Supplement to "Emissions of I/SVOCs from domestic fuels used in Delhi, India"

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S1 Combustion of samples and filter collection

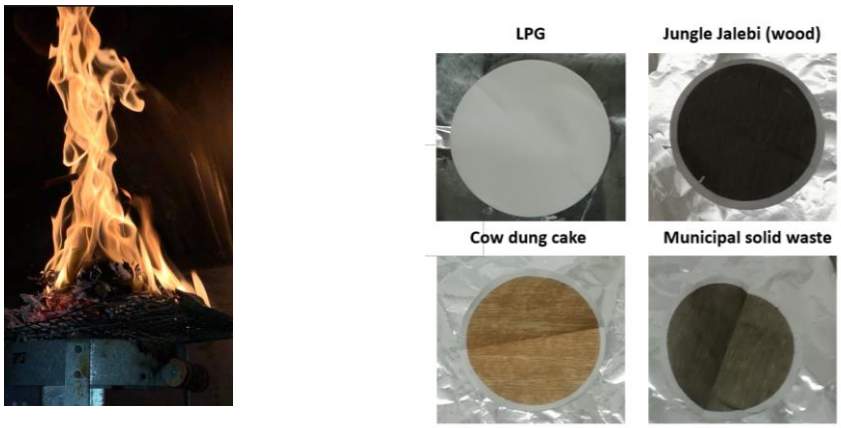


Figure 1. Left: Combustion of wood sample. Right: example PTFE filters from different fuel types.

S2 SPE and PTFE blanks

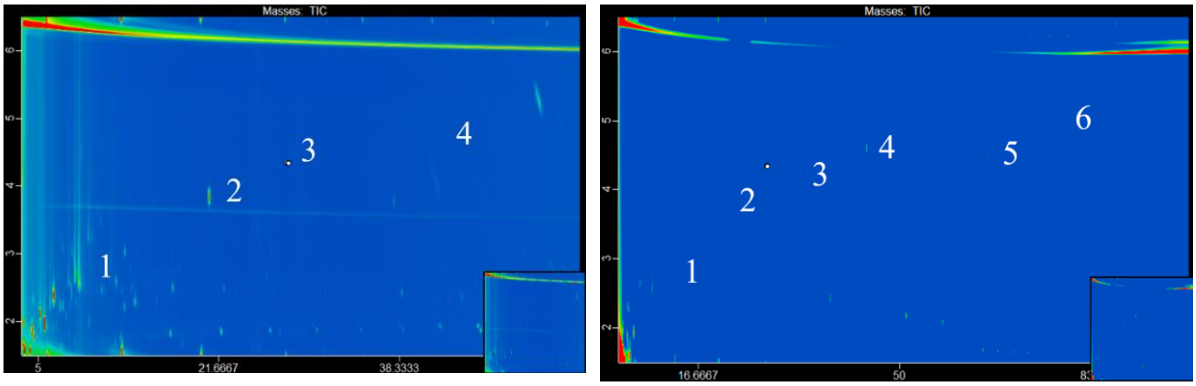


Figure 2. Left: penultimate SPE blank. Right: penultimate PTFE blank where peaks from the internal standard are 1 = 1,4-Dichlorobenzene-d_4, 2 = naphthalene-d_8, 3 = acenaphthene-d_{10}, 4 = phenanthrene-d_{10}, 5 = chrysene-d_{12} and 6 = perylene-d_{12}.

Figure 2 shows an SPE blank taken from the chamber after 21 burning samples had been collected (6 L min^{-1} for 30 mins, after chamber had been pumped for 20 mins post sample). The chromatogram is quite blank, with one of the most prominent peaks (around 1^o 20 mins, 2^o 4s) from napthalene-d8 from the internal standard. There are very faint peaks from *n*-alkanes from *n*-nonane to *n*-eicosane, but there are also peaks from the 1-alkene which indicates that there is some carryover/background from the burning chamber. This alkane/1-alkene effect is also seen in online GCxGC-FID burning chromatograms. There are also few aromatic peaks early in the chromatogram such as toluene, ethylbenzene, *m*/*p*/*o*-xylenes, trimethylbenzenes and 1,4,-dichlorobenzene which are likely to be from ambient air. There are a few peaks from 4 to 10 mins that are from contaminants in the EtOAc solvent such as Bicyclo[3.1.0]hexan-3-one, butyl acetate, 2-pentanone, 4-hydroxy-4-methyl and 3-penten-2-one, 4-methyl.

The PTFE blank shows minimum signal except for a few peaks from 4 to 10 mins that are solvent contaminants, such as 1,nitro-2-propanone, N,N,O-triacetylhydroxylamine, butyl acetate and pentatonic acid. There are the peaks from the internal standard and a few *n*-alkanes (*n*-docosane to *n*-tetracontane) which are either contaminants or from ambient aerosol. This method was prone to a small interference in the region of these alkanes, with the rubber septum on the sample vial caps identified as one source. This interference was still observed in some samples and it is suggested that this is not suitable for trace level analyses of these components. Issues with quantification of *n*-alkanes have been previously highlighted in samples with low emission factors, but high levels in the blank (Jayarathne et al., 2018).

S3 Breakthrough testing

Comparison of % area from 6 spikes containing 136 compounds (50 µL at 20 µg mL^{-1}) directly into 0.95 mL of EtOAc, 6 separate PTFE filters (black) and SPE disks (red) spiked with the standard solution containing 136 compounds (50 µL at 20 µg mL^{-1}) extracted and analysed and SPE disks spiked with 96 compounds of interest (4 times, 50 µL at 20 µg mL^{-1}), subject to a purified air flow of 6 L min^{-1} for 30 mins then extracted and analysed (green).

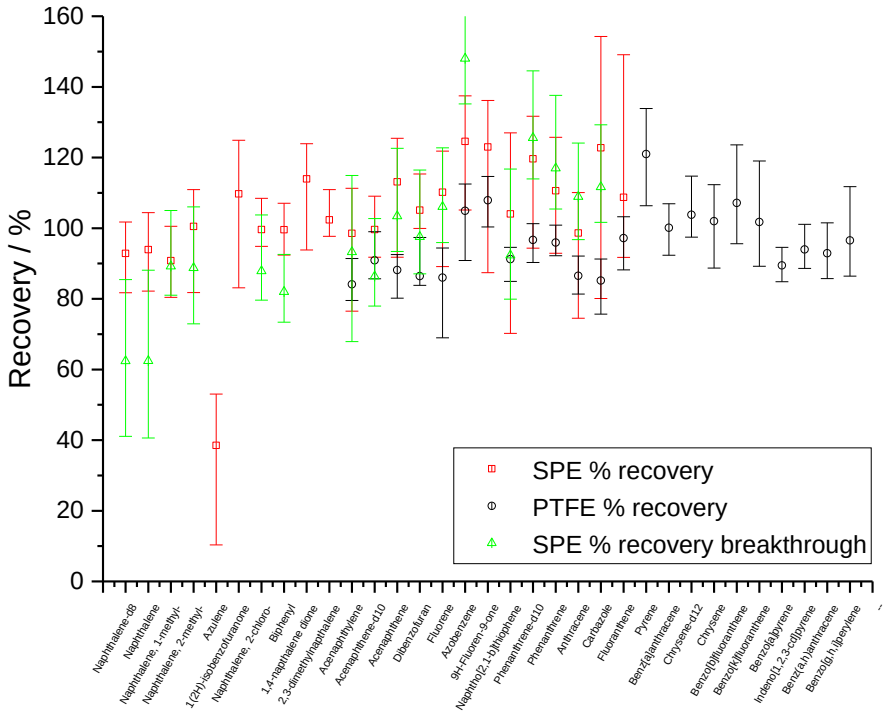


Figure 3. PAH breakthrough test.

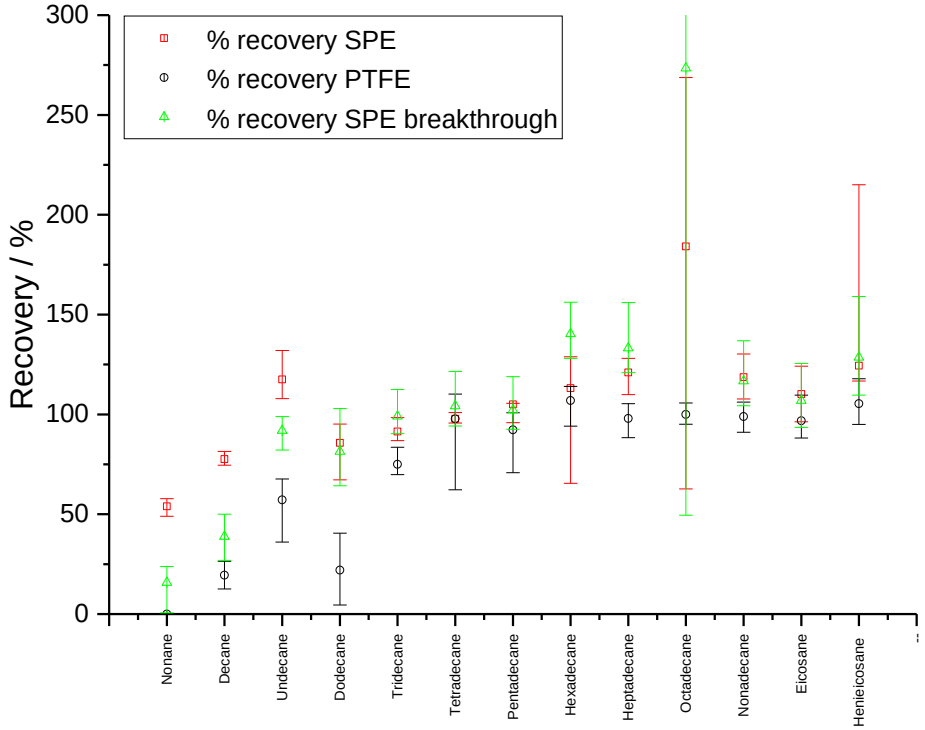


Figure 4. Alkane breakthrough test. The large over recovery of *n*-octadecane is assumed to be from the C_{18} coating on SPE disks.

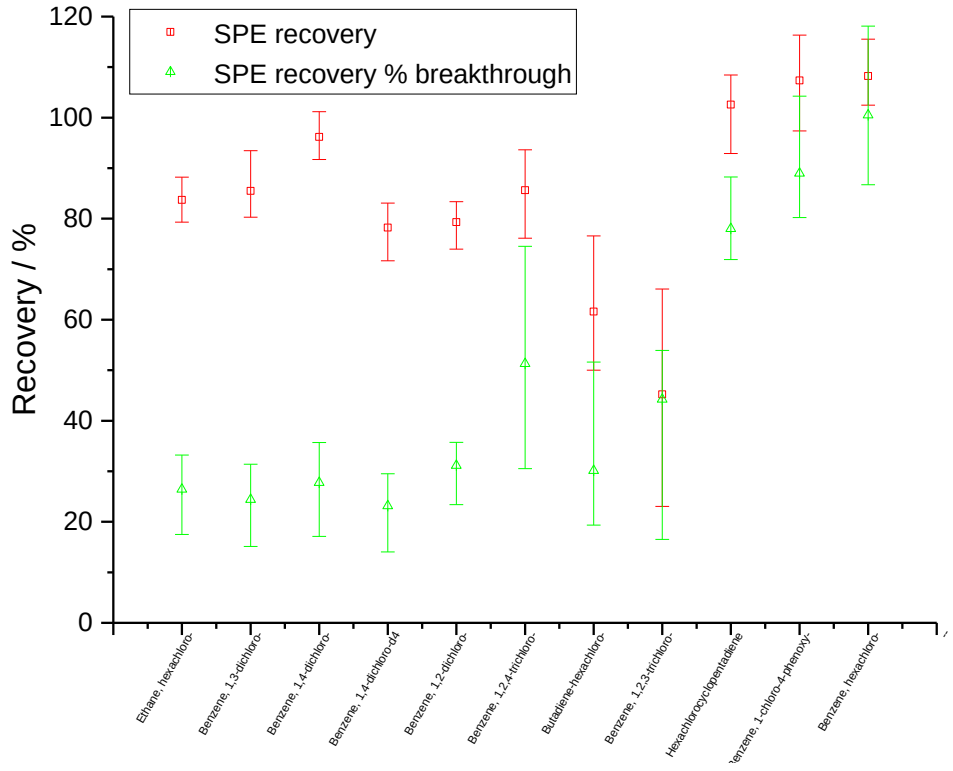
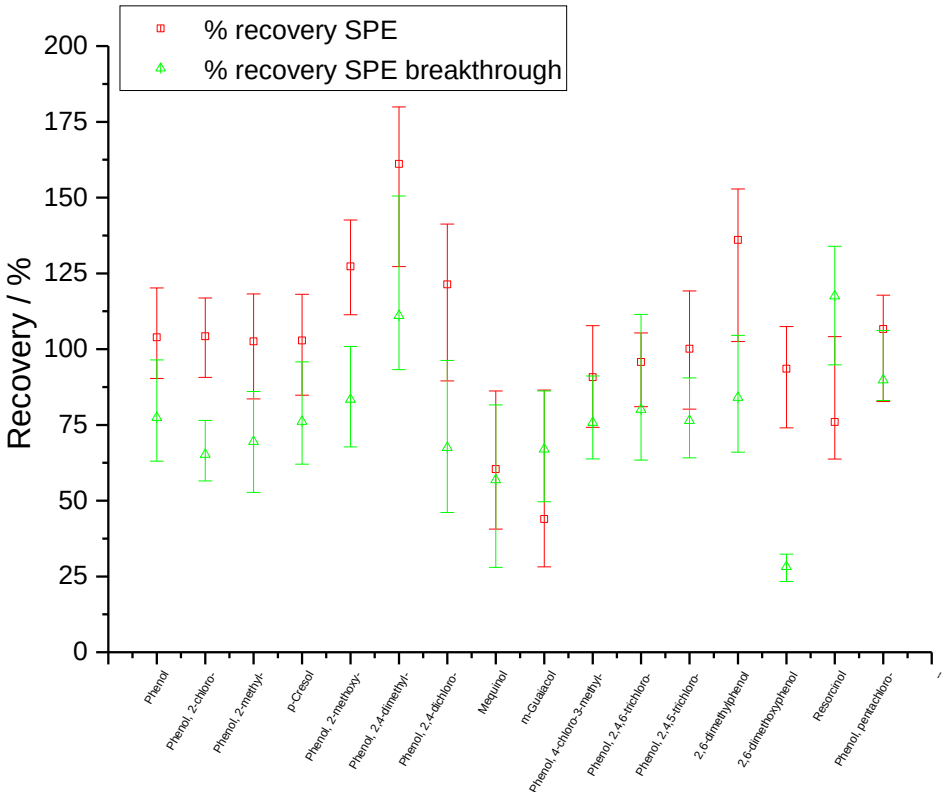


Figure 5. Chlorine containing species breakthrough test.



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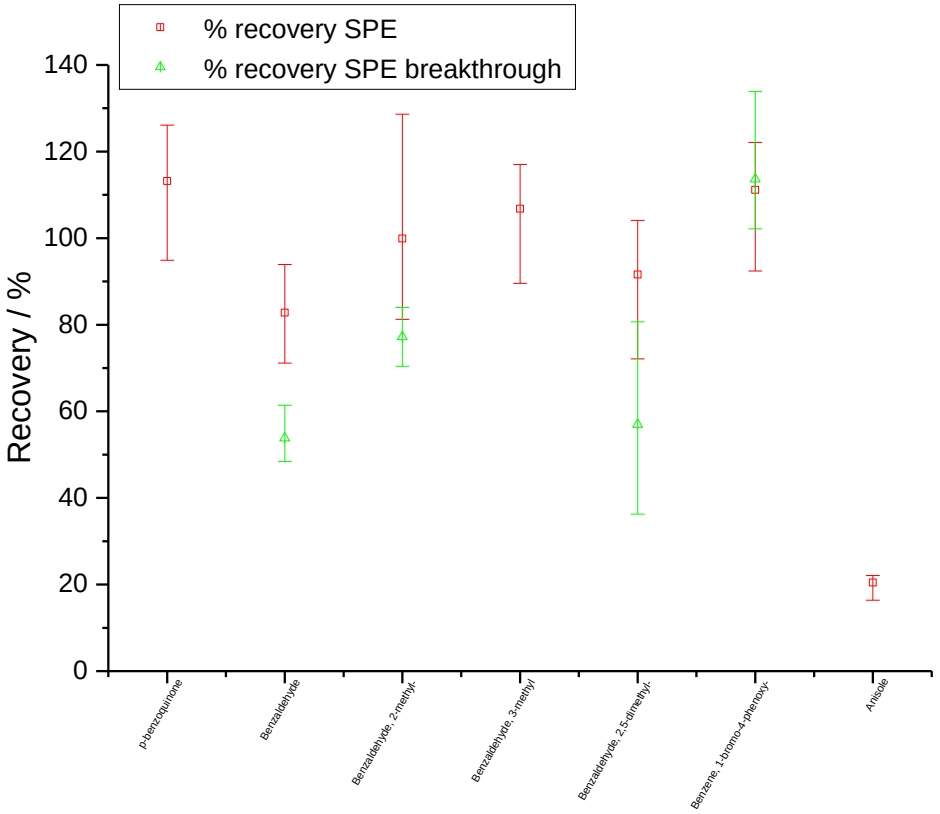
65 Figure 6. Phenols breakthrough test.



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67 Figure 7. Oxygenated aromatics breakthrough test.

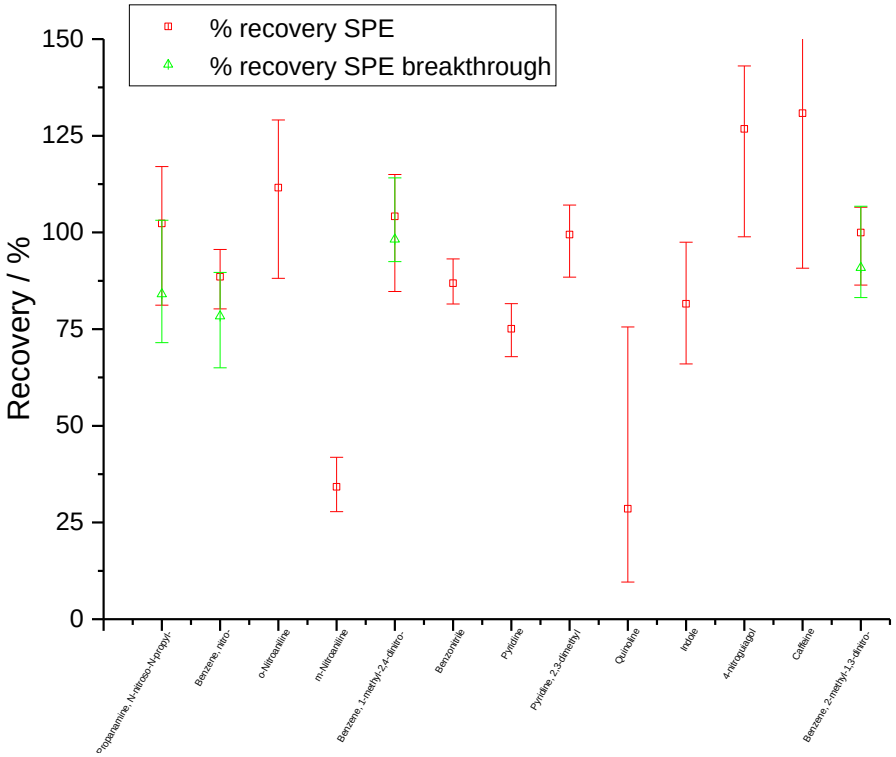

Figure 8. Nitrogen containing VOC breakthrough test.

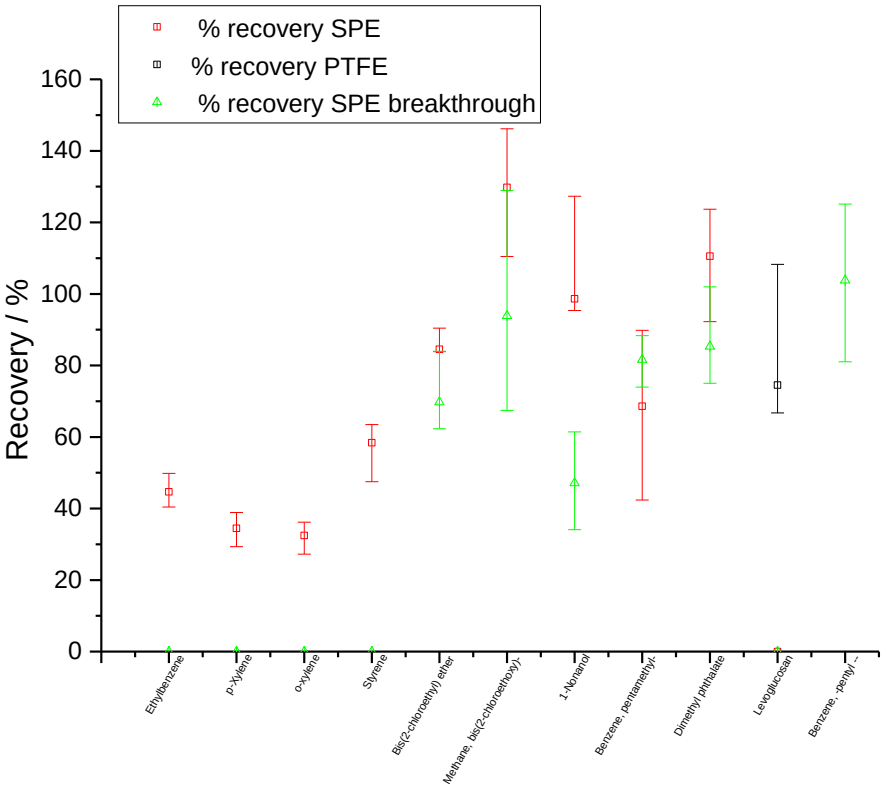

Figure 9. Aromatics and others breakthrough test. Levoglucosan PTFE recovery carried out from spiking stock solution in MeOH directly onto filter to give a final solution concentration of around 10 μg mL^{-1} due to low instrument sensitivity.

S4 *n*-Alkane comparison to GCxGC-FID

Comparison to PTR-ToF-MS is complicated by more than one species being present at a mass and aerosol samples passing through a chamber stage with either losses to walls or off gassing of the more volatiles from the aerosol sample post acquisition.

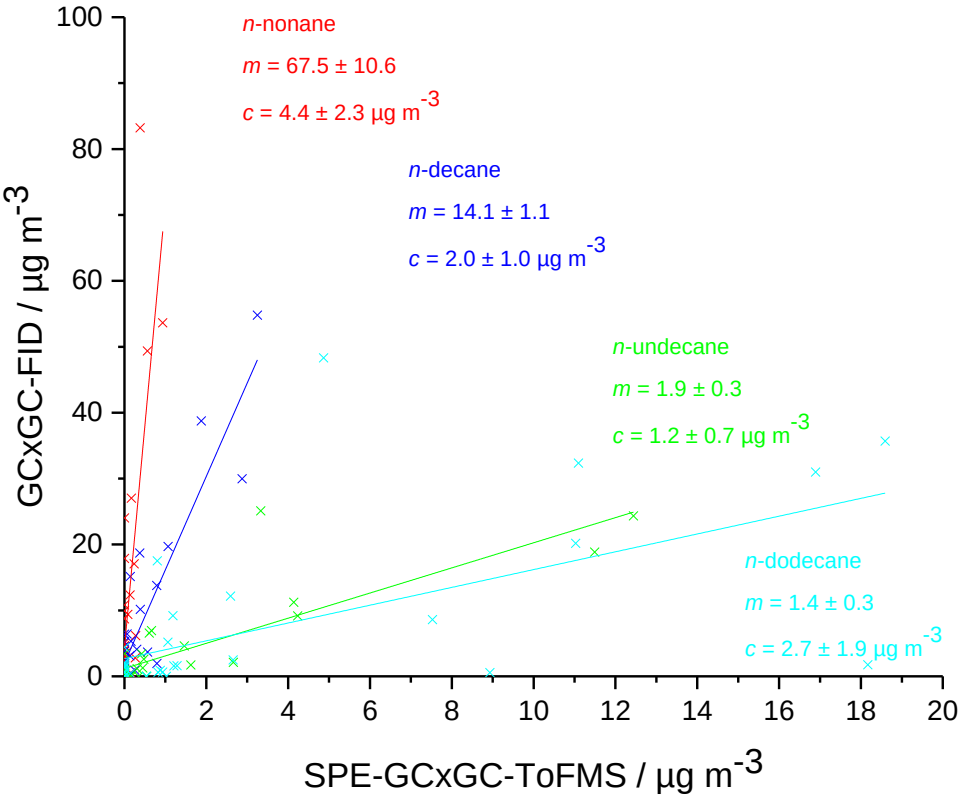

Figure 10. Comparison of GCxGC-FID to SPE-GCxGC-ToF-MS.

S5 PAH emission factors

Table 1. Emission factors of PAHs (g kg^{-1}) where (G) represents gas phase and (A) represents aerosol phase and N*n* = naphthalene, MN*n* = methylnaphthalene, DMN*n* = dimethylnaphthalenes, B = biphenyl, Fno = 9H-Fluoren-9-one, AE = Acenaphthylene, DF = Dibenzofuran, F*n* = Fluorene, P*n* = Phenanthrene, A*n* = Anthracene, Ca = carbazole, FL*n* = Fluoranthene, PY*n* = Pyrene, BaA = Benz[a]anthracene, C*n* = Chrysene, BbF = Benzo[B]fluoranthene, BkF = Benzo[K]fluoranthene, BaP = Benzo[A]pyrene, IP = Indeno[1,2,3-cd]pyrene, AH = Dibenz(A,H)Anthracene and ghi = Benzo[ghi]perylene.

Sample	**N*n* (G)**	**MN*n* (G)**	**DMNn (G)**	**B (G)**	**Fno (G)**	**AE (G)**	**DF (G)**	**DF (A)**	**F*n* (G)**	**F*n* (A)**	**P*n* (G)**	**P*n* (A)**
Brassica spp	0.7911	0.2511	0.1327	0.0055	0.0006	0.0254	0.0068	0.0000	0.0044	0.0000	0.0099	0.0020
Melia	0.2800	0.1052	0.0596	0.0017	0.0000	0.0097	0.0027	0.0000	0.0019	0.0000	0.0050	0.0005
Plywood	0.1523	0.0473	0.0159	0.0004	0.0000	0.0035	0.0008	0.0000	0.0006	0.0000	0.0010	0.0010
Prosopis spp	0.0341	0.0110	0.0000	0.0005	0.0000	0.0026	0.0012	0.0000	0.0005	0.0000	0.0011	0.0000
Eucalyptus spp	0.0375	0.0099	0.0000	0.0003	0.0000	0.0018	0.0009	0.0000	0.0004	0.0000	0.0006	0.0001
Azadirachta	0.0519	0.0161	0.0000	0.0008	0.0000	0.0020	0.0017	0.0000	0.0009	0.0000	0.0016	0.0002
Mangifera	0.0896	0.0308	0.0128	0.0006	0.0000	0.0014	0.0012	0.0000	0.0007	0.0000	0.0012	0.0007
Morus spp	0.2381	0.1013	0.0450	0.0033	0.0003	0.0078	0.0063	0.0003	0.0040	0.0010	0.0041	0.0051
Pithecellobium	0.1405	0.0484	0.0201	0.0012	0.0003	0.0042	0.0028	0.0000	0.0016	0.0000	0.0029	0.0004
Shorea spp	0.0963	0.0283	0.0000	0.0014	0.0003	0.0054	0.0059	0.0001	0.0020	0.0000	0.0064	0.0006
Solanum melongena	0.1253	0.0425	0.0185	0.0013	0.0003	0.0060	0.0038	0.0000	0.0018	0.0001	0.0057	0.0012
Ficus religiosa	0.5633	0.2279	0.0962	0.0009	0.0003	0.0036	0.0014	0.0000	0.0009	0.0000	0.0027	0.0007
Syzygium spp	0.1155	0.0244	0.0159	0.0043	0.0005	0.0119	0.0057	0.0002	0.0038	0.0003	0.0057	0.0007
Ficus spp	0.0873	0.0269	0.0000	0.0009	0.0002	0.0035	0.0020	0.0002	0.0010	0.0003	0.0019	0.0000
Vachellia spp	0.0608	0.2784	0.0244	0.0033	0.0003	0.0087	0.0052	0.0001	0.0033	0.0001	0.0054	0.0016
Dalbergia sis	0.0912	0.0304	0.0142	0.0012	0.0003	0.0031	0.0025	0.0002	0.0012	0.0002	0.0027	0.0005
Ricinus spp	0.0797	0.0198	0.0000	0.0011	0.0002	0.0043	0.0021	0.0001	0.0012	0.0002	0.0027	0.0000
Holoptelea spp	0.0871	0.0253	0.0000	0.0010	0.0002	0.0050	0.0016	0.0001	0.0011	0.0002	0.0022	0.0000
Saraca indica	0.1587	0.0734	0.0287	0.0023	0.0004	0.0113	0.0041	0.0000	0.0032	0.0000	0.0053	0.0005
Cocos nucifera	0.4622	0.1533	0.0655	0.0040	0.0002	0.0114	0.0074	0.0006	0.0038	0.0000	0.0037	0.0059
Charcoal	0.0849	0.0332	0.0156	0.0014	0.0000	0.0051	0.0025	0.0000	0.0019	0.0000	0.0024	0.0001
Sawdust	0.8312	0.2007	0.0893	0.0075	0.0011	0.0171	0.0103	0.0002	0.0079	0.0004	0.0091	0.0087
Dung	0.9502	0.3785	0.1899	0.0077	0.0006	0.0147	0.0069	0.0003	0.0055	0.0012	0.0073	0.0056
Waste	0.5801	0.1783	0.0943	0.0211	0.0015	0.0185	0.0080	0.0000	0.0099	0.0008	0.0148	0.0083
LPG	0.0270	0.0072	0.0000	0.0020	0.0000	0.0029	0.0014	0.0000	0.0029	0.0000	0.0104	0.0001
Mean wood	**0.1391**	**0.0650**	**0.0196**	**0.0015**	**0.0002**	**0.0053**	**0.0028**	**0.0001**	**0.0017**	**0.0001**	**0.0031**	**0.0007**
Mean crop	**0.4595**	**0.1490**	**0.0722**	**0.0036**	**0.0004**	**0.0143**	**0.0060**	**0.0002**	**0.0033**	**0.0000**	**0.0064**	**0.0030**

Table 1 continued.

Sample	**A*n* (G)**	**Ca (G)**	**C*a* (A)**	**FL*n* (G)**	**FL*n* (A)**	**PY*n* (G)**	**PY*n* (A)**	**BaA (A)**	**C*n* (A)**	**BbF (A)**	**BkF (A)**	**BaP (A)**	**IP (A)**	**AH (A)**	**ghi (A)**
Brassica spp	0.0011	0.0000	0.0009	0.0008	0.0049	0.0008	0.0046	0.0021	0.0037	0.0012	0.0018	0.0014	0.0008	0.0000	0.0016
Melia	0.0000	0.0000	0.0002	0.0002	0.0010	0.0002	0.0009	0.0004	0.0004	0.0002	0.0004	0.0003	0.0000	0.0001	0.0003
Plywood	0.0000	0.0000	0.0007	0.0000	0.0022	0.0000	0.0020	0.0007	0.0010	0.0004	0.0007	0.0005	0.0016	0.0000	0.0006
Prosopis spp	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
Eucalyptus spp	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Azadirachta	0.0000	0.0000	0.0005	0.0000	0.0006	0.0000	0.0005	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mangifera	0.0000	0.0000	0.0009	0.0000	0.0010	0.0000	0.0008	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000
Morus spp	0.0005	0.0000	0.0052	0.0000	0.0052	0.0000	0.0049	0.0024	0.0030	0.0010	0.0017	0.0017	0.0007	0.0000	0.0013
Pithecellobium	0.0002	0.0001	0.0000	0.0001	0.0003	0.0002	0.0003	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Shorea spp	0.0000	0.0000	0.0003	0.0000	0.0014	0.0005	0.0011	0.0013	0.0027	0.0009	0.0013	0.0007	0.0003	0.0000	0.0009
Solanum melongena	0.0000	0.0000	0.0008	0.0000	0.0028	0.0003	0.0023	0.0008	0.0017	0.0005	0.0009	0.0006	0.0004	0.0000	0.0010
Ficus religiosa	0.0000	0.0000	0.0010	0.0001	0.0024	0.0000	0.0019	0.0005	0.0011	0.0002	0.0005	0.0003	0.0003	0.0000	0.0006
Syzygium spp	0.0004	0.0000	0.0010	0.0003	0.0019	0.0003	0.0016	0.0007	0.0007	0.0006	0.0009	0.0006	0.0029	0.0002	0.0016
Ficus spp	0.0000	0.0000	0.0005	0.0001	0.0009	0.0000	0.0008	0.0005	0.0000	0.0006	0.0008	0.0006	0.0007	0.0003	0.0017
Vachellia spp	0.0005	0.0000	0.0032	0.0002	0.0028	0.0002	0.0024	0.0008	0.0011	0.0005	0.0009	0.0007	0.0010	0.0001	0.0011
Dalbergia sis	0.0000	0.0000	0.0012	0.0001	0.0018	0.0001	0.0015	0.0005	0.0003	0.0004	0.0007	0.0004	0.0004	0.0002	0.0008
Ricinus spp	0.0000	0.0000	0.0004	0.0001	0.0006	0.0002	0.0005	0.0003	0.0000	0.0004	0.0007	0.0004	0.0009	0.0002	0.0012
Holoptelea spp	0.0000	0.0000	0.0005	0.0001	0.0009	0.0002	0.0008	0.0005	0.0004	0.0006	0.0011	0.0006	0.0023	0.0002	0.0014
Saraca indica	0.0000	0.0000	0.0004	0.0002	0.0011	0.0000	0.0012	0.0004	0.0002	0.0002	0.0005	0.0004	0.0002	0.0000	0.0007
Cocos nucifera	0.0004	0.0000	0.0052	0.0000	0.0077	0.0002	0.0075	0.0049	0.0061	0.0023	0.0039	0.0038	0.0020	0.0002	0.0031
Charcoal	0.0001	0.0003	0.0008	0.0001	0.0005	0.0001	0.0005	0.0004	0.0005	0.0002	0.0004	0.0002	0.0000	0.0000	0.0001
Sawdust	0.0000	0.0000	0.0047	0.0003	0.0110	0.0000	0.0061	0.0056	0.0068	0.0047	0.0039	0.0035	0.0018	0.0003	0.0036
Dung	0.0000	0.0001	0.0097	0.0003	0.0087	0.0004	0.0079	0.0060	0.0080	0.0027	0.0044	0.0040	0.0024	0.0010	0.0031
Waste	0.0019	0.0000	0.0044	0.0007	0.0124	0.0005	0.0102	0.0103	0.0128	0.0075	0.0081	0.0058	0.0041	0.0020	0.0052
LPG	0.0012	0.0000	0.0000	0.0003	0.0000	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mean wood	**0.0001**	**0.0000**	**0.0010**	**0.0001**	**0.0014**	**0.0001**	**0.0013**	**0.0006**	**0.0006**	**0.0004**	**0.0006**	**0.0004**	**0.0007**	**0.0001**	**0.0007**
Mean crop	**0.0005**	**0.0000**	**0.0023**	**0.0003**	**0.0052**	**0.0004**	**0.0048**	**0.0026**	**0.0039**	**0.0013**	**0.0022**	**0.0020**	**0.0011**	**0.0000**	**0.0019**

S6 Emission factors

The total volume of air convectively moving up the stack was determined from

$$V_{\mathrm{d}} = \sqrt{\frac{2gP_{\mathrm{s}}}{D_{\mathrm{s}}}}$$

where V_{d} = vertical displacement up the flue (ms^{-1}), g = 9.81 m^{-2}, P_{s} = average stack pressure (mmH_2O) and D_{s} is determined by:

$$D_{\mathrm{s}} = \frac{TD_{\mathrm{a}}}{T_{\mathrm{s}}}$$

where T = ambient temperature (k), D_{a} = density of air (1.1455 kg m^{-3}), T_{s} = average stack temperature ($^{\mathrm{o}}$K). The emission factor (EF) was calculated by:

$$\mathrm{EF} = \frac{tCV_{\mathrm{d}}A_{\mathrm{d}}}{M}$$

where t = time burned (s), C = concentration (g m^3), A_{d} = area of flue, M = mass of fuel burnt (kg).