filter #2	Sodium	IC	not detected

The results in Table 4 show that the quartz and Nylon® filters taken from CARB's stock were very clean. It should be explained that the Teflon® filters were evaluated by subtracting the tare mass determined at CARB from the tare mass determined several days later at NAREL. Table 4 shows perfect agreement between CARB and NAREL for measuring the tare mass of the Teflon® filters. XRF analysis was not performed for the Teflon® filters listed in Table 3 and Table 4.

Good laboratory practices were generally observed for supplying clean filters to the supported field sites and for retrieving the loaded filters following sample collection. No deficiencies were noted for this area of laboratory operations.

Carbon Thermal Optical Analysis (TOA) Laboratory

The thermal optical analysis of exposed quartz microfiber filters to determine the organic and elemental carbon fractions is normally performed by Peter Samra using an SOP that is available for viewing on the web (see reference 3). Peter uses a DRI Model 2001 carbon analyzer to perform this work.

Significant changes were implemented at CARB in 2007 affecting both the sampling and the analysis of PM_{2.5} carbon. Three of the seven speciation field sites supported by CARB have been converted to the URG 3000N samplers, and quartz filters are currently provided only to the converted sites. Quartz filters are no longer collected using the Met One SASS samplers, and therefore the carbon analysis is no longer performed for the four sites that have not been converted. Furthermore, at the laboratory the IMPROVE_A method has been adopted for analysis of the carbon fractions after discontinuing the custom analytical method that was used previously. The fundamental change in the carbon analysis was the temperature protocol. Table 5 shows the custom temperature protocol previously used at CARB along with the IMPROVE_A protocol for comparison.

Table 5. Comparison of the Temperature Protocols for Two TOA Methods

Custom Method Previously Used at CARB	IMPROVE_A Method Currently Used at CARB	Carrier Gas
heater off (90s)	heater off (90s)	He Purge
250°C (180s)	140°C (150-580s)	He
400°C (150s)	279°C (150-580s)	He

Table 5. Comparison of the Temperature Protocols for Two TOA Methods

Custom Method Previously Used at CARB	IMPROVE_A Method Currently Used at CARB	Carrier Gas
550°C (150s)	480°C (150-580s)	He
700°C (270s)	580°C (150-580s)	He
heater off (60s)	-----	
550°C (100s)	580°C (150-580s)	He/O ₂
650°C (100s)	740°C (150-580s)	He/O ₂
750°C (100s)	840°C (150-580s)	He/O ₂
850°C (100s)	-----	He/O ₂
900°C (170s)	-----	He/O ₂
heater off (200s)	heater off (200s)	He/O ₂ +IS

The custom method shown in Table 5 was implemented at CARB in 2003 (see reference 4) to achieve better agreement with the carbon results produced at EPA’s national contract laboratory for the urban air monitoring network (Chemical Speciation Network, CSN). Over the next few years, however, EPA had growing concerns about unresolved differences in carbon data produced by the CSN and the rural air monitoring program (Interagency Monitoring of PROtected Visual Environments, IMPROVE). EPA announced a plan in 2006 to convert all the CSN field sites to carbon sampling and analysis protocols that parallel the IMPROVE program (see reference 5). Gradually over a three-year period, the URG 3000N sampler will be installed at all CSN sites, and like the IMPROVE samplers, the 3000N unit is designed to pull ambient air through a 25-mm quartz filter at 22 liters per minute. The Met One SASS units are designed to pull ambient air through a 47-mm filter at 6.7 liters per minute.

The IMPROVE_A analytical method was implemented at CARB’s laboratory in 2007 after the first three field sites were converted to URG 3000N sampling. The IMPROVE_A method should help CARB’s analysis in two ways.

1. Previously when CARB used a custom heating protocol, only two useful carbon fractions, total OC and total EC, were reported to the national database. With the IMPROVE_A method, several extra useful carbon fractions can be reported to the national database.
2. Significantly lower detection limits can be achieved with the new sampling since the 3000N unit samples a volume of air three times larger than the SASS unit during each collection period, and the collected deposit area is approximately four times smaller for a 25-mm filter than for a 47-mm filter.

NAREL has sponsored an annual inter-laboratory study for the past three years that included replicate quartz filter sets distributed to those laboratories that routinely analyze speciation filter samples. All of the participating labs were allowed to report TOA carbon results from different instruments and also from different methods. CARB reported results for the first study in 2005 based upon its custom temperature protocol, and results from CARB were in good agreement with the other participating labs (see reference 6). For the second study in 2006, CARB reported results based upon its custom method and also based upon the IMPROVE_A method, and all of CARB’s results were in good agreement with the other participating labs (see reference 7). For the most recent 2007 study, CARB reported results from only the IMPROVE_A method, and those results were discussed during the audit. The most recent 2007 results were also in good agreement with the

other participating labs (see reference 8). No technical problems were observed for the carbon TOA laboratory as a result of this audit.

Gravimetric Laboratory

Debbie Moreno-Thornsberry is the analyst primarily responsible for the gravimetric mass analysis following an SOP that is available for viewing on the web (see reference 9). The weighing lab is a dedicated room with controlled temperature, humidity, and dust. Chamber blanks which are left open inside the room are routinely analyzed to monitor dust. A Dickson data logger was brought to the audit and placed near CARB’s temperature and humidity sensors located inside the weighing room. The temperature and humidity inside the weighing chamber are routinely recorded onto a rotating disk shown in Figure 1. Good agreement was observed between measurements recorded on the local chart and the Dickson data logger.

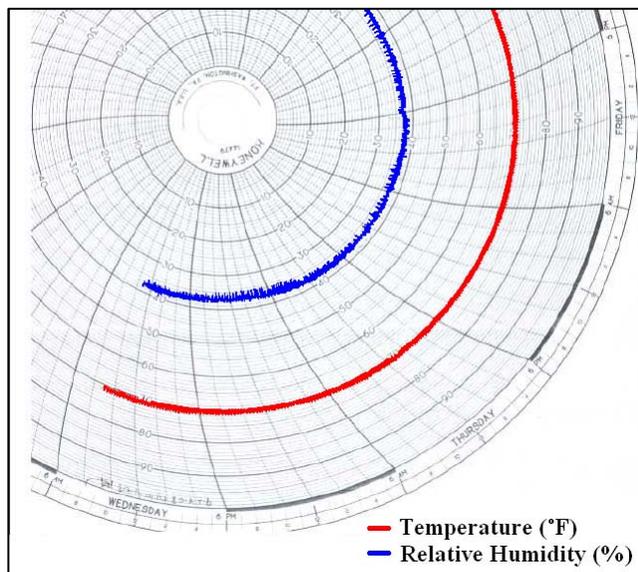


Figure 1

The microbalance used for weighing the PM2.5 Teflon® filters was a Sartorius MC5. Even though excellent gravimetric mass results were reported for CARB’s recent PE samples, two metallic mass units and two clean Teflon® filters were brought to the interview so that direct observations could be made as they were weighed. Results from the observed weighings are presented in Table 6.

Table 6. Results from Weighing Metallic Units

Metallic weight ID	NAREL Value (mg)	CARB Value (mg)	Difference (mg)
MW08-12548	181.335	181.337	-0.002
MW08-12549	93.776	93.777	-0.001
T08-12538	152.882	152.885	-0.003
T08-12539	145.890	145.893	-0.003

No deficiencies for the gravimetric lab were noted. Overall good laboratory practices were observed during this TSA.

X-Ray Fluorescence (XRF) analysis Laboratory

The XRF analyses are currently performed by Mike Humenny, and the latest version of his SOP is available on the web (see reference 10). Mike uses a QuanX EC energy dispersive instrument available from the Thermo Electron Corporation. The instrument uses a liquid nitrogen cooled detector and has been set up to routinely acquire four spectra to support the analysis of each sample using instrument conditions that are listed in Table 7.

Table 7. XRF Analysis at the CARB Laboratory

Instrument: Thermo QuanX EC Software: WinTrace 3.0.2		Instrument Conditions for Routine Sample Analysis			
Parameter	#1	#2	#3	#4	
X-ray tube parameters:					
Tube voltage (kV)	10	30	50	50	
Tube current (mA)	1.98	1.66	1.00	1.00	
Tube anode material	rhodium	rhodium	rhodium	rhodium	
Direct excitation of sample:					
Filter Material	cellulose	palladium	palladium	copper	
Filter thickness (mm)	unknown	0.025 mm	0.125 mm	0.377 mm	
Secondary excitation of sample:					
Secondary Fluorescor	none	None	None	None	
Filter material					
Filter thickness (mm)					
Acquisition time (seconds)	800	400	400	800	
Energy range acquired (keV)	0-10	0-20	0-40	0-40	
Number of [MCA] channels	512	1024	2048	2048	
Sample rotation (yes/no)	yes	yes	yes	yes	
Beam spot size, diameter (mm)	unknown	unknown	unknown	unknown	
Atmosphere (vacuum, He, air)	vacuum	vacuum	vacuum	vacuum	
Elements Reported	Al Si P S Cl K Ca	Ti V Cr Mn Fe Co Ni Ba	Cu Zn As Se Br Rb Sr Y Mo Hg Pb	Sn Sb	

The instrument at CARB is very similar to the three XRF units at EPA’s national contract laboratory, Research Triangle Institute (RTI) located in Research Triangle Park, NC. The XRF instruments at RTI are also QuanX EC instruments with slightly different hardware options. It is worth noting that CARB has decided to report only twenty-eight elements while RTI currently reports forty-eight.

The XRF lab was able to participate in NAREL’s most recent 2007 inter-laboratory study, and results from that study were discussed during the audit. Each participating lab analyzed a replicate set of six filters which had previously been analyzed at EPA’s National Exposure Research Lab in Research Triangle Park, NC. CARB’s results were in good agreement with the other participating labs.

Ion Chromatography (IC) Laboratory

The IC analyses are performed by George Dunstan, and an SOP is available on the web that describes the IC analysis at CARB (see reference 11). The laboratory is equipped with an automated Dionex IC instrument. One channel is optimized for the analysis of anions and another channel is optimized for the analysis of cations. The lab also has access to equipment for cleaning and

extracting Nylon® filters. Filter extractions are performed using an ultrasonic bath and a shaker table. Nanopure deionized water is the extraction solvent. Multilevel standards are used to develop calibration curves and establish retention times for the ions of interest. New calibration curves are checked against a standard from a secondary source. Fresh curves are prepared when the routine check samples indicate excessive calibration drift. Replicate injections of low-level standards have been used to estimate sensitivity and low level precision. Duplicate injections of sample extracts have been used to evaluate mid-level precision. Blank spikes are extracted along with field samples to evaluate method accuracy. Statistically derived limits have been developed over time and are used to control the analytical system.

The only specific samples discussed were those from the recent PE study in which several laboratories analyzed a replicate set of single-blind filter samples. Records and raw data from the PE samples were examined during the audit. The results from the PE study indicate good performance from the IC laboratory.

The field blanks summarized in Table 1 shows respectably low levels of ion contamination. Therefore the overall process used to clean new Nylon® filters, assemble/disassemble canisters, and extract the filters offers an attractive baseline for IC measurements at CARB.

Other Staff Interviews

Mike Poore will be retiring soon after a long tenure as the Northern Laboratory Branch Chief. Ken Stroud will be Mike's successor, and therefore Ken was present for all of the activities and interviews during the audit. Merrin Wright was available to discuss any QA issues from her perspective. She provided the auditors with a copy of the most recent internal audit summary report. George Dunstan is scheduled to retire soon, and Samantha Scola will be assuming many of George's responsibilities. Samantha was present for most of the activities and interviews. Dan Tackett used his skills to provide the auditors with historical data that were requested during the audit. He provided the field blank data and the backup quartz filter data which is summarized in Table 1 and Table 2 of this report.

Conclusions

This audit was preceded by single-blind PE samples which were submitted to all of the labs that were inspected. Results from all of the PE samples were discussed with the analysts and supervisors involved. Some of the supporting raw data were examined during the audit, and some raw data were carried back to NAREL for examination as part of the audit follow-up. The auditors are pleased to report that no significant technical problems were found during the audit. One observation is worth mentioning again, however. Quartz filters are currently not supplied to the four field sites which have not yet received a URG 3000N sampler. If carbon data are important for these sites, CARB should reconsider supplying quartz filters for the Met One SASS samplers at these sites.

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