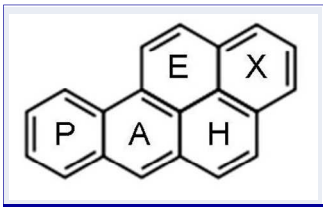

Population Exposure to PAH

Technical Report on
Ancillary Measurements and the Intercomparison Study – Action 3.2.3 Inter-comparison.

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Introduction

Both the preliminary investigation and the first regular campaign, originally foreseen to be undertaken by summer 2011, have been postponed due to the delay in the purchase of the sampling instruments. Nevertheless, an important activity has been performed, which is of key importance for future work.

Overall, three PM collections have been made in duplicate, inside the Metro network of Rome, to have preliminary information about the general quality (i.e., repeatability and reproducibility) of our analytical approach to measure PAH collected at low-volume conditions.

Afterward, the PAH dimensional distribution in PM (eight size fractions between 0.18 and 18 μm) has been investigated both in indoor and outdoor environments.

Experimental

1. Indicative PAH measurements in indoor environment: the public METRO lines of Rome

A very preliminary approach, aimed to test the ability of Partners to monitor PAH at low-volume conditions and the homogeneity of results, was conducted through twin samplings and analyses. Samplings were carried out during three different days, by using a pair of SKC low volume sampler, each one equipped with a $PM_{2.5}$ inlet (breathable fraction) and a 37 mm o.d. filter holder. Sampled particles were processed according to the procedure set-up by CNR-IIA and shared to INAIL, which is based on solvent extraction (dichloromethane/acetone, ultra-sonic bath), clean-up through column chromatography (basic alumina) and CGC-MSD analysis.

1.1. Metro Line A (between *Battistini* and *Vittorio Emanuele* stations): April 29th, 2011. 8-h samplings (from 09:15h to 17:15h). $PM_{2.5}$ collection operated by IIA, INAIL and ARPA Personnel. Analyses made by IIA and INAIL (INAIL data are not reported).

As for the sampling "quality", after each collection the soot did not appear as uniformly distributed over the filter surface; on the contrary, discrete aggregation points were observed over the active surface, suggesting that the gas flow through the filter was irregular. That potentially gave rise to marked differences between two samples formally collected in parallel. Moreover, it remains under question how much the samples collected were indicative of the true environmental conditions. In conclusion, the first field experiments (and similarly, the second and the third ones) confirmed that dedicated sampling systems and procedures are mandatory for PAH monitoring in indoor environments and/or at low-volume conditions.

Despite the above mentioned limitations, PAHs were determined in the sample to preliminarily investigate both intra- and inter-laboratory variability. These samples were processed by CNR-IIA with two different CGC-MSD systems, which provided the results reported below. Concentrations as low as 0.09 ng/m^3 could be evaluated, although the air volume was only 1.47 m^3.

Table 1. PAH concentrations in the Metro A line, April 29th, 2011 (data provided as ng/m^3). "Total PAHs" includes "non-carcinogenic" PAH congeners.

compound	**IIA (1)**	**IIA (2)**
fluoranthene	2.25	2.44
pyrene	1.39	1.55
benz(a)anthracene	0.44	0.46
chrysene+triphenylene	1.02	1.05
benzo(b/j)fluoranthene	0.84	0.88
benzo(k)fluoranthene	0.30	0.32
benz(e)pyrene	0.37	0.39
benzo(a)pyrene	0.10	0.11
indeno(1,2,3-cd)pyrene	0.22	0.23
benzo(ghi)perylene	0.27	0.28
dibenz(a,h)anthracene	0.09	0.09
total PAHs	*8.5*	*8.9*

Semi-volatile PAHs were also present in the PM extracts, overall phenanthrene and anthracene. Nevertheless, the procedure adopted was unable to determine the corresponding contents in the air, due to the wide and irregular losses observed along the analytical run.
Similarly, the outputs of fluoranthene and pyrene (known to occur at least at 50% as vapours in the air) were the most affected by uncertainty. Since they are not regarded as carcinogenic, their evaluation will not carried out in the future. By contrast, both chrysene and benzo(e)pyrene are not included among carcinogenic PAHs; nevertheless, they were determined, since their ratios vs. benz(a)anthracene and benzo(a)pyrene, respectively, provide indication of the PAH degradation in induced by light or atmospheric oxidants.

1.2. Metro Line B (shopping centre at the underground floor of the *Termini* railway station): May 11th, 2011. 8-h samplings (from 09:15h to 17:15h). $PM_{2.5}$ collection operated by IIA, INAIL and ARPA Personnel. These samples were processed by CNR-IIA with the same CGC-MSD system. Burdens as low as 0.04 ng/m^3 were measured in ~1.73 m^3 of air. One CGC-MSD set-up was used for both analyses. The results are reported below.

Table 2. PAH concentrations in the Metro B line, May 11th, 2011 (data provided as ng/m3). "Total PAHs" includes "non-carcinogenic" congeners.

compound	**IIA (1)**	**IIA (1)**	average
BaA	0.11	0.18	0.15 ± 0.05
CHT	0.37	0.46	0.41 ± 0.06
BbjF	0.35	0.34	0.35 ± 0.00
BkF	0.17	0.16	0.16 ± 0.01
BeP	0.23	0.23	0.23 ± 0.01
BaP	0.11	0.11	0.14 ± 0.00
IP	0.16	0.16	0.14 ± 0.00
BPE	0.25	0.25	0.20 ± 0.00
DBahA	0.04	0.04	0.04 ± 0.00
Total PAHs	2.3	2.6	2.5 ± 0.2

Symbols: BaA = benz(a)anthracene; CHT = chrysene + triphenylene; BbjF = benzo(b)fluoranthene + benzo(j)fluoranthene; BkF = benzo(k)fluoranthene; BeP = benzo(e)pyrene; BaP = benzo(a)pyrene; IP = indeno(1,2,3-cd)pyrene; BPE = benzo(ghi)perylene); DBahA = dibenzo(a,h)anthracene; X = detected but not quantified (amount < limit of quantification); n.d. = not detected (amount < limit of detection).

In conclusion, PAH could be determined with good precision [variability within 10%, except for benz(a)anthracene (±30%) and chrysene (±15%)].

1.3. Metro Line A (from *Re di Roma* to *Battistini* stations): May 12th, 2011. (from 09:15h to 17:15h). $PM_{2.5}$ collection operated by IIA, INAIL and ARPA Personnel. Analyses made by IIA (see &1.2). Sampled air volumes were 2.12 and 2.06 m^3. The results are reported below:

Table 3. PAH concentrations in the Metro A line, May 12th, 2011 (data provided as ng/m3). "Total PAHs" includes "non-carcinogenic" PAH congeners.

compound	**IIA (1)**	**IIA (1)**	average
BaA	0.36	0.41	0.39 ± 0.04
CHT	0.90	1.13	1.02 ± 0.16
BbjF	0.77	0.95	0.86 ± 0.13
BkF	0.31	0.32	0.32 ± 0.01
BeP	0.37	0.44	0.40 ± 0.05
BaP	0.13	0.15	0.14 ± 0.01
IP	0.14	0.18	0.14 ± 0.05
BPE	0.17	0.22	0.20 ± 0.04
DBahA	X	0.04	0.04 ± 0.01
Total PAHs	3.8	4.5	4.2 ± 0.3

In this case, the uncertainty was some higher than in the previous tests (14%, on the average, vs. 4%). Nevertheless, carcinogenic PAH could be reliably determined.
According to the Tables above reported, PAH resulted prone to be monitored in indoor suspended particulates, conceded the content in the air of each congener reaches or exceeds 0.04 ng/m^3. It is worth noting that the highest uncertainties are observed for the semi-volatile, non-

carcinogenic PAH (namely, fluoranthene and pyrene) and dibenz(a,h)antracene, which is often the less abundant PAH congener in atmospheric samples.

2. Study of the PAH congener partition among the size fractions of aerosols.

Two experiments have been carried out at the IIA building (Montelibretti RM, Italy). In each experiments, particulates were collected by means of a MOUDI-100 cascade impactor (MSP Corporation, MN, USA) running at 30 L/min, equipped with nine cut-off lines and one end-point filter collecting residual particles. The 50%-efficiency cut-offs were fixed at 18 (inlet), 10, 3.2, 1.8, 1.0, 0.56, 0.32, 0.18 µm. Samplings were performed in parallel indoor (inside an office room) and outdoor (just in front of the building windows) and lasted seven consecutive days. The experiments were made from April 26th to May 3rd, 2011 and from May 3rd to May 10th, 2011. The PM fractions (labeled from S0 up to S9, in the order) were collected on pre-baked 47-mm o.d. quartz membranes. An aliquot of 1.50 cm^2 of the active surface of the filters (14% of the total surface) was cut to carry out the evaluation of both elemental and organic contents in each size fraction of particulates. PAH were measured on the remaining portion of the filter, by applying the same procedure used for low-volume experiments inside the Metro lines (&1).

2.1. The first experiment was carried out outside and inside an office room that had been closed and unused for several months. Two identical multi-stage impactors were used for the purpose, each of which collected 284 m^3 of air.

The results of the experiment are shown in Tables 4-5, where the PAH contents in the samples are provided as nanograms per volume unit (m^3). Tables 6-7 report the percent distribution of each congener within the PM size fractions.

Finally, Figure 1 provides the percent distribution of total PAH along the size-segregated particulates.

As expected, we found that most PAH were associated to the finest fractions, although some percentages accumulated on the large particles.

Table 4. Concentrations of individual PAHs in the size-segregated particulates. Montelibretti, April 26th – May 3rd, 2011. Numbers in ng/m^3 of air. Indoor sampling.

fraction	**S0**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**
particle size, µm	>18	10 - 18	5.6 - 10	3.2 - 5.6	1.8 - 3.2	1.0 - 1.8	0.56 – 1.0	0.32 -0.56	0.18 -0.32	< 0.18
BaA	X	n.d.	n.d.	n.d.	n.d.	X	0.004	X	X	X
CHT	0.006	n.d.	n.d.	n.d.	X	0.004	0.006	0.006	0.009	0.007
BbjF	0.025	X	X	0.003	0.003	0.012	0.020	0.020	0.019	0.020
BkF	0.008	n.d.	X	X	X	0.003	0.006	0.005	0.006	0.005
BeP	0.014	n.d.	X	X	X	0.006	0.012	0.010	0.010	0.009
BaP	0.009	n.d.	n.d.	X	X	0.004	0.006	0.007	0.005	0.002
IP	0.013	X	n.d.	X	X	0.007	0.012	0.014	0.013	0.007
BPE	0.013	n.d.	n.d.	X	X	0.007	0.012	0.014	0.013	0.007
DBahA	X	n.d.	n.d.	X	n.d.	X	0.003	X	X	X
Total PAH	0.122	0.006	0.006	0.017	0.017	0.064	0.112	0.106	0.111	0.088

Table 5. Concentrations of individual PAHs in the size-segregated particulates. Montelibretti, April 26th – May 3rd, 2011. Numbers in ng/m3 of air. Outdoor sampling.

fraction	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
BaA	n.d.	X	X	X	X	0.010	0.010	0.013	0.010	0.009
CHT	X	0.006	0.004	0.006	0.010	0.029	0.032	0.044	0.037	0.038
BbjF	X	0.005	0.004	0.005	0.016	0.045	0.073	0.100	0.070	0.055
BkF	0.003	0.004	0.003	0.005	0.008	0.032	0.056	0.082	0.055	0.040
BeP	X	0.004	0.003	0.005	0.013	0.034	0.061	0.082	0.058	0.038
BaP	X	X	X	0.005	0.005	0.020	0.037	0.044	0.023	0.010
IP	X	X	X	0.003	0.010	0.044	0.066	0.085	0.045	0.022
BPE	X	X	X	0.003	0.010	0.041	0.061	0.087	0.052	0.027
DBahA	n.d.	n.d.	n.d.	X	X	0.008	0.009	0.012	0.006	0.003
Total PAH	0.029	0.042	0.035	0.063	0.109	0.342	0.513	0.708	0.492	0.341

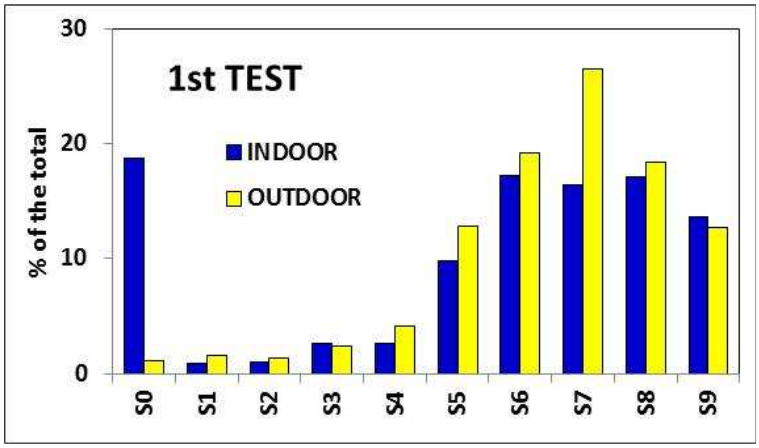
Table 6. Percent distribution of individual PAHs in the size-segregated particulates. Montelibretti, April 26th – May 3rd, 2011. Indoor sampling.

fraction	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
particle size, µm	>18	10 - 18	5.6 - 10	3.2 - 5.6	1.8 - 3.2	1.0 - 1.8	0.56 – 1.0	0.32 -0.56	0.18 -0.32	< 0.18
BaA	13.8	0.2	0.8	0.2	2.6	11.3	27.5	14.2	17.7	11.6
CHT	16.2	0.6	1.2	0.4	2.0	9.9	15.0	14.6	22.6	17.5
BbjF	20.1	0.7	0.9	2.1	2.3	9.5	16.1	16.1	15.9	16.2
BkF	21.4	0.8	1.5	2.9	1.8	8.1	17.0	14.4	18.2	14.0
BeP	21.4	0.7	1.1	2.1	2.1	9.5	18.0	15.8	15.6	13.8
BaP	26.0	1.1	1.0	1.9	2.0	10.6	17.7	18.3	14.8	6.7
IP	18.5	0.9	0.5	2.5	2.1	10.0	17.2	20.1	18.2	9.9
BPE	17.9	0.7	0.3	2.7	2.1	10.3	16.5	20.6	18.9	9.8
DBahA	14.1	0.9	1.1	6.0	2.7	11.4	27.2	17.0	12.5	7.1
Total PAH	18.7	0.9	1.0	2.6	2.6	9.8	17.2	16.4	17.1	13.6

Table 7. Percent distribution of individual PAHs in the size-segregated particulates. Montelibretti, April 26th – May 3rd, 2011. Outdoor sampling.

fraction	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
BaA	0.8	1.3	1.3	2.3	3.8	17.8	17.3	22.8	17.1	15.4
CHT	1.1	3.0	1.9	2.9	4.8	13.7	15.1	21.2	17.9	18.4
BbjF	0.6	1.3	1.2	1.4	4.4	11.9	19.4	26.6	18.8	14.6
BkF	0.9	1.4	1.0	1.6	2.8	11.0	19.5	28.6	19.1	14.0
BeP	0.6	1.2	1.0	1.7	4.4	11.4	20.3	27.3	19.5	12.6
BaP	0.4	0.6	0.5	3.2	3.3	13.8	25.7	30.3	15.5	6.8
IP	0.3	0.5	0.5	1.0	3.6	15.9	23.7	30.6	16.1	7.8
BPE	0.4	0.5	0.7	1.2	3.5	14.3	21.4	30.5	18.2	9.4
DBahA	0.5	0.5	0.4	1.4	4.0	19.2	21.8	29.2	14.8	8.1
Total PAH	1.1	1.6	1.3	2.4	4.1	12.8	19.2	26.5	18.4	12.8

Figure 1. Percent distribution of total PAHs in the size-segregated suspended particulate fractions. Montelibretti, April 26th – May 3rd, 2011.



Symbols: S0, d >18 µm; S1, 10 µm≤ d ≤ 18µm; S2, 5.6 µm≤ d ≤ 10µm; S3, 3.2 µm≤ d ≤ 5.6µm; S4, 1.8 µm≤ d ≤ 3.2µm; S5, 1.0 µm≤ d ≤ 1.8 µm; S6, 0.56 µm≤ d ≤ 1.0 µm; S7, 0.32 µm ≤ d ≤ 0.56 µm; S8, 0.18 µm≤ d ≤ 0.32 µm; S9, d ≤ 0.18 µm.

Although total amounts of PAHs associated to indoor PM were much lower than outdoors (namely, 0.65 ng/m^3 vs. 2.67 ng/m^3), the percent distribution was similar, except for the important contribution from S0 particles (~18% vs. 1%) and the reduced contribution of S7 fraction (~16% vs. 27%) indoor.

As for organic and elemental carbon, the absolute amounts associated to PM fractions are reported in Table 8. Considering the blank values, the detection limit for these samples is 1 µg/sample for EC and 12 µg/sample for OC.

Table 8. Organic and elemental carbon contents in the PM size-segregated fractions. Indoor and outdoor aerosols, Montelibretti, April 26th – May 3rd, 2011. Amounts in µg.

amounts, µg	OC			EC		
size, µm	**IN**	**OUT**	$R_{i/o}$	**IN**	**OUT**	$R_{i/o}$
> 18	50	87	0.57	b.d.l.	b.d.l.	
10 -18	65	144	0.45	b.d.l.	b.d.l.	
5.6 - 10	31	71	0.43	b.d.l.	b.d.l.	
3.2 - 5.6	105	116	0.90	3.7	b.d.l.	
1.8 - 3.2	125	91	1.38	b.d.l.	1.4	
1.0 - 1.8	215	123	1.74	1.4	2.5	0.56
0.56 - 1	228	169	1.35	2.6	3.9	0.67
0.32 - 0.56	632	677	0.93	3.8	5.6	0.67
0.18 - 0.32	443	395	1.12	3.7	2.7	1.38
< 0.18	175	82	2.12	37.8	21.8	1.74
total	*2068*	*1956*	*1.06*	*53*	*38*	*1.40*

Figures 2 reports the indoor and outdoor size distribution of EC and OC, respectively. Concentrations are expressed as ug/m^3. The data show that most of the elemental carbon is in the size fraction below 180 nm, and that the rest of it is distributed with a relative maximum in the size between 0.32 and 0.56 μm (S7), as in the case of PAH. The same maximum in S7 is shown by organic carbon. For both elemental carbon and organic carbon, the difference between indoor and outdoor concentration was very small and variable between the size ranges. A general prevalence of the indoor concentration of elemental carbon over outdoor values is however observed for the size ranges between 0.32 and 1.8 μm.

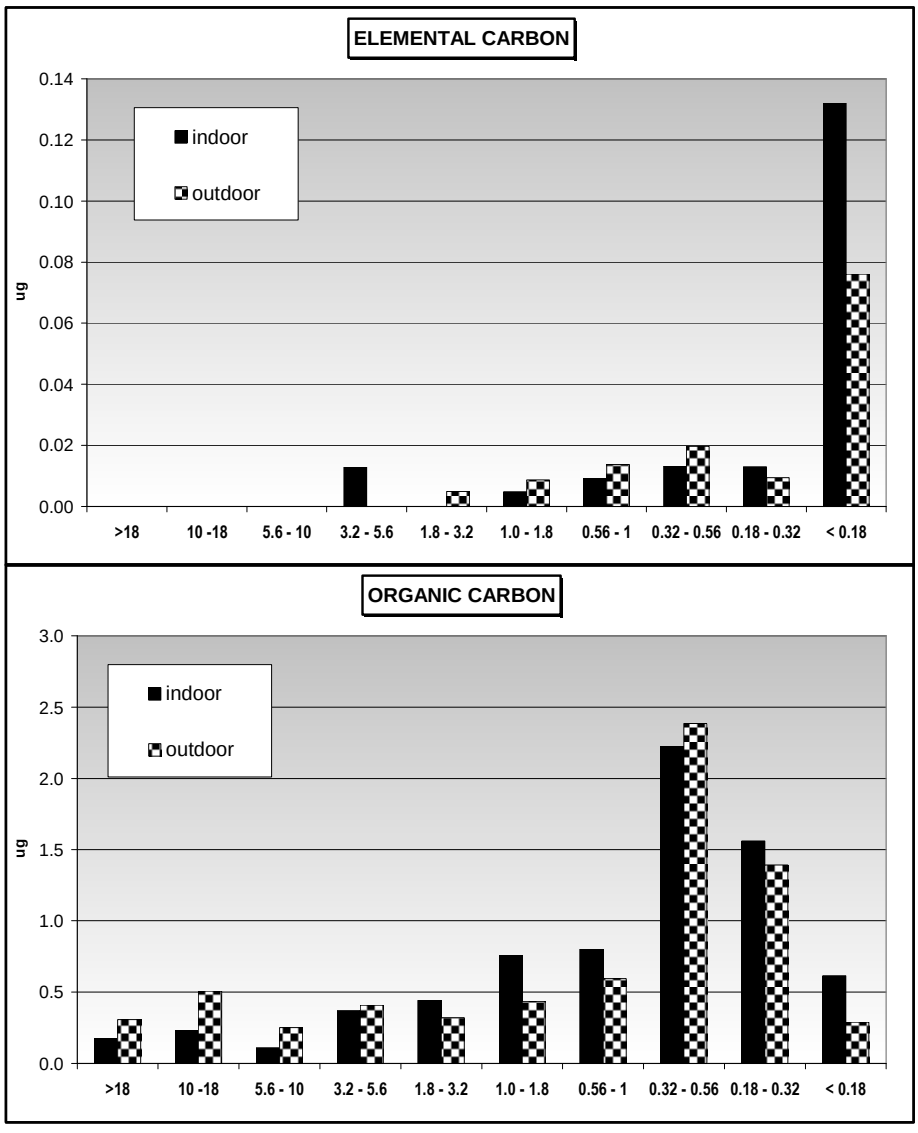


Figure 2. Size distribution of EC and OC inPM

2.2. The second experiment was carried out outside, and inside an office room which was opened and partly used. Two multiple impactor were used for the purpose, each of which collected 286 m^3 of air. The results of the experiment are shown in Tables 9-10, where the PAH contents in the samples are provided as nanograms per volume unit (m^3).

Table 9. Concentrations of individual PAHs in the size-segregated particulates. Montelibretti, May 3rd – 10th, 2011. Numbers in ng/m3 of air. Indoor sampling.

fraction	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
particle size, µm	>18	10 - 18	5.6 - 10	3.2 - 5.6	1.8 - 3.2	1.0 - 1.8	0.56 – 1.0	0.32 -0.56	0.18 -0.32	< 0.18
BaA	X	n.d.	n.d.	X	X	0.005	0.008	0.007	0.005	0.004
CHT	0.003	0.003	0.003	0.005	0.013	0.019	0.025	0.023	0.019	0.020
BbjF	0.003	0.003	0.003	0.006	0.014	0.025	0.038	0.036	0.030	0.039
BkF	X	0.003	0.002	X	0.008	0.016	0.027	0.025	0.024	0.022
BeP	0.003	X	X	0.004	0.008	0.019	0.028	0.028	0.023	0.019
BaP	X	X	X	0.002	0.002	0.009	0.016	0.014	0.008	0.004
IP	X	X	X	0.003	0.005	0.018	0.033	0.033	0.020	0.011
BPE	X	X	X	0.003	0.004	0.017	0.030	0.032	0.023	0.014
DBahA	X	X	n.d.	X	X	0.002	0.000	0.004	0.003	0.002
Total PAH	0.034	0.025	0.028	0.052	0.088	0.205	0.305	0.295	0.224	0.180

Table 10. Concentrations of individual PAHs in the size-segregated particulates. Montelibretti, May 3rd – 10th, 2011. Numbers in ng/m3 of air. Outdoor sampling.

fraction	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
BaA	X	X	X	X	X	0.004	0.006	0.009	0.006	0.004
CHT	0.004	0.003	0.009	0.006	0.010	0.013	0.019	0.030	0.023	0.027
BbjF	0.006	0.003	0.007	0.007	0.019	0.022	0.039	0.054	0.038	0.066
BkF	0.004	0.002	0.005	0.004	0.014	0.015	0.026	0.047	0.026	0.040
BeP	0.010	0.002	0.004	0.005	0.015	0.017	0.029	0.048	0.031	0.042
BaP	X	X	0.003	0.002	0.005	0.008	0.015	0.023	0.012	0.004
IP	0.005	X	X	0.004	0.010	0.016	0.032	0.049	0.021	0.010
BPE	0.014	X	X	0.005	0.009	0.015	0.030	0.052	0.025	0.013
DBahA	0.004	n.d.	n.d.	X	X	X	0.005	0.007	0.003	0.002
Total PAH	0.066	0.028	0.054	0.060	0.124	0.175	0.286	0.443	0.281	0.268

Tables 11-12 report the percent distribution of each congener within the PM size fractions. Figure 3 provides the percent distribution of total PAH in the size-segregated particulates.

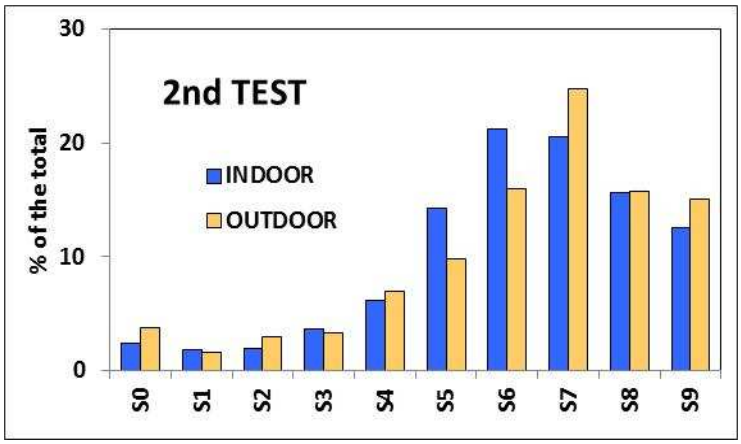
Table 11. Percent distribution of individual PAHs in the size-segregated particulates. Montelibretti, May 3rd – 10th, 2011. Indoor sampling.

fraction	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
particle size, µm	>18	10 - 18	5.6 - 10	3.2 - 5.6	1.8 - 3.2	1.0 - 1.8	0.56 – 1.0	0.32 -0.56	0.18 -0.32	< 0.18
BaA	2.3	1.4	1.4	3.7	6.8	14.8	21.9	20.6	15.2	11.9
CHT	2.1	2.0	2.1	3.8	10.0	14.7	18.7	17.1	14.5	14.9
BbjF	1.5	1.5	1.7	2.8	7.3	12.8	19.4	18.1	15.3	19.7
BkF	1.6	1.9	1.6	1.1	6.1	12.0	20.5	19.2	18.6	17.3
BeP	1.9	1.6	1.4	2.9	5.9	14.2	20.4	20.8	16.8	14.0
BaP	2.3	1.3	1.4	3.1	3.4	15.4	27.3	24.5	14.0	7.2
IP	2.0	0.9	1.1	2.5	3.6	13.9	25.7	25.6	15.7	8.9
BPE	1.8	1.0	1.0	2.6	3.2	12.9	23.4	25.1	17.9	11.1
DBahA	13.8	3.7	2.9	4.9	4.5	12.8	2.3	24.9	19.1	11.1
Total PAH	2.4	1.8	1.9	3.6	6.1	14.3	21.3	20.6	15.6	12.6

Table 12. Percent distribution of individual PAHs in the size-segregated particulates. Montelibretti, May 3rd – 10th, 2011. Outdoor sampling.

fraction	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
BaA	2.4	1.7	0.6	3.8	6.7	11.3	17.4	25.9	17.3	12.9
CHT	2.7	2.2	6.2	4.2	6.8	9.3	13.3	20.5	16.1	18.7
BbjF	2.4	1.3	2.6	2.7	7.2	8.4	15.0	20.7	14.4	25.4
BkF	2.2	1.1	2.5	2.1	7.9	8.2	14.1	25.5	14.3	22.1
BeP	4.8	1.1	2.1	2.6	7.3	8.5	14.5	23.7	15.0	20.5
BaP	2.8	0.9	3.5	2.9	6.6	10.5	20.6	31.3	15.4	5.3
IP	3.3	0.7	1.1	2.7	6.4	10.8	21.2	32.6	14.2	7.0
BPE	8.5	0.8	1.2	3.2	5.4	9.0	18.0	31.1	15.0	7.8
DBahA	15.8	0.7	1.3	2.8	6.3	9.6	18.5	26.2	12.5	6.2
Total PAH	3.7	1.6	3.0	3.3	7.0	9.8	16.0	24.8	15.8	15.0

Figure 3. Percent distribution of total PAHs in the size-segregated suspended particulate fractions. Montelibretti, May 3rd – 10th, 2011.



In the 2nd test total concentrations of PAH indoors and outdoors were quite similar (~1.4 vs. 1.8 ng/m^3). The distribution in the PM fraction did not exhibit the important contribution of large particles indoors. Most PAH accumulated into the finest fractions.

As for the "penetration factor" ($R_{i/o}$) of PAH from indoors into indoors, the average equals 0.24 in the first test and 0.70 in the second one. Thus, $R_{i/o}$ varies appreciably from sample to sample.

Looking to organic and elemental carbon, the absolute amounts associated to PM fractions are reported in Table 13.

Table 13. Organic and elemental carbon in the PM size-segregated fractions. Montelibretti, April 26th – May 3rd, 2011. Amounts in µg.

amounts, µg	OC			EC		
size, µm	**IN**	**OUT**	$R_{i/o}$	**IN**	**OUT**	$R_{i/o}$
> 18	b.d.l.	158		b.d.l.	b.d.l.	
10 -18	65	201	65	b.d.l.	b.d.l.	
5.6 - 10	41	92	41	b.d.l.	b.d.l.	
3.2 - 5.6	100	122	100	b.d.l.	1.8	
1.8 - 3.2	86	40	86	b.d.l.	b.d.l.	
1.0 - 1.8	127	90	127	1.3	2.7	1.3
0.56 - 1	150	130	150	0.5	2.3	0.5
0.32 - 0.56	409	485	409	2.9	5.1	2.9
0.18 - 0.32	318	296	318	1.2	2.6	1.2
< 0.18	115	89	115	19.2	15.5	19.2
total	1411	1702	1411	25	30	25

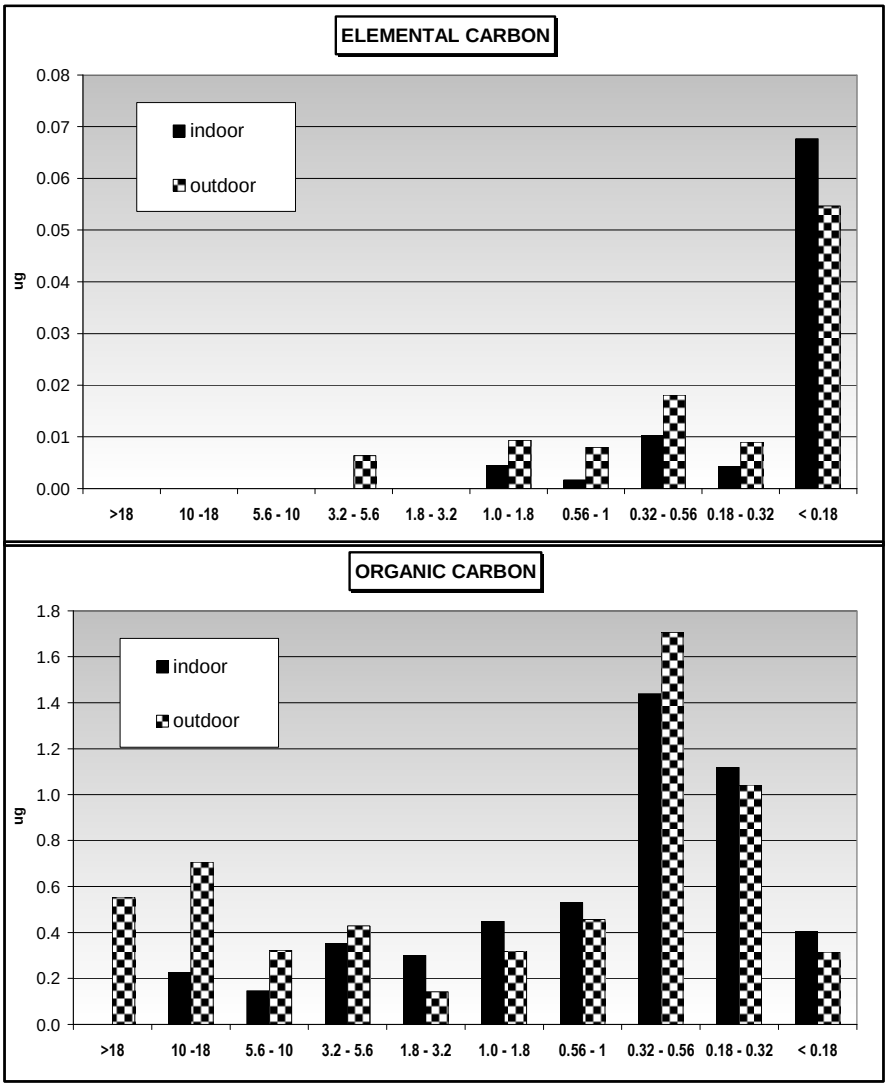


Figure 4. Size distribution of EC and OC inPM

Figures 4 reports the indoor and outdoor size distribution of EC and OC, respectively, during the 2nd test. Concentrations are expressed as ug/m3. The data show that, as for the 1st test, most of the elemental carbon is in the size fraction below 180 nm, and that the rest of it is distributed with a relative maximum in the size between 0.32 and 0.56 μm (S7), as in the case of PAH. The same maximum in S7 is shown by organic carbon. For both elemental carbon and organic carbon, the difference between indoor and outdoor concentration was very small and variable between the size ranges. A general prevalence of the indoor concentration of elemental carbon over outdoor values is, again, observed for the size ranges between 0.32 and 1.8 μm.

3. Remarks and Conclusions

The analytical procedure set-up for PAH monitoring at low-volume conditions in indoor environments seems reliable for the purpose. One further, conclusive test is scheduled for next September, when a Reference material (i.e. an urban particulate matter), whose PAH contents are certified, will be analyzed at conditions simulating the low-volume experiments.

According to the two test performed, the distribution of all PAH congeners is similar indoors and outdoors, unlike the indoor environment is “sealed” for long time and prevented from outer contamination. In particular, BaP accounts for ~5.5% of total PAHs at both sides in the first test, and for ~4.2% in the second one.

EC/OC results show that the dimensional distribution of these species is in the finest range, with maximum in the interval 0.32 – 0..56 μm for organic carbon and bimodal distribution with maxima in the ranges below 0.18 μm and between 0.32 and 0..56 μm for elemental carbon. Outdoor-indoor differences higher than 1 are observed only for EC in the size range between 0.32 and 1.8 μm

Area della Ricerca del CNR di Montelibretti, July 22nd, 2011

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