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Emission measurements after 28 days

(3 appendices)

Object

One sample of a carpet was delivered to RISE by the customer.

| | |
|--------------------------|----------------------------------|
| Product name: | Entré Miljø |
| Production date: | 2019-04-01 |
| Size of sample: | 1.1 x 1.0 m, packed in cardboard |
| Date of arrival to RISE: | 2019-05-29 |
| Date of analysis: | week 23 – 28, 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 2019-06-04. A specimen of 20 x 20 mm was cut out from the center of the folded sample. The specimen was placed on a plate of glass and edges were sealed with aluminium tape.

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 2019-07-01.

RISE Research Institutes of Sweden AB

| | | |
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Test conditions in the chamber:

| | |
|-----------------------------------|---------------------------------------|
| Chamber volume: | 0.03 m ³ |
| Temperature: | 23 ± 0.5 °C |
| Relative humidity: | 50 ± 3 % RH |
| Surface area of test specimen: | 0.040 m ² |
| Air exchange rate: | 0.67 h ⁻¹ |
| Area specific air flow rate: | 0.52 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 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 20 to 40 L.

Results

The results relate only to the items tested. The results in Table 1 are expressed as area specific emission rates 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. **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 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 **Entré Miljö** 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 ($C_6 - C_{16}$) | -- | 6.9 – 39 | B | < 10 | < 10 | -- | -- |
| Volatile Carcinogens ² | | 6.9 – 39 | | | | | |
| No substances detected | -- | -- | B | < 1 | < 1 | -- | -- |
| VOC with LCI ³ | | 6.9 – 39 | | | | | |
| Nonanal | 124-19-6 | 24.0 | A | 4 | < 5 | 900 | -- |
| Ethanol, 2-(2-butoxyethoxy)- | 112-34-5 | 26.9 | A | 8 | 6 | 670 | 0.009 |
| Σ VOC with LCI | -- | -- | A | 12 | 6 | -- | -- |
| VOC without LCI ⁴ | | 6.9 – 39 | | | | | |
| No substances detected | -- | -- | B | < 2 | < 5 | -- | -- |
| Σ VOC without LCI | -- | -- | B | < 2 | < 5 | -- | -- |
| SVOC ($C_{16} - C_{22}$) ⁵ | | 39 - 52 | | | | | |
| No substances detected | -- | -- | B | < 2 | < 5 | -- | -- |
| Σ SVOC | -- | -- | B | < 2 | < 5 | -- | -- |
| VVOC ($< C_6$) ⁶ | | 5.3 – 6.9 | | | | | |
| Formaldehyde ⁷ | 50-00-0 | -- | A | < 2 | < 5 | 100 | -- |
| Acetaldehyde ⁷ | 75-07-0 | -- | A | < 2 | < 5 | 1 200 | -- |
| Σ VVOC | -- | -- | A | < 2 | < 5 | -- | -- |
| R = $\Sigma C_i / \text{LCI}_i$ ⁸ | -- | -- | -- | -- | -- | -- | 0. |

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).

Quantification limit for TVOC is $10 \mu\text{g}/\text{m}^2\text{h}$. Measurement uncertainty for VOC is 15 % (rel) and for formaldehyde 30 % (rel). Background of TVOC in the empty chamber was below $10 \mu\text{g}/\text{m}^3$ and is subtracted.

See Appendix 1 for a gas chromatogram (FID spectra) and Appendix 2 for a photo of the test specimen.

Summary of the test results

The test results are summarized in Table 2.

Table 2.
Summary of the emission results after 28 days of **Entré Miljø**

| Compounds | Emission rate ($\mu\text{g}/\text{m}^2\text{h}$) | Concentration in reference room (floor scenario) ($\mu\text{g}/\text{m}^3$) |
|---------------------------------|---|--|
| TVOC | < 10 | < 10 |
| Σ Carcinogenic VOCs | < 1 | < 1 |
| Σ VOC with LCI | 12 | 6 |
| Σ VOC without LCI | < 2 | < 5 |
| Σ VVOC | < 2 | < 5 |
| Formaldehyde | < 2 | < 5 |
| Σ SVOC | < 2 | < 5 |
| $R = \Sigma C_i / \text{LCI}_i$ | < 0.01 | |

Evaluation of the test results

Svenska Byggvarubedömningen has criteria regarding Emissions to indoor environment. The emissions are to be measured according to a standard method such as ISO 16000-9 after 28 days regarding VOC and formaldehyde. The requirements for the *Recommended class* is that the requirements to one of the following systems are being met: Emission class EC1, Emission class EC1^{PLUS}, Blue Angel, M1 (RTS) or GUT.

The results of the tested sample are compared to M1.

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 **Entré Miljö** compared to the relevant requirements in M1

| Compounds | Requirement M1 (mg/m ² h) | Test Results (mg/m ² h) | Pass / Fail |
|---------------------------------|---|---------------------------------------|-------------|
| TVOC | < 0.2 | < 0.010 | PASS |
| Formaldehyde | < 0.05 | < 0.002 | PASS |
| CMR 1A+1B | < 0.005 | < 0.001 | PASS |
| Single VOC (µg/m ³) | ≤ EU-LCI | ≤ EU-LCI | PASS |
| Ammonia | < 0.03 | not measured | -- |
| Odour | ≥ 0.0 | not measured | -- |

The test results are in compliance with the tested requirements of M1 and meet the requirements for the *Recommended class*.

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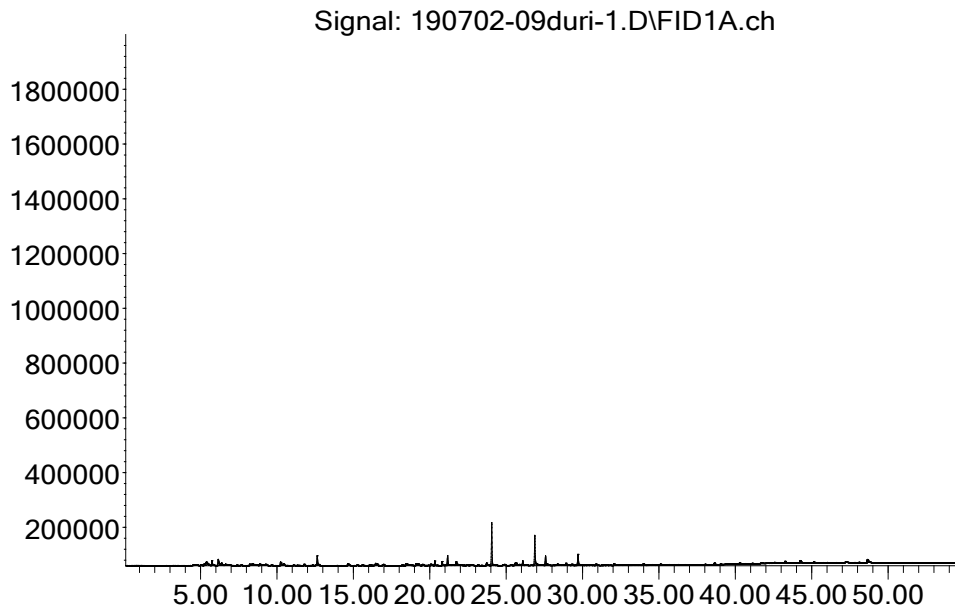
Appendices

1. Gas Chromatogram
2. Photo of the test specimen

Appendix 1

Gas chromatogram

Entré Miljö, after 28 days:
Abundance



TVOC between C_6 and C_{16} , means compounds eluting between 6.9 and 39 minutes.

Appendix 3

Photo of the test specimen