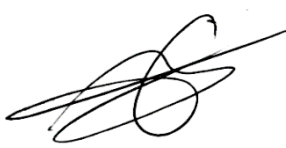



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Evaluation of Volatile Organic Compounds emitted according to ISO 16000

ANALYTICAL REPORT R/19/18151AGb

Version #	Validation - Scientific & Technical Direction / Quality Direction	Verification – Assistant of the Scientific & Technical Direction	Edition date of the version	Date of amendment
1	J.-F. LACROIX 	G.HAZAN 	19/06/2019	/

File 4597/19/00001
Report R/19/18151AGb

19/06/2019
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Ce rapport ne concerne que l'échantillon soumis à l'analyse. Reproduction partielle interdite sans l'accord d'Analytice. Seul le rapport original fait foi.
F-63 – V2 – 22/04/2009

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SAMPLE IDENTIFICATION

Our References	Information provided by the customer		Date of preparation	Date of analysis
	Your references	Description		
E/19/74914	Dalle Hexdalle HE 500X500mm épaisseur 25-35-45-55-65mm utilisation : sol pour aire de jeux intérieur ou extérieur	Rubber damping floor tiles (500x500mm)	/	From 07/05 to 03/06/2019

Your order: **Proforma Bon Pour Accord**

1. Mission

The firm FRANCE CONSTRUCTION asks to the firm Analytice to undertake tests of characterization and quantification of the emissions of volatile organic compounds (VOCs), Aldehydes and Formamide (CAS :75-12-7) emitted to comply with the decree N° 2011-321 of March 2011 and 19th April 2011. Emission ratings were established on the basis of measurements taken after 28 days in an emission test chamber. The aim was to classify emission rate from A+ to C, A+ indicating a very low level of emissions and C a high level of emissions. The level of emissions is indicated by the exposure concentration, expressed in $\mu\text{g.m}^{-3}$.

2. Principle of the test

The sample was conditioned as described in the ISO 16000-9 method for 28 days in an emission test chamber under constant conditions of temperature, relative humidity and air flow rate per unit specific surface.

Samples of chamber air emissions were carried out after 28 days of conditioning according to ISO 16000-6 methods for VOC analysis and ISO 16000-3 method for aldehydes analysis.

The interpretation of the results was based on targets set by the table below.

Ratings	C	B	A	A+
Formaldehyde	> 120	< 120	< 60	< 10
Acetaldehyde	> 400	< 400	< 300	< 200
Toluene	> 600	< 600	< 450	< 300
Tetrachloroethylene	> 500	< 500	< 350	< 250
Xylene	> 400	< 400	< 300	< 200
1,2,4-Trimethylbenzene	> 2 000	< 2 000	< 1 500	< 1 000
1,4-Dichlorobenzene	> 120	< 120	< 90	< 60
Ethylbenzene	> 1 500	< 1 500	< 1 000	< 750
2-Butoxyethanol	> 2 000	< 2 000	< 1 500	< 1 000
Styrene	> 500	< 500	< 350	< 250
TVOC	> 2 000	< 2 000	< 1 500	< 1 000

3. References

This report was prepared based on the analytical report from a laboratory, which is accredited according to ISO 17025 (ILAC full member) for the proposed methods, which realized the analysis.

3.1. Preparation of sample

NF EN ISO 16000-11: Indoor air - Part 11: Determination of the emission of volatile organic compounds from building products and furnishing - Sampling, storage of samples and preparation of test specimens (AFNOR, 2006).

3.2. Conditioning

NF EN ISO 16000-9: Indoor air - Part 9: Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method (AFNOR, 2006).

3.3. Sampling and analyses

NF ISO 16000-3: Indoor air – Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber (AFNOR, 2001).

NF ISO 16000-6: Indoor air - Part 6: Determination of volatile organic compounds in indoor air and test chamber by active sampling on Tenax TA® sorbent, thermal desorption and gas chromatography using MS or MS-FID (AFNOR, 2012).

4. Description of sample

Conditioning period:	28 days
Beginning of the test:	07/05/2019 11:00
End of the test:	03/06/2019 10:25
Relative Humidity:	50 ± 5 %
Temperature:	23 ± 2 °C

5. Preparation of the test specimen

Reverse side and sides were covered of aluminium foil and the specimen was introduced in clean emission chamber.

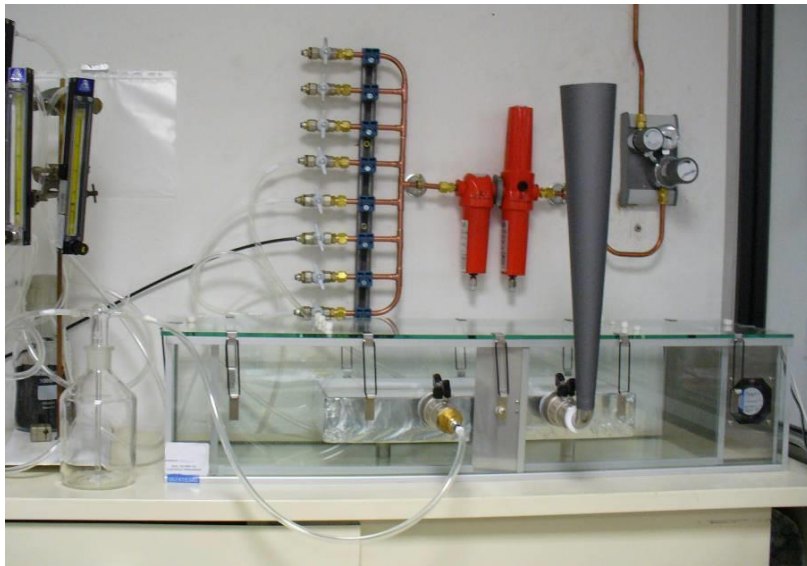


Figure 1: Emission chamber with specimen

6. Conditioning of sample

The test parameters below have been applied:

Test Parameters	Conditions
Emission test chamber	CLIMPAQ glass
Scenario	Floor/Roof
Specimen surface	0,054 m ²
Loading rate	1,061 m ² /m ³
Air flow	1,13 L/min
Air speed	0,22 m/s
Specific ventilation rate (q c)	1.25 m ³ /(m ² .h)

7. Sampling conditions of VOCs, aldehydes and formamide

The VOC samplings were conducted according to NF ISO 16000-6. It was carried out in double on Tenax tube before the start of the trial (D0) and after 28 ± 2 days (D28) of conditioning in the emission chamber.

Sampling	VOC	
Number of tubes	2	
Adsorbent support	Tenax TA	
Duration of sampling	60 min	30 min
Sampling flow	80 ml. min ⁻¹	80 ml. min ⁻¹
Volume of sampled air	4.8 L	2.4 L

The samples of aldehydes were produced at the same time as the VOC samples on adsorbent cartridges impregnated with DNPH (2,4-dinitrophenylhydrazine) according to standard NF ISO 16000-3.

Sampling	Aldéhydes
Number of tubes	1
Adsorbent support	DNPH
Duration of sampling	120 min
Sample flow	700 ml. min ⁻¹
Volume of sampled air	84 L

8. Conditions of analysis of VOC and aldehydes sampling

The VOC analysis was performed using a Perkin Elmer thermodesorber 650 coupled to a GC Clarus 680/ MS Clarus 600C/FID Perkin Elmer according to NF ISO 16000-6. The tubes were heated by thermodesorber for 30 min at 280°C. This heating causes a desorption of volatile substances which then pass through the chromatographic column and are detected by mass spectrometry (MS) and FID.

Appliance	Parameter	Conditions
Thermodesorber	Temperature of valve	250°C
	Temperature of tube	280°C
	Time of desorption	15 min
	Flow of inlet split	30 ml/min
	Cooling temperature	- 30°C
	Heating trap temperature	300°C
	Increase of temperature of the trap	40°C/s
GC	Program of temperature for GC	40°C during 2min 3°C/min until 92°C 5°C/min until 160°C 10°C/min until 280°C 280°C during 10 min
	Column	not polar capillary column (stationary phase: 5% phenylmethylsiloxane) 50 m x 0,32 mm x 0,52µm
FID	Flux	280°C O2: 450ml/min H2: 45ml/mi Attenuation: -6
MS	Scan	29 à 520 uma
	Inter scan time	0,1 s



Figure 2: Photography of Thermal desorption System coupled to GC-MS/FID

Analysis of aldehydes was carried out according to standard NF ISO 16000-3. The cartridges were eluted in 5 ml of acetonitrile. Two injections of 6 μ L of the elution solution were then analyzed by high performance liquid chromatography (HPLC) on a Perkin Elmer system equipped with a UV detector diode array.

The aldehydes were identified and quantified by specific calibration.

Sampling	Aldéhydes
Detector	UV-VIS diode array (360 nm)
Column	Inverse phase C18, 2,7 μ m, diameter = 3,0mm, L = 15 cm, Inox tube
Elution Flow	0,35 ml/min
Temperature of column	60°C



Figure 3: Photography of HPLC

9. Test Results

9.1. Exposure concentrations

C exp in $\mu\text{g}\cdot\text{m}^{-3}$ is the concentration that would result in a model room defined in the decree of 19th April 2011

$$C \text{ exp} = \text{SER} / q \text{ e}$$

q e: Ventillation rate of model room ($\text{m}^3\cdot\text{m}^{-2}\cdot\text{h}^{-1}$)

SER: Emission factor of VOC and aldehydes ($\mu\text{g}\cdot\text{m}^{-2}\cdot\text{h}^{-1}$)

$$\text{SER} = C \text{ mes} * q \text{ c}$$

q c: Ventillation rate of chamber ($\text{m}^3\cdot\text{m}^{-2}\cdot\text{h}^{-1}$)

C mes: Concentration of VOC in emission chamber ($\mu\text{g}\cdot\text{m}^{-3}$)

CAS	Name of compound	Rt (min)	C exp ($\mu\text{g}/\text{m}^3$)
			after 28 days
75-12-7	Formamide	10.0	<LQ (ND)
50-00-0	Formaldehyde	11.51	3.85
75-07-0	Acetaldehyde	14.50	6,62
108-88-3	Toluene	9.69	<LQ (trace)
127-18-4	Tetrachloroethylene	11.31	<LQ (ND)
1330-20-7	Xylenes (m-, o-, p-)	14.20 et 15.35	<LQ (ND)
95-63-6	1,2,4-Triméthylbenzene	20.37	<LQ (ND)
106-46-7	1,4-Dichlorobenzene	21.33	<LQ (ND)
100-41-4	Ethylbenzene	13.82	<LQ (ND)
111-76-2	2-Butoxyethanol	12.64	<LQ (ND)
100-42-5	Styrene	15.11	<LQ (ND)
Total VOC FID			205.8

- Wide absolute incertitude of formaldehyde: 36%.
- ND: Not Detected
- LOQ formaldehyde: $2.0 \mu\text{g}/\text{m}^3$ et LOD formaldehyde: $0.5 \mu\text{g}/\text{m}^3$
- LOQ acetaldehyde: $2.8 \mu\text{g}/\text{m}^3$
- LOQ other VOC: $2.0 \mu\text{g}/\text{m}^3$
- Rt: Retention time

Recommended labelling of product:

The concentrations of 10 VOC and Total VOC targeted by labeling are less than the limits below. These do not take into account the measurement uncertainty.

Labelling	C	B	A	A+
Formaldehyde	>120	<120	<60	<10
Acétaldehyde	>400	<400	<300	<200
Toluene	>600	<600	<450	<300
Tetrachloroethylene	>500	<500	<350	<250
Xylenes	>400	<400	<300	<200
1,2,4-Trimethylbenzene	>2 000	<2 000	<1 500	<1 000
1,4-Dichlorobenzene	>120	<120	<90	<60
Ethylbenzene	>1 500	<1 500	<1 000	<750
2-Butoxyethanol	>2 000	<2000	<1 500	<1 000
Styrene	>500	<500	<350	<250
COVT	>2 000	<2 000	<1 500	<1 000

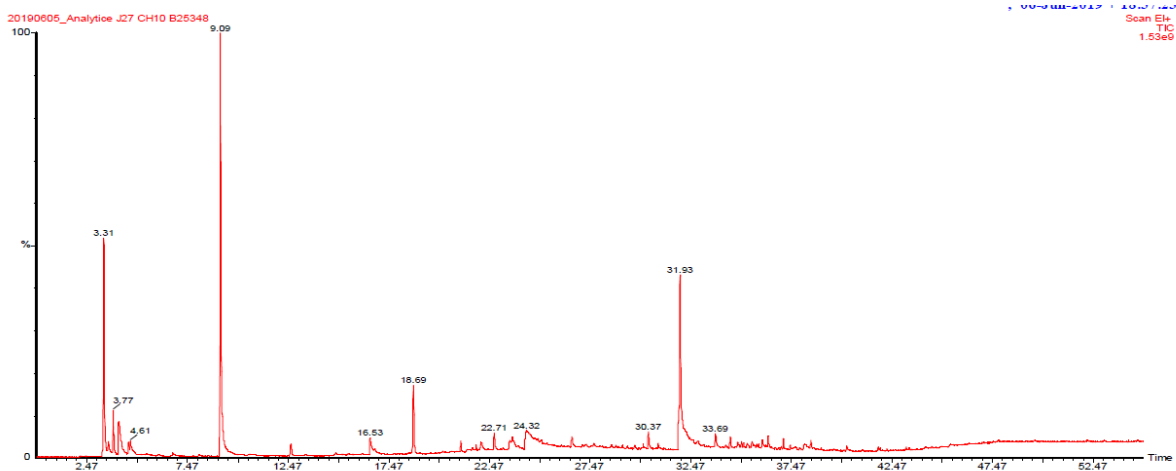
* Information representative of the indoor air emissions of volatile substances posing an inhalation toxicity risk on a scale from C (high emissions) to A+ (very low emissions)



Following those analysis, Formamide was not detected (Limit of quantification 2 µg/m³).

10. Appendix

10.1. Chromatogramme D 28



10.2. Quality

The background concentration of formaldehyde is conform to standard ISO 16000-9.
Recovery rates of toluene and n-dodecane are higher than 80%.
The above information, duplicate analysis and recording of test conditions are available upon request.