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Emission measurements after 28 days

(3 appendices)

Object

One sample of an interior frame was delivered to RISE by the customer.

Product name:	Sample 2, MDF medium-density fiberboard
Production date:	week 19, 2019
Size of sample:	4 pieces, 250 x 1000 mm, thickness 18 mm, wrapped in plastic foil
Date of sampling:	week 19, 2019
Date of arrival to RISE:	2019-05-16
Date of analysis:	week 21 – 27, 2019

Assignment

Emission measurement according to ISO 16000-9:2006 (Indoor air – Part 9: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test chamber 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), formaldehyde and acetaldehyde (ISO 16000-3:2011). Evaluation according to EN 16516:2017 (EU-LCI values).

Method

The test was started 2019-05-23. One piece was used and cut to 500 mm, backside and edges were sealed with aluminium foil and -tape. One long edge was not sealed. The specimen was placed in a separate conditioning container (with air velocity of ca 0.2 m/s) in a room with controlled climate conditions of 23 ± 2 °C and 50 ± 5 % RH. The test specimen was placed into the chamber three days prior to air samplings. Air samplings after 28 days of conditioning were carried out on 2019-06-20.

Test conditions in the chamber:

Chamber volume:	0.25 m ³
Temperature:	23 ± 1.0 °C
Relative humidity:	50 ± 5 % RH
Surface area of test specimen:	0.13 m ²
Air exchange rate:	0.5 h ⁻¹
Area specific air flow rate:	0.93 m ³ /m ² h
Air velocity at specimen surface:	0.1 – 0.3 m/s

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Tenax TA was used as adsorption medium for VOC. The tubes were thermally desorbed and analysed in accordance to RISE 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 capillary column used is coated with 5% phenyl/ 95 % methylpolysiloxane. 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. Minimum duplicate air samples were taken and the results are mean values. Sampled volumes are 3 to 7 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 µg/m³ and above.

The samplings of aldehydes were carried out with DNPH samplers. The samplers were analysed according to RISE 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. Duplicate air samples were taken and the results are mean values. Sampled volumes were 30 to 50 L.

Results

The results relate only to the items tested.

The results in Table 1 are expressed as area specific emission rates (according to ISO 16000-6) and as concentrations in a reference room (according to EN 16516:2017). 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 m², floor area is 12 m², small area, like a door, is 1.6 m² and very small area, like sealant, is 0.2 m². **Small 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 µg/m³

E_a = area specific emission rate, in µg/m²h

A = surface area of product in reference room, in m²

n = air exchange rate, in changes per hour, here 0.5 h⁻¹

V = volume of the reference room, in m³, here 30 m³

Table 1.

 Emission results of **Sample 2, MDF medium-density fiberboard** after 28 days

Volatile organic compounds	CAS number	Retention time (min)	ID ¹	Emission rate ($\mu\text{g}/\text{m}^2\text{h}$)	Concentration in reference room ($\mu\text{g}/\text{m}^3$)	LCI _i ($\mu\text{g}/\text{m}^3$)	R _i (c_i/LCI_i)
TVOC (C₆ – C₁₆)	--	6.9 – 39	B	120	< 10	--	--
Volatile Carcinogens²		6.9 – 39					
No substances detected	--	--	B	< 1	< 1	--	--
VOC with LCI³		6.9 – 39					
Acetic acid (VVOC)	6.2	64-19-7	A	23	< 5	1200	--
Ethanol, 2-butoxy-	111-76-2	16.5	A	8	< 5	1600	--
Dipropylene glycol monomethylether	34590-94-8	19.9-20.8	A	80	9	3100	0.003
∑ VOC with LCI	--	--	A	110	9	--	--
VOC without LCI⁴		6.9 – 39					
2-Propanol, 1-butoxy-	5131-66-8	17.9	B	40	< 5	--	--
Probably: Di-sec-butyl ether	6863-58-7	18.4	B	4	< 5	--	--
Unknown	--	30.6	B	13	< 5	--	--
∑ VOC without LCI	--	--	B	57	< 5	--	--
SVOC (C₁₆ – C₂₂)⁵		39 - 52					
No substances detected	--	--	B	< 2	< 5	--	--
∑ SVOC	--	--	B	< 2	< 5	--	--
VVOC (< C₆)⁶		5.4 – 6.9					
Formaldehyde ⁷	50-00-0	--	A	5	< 5	100	--
Acetaldehyde ⁷	75-07-0	--	A	6	< 5	1 200	--
∑ VVOC	--	--	A	11	< 5	--	--
R = ∑ C_i / LCI_i⁸	--	--	--	--	--	--	< 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, July 2018

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 $\mu\text{g}/\text{m}^2\text{h}$ are listed in Table 1, carcinogenic compounds $\geq 1 \mu\text{g}/\text{m}^2\text{h}$. Only the compounds with a concentration in the reference room $> 5 \mu\text{g}/\text{m}^3$ are evaluated based on LCI (= lowest concentration of interest). TVOC expressed in $\mu\text{g}/\text{m}^3$ is the sum of all individual substances with concentrations $\geq 5 \mu\text{g}/\text{m}^3$ (in toluene equivalents). The emission rate of TVOC ($\mu\text{g}/\text{m}^2\text{h}$) includes all compounds $\text{ca} \geq 1 \mu\text{g}/\text{m}^2\text{h}$ in the chamber (ISO 16000-6).

Quantification limit for TVOC is 10 µg/m²h. Measurement uncertainty for VOC is 15 % (rel) and for formaldehyde 30 % (rel). Background of TVOC in the empty chamber was below 20 µg/m³ and is subtracted.

See Appendix 1 for a gas chromatogram (FID spectra) and Appendix 2 for a photo of the test specimen. Appendix 3 is the sampling report received from the customer.

Summary of the test results

The test results are summarized in Table 2.

Table 2.

Summary of the emission results after 28 days of **Sample 2, MDF medium-density fiberboard**

Compounds	Emission rate (µg/m ² h)	Concentration in reference room (small area scenario) (µg/m ³)
TVOC	120	< 10
∑ Carcinogenic VOCs	< 1	< 1
∑ VOC with LCI	110	9
∑ VOC without LCI	57	< 5
∑ VVOC	11	< 5
Formaldehyde	5	< 5
∑ SVOC	< 2	< 5
$R = \sum C_i / LCI_i$	< 0.01	

Evaluation of the test results

The emission results can be compared to different Emission Labelling Systems.

Sintef Miljøcertifikat has emission requirements on products that affect the indoor environment. The test shall be performed according to ISO 16000-9 and the calculation and reporting of TVOC according to EN 16516. The emission results of the tested sample are compared to these requirements, see Table 3.

Decision rule: When comparing the measured results and requirement level, the average value of the measured results has been compared with the requirement level. No account is taken to the measurement uncertainty.

Table 3.

The test results of **Sample 2, MDF medium-density fiberboard** compared to the requirements of Sintef

Compounds	Requirement Sintef ($\mu\text{g}/\text{m}^2\text{h}$)	Test Results ($\mu\text{g}/\text{m}^2\text{h}$)	Pass / Fail
TVOC	< 200	< 90 ⁹⁾	PASS
Formaldehyde	< 50	5	PASS
Sum of carcinogenic VOC	< 10	< 1	PASS

⁹⁾ According to **ISO 16000-6 and ISO 16000-9**, TVOC is the total area of the chromatogram. This total area expressed in emission rate is $120 \mu\text{g}/\text{m}^2\text{h}$. According to **EN 16516**, TVOC is the sum of all individual substances with concentrations in the reference room $\geq 5 \mu\text{g}/\text{m}^3$. Here this sum is $< 10 \mu\text{g}/\text{m}^3$. This sum expressed in emission rate is $< 95 \mu\text{g}/\text{m}^2\text{h}$.

The test results are in compliance with the emission requirements of Sintef Miljøcertifikat.

RISE Research Institutes of Sweden AB **Chemistry and Materials - Chemistry**

Performed by

Examined by

Maria Rådemar

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Appendices

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

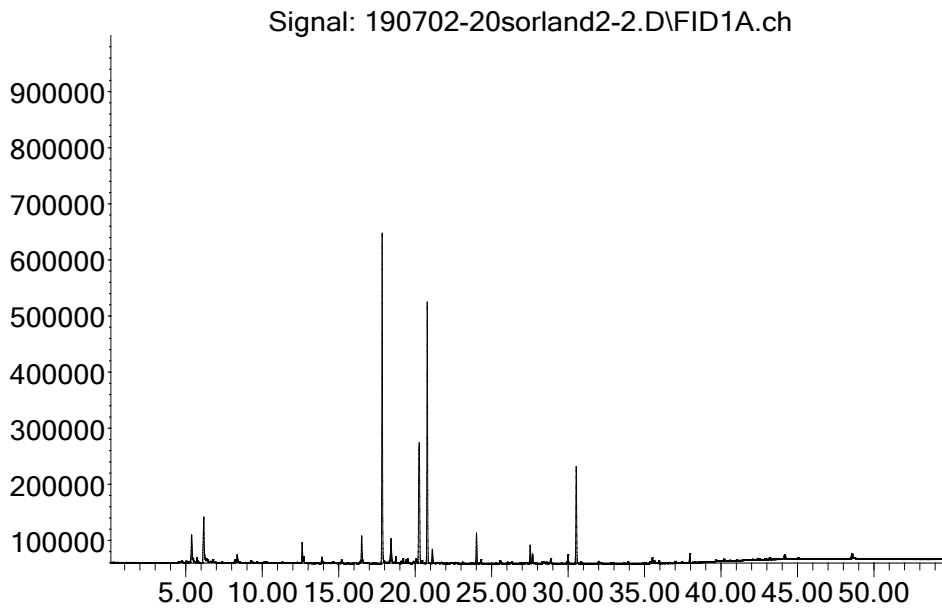
Appendix 1

Gas chromatogram

Sample 2, MDF medium-density fiberboard, after 28 days:

Sampled volume = 4.5 L

Abundance



TVOC between C₆ and C₁₆, means compounds eluting between 6.9 and 39 minutes.

Appendix 2

Photo of the test specimen

Appendix 3

Sampling Report

Sampler (Name, Company, contact info): Kjetil Thoresen Sørlandslisten AS Reddalsveien 35 N-4886 Grimstad	Manufacturer of the product (Company, address): Pfeilderer MR Nordic Swan (Enclosed in test package # 2)
Name of product: MDF, medium-density fiberboard	Type of product: MDF, medium-density fiberboard
Manufacturing Date: Week 19. 2019, Grimstad	Batch No:
Date of sampling: Week 19. 2019, Grimstad	Amount/size of material sampled: Approx. 1m ² Packing material: Plastic
Sample is taken from: Production line <input checked="" type="checkbox"/> Stock / Storage <input type="checkbox"/> Miscellaneous <input type="checkbox"/> -where, specify:	How was the product stored before sampling? Product shipped from Original manufacture in open sheets in size 1.2mx4.2m.
If a sub-sample was collected from a larger material amount, describe how the sub-sample was taken: Enclosed sample is a piece from a 1.2x4.2m sheet. Then re-molded and painted.	
Observations and remarks: Side to be tested is NOT marked with an "X"	
Confirmation I hereby confirm that the sample was selected, taken and packed in accordance with the instructions.	
Date: 10.05.2019	Signature: 