Electronic Supplementary Material (ESI) for Analytical Methods

An investigation into the performance of a multi-sorbent sampling tube for the measurement of VVOC and VOC emissions from products used indoors

Veronica M. Brown and Derrick R. Crump

Supplementary information

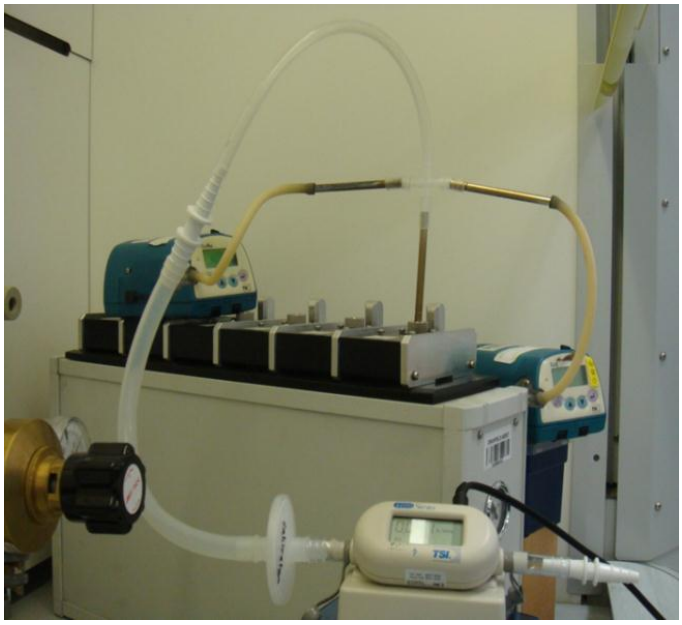

Fig. S1 Picture of µ-CTE set up to undertake duplicate sampling

Fig. S2 Picture of foam sealant sample being tested under FLEC

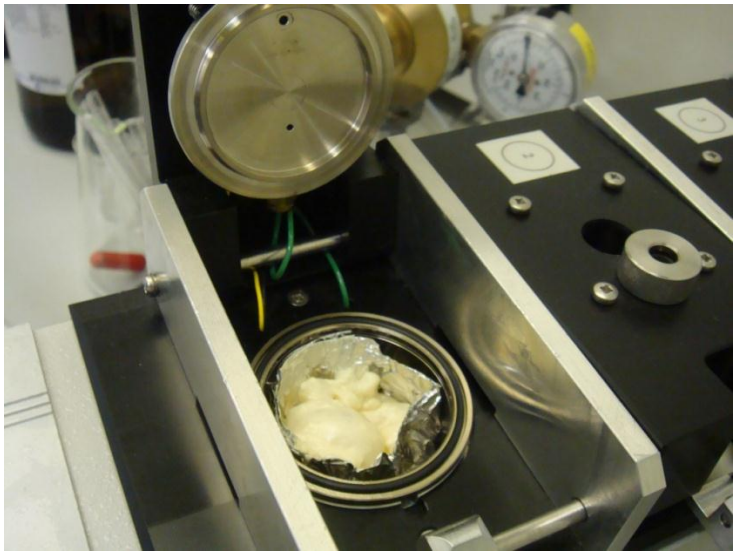

Fig. S3 Picture of foam sealant sample in µ-CTE

Fig. S4 Picture of experimental set up for Nalophan bag tests

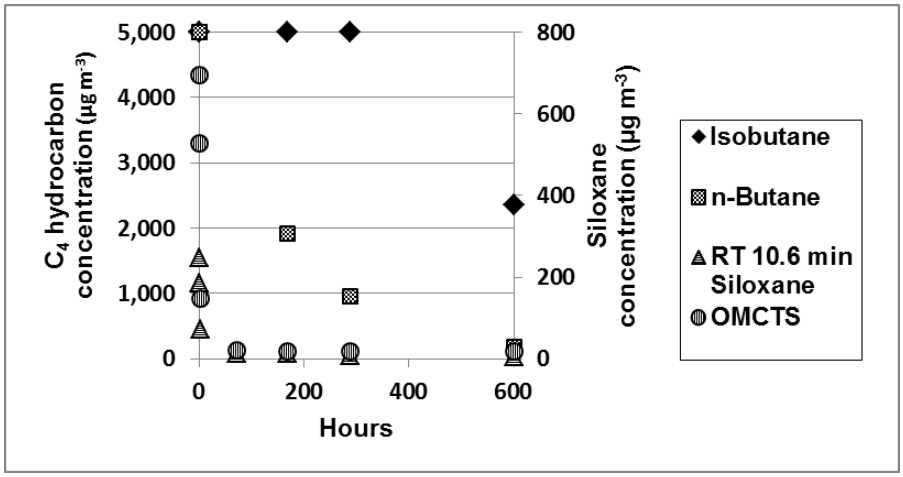

Fig. S5 Approximate concentrations of two C_4 hydrocarbons and two siloxanes released from foam sealant placed under FLEC (all compounds quantified as toluene and values above 5,000 µg m^{-3} set at this value)

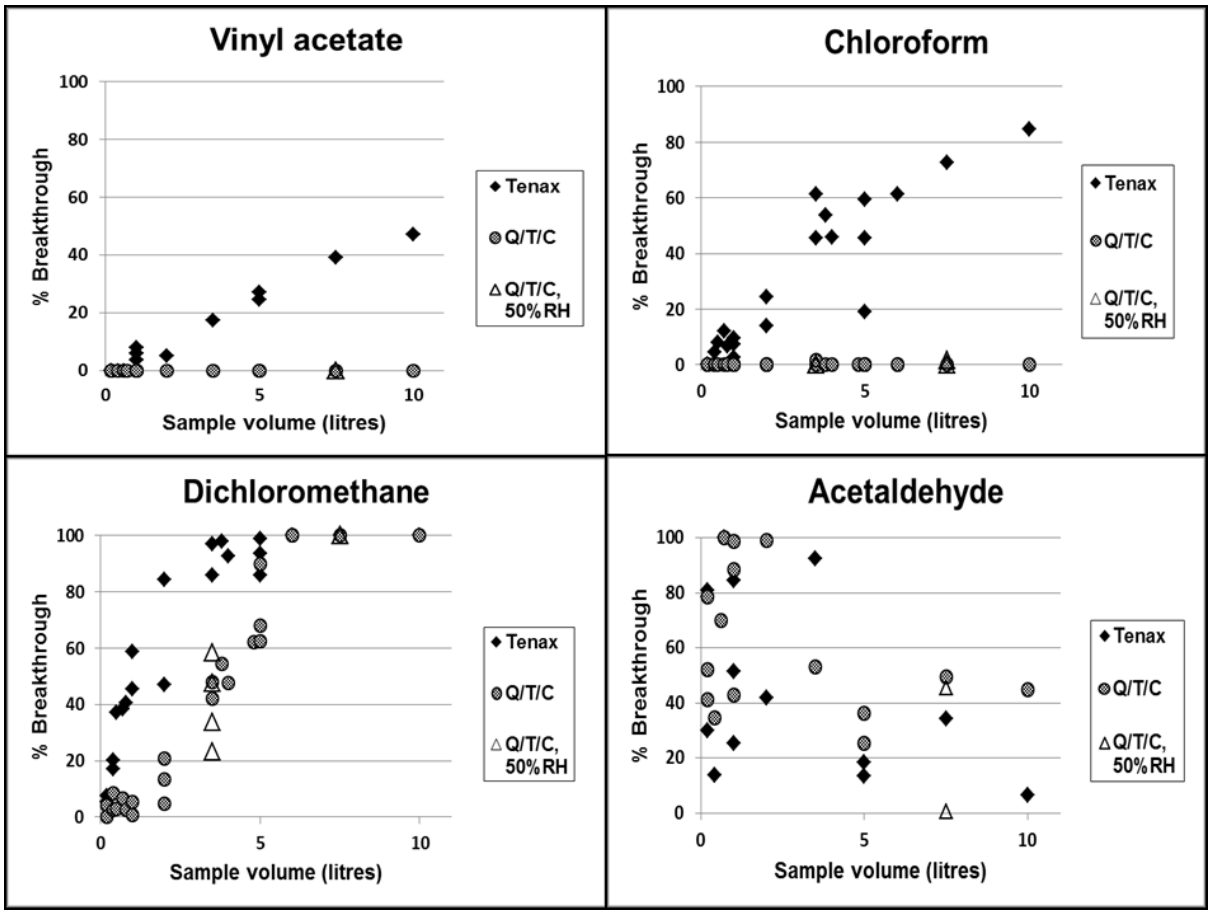

Fig. S6 Breakthrough of a further four VVOCs using two sorbent tubes connected in series sampling from an atmosphere of these compounds contained within a Nalophan bag

Table S1 Concentrations of VVOCs/VOCs in the emissions from samples of PU foam trapped onto two sorbent types (µg m^{-3}) and details of statistical tests

(a) Dominant compounds

Compound	n-Pentane		MCB †		Butyl acetate		m/p-Xylene		Styrene		o-Xylene		2-Ethoxyethyl-acetate †		Benzaldehyde †	
Sorbent	Tenax ‡	Q/T/C §	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C
Mean	284	461	1,735	2,284	136	133	233	230	3,470	3,410	150	147	281	252	162	166
SD	114	148	431	534	95.7	90.9	148	139	1,690	1,550	86.5	79.4	152	104	129	128
Max	525	697	2,662	3,315	339	327	545	526	6,890	6,500	334	316	586	419	431	425
Min	162	284	1,289	1,765	64.4	63.5	120	119	2,030	2,000	84.7	87.8	125	121	9.3	6.7
n	9	9	9	9	7	7	7	7	7	7	7	7	7	7	9	9
P	0.0001		<0.001		0.1801		0.5065		0.812		0.3101		0.2733		0.1125	
t	8.7682		11.655		1.5169		0.7063		0.9449		1.1086		1.2057		1.7823	
NS or S ¶	S		S		NS		NS		NS		NS		NS		NS	

(b) Compounds detected in smaller amounts

Compound	MiBK		Toluene		Ethylbenzene		1-methoxy-2-propylacetate †		Benzene-acetaldehyde †		Epoxyethyl-benzene †		Unidentified ester †		Benzoic acid †	
Sorbent	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C
Mean	30.3	30.2	33.6	37.2	41.3	41.1	66.6	64.6	36.0	63.2	65.6	21.8	15.0	16.0	23.2	25.6
SD	16.0	15.2	30.7	33.8	26.1	25.1	36.9	35.8	16.6	40.7	44.3	10.1	3.7	4.0	9.1	13.0
Max	62.2	60.9	98.3	97.2	95.4	93.8	145	141	56.5	144	145	33.4	20.8	22.2	36.6	40.2
Min	16.4	16.2	5.6	7.3	19.6	19.8	37.3	34.7	10.1	20.6	18.5	7.6	11.1	11.8	11.2	9.2
n	7	7	9	9	7	7	7	7	7	7	6	6	5	5	8	8
P	0.8436		0.2913		0.6526		0.0324		0.0778		0.0747		0.1751		0.5574	
t	0.2060		1.1298		0.4736		2.7697		2.1248		2.2457		1.6462		0.6160	
NS or S ¶	NS		NS		NS		S		NS		NS		NS		NS	

† Unidentified or only tentatively identified from NIST library, no pure standard available to confirm identity, quantified using response factor for toluene;

‡Tenax = Tenax TA; § Q/T/C = quartz wool/Tenax TA/Carbograph 5TD;

¶ NS = not significantly different at the $P = 0.05$ probability level, S = significantly different at the $P = 0.05$ probability level

Table S2 Concentrations of VVOCs/VOCs in the emissions from samples of foam sealant trapped onto two sorbent types (µg m^{-3}) and details of statistical tests

(a) Dominant compounds, sample volume 0.5-1.5 litres

Compound	Dimethyl ether †		Isobutane †		n-Butane †		Isopentane †		RT ‡ 10.6 min Siloxane †		RT 23.9 min Siloxane †		OMCTS †, §		RT 32.8 min Siloxane †		DMCPS †, ¶	
Sorbent	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C
Mean	758	571	2,120	3,700	771	2,390	38.6	247	251	246	296	290	496	495	208	200	317	295
SD	607	491	1,980	1,720	1,030	2,160	50.6	340	399	380	450	447	1,190	1,200	301	297	503	477
Max	2,140	1,630	7,230	7,580	3,450	7,500	136	826	1,060	1,030	1,120	1,150	3,850	3,870	745	768	1,300	1,300
Min	29.4	132	255	1,820	4.5	187	3.4	14.2	14.2	12.9	8.3	8.3	18.8	15.2	12.9	11.3	5.4	5.5
n	9	9	11	11	11	11	8	8	9	9	8	8	10	10	7	7	8	8
P	0.2179		0.0024		0.0011		0.0821		0.9053		0.5388		0.9981		0.5305		0.9298	
t	1.3373		4.0276		4.5429		2.0287		0.1228		0.6461		0.0024		0.6655		0.0897	
NS or S	NS		S		S		NS		NS		NS		NS		NS		NS	

(b) Compounds detected in smaller amounts, sample volume 0.5-1.5 litres

Compound	Propan-2-ol		n-Hexane		Methyl-cyclopentane †		1,4-Dioxane		n-Hexanal		RT 38.1 min Siloxane †		RT 39.9 min Siloxane †		RT 41.3 min Siloxane †		n-Tetradecane	
Sorbent	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C
Mean	66.4	120	159	208	52.1	96.2	79.9	84.0	87.9	82.1	89.7	84.9	36.0	33.6	26.2	25.0	29.4	28.5
SD	73.5	160	234	318	62.1	119	72.2	74.6	78.4	72.5	108	105	39.0	37.1	14.1	15.9	15.8	15.4
Max	255	587	576	845	139	283	221	240	234	230	297	298	108	109	50.1	55.7	57.6	56.4
Min	13.4	16.1	6.4	6.4	6.0	9.8	22.3	25.7	4.1	3.9	11.7	10.3	5.7	5.6	10.8	11.7	4.7	5.2
n	11	11	9	9	6	6	7	7	8	8	7	7	7	7	7	7	7	7
P	0.0908		0.1473		0.1391		0.3493		0.3702		0.4247		0.3807		0.5542		0.3919	
t	1.8714		1.6045		1.7581		1.015		0.9576		0.8564		0.946		0.6263		0.9225	
NS or S	NS		NS		NS		NS		NS		NS		NS		NS		NS	

† Unidentified or only tentatively identified from NIST library, no pure standard available to confirm identity, quantified using response factor for toluene;
‡ RT = retention time; § OMCTS = Octamethylcyclotetrasiloxane; ¶ DMCPS = Decamethylcyclopentasiloxane

(c) Compounds showing some effect of sorbent, sample volume 1.5-5.0 litres

Compound	Isopentane		Propan-2-ol		n-Hexane		Methylcyclopentane	
Sorbent	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C	Tenax	Q/T/C
Mean	9.5	60.9	32.5	70.2	33.1	39.9	10.4	18.4
SD	6.5	58.6	19.1	31.2	36.8	44.9	7.2	13.9
Max	19.9	172	65.3	131	109	135	21.2	41.0
Min	3.3	14.2	11.9	24.6	1.1	1.4	3.0	5.9
n	6	6	8	8	8	8	5	5
P	0.0615		0.0012		0.0581		0.0612	
t	2.4016		5.2700		2.2622		2.5814	
NS or S	NS		S		NS		NS	