



24/01/2014

Determining Flame Retardant Emission Factors from Treated Goods

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ESR3

Polyurethane foam



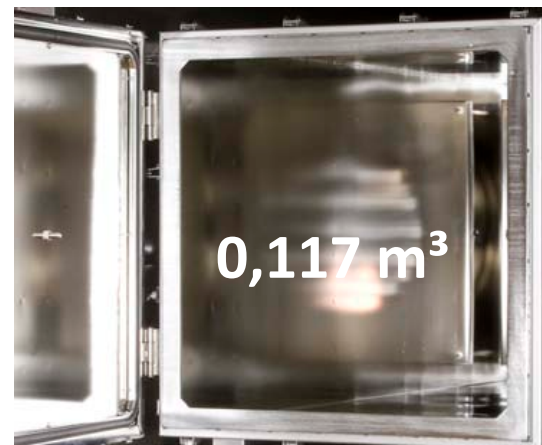
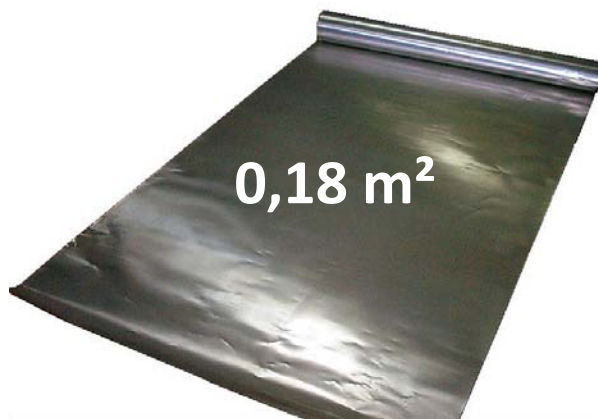
5. Samenstelling en informatie over de bestanddelen

Naam	CAS-nr. EINECS/ELINCS	Conc.	In D
tris(2-chloor-1-methylethyl)fosfaat	13674-84-5 237-158-7	1%<C<25%	X
polymethyleenpolyfenylisocyanaat	9016-87-9	C>25%	C X X

Emission test parameters

» Temperature	ISO 554	23 °C
» Relative humidity	ISO 554	50 %
» Air exchange rate	ISO 16000-9	0,5 h ⁻¹
» Loading factor		1,54 m ² /m ³
» Air velocity	ISO 16000-9	0,1 – 0,3 m/s
» Age of the product		NEW

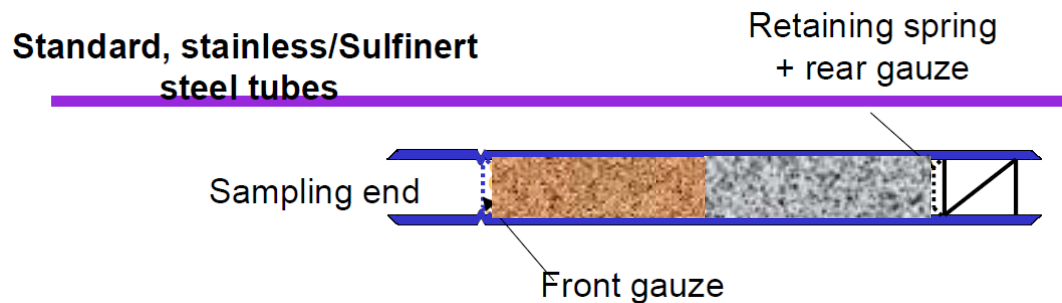
PU Foam emission test /sampling plan/



	Hours				Days																		
	0	24	48	72	6	14	23	30	41	55	73	84	120	130	140	135	150	157	164	174	181	188	210
T°C																							
RH %																							
TVOC																							
TCIPP																							

Sampling and detecting

PDMS/Tenax > TD-GC-MS

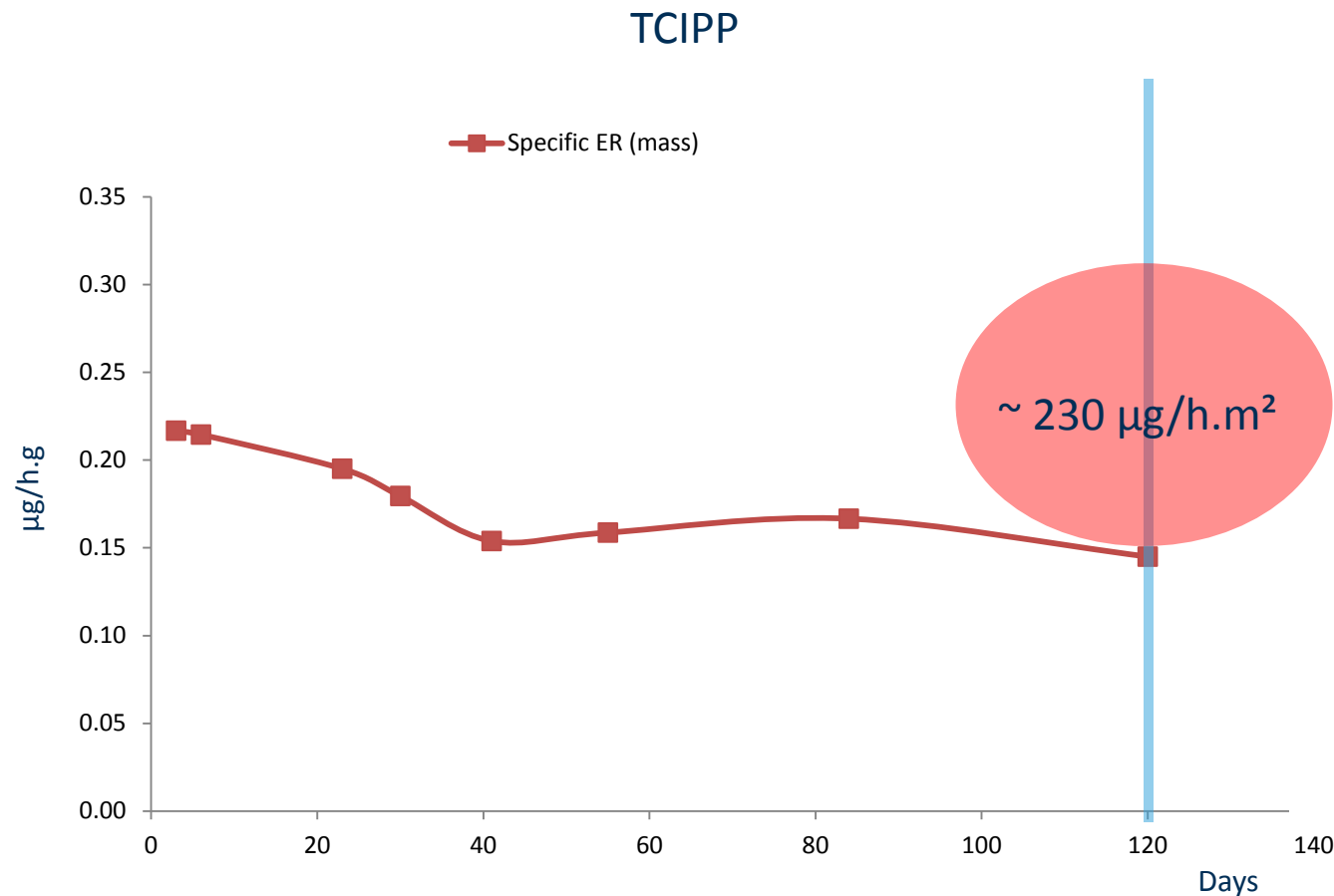


Sampling flow rate	300 ml/min
Sampling duration	120 min
Sampling volume	36 L



Lazarov, B., Swinnen, R., Spruyt, M., Goelen, E., Stranger, M., Desmet, G., and Wauters, E. Optimisation steps of an innovative air sampling method for semi volatile organic compounds. *Atmos. Environ.* 79, 780-786, **2013**.

Specific emission rates – Emission test outcome



$$SRF_{(s)TCIPP} \sim 230 \mu\text{g}/\text{h}.\text{m}^2$$

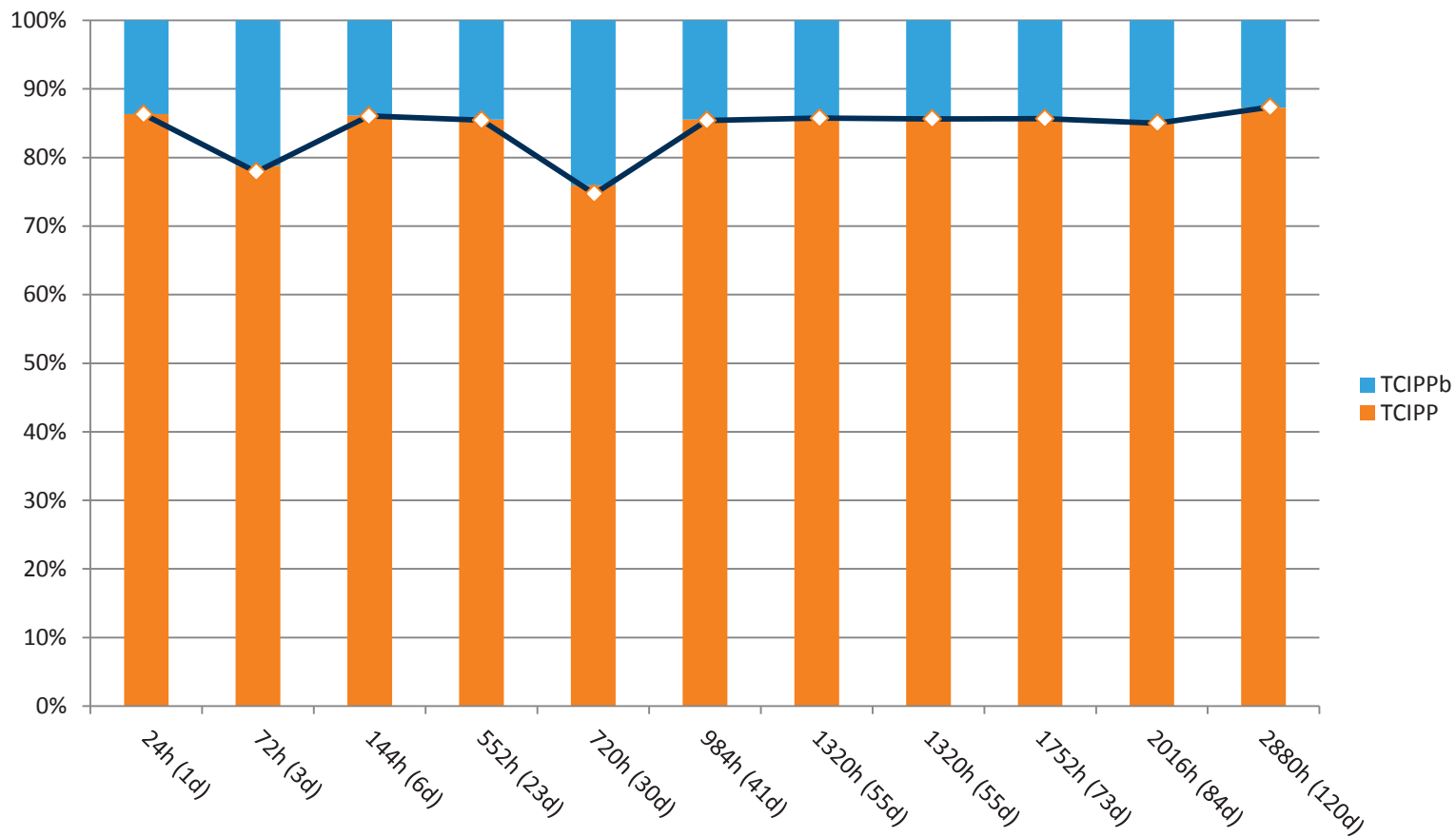
0,13 m²



$\sim 30 \mu\text{g}/\text{h TCIPP}$



TCIPP isomers - ratio

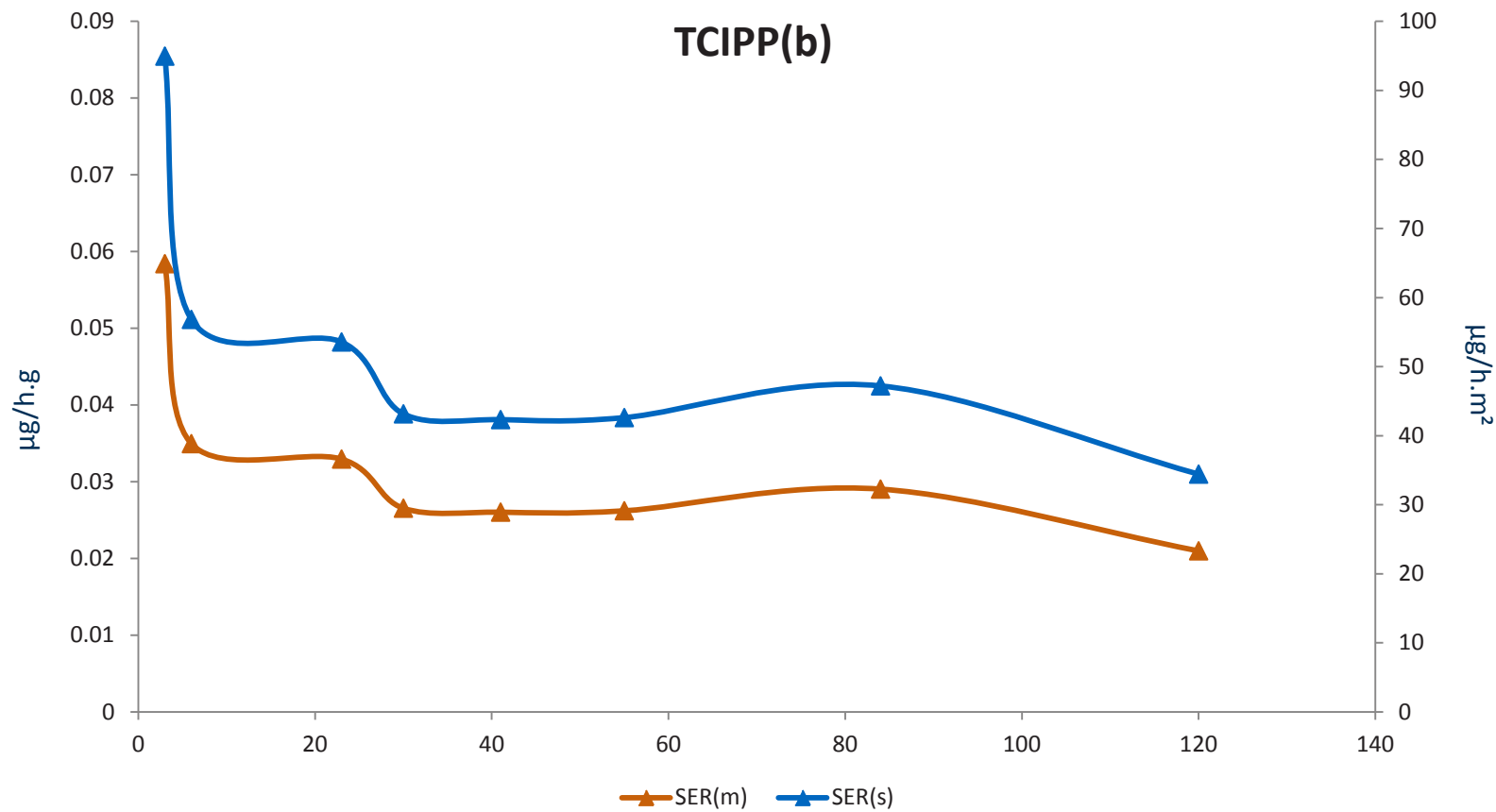


TCIPP isomers - ratio

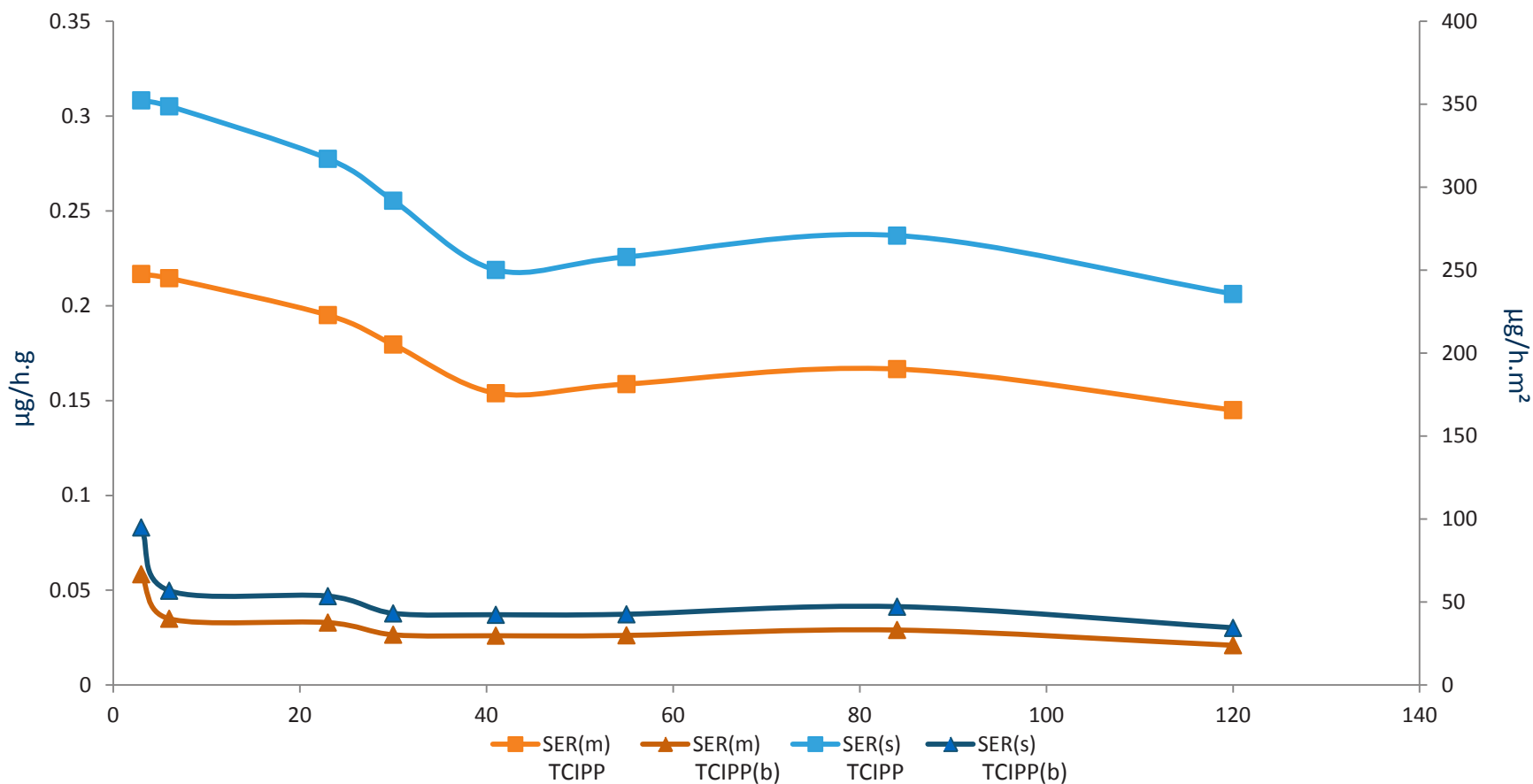
tris(2-Chloroisopropyl) phosphate (TCPP)			
TCPP-1	TCPP-2	TCPP-3	TCPP-4
TCPP-1 / TCPP-2 / TCPP-3 / TCPP-4 = 69.63 : 26.43 : 3.72 : 0.22			

A. Marklund et al., *J. Environ. Monit.*, 2005, **7**, 814-819

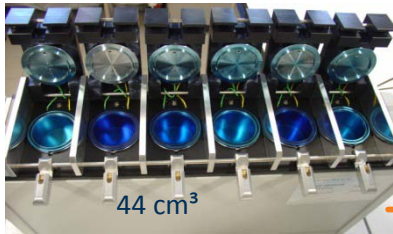
TCIPP isomer b



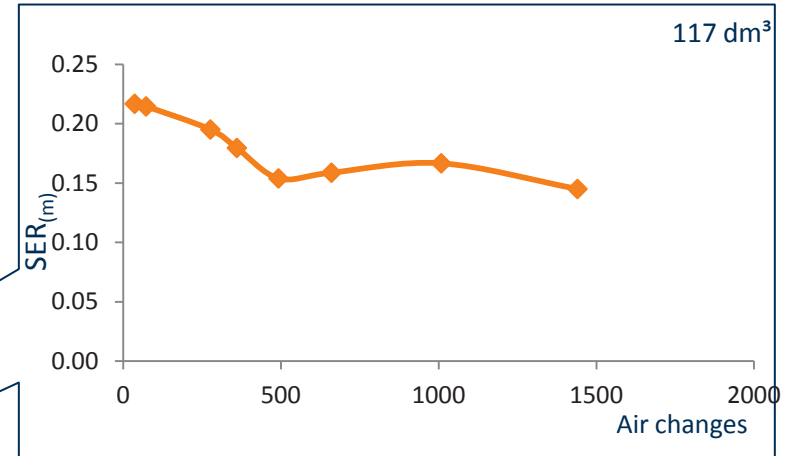
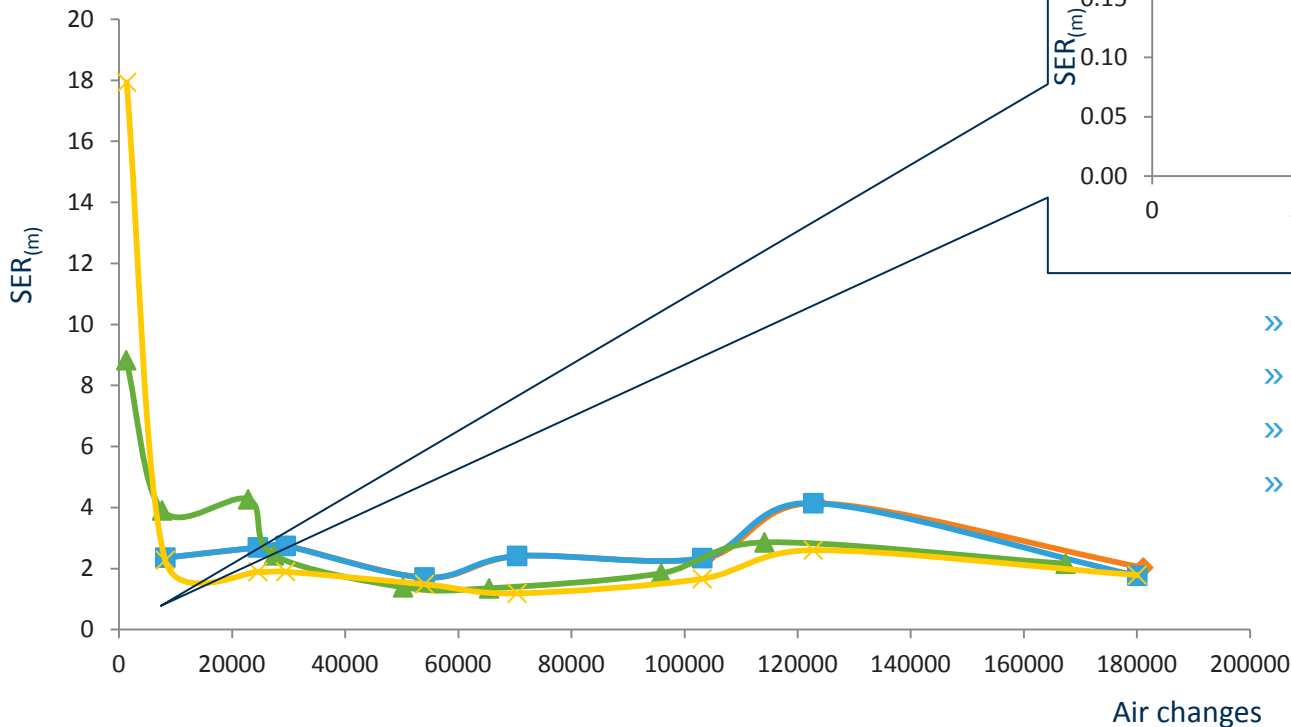
TCIPP isomers - SER



μ -chamber to optimize emission tests

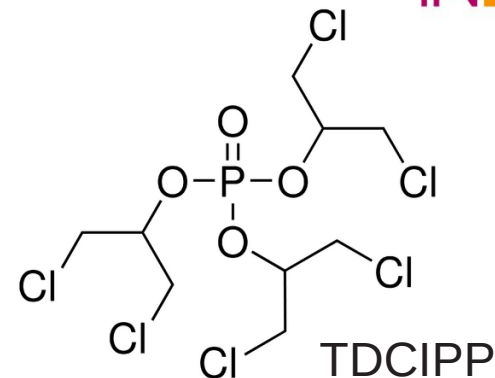


Cell 1 Cell 2 Cell 3 Cell 4

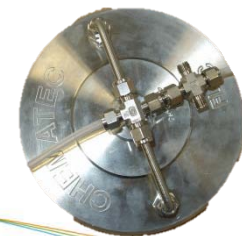


- » Study of reproducibility
- » Study of the emission profile
- » After more air changes
- » Optimize emission test
 - » No controlled RH!
 - » Low sink effect (wall/substrate ratio)

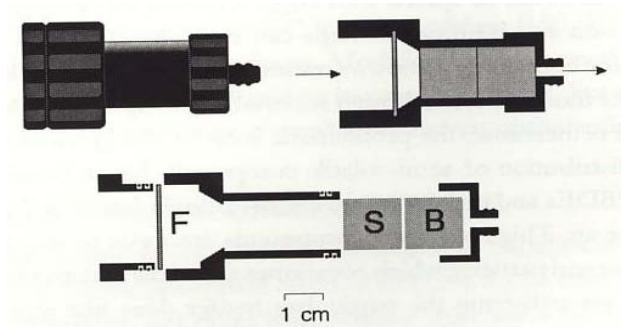
Next steps



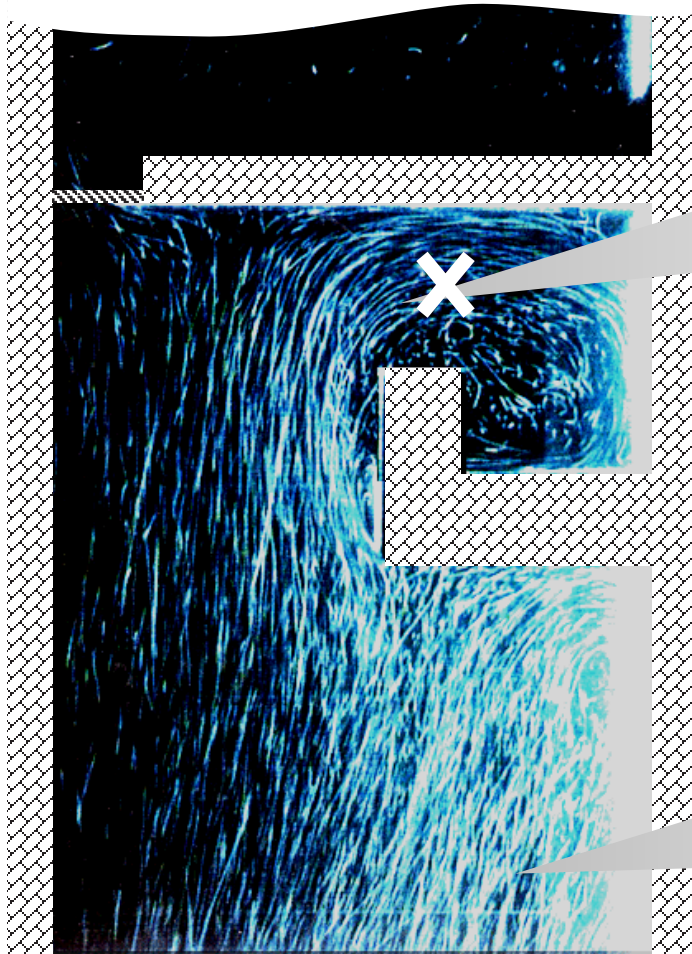
- » Reproducibility of the emission test protocol
(same type of product – another FR)
- » Optimization of the sampling/analysis method for NBFRs
- » Testing of the emission test protocol for another type of building materials
- » Sink effect assessment



Secondment at Stockholm University



Sampling place



Sampling setup



	Batch 1			Batch 2			Batch 3		
	24h	48h	72h	24h	48h	72h	24h	48h	72h
PDMS/Tenax									
PUF									
T, °C									
RH, %									

PDMS/Tenax TA sampling of PAHs

Table 4

Comparison of measured PAH concentrations obtained by high-volume sampling (filter + PUF) and PDMS/TENAX TA mixed bed method, period: April 2005–March 2006

Component	Hvol (+PUF) (ng/m ³)	Mixed Bed (ng/m ³)	Ratio	TEF ^a	TEQ ^b	
					Hvol (+PUF)	PDMS
Naphthalene	3.33	116.49	35.0	0.001	0.003	0.116
Acenaphtylene	3.08	6.11	2.0	0.001	0.003	0.006
Acenaphtene	0.31	7.14	23.0	0.001	0.000	0.007
Fluorene	5.38	7.92	1.5	0.001	0.005	0.008
Phenanthrene	11.74	13.85	1.2	0.001	0.012	0.014
Anthracene	0.72	0.92	1.3	0.01	0.007	0.009
Fluoranthene	3.43	4.50	1.3	0.001	0.003	0.005
Pyrene	1.98	2.90	1.5	0.001	0.002	0.003
Benz [a]anthracene	0.36	1.01	2.8	0.1	0.036	0.101
Chrysene	0.81	1.96	2.4	0.01	0.008	0.020
Benzo[b]fluoranthene	0.57	1.78	3.1	0.1	0.057	0.178
Benzo[k]fluoranthene	0.29	0.52	1.8	0.1	0.029	0.052
Benzo[e]pyrene	NM	1.49				
Benzo[a]pyrene	0.48	1.11	2.3	1	0.480	1.110
Indeno[1,2,3-cd]pyrene	0.67	1.24	1.9	0.1	0.067	0.124
Dibenz [a,h]anthracene	0.30	0.45	1.5	1	0.300	0.450
Benzo[ghi]perylene	0.65	1.07	1.6	0.01	0.007	0.011
Sum	34.10	170.44			1.019	2.214

^a TEF, benz[a]pyrene toxicity equivalent factor [39].

^b TEQ, measured concentration × TE.

E. Wauters et al. / J. Chromatogr. A 1190 (2008) 286–293

Results



Thank you for your attention!