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Emission measurement according to M1

(3 appendices)

Assignment

At the request of Flowcrete Sweden AB an emission measurement regarding VOC according to "M1 Emission Classification of Building Materials: Protocol for Chemical and Sensory Testing of Building Materials", ver 22.1.2015, has been carried out.

The measurements are made after 28 days of conditioning regarding volatile organic compounds, carcinogenic compounds (EU Regulation No 1272/2008 Annex VI, cat 1A and 1B), formaldehyde, ammonia and sensory acceptability.

Product/test specimen

Product type:	Floor coatings
Product name:	**Peran STB Public**
Batch No:	See Sampling report
Manufacturing date:	2016-04-21
Packaging:	Delivered by the client by car, in cardboard sheets
Arrived at SP:	2016-04-22
Test specimen preparation:	The sample preparation was made by the client, see Sampling report. The preparation was made on four stainless steel plates of 0.60 x 0.60 m each. Chemical testing: One piece was used. Surface area is 0.36 m^2. Sensory testing: Two pieces were used. Total surface area is 0.72 m^2.
Deviation from protocol:	The size for the sensory testing is little larger than stated 0.65 m^2.
Test period started, date:	2016-04-22
Conditions during ageing:	23 ± 2 °C, 50 ± 5 % RH
Emission samplings, date:	2016-05-20

Methods

The specimens were conditioned outside the testing chambers in separate conditioning containers in a room with controlled climate conditions of 23 ± 2 °C and 50 ± 5 % RH. The

specimens were placed in the chambers three days before the measurements of the chemical emission and two days before the sensory evaluation.

Chamber conditions of the test of chemical emissions:

Test chamber volume:	1.0 m^3, stainless steel
Temperature:	23 ± 1 ^oC
Relative Humidity:	50 ± 3 % RH
Air exchange rate:	0.5 h^{-1}
Air velocity at specimen surface:	0.1 – 0.3 m/s
Area of sample:	0.36 m^2
Area specific air flow rate:	1.4 m^3/m^2h

Chamber conditions of the test of sensory acceptability:

Test chamber volume:	1.0 m^3, stainless steel
Temperature:	23 ± 1 ^oC
Relative Humidity:	50 ± 3 % RH
Supply air flow rate:	0.9 l/s = 3.24 m^3/h
Area of sample:	0.72 m^2

Emission sampling and analytical methods:

Test	**Sampling method**	**Adsorbent**	**Sampling volume (litre)**	**Analysis method / Quantification**	**Detection limit**
VOC	ISO 16000-9:2006 [1]	Tenax TA	3 - 16	SP 0601 [2] / FID quantification	1 µg/m^3
Formaldehyde	ISO 16000-9:2006 [1]	DNPH	78, 101	SP 2303 [3] / HPLC-UV	0.03 µg/sampler
Ammonia	ISO 16000-9:2006 [1]	Treated silica gel	279, 225	Liquid chromatograph with conductivity detector [4]	0.9 µg/sampler
Sensory evaluation	Untrained panel of min 15 persons	--	--	--	--

[1)] Accredited method.
[2)] In accordance with ISO 16000-6:2011 and M1 protocol, accredited method.
[3)] In accordance with ISO 16000-3:2001, accredited method.
[4)] The determinations of the sampled silica gel tubes were done by Sahlgrenska Universitetssjukhuset, Miljökemiska laboratoriet, Göteborg, not accredited method.

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 (FID) and mass selective detector (MS). The FID signals are used for compound quantification. The TVOC is quantified as toluene equivalents. The mass selective detector is used for identification of compounds. The capillary column used is coated with 5% phenyl/ 95 % methylpolysiloxane.

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), 0.001 mg/m^3 and above. The compound specific response factors were calculated.

The sampling of formaldehyde was 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), which means analysis on a liquid chromatograph with absorbance detector.

The sampling of ammonium was carried out with silicagel treated adsorbent tubes and analysis on a liquid chromatograph with conductivity detector.

Two subsequent samples were taken for the VOC determination, for the formaldehyde and for the ammonia respectively.

Results

The results of the chemical testing are expressed as concentrations in the model room and as area specific emission rates:

A model room has a volume of 30 m^3 and an air change rate of 0.5 changes per hour. The concentration of VOC in the model room can be calculated according to this equation:

$$Conc = \frac{SER_A \times A}{n \times V}$$

Conc = concentration of a VOC in the model room, in µg/m^3
SER_a = area specific emission rate, in µg/m^{2}h
A = area of sample, in m^2 (12 m^2 for flooring)
n = air exchange rate, in changes per hour
V = volume of the model room, in m^3

Results of the chemical testing of the sample of **Peran STB Public** after 28 days:

Compound	**Concentration in model room** mg/m^3	**Emission rate** mg/m^{2}h	**Criteria M1** mg/m^{2}h
TVOC	0.085	**0.110**	< 0.2
Carcinogens	< 0.001	**< 0.001**	< 0.005
Formaldehyde	< 0.002	**< 0.002**	< 0.05
Ammonia	< 0.005	**< 0.006**	< 0.03

Test report from Sahlgrenska Universitetssjukhuset: test report 2016:11 dated 2016-06-09.

See appendix 1 for gas chromatogram from the VOC determination.

Results of the sensory evaluation of the sample of **Peran STB Public** after 28 days:

Evaluator	Sensory evaluation	Criteria M1
1	0.95	
2	1.00	
3	0.85	
4	0.95	
5	0.95	
6	1.00	
7	0.85	
8	0.90	≥ + 0.0
9	0.90	
10	1.00	
11	0.55	
12	0.95	
13	0.90	
14	1.00	
15	1.00	
Arithmetic mean of acceptability:	**0.9**	

Standard deviation: 0.11
90 % Confidence interval of arithmetic mean: 0.05

The empty sensory test chamber acceptability was determined 2016-05-18. The mean acceptability vote of the empty chamber was > 0.8.

Interpretation of the results

The tested product **Peran STB Public** complies with all the requirements of M1 for the tested parameters.

Detailed results

Detailed results (emission rates) of the chemical testing after 28 days:

Sample	TVOC (mg/m^2h) as toluene equivalents between C_6-C_{16}	Formaldehyde (mg/m^2h)	Ammonia [5] (mg/m^2h)	Carcinogens (mg/m^2h) between C_6-C_{16}
1	0.106	< 0.003	< 0.005	< 0.002
2	0.107	< 0.002	< 0.006	< 0.002

[5)] Not accredited method.

Single VOCs above 0.005 mg/m^3 in the model room (as toluene equivalents):

Single VOCs	**Retention time** (min)	**CAS number**	**Concentration** (mg/m^3)	
			Sample 1	**Sample 2**
Single VOCs C_6-C_{16}:	6.2 - 37.9			
Triethylamine	8.1	121-44-8	0.015	0.014
Ethanol, 2-(2-ethoxyethoxy)-	19.1	111-90-0	0.020	0.021
Dipropylene glycol n-butyl ether	27.6+27.7	29911-28-2	0.064	0.065
1-Dodecanol	34.8	112-53-8	0.006	0.006
		TVOC:	0.106	0.107
Single VOC outside $C_6 – C_{16}$:				
VVOC (< C_6) [6]	5.0 – 6.2			
No single VVOC detected	--	--	--	--
SVOC ($C_{16} – C_{22}$) [7]	37.9 - 42.0			
No single SVOC detected	--	--	--	--

[6] VVOC = very volatile organic compounds, as defined in ISO 16000-6 (not accredited)
[7] SVOC = semi-volatile organic compounds, as defined in ISO 16000-6 (not accredited)

Level of identification of compounds is 100 % for all compounds ≥ 0.005 mg/m^3.

Measurements uncertainty

SER_{TVOC}: ± 15 %, $SER_{Formaldehyde}$: ± 30 %, SER_{NH3}: ± 14 %

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Performed by

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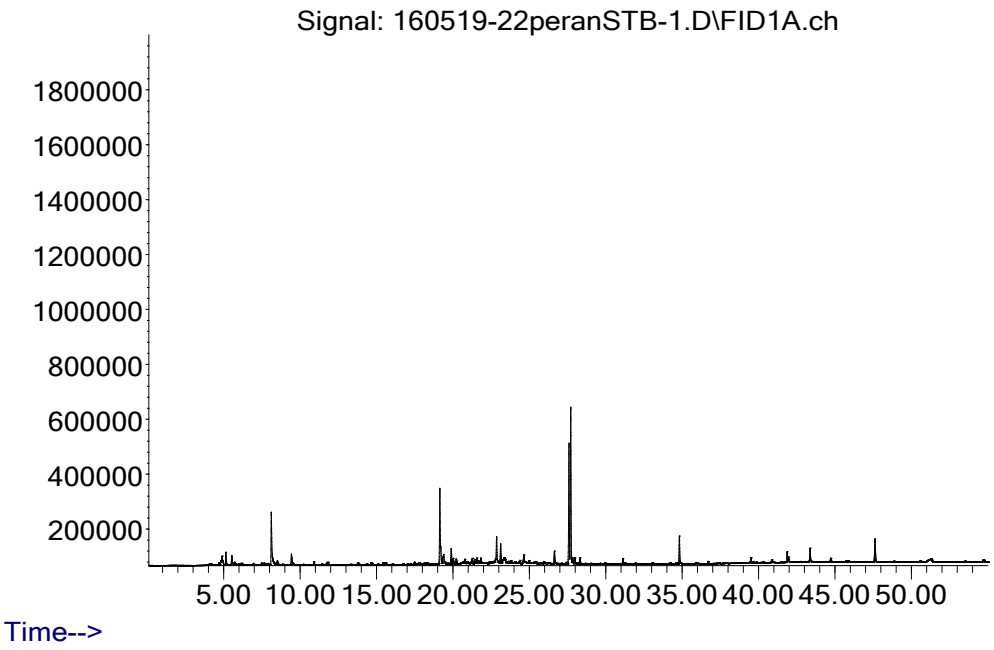
Appendices

1. Gas Chromatogram
2. Photo of test specimen
3. Sampling report

Appendix 1

Gas chromatogram

Sample: **Peran STB Public**, after 28 days (sampled volume: 4.2 litres):



TVOC between C_6 and C_{16}, means compounds eluting between 6.2 and 37.9 minutes.

Appendix 2

Photo of test specimen

Peran STB Public

One of the specimens

Appendix 3

Sampling Report (paints etc) Peran STB Public

Sampler (Name, Company, contact info) Mikael Ströbeck Technical Manager Flowcrete Sweden AB mikael@flowcrete.com +46 435 400138	**Manufacturer of the product** Flowcrete Sweden AB Perstorp Industripark SE-284 80 Perstorp
Name of product **System**: Peran STB Public **Products included in the system:** Primer: Hydraseal DPM Natural + quartz 1,0-1,8 mm Mainlayer: Peran STC LE + Peran Compact White (slurry) + coloured quartz. Topcoat: Peran STC LE	**Product category according to** EN 16402:20113, clause 5:
Manufacturing Date Hydraseal DPM Natural Base A 090401 Hydraseal DPM Natural Hardener B 140408 Quartz 1,0-1,8 mm 151110 Peran STC LE Base A 160415 Peran STC LE Hardener B 160201 Peran Compact White 151019 Coloured quartz 130712 Flowseal PU Matt Ultra Base A 151026 Flowseal PU Matt Ultra Hardener B 201610	**Batch No** Hydraseal DPM Natural Base A 0948093 Hydraseal DPM Natural Hardener B 10014434 Quartz 1,0-1,8 mm 151110 Peran STC LE Base A lab sample, ref. STC Resin 6 Peran STC LE Hardener B UBX0405-01 Peran Compact White 20151019 Coloured quartz 130712-1 Flowseal PU Matt Ultra Base A 151026 Flowseal PU Matt Ultra Hardener B 201610
Amount of material sampled *Adhesive primer: Peran Primer W 0,15 kg/m² Primer: Hydraseal DPM Natural 0,3 kg/m² + quartz 1,0-1,8 mm 0,5 kg/m² Mainlayer: Peran STC LE 1,0 kg/m² + Peran Compact White 1,0 kg/m² + Coloured quartz 3,5 kg/m² Topcoat: Peran STC LE 0,2 kg/m² ** The Peran Primer W (A. 10015409 / 140601, B. 10015660 / 140708) is used only as an adhesive primer to the alumina plates since the Peran STB Public system is intended to be applied on concrete or pumpable cementitious screeds and the Hydraseal DPM Natural does not work on metal substrates.*	
Sample is taken from: Production line ☐ Stock / Storage ☐ Miscellaneous X -where, specify: The system Peran STB Public is a multi layer resin floor system and the samples was produced at our sample department.	**How was the product stored before sampling?** The resins were stocked at our warehouse, sample department & laboratory before the system was applied at our sample department.

M1 2014

Appendix 3

If a sub-sample was collected from a larger material amount, describe how the sub-sample was taken	Packing material:
Recommended application amount, solid content, density or other The recommended thickness for the system is 3 mm.	
Confirmation I hereby confirm that the sample was selected, taken and packed in accordance with M1 testing protocol	
Date of sampling 2016-04-21	**Signature** Mikael Ströbeck

M1 2014