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Laboratório Qualidade do Ar Interior



Determination of VOC, SVOC and VVOC emissions from building products – AgBB requirements

Process: LQAI.MC.52/22
Report Nr. LQAI.2023.099

Identification of the Material: Aglomerado de Cortiça Expandida (ICB)
Client: Amorim Cork Insulation

IPAC is a signatory to the EA MLA and ILAC MRA for testing.

The results presented refer only to the item tested.

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0. DOCUMENTAL CONTROL

0.1 IDENTIFICATION OF DOCUMENT

Projet	---
Name of Document	Determination of VOC, SVOC and VVOC emissions from building products - AgBB requirements
Name of file	---

0.2 CONTROL OF VERSIONS

Version	Edition	Revision	Date	Description	Approved by
1	1	0	2023-03-02	Original version	SM

0.3 AUTHOR(S)

Name	Entity	Initials
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0.4 REVISER(S)

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0.5 LIST OF DISTRIBUTION

Name	Entity	Initials
Laboratório Qualidade Ar Interior	INEGI	LQAI
---	Amorim Cork Insulation	

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1. OBJECTIVE

Determination of emissions of Volatile Organic Compounds (VOC), Semi Volatile Organic Compounds (SVOC) and Very Volatile Organic Compounds (VVOC) from a sample of material in order to obtain the material classification under the criteria established by AgBB - Evaluation procedure for VOC emissions from building products – 2021.

2. CLIENT

Amorim Cork Insulation
Estrada de Lavre, Km 6
7080-026-VENDAS NOVAS, EVORA

Reference of Proposal PE30221063 by 30/11/2022

3. METHODOLOGIES USED

The study was conducted on a sample of a material, designated by the client as “Aglomerado de Cortiça Expandida (ICB)”. The sample was delivered at LQAI on 2022/12/19. The selection of the product sample was the sole responsibility of the client. The tests and analysis presented were carried out in the permanent facilities of the laboratory. The sample was prepared according ISO 16000-11¹, in the facilities of the laboratory on 2023/01/06. Note that sample preparation is outside the scope of laboratory accreditation.

The test in the test chamber started on 2023/01/06 and was performed in accordance with the internal procedure IT.403 (annex B). This test is accredited in accordance with EN ISO/IEC 17025² for the compounds:

Test	Method
Determination of the emission of benzene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of toluene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of ethylbenzene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of 2-ethyl-1-hexanol from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of limonene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of tridecane from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of 1,2,4-trimethylbenzene from building products and furnishing — Emission test chamber method	IT.403.06

Note: IT.nnn.nn indicates internal laboratory procedure.

It should be noted that the remaining compounds determined in this test and are out the scope of accreditation, are determined using the same quality standards that apply to them.

The VOCs and SVOCs samples were collected, in tubes with Tenax TA, when the test chamber was empty (2023/01/06, volume: 4,90 l) and 3 days (2023/01/09, average volume: 4,44 l) and 28 days (2023/02/03, average volume: 5,17 l) after starting the test. The uncertainty associated with this sampling, calculated using the expansion factor of 2.01 which corresponds to a 95% confidence level, was 4.1%.

Formaldehyde, acetaldehyde, acrolein, glutaraldehyde and acetone were collected in cartridges impregnated with DNPH when the test chamber was empty (2023/01/06, volume: 83,8 l) and after 3 days (2023/01/09, volume: 85,0 l) and 28 days (2023/02/03, volume: 95,6 l) after starting the test.

The experimental conditions in the chamber during the conditioning time and the study were:

Period	T (°C)	HR (%)	v (m/s)	n (h ⁻¹)	A/V (m ² /m ³)
Test (28 days)	21.7±0.2	49.1±7.5	0.27	0.66	1.28

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 0.141 m³.

For the analysis, thermal desorption on line with gas chromatography coupled to a mass spectrometer detector for VOC and SVOC identification and quantification (GC/MSD) was used. The GC used is from Agilent Technologies, model 7890 and the mass spectrometer detector is from Agilent also, model 5975C. The thermal desorption system is from DANI, model TD Master. The analysis was conducted on 2023/01/13 and 2023/02/07 and was performed in accordance to the internal procedure IT.401 (annex B). This test is accredited in accordance with EN ISO/IEC 17025² for the compounds:

Test	Method
Determination of Benzene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of Toluene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of Octane by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of Ethylbenzene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-Ethoxyethylacetate by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 1,2,4-trimethylbenzene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-ethyl-1-hexanol by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of limonene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of dodecane by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-phenylethanol by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of tridecane by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of styrene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of tetrachloroethylene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-butoxyethanol by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of naphthalene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08

Nota: IT.nnn.nn indicates internal laboratory procedure.

It should be noted that the remaining compounds determined in this test which are not covered by the accreditation are determined using the same quality standards as applied to them.

The emission factors of the identified compounds were determined using the specific response factor, when possible. Total volatile organic compounds (TVOC) concentration was calculated as the sum of the emission factors of all compounds with retention times between hexane and hexadecane, with concentrations greater than 5 µg/m³, using the specific response factor for the identified compounds and the toluene response in the remaining cases. Total semi volatile organic compounds (COSVT) concentration was calculated as the sum of the emission factors of all compounds with retention times between hexadecane and docosane, with concentrations greater than 5 µg/m³, using the toluene response factor.

The global expanded uncertainties (resulting from the combination of sampling and analysis uncertainties – IT401 and IT.403) obtained for each of the compounds are shown below. The expanded uncertainty was calculated using the expansion factor of 2.01, corresponding to a 95% confidence level.

Compound	Global Expanded Uncertainty
Benzene (IT401 and IT403)	44%
Toluene (IT401 and IT403)	13%
Ethylbenzene (IT401 and IT403)	14%
2-ethyl-1-hexanol (IT401 and IT403)	14%
Limonene (IT401 and IT403)	15%
Tridecane (IT401 and IT403)	18%
1,2,4-Trimethylbenzene (IT401 and IT403)	26%

Formaldehyde, acetaldehyde, glutaraldehyde and acetone were determined according to ISO 16000-3³ and the internal procedure IT.402. Specifically, the compounds were analysed by high performance liquid chromatography (HPLC) using a 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 2023/01/17 and 2023/02/17. The uncertainty of the analytical method is ±13% for formaldehyde and ±12% for acetaldehyde. This analysis is out the scope of accreditation.

4. RESULTS

Table 1 show the emission factor for TVOC, TSVOC and individual compounds quantified as well as the results of the application of the AgBB (2021)⁴, considering the specific ventilation rate (q_v) of $0.5 \text{ m}^3 \text{ h}^{-1} \text{ m}^{-2}$

Table 1. Emission factors for the compounds quantified in the emissions from the sample of the material for 3 and 28 days of exposure for a specific ventilation rate of $0.5 \text{ m}^3 \text{ h}^{-1} \text{ m}^{-2}$ and application of AgBB criteria.

Compound	CAS	LCI ($\mu\text{g}/\text{m}^3$)	Emission Factor ($\mu\text{g}/(\text{m}^2\text{h})$)	
			3 days	28 days
acid acetic ⁺	64-19-7	1200	7,7	a)
ethyl methyl cetone ⁺	78-93-3	20000	24,5	11,6
toluene	108-88-3	2900	6,3	a)
2-etil-1-hexanol	104-76-7	300	80	11,2
nonanal ⁺	124-19-6	900	a)	2,87
formaldehyde ⁺	50-00-0	100	1,00	0,74
acetaldehyde ⁺	75-07-0	1200	8,40	3,91
acetone ⁺	67-64-1	1200	6,40	3,91
TVOC ⁺	---	---	118	25,6
TSVOC ⁺	---	---	a)	a)

Parameter to be assessed (AgBB)	Condition to be fulfilled	Results
3 days		
VOCs Carcinogenic 1A and 1B* ($\mu\text{g}/\text{m}^3$)	< 10	n.d.
TVOC ($\mu\text{g}/\text{m}^3$)	< 10000	236
28 days		
TVOC ($\mu\text{g}/\text{m}^3$)	< 1000	51,3
TSVOC ($\mu\text{g}/\text{m}^3$)	< 100	< 5,0
VOCs Carcinogenic 1A and 1B* ($\mu\text{g}/\text{m}^3$)	< 1	n.d.
$R = \Sigma (C_i/LC_{Li})$	< 1	0,10
ΣC_n ($\mu\text{g}/\text{m}^3$)	< 100	< 5,0
EVALUATION		Positive

a) Compound with concentration less than $5 \mu\text{g}/\text{m}^3$. Only substances with concentrations equal to or greater than $5 \mu\text{g}/\text{m}^3$ should be quantified.

LCI – Lowest concentration of interest; R – Index summarising the estimated health risk of a material emission (only listed substances whose concentrations in the test chamber air exceed $5 \mu\text{g}/\text{m}^3$ are evaluated based on LCI); C_i – concentration of an individual compound for which a LCI value is known; $C_i = FE / q_v$; $\Sigma (C_n)$ – Sum of the concentrations of the compounds, after 28 days of exposure, non-identified or for which a LCI value is not known; $C_n = FE / q_v$; n.d. – not detected.

*Classification according to Regulation (EC) No 1272/2008 Appendix VI Table 3.1.

+ Out of the scope of accreditation.

5. GENERAL CONCLUSIONS

By customer request, the results obtained are compared with the criteria established AgBB⁴. The decision rule chosen is that uncertainty is not applied to the final result. In other words, the result obtained is directly compared with the established criteria, without considering the uncertainty associated with this result.

The results presented in Table 1 show that, under the criteria set by AgBB the material "Aglomerado de Cortiça Expandida (ICB)" has a positive evaluation.

6. REFERENCES

- 1- ISO 16000-11 (2006). Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens (2006).
- 2- NP EN ISO/IEC 17025:2018 – Requisitos gerais de competência para laboratórios de ensaio e calibração.
- 3- ISO 16000-3 (2011). Determination of formaldehyde and other carbonyl compounds - Active sampling method.
- 4- AgBB - Evaluation procedure for VOC emissions from building products (2021).

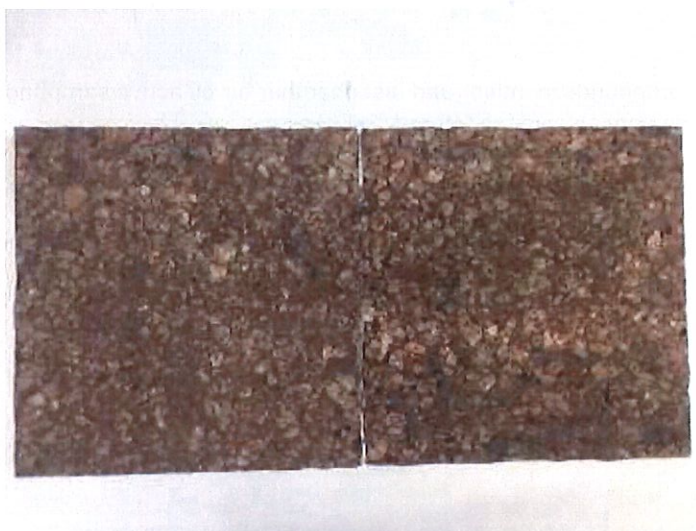
Porto, 02 March 2023

Susana Martins

Digitally signed by
[Assinatura Qualificada]
Susana Daniela da Silva
Martins
Date: 2023.03.02 11:28:26 Z

(Head of Laboratory)

Annex A - Photo of the sample of the material under study



Annex B – Bibliography that supported the elaboration of the internal procedures IT403 and IT401:

- ISO 16000-6 (2021): 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 or MS-FID.
- ISO 16000-9 (2006): Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method.
- ISO 16000-11 (2006): Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens.
- EN 16516:2017. Construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air



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Laboratório Qualidade do Ar Interior



Determination of VOC, SVOC, formaldehyde and
acetaldehyde emissions from building products –
EMICODE requirements

Process: LQAI.MC.52/22
Report Nr. LQAI.2023.100

Identification of the Material: Aglomerado de Cortiça Expandida (ICB)
Client: Amorim Cork Insulation

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1	1	0	2023-03-02	Original version	SM

0.3 AUTHOR(S)

Name	Entity	Initials
Susana Martins / Responsável Técnico do Laboratório	INEGI	SM

0.4 REVISER(S)

Name	Entity	Initials
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1. OBJECTIVE

Determination of emissions of Volatile Organic Compounds (VOC), Semi Volatile Organic Compounds (SVOC), formaldehyde and acetaldehyde from a sample of a material in order to obtain the material classification under the criteria established by EMICODE.

2. CLIENT

Amorim Cork Insulation
Estrada de Lavre, Km 6
7080-026-VENDAS NOVAS, EVORA

Reference of Proposal PE30221063 by 30/11/2022

3. METHODOLOGIES USED

The study was conducted on a sample of product, designated as “Aglomerado de Cortiça Expandida (ICB)”. The sample was delivered at LQAI on 2022/12/19. The selection of the product sample was the sole responsibility of the client. The tests and analysis presented were carried out in the permanent facilities of the laboratory.

The sample was prepared according ISO 16000-11¹, in the facilities of the laboratory on 2023/01/06. Note that sample preparation is outside the scope of laboratory accreditation.

The test in the test chamber started on 2023/01/06 and was performed in accordance with the internal procedure IT.403 (annex B). This test is accredited in accordance with EN ISO/IEC 17025² for the compounds:

Test	Method
Determination of the emission of benzene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of toluene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of ethylbenzene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of 2-ethyl-1-hexanol from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of limonene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of tridecane from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of 1,2,4-trimethylbenzene from building products and furnishing — Emission test chamber method	IT.403.06

Note: IT.nnn.nn indicates internal laboratory procedure.

It should be noted that the remaining compounds determined in this test and are out the scope of accreditation, are determined using the same quality standards that apply to them.

The VOCs and SVOCs samples were collected, in tubes with Tenax TA, when the test chamber was empty (2023/01/06, volume: 4,90 l) and 3 days (2023/01/09, average volume: 4,44 l) and 28 days (2023/02/03, average volume: 5,17 l) after starting the test. The uncertainty associated with this sampling, calculated using the expansion factor of 2.01 which corresponds to a 95% confidence level, was 4.1%.

Formaldehyde, acetaldehyde, acrolein, glutaraldehyde and acetone were collected in cartridges impregnated with DNPH when the test chamber was empty (2023/01/06, volume: 83,8 l) and after 3 days (2023/01/09, volume: 85,0 l) and 28 days (2023/02/03, volume: 95,6 l) after starting the test.

The experimental conditions in the chamber during the study were:

Period	T (°C)	HR (%)	v (m/s)	n (h ⁻¹)	A/V (m ² /m ³)
28 days	21.7±0.2	49.1±7.5	0.27	0.66	1.28

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 0.141 m³.

For the analysis, thermal desorption on line with gas chromatography coupled to a mass spectrometer detector for VOC and SVOC identification and quantification (GC/MSD) was used. The GC used is from Agilent Technologies, model 7890 and the mass spectrometer detector is from Agilent also, model 5975C. The thermal desorption system is from DANI, model TD Master. The analysis was conducted on 2023/01/13 and 2023/02/07 and was performed in accordance to the internal procedure IT.401 (annex B). This test is accredited in accordance with EN ISO/IEC 17025² for the compounds:

Test	Method
Determination of Benzene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of Toluene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of Octane by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of Ethylbenzene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-Ethoxyethylacetate by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 1,2,4-trimethylbenzene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-ethyl-1-hexanol by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of limonene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of dodecane by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-phenylethanol by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of tridecane by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of styrene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of tetrachloroethylene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-butoxyethanol by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of naphthalene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08

Nota: IT.nnn.nn indicates internal laboratory procedure.

It should be noted that the remaining compounds determined in this test which are not covered by the accreditation are determined using the same quality standards as applied to them.

The emission factors of the identified compounds were determined using the specific response factor, when possible. Total Volatile Organic Compounds (TVOC) concentration was calculated for all compounds with concentration higher than 5 µg/m³, eluted between hexane and hexadecane, using toluene response factor (excluding emissions of acetic acid). Total Semivolatile Organic Compounds (SVOC) concentration was calculated for all compounds with concentration higher than 5 µg/m³, eluted between hexadecane and docosane, using toluene response factor.

The global expanded uncertainties (resulting from the combination of sampling and analysis uncertainties – IT401 and IT.403) obtained for each of the compounds are shown below. The expanded uncertainty was calculated using the expansion factor of 2.01, corresponding to a 95% confidence level.

Compound	Global Expanded Uncertainty
Benzene (IT401 and IT403)	44%
Toluene (IT401 and IT403)	13%
Ethylbenzene (IT401 and IT403)	14%
2-ethyl-1-hexanol (IT401 and IT403)	14%
Limonene (IT401 and IT403)	15%
Tridecane (IT401 and IT403)	18%
1,2,4-Trimethylbenzene (IT401 and IT403)	26%

Formaldehyde, acetaldehyde, glutaraldehyde and acetone were determined according to ISO 16000-3³ and the internal procedure IT.402. Specifically, the compounds were analysed by high performance liquid chromatography (HPLC) using a 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 2023/01/17 and 2023/02/17. The uncertainty of the analytical method is ±13% for formaldehyde and ±12% for acetaldehyde. This analysis is out the scope of accreditation

4. RESULTS

Table 1 show the concentration obtained for TVOC, SVOC, formaldehyde, acetaldehyde and individual compounds quantified, as well the results of the application of the EMICODE⁴ criteria, considering the specific ventilation rate (qe) of 0.5 m³ h⁻¹m⁻².

Table 1. Emission factors for the compounds quantified in the emissions from the sample of the material for 3 and 28 days of exposure and application of EMICODE criteria

Compound	CAS	LCI	Emission Factor (µg/(m²h))			
			3 days	28 days		
acid acetic ⁺	64-19-7	1200	7,7	a)		
ethyl methyl cetone ⁺	78-93-3	20000	24,5	11,6		
toluene	108-88-3	2900	6,3	a)		
2-etil-1-hexanol	104-76-7	300	80	11,2		
nonanal ⁺	124-19-6	900	a)	2,87		
TVOC ⁺	—	—	42	9,9		
TSVOC ⁺	—	—	a)	a)		
formaldehyde ⁺	50-00-0	100	1,00	0,74		
acetaldehyde ⁺	75-07-0	1200	8,40	3,91		
acetone ⁺	67-64-1	1200	6,40	3,91		
			Classes		MC.52/22 Results	
			<i>EC1^{PLUS}</i>	<i>EC1</i>		<i>EC2</i>
TVOC after 3 days (µg/m³)			≤ 750	≤ 1000	≤ 3000	84
TVOC after 28 days (µg/m³)			≤ 60	≤ 100	≤ 300	19,8
SVOC after 28 days (µg/m³)			≤ 40	≤ 50	≤ 100	< 5,0
“R” after 28 days *			< 1	—	—	0,10
Σ Cn, after 28 days (µg/m³)			≤ 40	—	—	n.d.
Formaldehyde after 3 days (µg/m³)			≤ 50	≤ 50	≤ 50	1,99
Acetaldehyde after 3 days (µg/m³)			≤ 50	≤ 50	≤ 50	16,8
Sum of formaldehyde and acetaldehyde after 3 days (ppm)			≤ 0.05	≤ 0.05	≤ 0.05	0,01
Σ of volatile substances of category 1A/1B*after 3 days (µg/m³)			≤ 10	≤ 10	≤ 10	n.d.
Every volatile substance of category 1A/1B* after 28 days (µg/m³)			≤ 1	≤ 1	≤ 1	n.d.

a) Compound with concentration less than 5 µg/m³. Only substances with concentrations equal to or greater than 5 µg/m³ should be quantified. LCI – Lowest concentration of interest (AgBB, 2021⁵); R - Index summarising the estimated health risk of a material emission (only listed substances whose concentrations in the test chamber air exceed 5 µg/m³ are evaluated based on LCI); Ci – concentration of an individual compound for which a LCI value is know; Ci = FE / qe; Σ (Cn) - Sum of the concentrations of the compounds, after 28 days of exposure, non-identified or for which a LCI value is not known; Cn = FE / qe;

*Classification according to Regulation (EC) No 1272/2008 Appendix VI Table 3.1.n.d. – not detected * limit of detection⁺ Out of the scope of accreditation

5. GENERAL CONCLUSIONS

By customer request, the results obtained are compared with the criteria established by EMICODE⁷. The decision rule chosen is that uncertainty is not applied to the final result. In other words, the result obtained is directly compared with the established criteria, without considering the uncertainty associated with this result.

An analysis of Table 1 allows us to conclude that the material “Aglomerado de Cortiça Expandida (ICB)” obtained the **EC1^{PLUS}** classification, according to the EMICODE criteria.

6. REFERENCES

- 1- ISO 16000-11 (2006). Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens (2006).
- 2- NP EN ISO/IEC 17025 – Requisitos gerais de competência para laboratórios de ensaio e calibração.
- 3- ISO 16000-3 (2011). Determination of formaldehyde and other carbonyl compounds – Active sampling method.
- 4- EMICODE: www.emicode.com
- 5- AgBB evaluation procedure for VOC emissions from building products (2021).

Porto, 02 March 2023

Susana Martins

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Silva Martins
Date: 2023.03.02 11:27:48 Z

(Head of Laboratory)

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



Annex B – Bibliography that supported the elaboration of the internal procedures IT403 and IT401:

- ISO 16000-6 (2021): 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 or MS-FID.
- ISO 16000-9 (2006): Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method.
- ISO 16000-11 (2006): Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens.
- EN 16516:2017. Construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air



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Laboratório Qualidade do Ar Interior



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

Process: LQAI.MC.52/22
Report No. LQAI.2023.098

Identification of the Material: Aglomerado de Cortiça Expandida (ICB)
Client: Amorim Cork Insulation

IPAC is a signatory to the EA MLA and ILAC MRA for testing.

The results presented refer only to the item tested.

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0.1 IDENTIFICATION OF DOCUMENT

Projet	---
Name of Document	Determination of VOC emissions, formaldehyde, acetaldehyde and other CMR substances from building products (French Legislation)
Name of file	---

0.2 CONTROL OF VERSIONS

Version	Edition	Revision	Date	Description	Approved by
1	1	0	2023/05/31	Original version	SM

0.3 AUTHOR(S)

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0.5 LIST OF DISTRIBUTION

Name	Entity	Initials
Laboratório Qualidade Ar Interior	INEGI	LQAI
	Amorim Cork Insulation	

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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.

2. CLIENT

Amorim Cork Insulation
Estrada de Lavre, Km 6
7080-026-VENDAS NOVAS, EVORA

Reference of Proposal: PE30221063 by 30.11.2022

3. METHODOLOGIES USED

The study was conducted on a sample of a material, designated by the client as "Aglomerado de Cortiça Expandida (ICB)". The sample was delivered at LQAI on 2022/12/19. The selection of the product sample was the sole responsibility of the client. Results apply to sample as received. The tests and analysis presented were carried out in the permanent facilities of the laboratory. The sample was prepared according ISO 16000-11¹, in the facilities of the laboratory on 2023/01/06. Note that sample preparation is outside the scope of laboratory accreditation.

The test in the test chamber started on 2023/01/06 and was performed in accordance with the internal procedure IT.403 (annex B). This test is accredited in accordance with EN ISO/IEC 17025² for the compounds:

Test	Method
Determination of the emission of benzene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of toluene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of ethylbenzene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of 2-ethyl-1-hexanol from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of limonene from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of tridecane from building products and furnishing — Emission test chamber method	IT.403.06
Determination of the emission of 1,2,4-trimethylbenzene from building products and furnishing — Emission test chamber method	IT.403.06

Note: IT.nnn.nn indicates internal laboratory procedure.

It should be noted that the remaining compounds determined in this test and are out the scope of accreditation, are determined using the same quality standards that apply to them.

The VOCs samples were collected, in tubes with Tenax TA, when the test chamber was empty (2023/01/06, volume: 4,90 l) and 28 days (2023/02/03, average volume: 5,17 l) after starting the test. The uncertainty associated with this sampling, calculated using the expansion factor of 2.01 which corresponds to a 95% confidence level, was 4.0%.

Formaldehyde and acetaldehyde were collected in cartridges impregnated with DNPH when the test chamber was empty (2023/01/06, volume: 83,8 l) and 28 days (2023/02/03, volume: 95,6 l) after starting the test. The collection of formaldehyde and acetaldehyde is out the scope of accreditation.

The experimental conditions in the chamber during the conditioning time and the study were:

Period	T (°C)	HR (%)	v (m/s)	n (h ⁻¹)	A/V (m ² /m ³)
Test (28 days)	21.7±0.2	49.1±7.5	0.27	0.66	1.28

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 0.141 m^3 .

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 7890 and the mass spectrometer detector is from Agilent also, model 5975C. The thermal desorption system is from DANI, model TD Master. The analysis was conducted on 2023/01/13 and 2023/02/07 and was performed in accordance to the internal procedure IT.401 (annex B). This test is accredited in accordance with EN ISO/IEC 17025² for the compounds:

Test	Method
Determination of Benzene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of Toluene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of Octane by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of Ethylbenzene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-Ethoxyethylacetate by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 1,2,4-trimethylbenzene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-ethyl-1-hexanol by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of limonene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of dodecane by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-phenylethanol by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of tridecane by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of styrene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of tetrachloroethylene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of 2-butoxyethanol by thermal desorption and Gas chromatography with mass selective detector	IT.401.08
Determination of naphthalene by thermal desorption and Gas chromatography with mass selective detector	IT.401.08

Nota: IT.nnn.nn indicates internal laboratory procedure.

It should be noted that the remaining compounds determined in this test which are not covered by the accreditation are determined using the same quality standards as applied to them. The emission factors of the identified compounds were determined using the specific response factor. Total volatile organic compounds (TVOC) concentration was calculated for all compounds eluted between hexane and hexadecane, using the toluene response factor.

The global expanded uncertainties (resulting from the combination of sampling and analysis uncertainties – IT401 and IT.403) obtained for each of the compounds are shown below. The expanded uncertainty was calculated using the expansion factor of 2.01, corresponding to a 95% confidence level.

Compound	Global Expanded Uncertainty
Benzene (IT401 and IT403)	44%
Toluene (IT401 and IT403)	13%
Ethylbenzene (IT401 and IT403)	14%
2-ethyl-1-hexanol (IT401 and IT403)	14%
Limonene (IT401 and IT403)	15%
Tridecane (IT401 and IT403)	18%
1,2,4-Trimethylbenzene (IT401 and IT403)	26%

Formaldehyde and acetaldehyde were determined according to ISO 16000-3³ and the internal procedure IT.402. Specifically, the compounds were analysed by high performance liquid chromatography (HPLC) using a 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 2023/01/17 and 2023/02/17. The uncertainty of the analytical method is $\pm 13\%$ for formaldehyde and $\pm 12\%$ for acetaldehyde. This analysis is out the scope of accreditation.

4. RESULTS

Table 1 shows the concentrations of substances or groups of substances, obtained for a specific ventilation rate of $0.5 \text{ m}^3\text{h}^{-1}\text{m}^{-2}$, as well as the concentration limits ($\mu\text{g}/\text{m}^3$) for different classes established by the French legislation (DEVL1101903D and DEVL1104875A)⁴.

Table 1. Limit values established by the French legislation and concentrations observed for the material after 28 days of exposure for a specific ventilation rate of $0.5 \text{ m}^3\text{h}^{-1}\text{m}^{-2}$.

Compound	CAS	Concentration (µg/m³)				MC.52/22 28 days
		Classes				
		C	B	A	A+	
Formaldehyde*	50-00-0	>120	<120	<60	<10	1.47
Acetaldehyde*	75-07-0	>400	<400	<300	<200	7.82
Toluene	108-88-3	>600	<600	<450	<300	4.21
Tetrachloroethylene*	127-18-4	>500	<500	<350	<250	< 1.02*
Xylene*	1330-20-7	>400	<400	<300	<200	< 1.00* ^T
1,2,4-trimethylbenzene	95-63-6	>2000	<2000	<1500	<1000	< 0.98*
1,4-dichlorobenzene*	106-46-7	>120	<120	<90	<60	< 1.00* ^T
Ethylbenzene	100-41-4	>1500	<1500	<1000	<750	< 1.05*
2-butoxyethanol*	111-76-2	>2000	<2000	<1500	<1000	< 5.17*
Styrene	100-42-5	>500	<500	<350	<250	< 0.98*
TVOC*		>2000	<2000	<1500	<1000	29.2

* Limit of quantification.

*^T Limit of quantification calculated for toluene

⁺ Out of the scope of accreditation.

Table 2 lists the concentration limits ($\mu\text{g}/\text{m}^3$) for CMR substances, imposed by the French legislation (DEVP0908633A and DEVP0910046A)⁵ and the observed values for the material under study to a specific ventilation rate of $0.5 \text{ m}^3\text{h}^{-1}\text{m}^{-2}$.

Table 2. Limit values established by the French legislation and concentrations observed for the material after 28 days of exposure for a specific ventilation rate of $0.5 \text{ m}^3\text{h}^{-1}\text{m}^{-2}$.

Compound	CAS	Concentration ($\mu\text{g}/\text{m}^3$)	
		Limit	MC.52/22 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 ⁺ (DEHP)	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, which means lower than the limit of detection.

* Limit of quantification for benzene = $0.91 \mu\text{g}/\text{m}^3$.

** Although it has not been evaluated analytically it is considered that this compound is not present in the emissions of the material under study, as stated by the manufacturer in the attached declaration

⁺ Out of the scope of accreditation.

5. GENERAL CONCLUSIONS

By customer request, the results obtained are compared with the criteria established by French regulations ^{4,5}. The decision rule chosen is that uncertainty is not applied to the final result. In other words, the result obtained is directly compared with the established criteria, without considering the uncertainty associated with this result.

The results presented in Table 1 and 2 shows that the material “Aglomerado de Cortiça Expandida (ICB)” is rated **A+** according to the French regulations and meets the criteria established by legislation^{5,6}.

6. REFERENCES

- 1- ISO 16000-11 (2006). Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens (2006).
- 2- NP EN ISO/IEC 17025:2018 – Requisitos gerais de competência para laboratórios de ensaio e calibração
- 3- ISO 16000-3 (2011). Determination of formaldehyde and other carbonyl compounds - Active sampling method.
- 4- Décret n° 2011-321 du 23 mars 2011 (DEVL1101903D) y Arrêté du 19 avril 2011 (DEVL1104875A) 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.
- 5- Arrêté du 30 avril 2009 (DEVP0908633A) y Arrête du 28 mai 2009 (DEVP0910046A) 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.

Porto, 31 May 2023

Susana Martins

Digitally signed by [Assinatura
Qualificada] Susana Daniela da
Silva Martins
Date: 2023.05.31 18:12:52
+01'00'

(Head of Laboratory)

Annex A – Photo of the sample of the material under study



Annex B – Bibliography that supported the elaboration of the internal procedures IT403 and IT401:

- ISO 16000-6 (2021): 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 or MS-FID.
- ISO 16000-9 (2006): Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method.
- ISO 16000-11 (2006): Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens.
- EN 16516:2017. Construction products: Assessment of release of dangerous substances - Determination of emissions into indoor air

DECLARATION

AMORIM CORK INSULATION, S.A. based in Vendas Novas, manufacturer of Insulation Corkboard, assumes and declares that in its industrial process, it does not use the DEHP compound or any other type of additive.

It uses only as raw material, cork called “falca” from the cork oak forest, without any previous treatment.

The production process only consists of using cork and superheated water vapor at a certain temperature and pressure, so the product is 100% natural.

Amorim Cork Insulation, S.A.
Amorim Cork Insulation, S.A.
Administração,

04/04/2023

Amorim Cork Insulation, S.A.



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