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Emission measurements

(3 appendices)

Object

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

Product name: **QVFR White (1) + (2)**
 Production date: (1): December 2017, batch: 175010
 (2): January 2018, batch: 180201
 Size of sample: 1 L, tin cans
 Date of arrival to RISE: 2018-03-08
 Date of analysis: week 13 – 19, 2018

Assignment

Emission measurements according to product standard EN 16402:2013 (Paints and varnishes – Assessment of emissions of substances from coatings into indoor air – Sampling, conditioning and testing) and the horizontal standard EN 16516:2017 (Construction products: Assessment of release of dangerous substances – Determination of emissions into indoor air). The measurements are performed 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).

Method

The paint system was applied with paint roller on two glass plates of 0.40 x 0.25 m. One coat of each paint was applied, with a drying time of 4 hours between the coats. Density and spreading rate were given by the customer. The date of application was 2018-03-27.

Table 1.

Density (g/cm ³)	Recommended spreading rate		Applied amount (g/coat and paint)
	(m ² /L)	(g/m ²)	
1.02 - 1.21	12	93	9.3

The product is classified as product category 4 (Table 3, EN 16402:2013).

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The specimens were 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. Air samplings after 28 days of conditioning were carried out on 2017-04-27, including 3 days of preconditioning.

Test conditions in the chamber:

Chamber volume:	0.25 m ³
Temperature:	23 ± 0.5 °C
Relative humidity:	50 ± 5 % RH
Surface area of test specimen:	0.20 m ²
Air exchange rate:	0.5 h ⁻¹
Area specific air flow rate:	0.62 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 30 to 50 L.

Results

The results in Table 2 are expressed as area specific emission rates and as concentrations in a reference room. 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. Wall 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 2.Emission results of **QVFR White (1) + (2)** 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 ($C_6 - C_{16}$)	--	6.5 – 38	B	110	220	--	--
Volatile Carcinogens ²		6.5 – 38					
No substances detected	--	--	B	< 1	< 1	--	--
VOC with LCI ³		6.5 – 38					
Propylene Glycol	57-55-6	9.7	A	240	500	2100	0.237
2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate	25265-77-4	32.1+32.7	A	33	70	600	0.116
Σ VOC with LCI	--	--	A	270	570	--	--
VOC without LCI ⁴							
No substances detected	--	--	B	< 2	< 5	--	--
Σ VOC without LCI	--	--	B	< 2	< 5	--	--
SVOC ($C_{16} - C_{22}$) ⁵		38 - 51					
No substances detected	--	--	B	< 2	< 5	--	--
Σ SVOC	--	--	B	< 2	< 5	--	--
VVOC ($< C_6$) ⁶		4.9 – 6.5					
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	--	--	--	--	--	--	0.35

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 2016

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

n.d. = not detected (detection limit is approx $1 \mu\text{g}/\text{m}^2\text{h}$).

Only VOC-compounds with an emission rate higher than $2 \mu\text{g}/\text{m}^2\text{h}$ are listed in Table 2, 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 $20 \mu\text{g}/\text{m}^3$ and is subtracted.

Individual substances can have response factors varying widely from the toluene response factor. The emission for example of propylene glycol was 240 $\mu\text{g}/\text{m}^2\text{h}$. This emission expressed in toluene equivalent, like TVOC, is 86 $\mu\text{g}/\text{m}^2\text{h}$.

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

Summary of the test results

The test results are summarized in Table 3.

Table 3.

Summary of the emission results after 28 days of **QVFR White (1) + (2)**

Compounds	Emission rate ($\mu\text{g}/\text{m}^2\text{h}$)	Concentration in reference room (wall scenario) ($\mu\text{g}/\text{m}^3$)
TVOC	110	220
Σ Carcinogenic VOCs	< 1	< 1
Σ VOC with LCI	270	570
Σ VOC without LCI	< 2	< 5
Σ VVOC	< 2	< 5
Formaldehyde	< 2	< 5
Σ SVOC	< 2	< 5
$R = \Sigma C_i / LCI_i$	0.4	

RISE Research Institutes of Sweden AB Chemistry and Materials - Chemistry

Performed by

Examined by

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Appendices

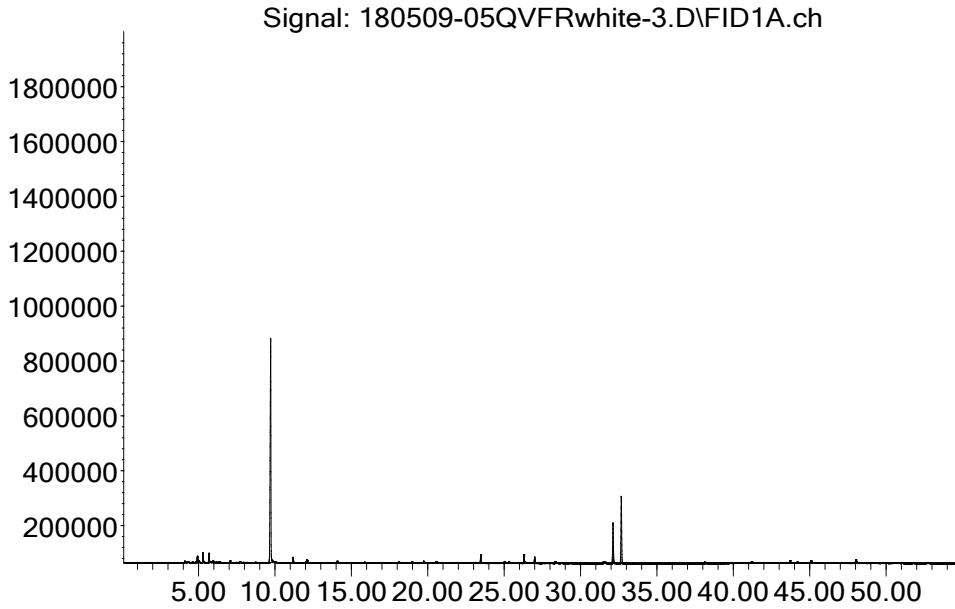
1. Gas Chromatogram
2. Photo of the test specimens
3. Sampling report

Appendix 1

Gas chromatogram

QVFR White (1) + (2), after 28 days:

Abundance



TVOC between C₆ and C₁₆, means compounds eluting between 6.5 and 38 minutes.

Appendix 2

Photo of the test specimens

Appendix 3

Sampling Report (paints etc)

Sampler (Name, Company, contact info): Scandinavian Trading Ltd, Unit 2, Glen court, Canada Road, Byfleet, Surrey, KT14 7JL, United Kingdom		Manufacturer of the product (Company, address): Intumescent Systems Ltd, Envirograf House, Barfrestone, Dover, Kent CT15 7JG, United Kingdom	
Name of product: QVFR White (1+2)		Product category according to EN 16402:2013, clause 5: Type 4 Function: passive fire protection, inc top coat	
Manufacturing Date: QVFR White 1: December 2017 QVFR White 2: January 2018		Batch No: QVFR White 1: 175010 QVFR White 2: 180201	
Amount of material sampled: 1 lit		Density (g/L): 1.02 – 1.21	
Solid content (vol %): QVFR White 1: 59% QVFR White 2: 36%		Spreading rate (m²/L): QVFR white 1: 85 μ QVFR white 2: 85 μ Total spreading rate 12m ² /lit per coat	
Sample is taken from: Production line <input type="checkbox"/> Stock / Storage <input checked="" type="checkbox"/> Miscellaneous <input type="checkbox"/> -where, specify:		How was the product stored before sampling? Indoor environment	
If a sub-sample was collected from a larger material amount, describe how the sub-sample was taken:		Packing material: Metal tin	
Remarks:			
Confirmation: I hereby confirm that the sample was selected, taken and packed in accordance with this protocol.			
Date of sampling: 15.02.2018		Signature: 