REPORT

issued by an Accredited Testing Laboratory

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Testing

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Emission Classification of Building Materials, M1

(3 appendices)

Assignment

At the request of Forbo Flooring AB an emission measurement 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.

For evaluation of test results the principle of shared risk is applied, i.e. for a max limit (≤) a result ≤ the limit complies and a result > the limit does not comply (ILAC G8 section 2.7).

Product/test specimen

Table 1.

Product type:	Floor underlay
Product name:	**Forbo Quickfit**
Manufacturing date:	2017-01-31
Packaging:	Two boards 60 x 120 cm packed in plastic foil
Arrived at SP:	Week 7, 2017
Test specimen preparation:	Chemical testing: Two pieces 60 x 34 cm was cut out and placed back-to-back. The edges were sealed with aluminium tape leaving an exposed surface area of 0.4 m^2. Sensory testing: Four pieces 60 x 28.5 cm were cut out and placed back-to-back. The edges and parts of the front sides were sealed with aluminium tape leaving an exposed surface area of 0.65 m^2.
Deviation from protocol:	No
Test period started, date:	2017-02-24
Conditions during ageing:	23 ± 2 ^oC, 50 ± 5 % RH
Emission samplings, date:	2017-03-24

Methods

The specimens were conditioned outside the testing chambers in a controlled climate conditions of 23 ± 2 ^oC and 50 ± 5 % RH. The specimens were placed in the chambers three days before the measurement of chemical emission and the sensory evaluation.

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Table 2.
Chamber conditions of the test of chemical emissions

Test chamber volume:	0.250 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:	0.40 m^2
Area specific air flow rate:	0.31 m^3/m^2h

Table 3.
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:	0.65 m^2

Table 4.
Emission sampling and analytical methods

Test	**Sampling method**	**Adsorbent**	**Sampling volume (litre)**	**Analysis method / Quantification**	**Detection limit**
VOC	ISO 16000-10:2006 [1]	Tenax TA	2.9 – 6.8	SP 0601 [2] / FID quantification	1 µg/m^3
Formaldehyde	ISO 16000-10:2006 [1]	DNPH	33 – 53	SP 2303[3] / HPLC-UV	0.03 µg/sampler
Ammonia	ISO 16000-10:2006 [1]	Treated silica gel	266 – 322	Liquid chromatograph with conductivity detector [4]	0.9 µg/sampler
Sensory evaluation	ISO 16000-28:2012 [5]	--	--	Acceptability, Untrained panel of min 15 persons	--

[1)] In accordance with ISO 16000-10:2006 and M1 protocol.
[2)] In accordance with ISO 16000-6:2011 and M1 protocol.
[3)] In accordance with ISO 16000-3:2001.
[4)] The determinations of the sampled silica gel tubes were done by Sahlgrenska Universitetssjukhuset, Miljökemiska laboratoriet, Göteborg, not accredited method.
[5)] In accordance with M1 protocol, not accredited method.

Tenax TA was used as adsorption medium for VOC The Tenax tubes were thermally desorbed and analysed in accordance to 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 sampling of formaldehyde was carried out with DNPH samplers. The samplers were analysed according to 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.

Minimum two subsequent samples were taken for the determination of VOC, formaldehyde and ammonia respectively.

Results

The results of the chemical testing are expressed as area specific emission rates and as concentrations in a model room. The model 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, small area -like a door- is 1.5 m^2 and very small area -like a sealant- is 0.2 m^2. Floor area is used for the calculation of the concentrations.

Calculation of the concentration from the emission rate:

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

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

Table 5.
Results of the chemical testing of the sample **Forbo Quickfit** after 28 days

Compound	**Concentration in model room** mg/m^3	**Emission rate** mg/m^2h	**Criteria M1** mg/m^2h
TVOC [6]	< 0.008	**< 0.010**	< 0.2
Carcinogens	< 0.001	**< 0.001**	< 0.005
Formaldehyde	0.029	**0.036**	< 0.05
Ammonia [7]	< 0.001	**< 0.001**	< 0.03

[6] The TVOC is calculated as the sum of the individual concentration $\geq$ 5 µg/m^3 in model room concentration.
[7] Not accredited method. Test report from Sahlgrenska Universitetssjukhuset: test report 2017:08 dated 2017-04-05.

Table 6.
Results of the sensory acceptability evaluation of the sample **Forbo Quickfit**, after 28 days

Evaluator	Sensory evaluation	Criteria M1
1	0.84	
2	0.62	
3	0.96	
4	0.74	
5	0.48	
6	0.28	
7	0.95	
8	0.88	
9	0.96	
10	-0.18	
11	0.43	
12	0.92	
13	0.27	
14	0.54	
15	0.74	
Arithmetic mean of acceptability [8]	**0.63**	≥ + 0.0
Standard deviation	0.33	
90 % confidence interval of arithmetic mean	0.14	
[8)] Not accredited method.		

The empty sensory test chamber acceptability was determined 2017-03-21. The mean acceptability vote of the empty chamber was > 0.8.

Interpretation of the results

The tested product **Forbo Quickfit** complies with all the requirements of M1 for the tested parameters.

Detailed results

Table 7.
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 (mg/m^2h)	Carcinogens (mg/m^2h) between C_6-C_{16}
1	< 0.010	0.034	< 0.001	< 0.001
2	< 0.010	0.037	< 0.001	< 0.001

Table 8.
Single VOCs above 5 $\mu g/m^3$ in the model room (flooring scenario), as toluene equivalents

Single VOCs	CAS number	Retention time (min)	Concentration (µg/m^3)	
			Sample 1	Sample 2
Single VOCs C_6-C_{16}:		5.6 – 37.9		
No single VOC detected	--	--	< 5	< 5
TVOC	--	5.6 - 37.9	< 5	< 5
Single VOC outside C_6 – C_{16}:				
VVOC (< C_6) [9]		4.8 – 5.6		
No single VVOC detected	--	--	< 5	< 5
SVOC (C_{16} – C_{22}) [10]		37.9 - 50.3		
No single SVOC detected	--	--	< 5	< 5

COMMENT:
TVOC is the sum of all individual substances with concentrations ≥ 5 µg/m^3.
Level of identification of compounds is 100 % for all compounds ≥ 5 µg/m^3.

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

Measurements uncertainty

The expanded measurement uncertainty of VOC result is 15 % (rel) and formaldehyde is 30 % (rel).
The expanded measurement uncertainty for ammonia is 14 % (rel) according to the test report from Sahlgrenska Universitetssjukhuset.

See appendix 1 for gas chromatogram from the VOC determination and appendix 2 for photo of a test specimen. Appendix 3 is the Sampling report received from the customer.

RISE Research Institutes of Sweden AB
Chemistry, Materials and Surfaces - Chemistry

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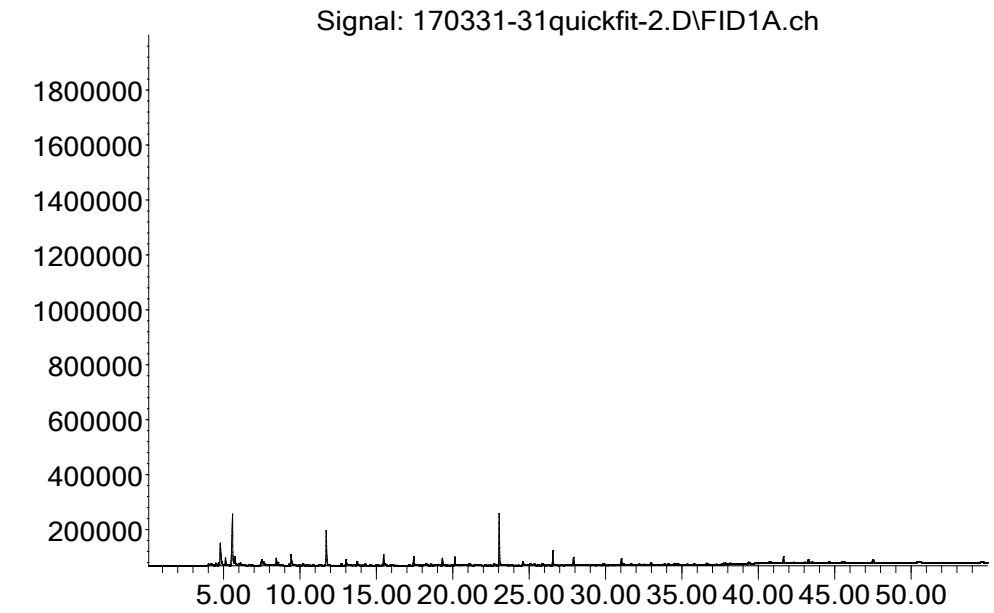
Appendices

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

Appendix 1

Gas chromatogram

Sample: **Forbo Quickfit**, after 28 days (sampled volume: 4.9 litres):



Appendix 2

Photo of test specimen

Forbo Quickfit

One of test specimens for sensory evaluation

Appendix 3

Sampling Report

Sampler (Name, Company, contact info) Forbo Flooring AB Ostmästargränd 4 Box 120 22 Årsta Mikael Taberman	**Manufacturer of the product** Forbo Flooring AB
Name of product Forbo Quickfit skivor	**Type of product** Undergolv av förlimmade mdf skivor
Manufacturing Date 2017-01-31	**Batch No** NA
Date of sampling 2017-02-10	**Amount of material sampled** 2 skivor med mått 60*120 cm
Sample is taken from: Production line ☐ Stock / Storage ☒ Miscellaneous ☐ -where, specify:	**How was the product stored before sampling?**
If a sub-sample was collected from a larger material amount, describe how the sub-sample was taken Varje förpackning innehåller 10 skivor. Förpackningen bryts, 2 skivor plockas ut och försluts med plastfolie.	
Observations and remarks	
Confirmation I hereby confirm that the sample was selected, taken and packed in accordance with M1 testing protocol	
Date 2017-02-10	**Signature**