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Emission measurements after 28 days

(2 appendices)

Object

One sample of a floor screed was supplied to SP by the client.

Sample name: **Avjämning Fin**
Batch No: 2016 09 08 334
sack of 20 kg

Date of arrival: 2016-09-30

Work requested and method

Emission measurement according accredited SP method 1598, similar to ISO 16000-10:2006 (Indoor air – Part 10: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test cell method), after 28 days regarding volatile organic compounds (VOC and VVOC/SVOC), carcinogenic substances (VOC-substances, EU Regulation No 1272/2008 Annex VI, cat 1A and 1B) and aldehydes (ISO 16000-3:2011). Evaluation according to CEN/TS 16516:2013 (EU-LCI values).

The test was started 2016-10-05. The material was mixed with water according to mixing instructions. 2.0 kg powder was mixed with 420 ml water. The mixture was applied in a mould with the size 250 x 250 x 3 mm. The test specimen was stored in a room with controlled climate conditions of 23 ± 2 °C and 50 ± 5 % RH. The specimen was placed into the test cell 24 hours prior to air samplings. The air samplings were carried out on 2016-11-02.

Test conditions in the chamber:

Chamber volume:	0.000035 m ³
Temperature:	23 ± 0.5 °C
Relative humidity:	50 ± 5 % RH
Air exchange rate:	171 h ⁻¹
Surface area of test specimen:	0.0177 m ²
Area specific air flow rate:	0.34 m ³ /m ² h.
Air velocity at specimen surface:	0.1 – 0.3 m/s

Tenax TA was used as adsorption medium for VOC. The Tenax tubes were thermally desorbed and analysed in accordance to accredited SP method 0601, similar to ISO 16000-6:2011 (Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS/FID). This means an analysis in a gas chromatograph and detection with a flame ionisation detector

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(FID) and mass selective detector (MS). The FID signals are used for compound quantification. The total volatile organic compounds (TVOC) means compounds eluting between and including n-hexane to hexadecane, having boiling points in the range of about 70-260 °C. The emission rate of TVOC is quantified in toluene equivalents and includes all compounds $ca \geq 1 \mu\text{g}/\text{m}^3$ in the chamber. The mass selective detector is used for identification of single compounds, quantified in compound specific amounts when possible, otherwise in toluene equivalents. Minimum duplicate air samples were taken and the results are mean values. Sampled volumes were 1 to 4 L.

Tenax TA was also used as adsorption medium for testing of volatile carcinogenic compounds, according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B), (exclusive formaldehyde), $1 \mu\text{g}/\text{m}^3$ and above.

The samplings of the aldehydes/ketones formaldehyde, acetaldehyde, acetone and propanal were carried out with DNPH samplers. The samplers were analysed according to accredited SP method 2302, similar to ISO 16000-3:2011 (Indoor air--Part 3: Determination of formaldehyde and other carbonyl compounds – Active sampling method). This means analysis on a liquid chromatograph with absorbance detector. The other aldehydes (butanal, pentanal, hexanal, benzaldehyde, 3-methylbenzaldehyde, 2-methylbenzaldehyde, 4-methylbenzaldehyde and 2,5-dimethylbenzaldehyde) were analyzed on GC-MS/FID by sampling on Tenax TA. Duplicate air samples were taken and the results are mean values. Sampled volumes were 11.4 L.

Results

The results in table 1 are expressed as area specific emission rates and as concentrations in a reference room (according to CEN/TS 16516:2013). The reference room has a base area of 3 m x 4 m and a height of 2.5 m, with an air exchange rate of 0.5 h^{-1} . The wall area is 31.4 m^2 , floor area is 12 m^2 and small area, like a door, is 1.5 m^2 . Floor area is used for the calculation of the concentrations.

Calculation of the concentration from the emission rate:

$$C = \frac{E_a \times A}{n \times V}$$

C = concentration of VOC in the reference room, in $\mu\text{g}/\text{m}^3$
E_a = area specific emission rate, in $\mu\text{g}/\text{m}^2\text{h}$
A = surface area of product in reference room, in m^2
n = air exchange rate, in changes per hour, here 0.5 h^{-1}
V = volume of the model room, in m^3 , here 30 m^3

Table 1.
Results of **Avjämning Fin**, after 28 days:

Volatile organic compounds	CAS number	Retention time (min)	ID ¹	Emission rate (µg/m ² h)	Concentration in reference room (floor scenario) (µg/m ³)	LCI _i (µg/m ³)	R _i (c _i /LCI _i)
TVOC	--	6.2 – 37.9	B	< 10	< 10	--	--
Volatile Carcinogens ²		6.2 – 37.9					
No substances detected	--	--	B	< 1	< 1	--	--
VOC with LCI ³		6.2 – 37.9					
No substances detected	--	--	B	< 2	< 5	--	--
∑ VOC with LCI	--	--	B	< 2	< 5	--	--
VOC without LCI ⁴							
Propylene glycol	57-55-6	9.4	A	5	< 5	--	--
∑ VOC without LCI	--	--	A	5	< 5	--	--
SVOC ⁵		37.9 - 50.0					
No substances detected	--	--	B	< 2	< 5	--	--
∑ SVOC	--	--	B	< 2	< 5	--	--
VVOC ⁶		4.5 – 6.2					
Formaldehyde ⁷	50-00-0		A	< 2	< 5	100	--
Acetaldehyde ⁷	75-07-0	--	A	< 2	< 5	1 200	--
∑ VVOC	--	--	A	< 2	< 5	--	--
R = ∑ C_i / LCI_i ⁸	--	--	--	--	--	--	< 0.01

¹⁾ ID: A = quantified compound specific, B = quantified as toluene-equivalent

²⁾ Volatile carcinogens = VOCs according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B

³⁾ VOC with LCI = identified VOC-compound with LCI-value according to EU-LCI, Dec 2015

⁴⁾ VOC without LCI = VOC-compound without LCI-value or not identified.

⁵⁾ SVOC = semi-volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)

⁶⁾ VVOC = very volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)

⁷⁾ VVOC-aldehydes measured with DNPH samplers (ISO 16000-3)

⁸⁾ All VVOC, VOC, SVOC and carcinogens with LCI

Only VOC-compounds with an emission rate higher than 2 µg/m²h are listed in the table. Quantification limit for TVOC is 10 µg/m²h. Measurement uncertainty for TVOC is 15 % (rel) and for formaldehyde 30 % (rel). Background of TVOC in the empty chamber was below 10 µg/m³ and is subtracted.

Only the compounds with a concentration in the model room > 5 µg/m³ are evaluated based on LCI (= lowest concentration of interest). TVOC is the sum of all individual substances with concentrations ≥ 5 µg/m³ (in toluene equivalents) within the retention range C₆ – C₁₆.

See Appendix 1 for gas chromatogram (FID spectra).

Summary of the test results

The test results are summarized in table 2.

Table 2.
Summary of emission results of **Avjämning Fin**

Compounds	Emission rate ($\mu\text{g}/\text{m}^2\text{h}$)	Concentration in reference room ($\mu\text{g}/\text{m}^3$)
TVOC	< 10	< 10
Σ Carcinogenics	< 1	< 1
Σ VOC with LCI	< 2	< 5
Σ VOC without LCI	5	< 5
Σ VVOC	< 2	< 5
Σ SVOC	< 2	< 5
$R = \Sigma C_i / \text{LCI}_i$	< 0.01	

The emission after 28 days was very low, TVOC was less than $10 \mu\text{g}/\text{m}^2\text{h}$ and formaldehyde was less than $2 \mu\text{g}/\text{m}^2\text{h}$.

There were no carcinogenic substances detected in the emission.

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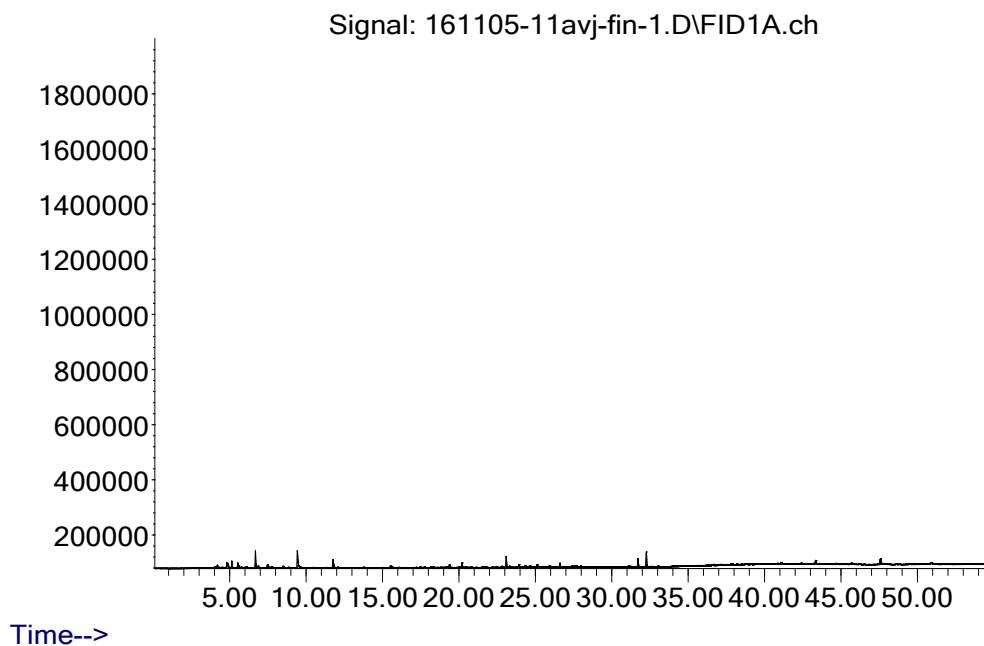
Appendices

1. Gas Chromatogram
2. Photo of test specimen

Appendix 1

Gas Chromatogram

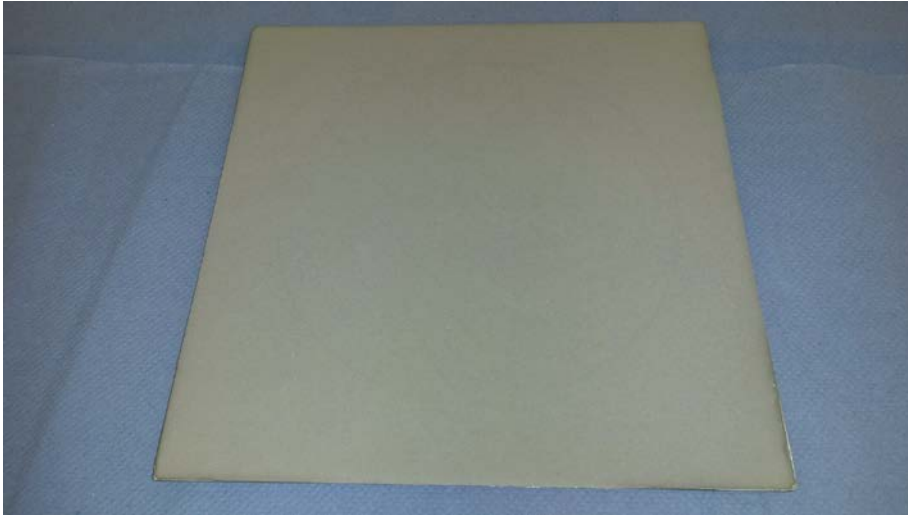
Avjämning Fin, after 28 days:
(sampled volume= 3.6 L)
Abundance



TVOC between C₆ and C₁₆, means compounds eluting between 6.2 and 37.9 minutes.

Appendix 2

Photo of test specimen



Avjämning Fin