

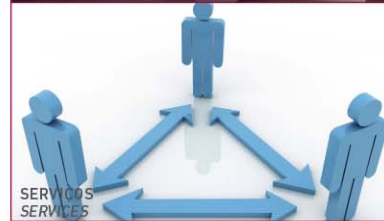
INSTITUTO DE CIÊNCIA E INOVAÇÃO EM ENGENHARIA MECÂNICA E ENGENHARIA INDUSTRIAL

## LABORATÓRIO DA QUALIDADE DO AR INTERIOR

Determination of VOC emissions,  
formaldehyde, acetaldehyde and other  
CMR substances from building products  
(French Legislation)

TECTEND

Process: LQAI.MC.17/15





## o Documental Control

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The results presented refer only to the item tested.

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## TABLE OF CONTENTS

1. Objective.....	5
2. Applicant data .....	5
3. Methodologies used.....	6
4. Results.....	7
5. Discussion of the results .....	8
6. References .....	8

## 1. Objective

Determination of emitted volatile organic compounds, formaldehyde, acetaldehyde and some CMR substances (carcinogenic, mutagenic and reprotoxic) intending the material classification according to the criteria established by the French legislation<sup>1,2</sup>.

## 2. Applicant data

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### 3. Methodologies used

The study was conducted on a sample of ceiling material, designated as 'Tectend Mate'. The sample was delivered at LQAI on 5 March 2015 and the test began on 6 March 2015.

The emissions were monitored, from a test chamber, for 28 days of exposure, according to the norm ISO 16000-9<sup>3</sup> (internal proceedings: IT-005, IT-007, IT-008 e IT-011). The air samples were collected in tubes with Tenax TA. For the analysis, thermal desorption on line with gas chromatography coupled to a mass spectrometer detector for VOC identification and quantification (GC/MSD) was used. The GC used is from Agilent Technologies, model 6890N and the mass spectrometer detector is from Agilent also, model 5973. The thermal desorption system is from DANI, model STD 33.50. The analysis was conducted according to the norm ISO 16000-6<sup>4</sup> (internal proceedings: IT-016, IT-017, IT-018 e IT-022), on 2015/04/07. The emission factors of the major compounds were determined using the specific response factor of each identified compound, when possible. Total volatile organic compounds (TVOC) concentration was calculated for all compounds eluted between hexane and hexadecane, using the toluene response factor. The uncertainty of the analytical method, calculated for toluene is  $\pm 5.1\%$ .

For Bis(2-ethylhexyl) phthalate (DEHP) analysis the procedure described by Otake *at al.*<sup>5</sup> was used. The air samples from test chamber were collected in tubes containing Carbotrap. The tubes were after subjected to solvent extraction, using toluene as solvent, and after subjected to ultrasound (10 minutes) and centrifuged (5 minutes at 3000 rpm). The analysis was performed by CG/MSD. The GC used is from Agilent Technologies, model 7890A and the mass spectrometer detector is from Agilent also, model 5975C. The analysis took place on 2015/04/08. The emission factor of the DEHP was calculated using the specific response factor of the analytical method.

Formaldehyde was determined according to the norm ISO 16000-3<sup>6</sup>, together with acetaldehyde. Specifically, after 28 days, the aldehydes were collected in cartridges impregnated with DNPH and analysed by high performance liquid chromatography (HPLC) using a gas chromatograph Agilent Technologies brand, model 1220 Infinity LC. The emission factor of the compounds was calculated based on the specific response factor of the analytical method. The analysis took place on 2015-03-18 and 2015-04-09.

The average experimental conditions in the chambers during the study were:

T (°C)	HR (%)	v (m/s)	n (h <sup>-1</sup> )	A/V (m <sup>2</sup> /m <sup>3</sup> )
22.6	52.9	0.17	1.00	0.73

where T is the temperature, HR the relative humidity, v the air velocity at the surface of the material, n the air exchange rate and A/V the ratio of sample area to chamber volume (loading factor). The volume of the chamber used is 0.255 m<sup>3</sup>.

## 4. Results

Table 1 shows the concentrations of substances or groups of substances, obtained for a specific ventilation rate of  $1.25 \text{ m}^3\text{h}^{-1}\text{m}^{-2}$ , as well as the concentration limits ( $\mu\text{g}/\text{m}^3$ ) for different classes established by the French legislation<sup>1</sup>.

Table 2 lists the concentration limits ( $\mu\text{g}/\text{m}^3$ ) for CMR substances, imposed by the French legislation<sup>2</sup> and the observed values for the material under study to a specific ventilation rate of  $1.25 \text{ m}^3\text{h}^{-1}\text{m}^{-2}$ .

Table 1. Limit values established by the French legislation<sup>1</sup> and concentrations observed for the material after 28 days of exposure for a specific ventilation rate of  $1.25 \text{ m}^3\text{h}^{-1}\text{m}^{-2}$ .

Compound	CAS	Concentration ( $\mu\text{g}/\text{m}^3$ )				MC.17/15 28 days
		Classes				
		C	B	A	A+	
Formaldehyde	50-00-0	>120	<120	<60	<10	4.17
Acetaldehyde	75-07-0	>400	<400	<300	<200	n.d.
Toluene	108-88-3	>600	<600	<450	<300	n.d.
Tetrachloroethylene	127-18-4	>500	<500	<350	<250	n.d.
Xylene	1330-20-7	>400	<400	<300	<200	n.d.
1,2,4-	95-63-6	>2000	<2000	<1500	<1000	n.n.
1,4-dichlorobenzene	106-46-7	>120	<120	<90	<60	n.d.
Ethylbenzene	100-41-4	>1500	<1500	<1000	<750	n.n.
2-butoxyethanol	111-76-2	>2000	<2000	<1500	<1000	n.d.
Styrene	100-42-5	>500	<500	<350	<250	n.d.
TVOC		>2000	<2000	<1500	<1000	289

n.d. – not detected

Table 2. Limit values established by the French legislation<sup>2</sup> and concentrations observed for the material after 28 days of exposure for a specific ventilation rate of  $1.25 \text{ m}^3\text{h}^{-1}\text{m}^{-2}$ .

Compound	CAS	Concentration ( $\mu\text{g}/\text{m}^3$ )	
		Limit	MC.17/15 28 days
Trichloroethylene	79-01-6	< $1 \mu\text{g}/\text{m}^3$	n.d.
Benzene	71-43-2	< $1 \mu\text{g}/\text{m}^3$	n.d.
Bis(2-ethylhexyl) phthalate	117-81-7	< $1 \mu\text{g}/\text{m}^3$	n.d.
Dibutyl phthalate (DBP)	84-74-2	< $1 \mu\text{g}/\text{m}^3$	n.d.

n.d. – not detected

## 5. Discussion of the results

The results presented in Table 1 and 2 show that the material is rated **A+** according to the French regulations and meets the criteria established by legislation.

## 6. References

- 1.- Arrêté du 19 avril 2011 relatif à l'étiquetage des produits de construction ou de revêtement de mur ou de sol et des peintures et vernis sur leurs émissions de polluants volatils.
- 2.- Arrêté du 30 avril 2009 relatif aux conditions de mise sur le marché des produits de construction et de décoration contenant des substances cancérigènes, mutagènes ou reprotoxiques de catégorie 1 ou 2.
- 3.- ISO 16000-9 (2006). Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method.
- 4.- 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.
- 5.- Otake T, Yoshinaga J, Yanagisawa Y. 2001. Analysis of organic esters of plasticizer in indoor air by GC-MS and GC-FPD. Environ Sci Technol (35):3099-3102.
- 6.- ISO 16000-3 (2011). Determination of formaldehyde and other carbonyl compounds - Active sampling method.

Porto, 9 April 2015



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(Responsável Técnica do LQAI)



**Annex:** Photo of the sample of the material under study





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