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Bellaterra: 18-09-2018

Report N#: **18/17706-1421**

Test Petitioner **GARDENIA QUÍMICA, S.A.**
Av. Real de Extremadura, nº 25
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TEST REPORT

Requested Trial:

Measurement of acoustic absorption in a reverberant chamber, in accordance with the UNE: EN ISO 354: 2004 standard, of a projected natural cork museum of 2 mm nominal thickness with commercial reference ISOLATE

Trial date: 13-07-2018

Test conducted by: Xavier Molins (Laboratory of Acoustics- LGAI Technological Center)

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1. Objective of the Test

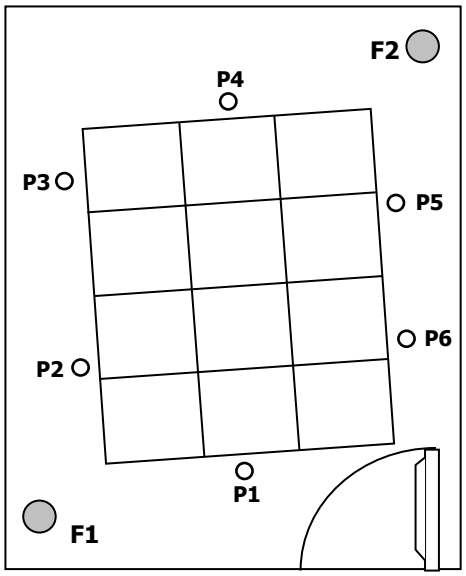
Measurement of the acoustic absorption in a reverberant chamber, in accordance with the UNE: EN ISO 354: 2004 standard, of a projected natural cork sample of 2 mm nominal thickness with commercial reference ISOLATE

2. Measurement Equipment

The equipment used to perform the measurements are the following:

- Spectrum analyzer n #: 170701 (Bruel & Kjaer mod. Pulse LAN-XI)
- Sound calibrator n #: 103032 (Bruel & Kjaer mod 4231)
- Diffuse field microphones n #: 103128,103131 and 170093 (Bruel & Kjaer mod 4943)
-Sources of noise omni n #: 1030 (AVM mod.DO12) and 103124 (CESVA mod BP012)
- Noise generator n #: 103195 (Bruel & Kjaer mod.1049)
- Power amplifier n #: 103097 (INTER mod.M700)
- Equalizer n #: 170092 (INTER mod.EQ-9231)
- Thermo-hygrometer and barometer n #: 170680 (PCE mod.THB-40)
- Flexometer n #: 103095 (Stanley mod.Powerlock)

3. Measurement Procedure



The measurements are made in accordance with the UNE test standard: EN ISO 354: 2004 "Measurement of acoustic absorption in a reverberant chamber." The test method is basically about comparing the reverberation times of the room with the sample and without it. The evaluation of the results and the classification is done according to the UNE-EN 11654: 1998 standard. Around the sample 6 microphone positions are defined (P1, P2, P3, P4, P5, and P6 schematically)

The measurements are made with the noise sources at positions F1 and F2.

The test is carried out by exciting the room with pink noise.

With the measured reverberation times, the formula of section 4.3 is applied.

4. Definitions and Classification

4.1. Reverberation time

Time, in seconds, necessary so that the sound pressure level decreases 60 dB after the cessation of the emission of the sound source

4.2. Sound absorption area equivalent to an enclosure

Hypothetical area of a totally absorbent surface without diffraction effects that, if it were the only absorbing element in the enclosure, would have the same reverberation time as the enclosure considered.

4.3. Sound absorption area equivalent to the test sample, AT

Difference between the areas of equivalent sound absorption of the reverberant chamber with and without the test sample. To obtain this parameter, the average reverberation time in the reverberant chamber was measured with and without a test sample. From these reverberation times, the equivalent sound absorption area A + is calculated by means of the Sabine equation:

$$A_T = A_2 - A_1 = 55.3V\left(\frac{1}{c_2T_2} - \frac{1}{c_1T_1}\right) - 4V(m_2 - m_1)$$

where:

- CI and C2 are the velocity of sound propagation in the air at temperatures T1 and T2.
- V is the volume, in cubic meters, of the empty reverberant camera;
- T1 is the reverberation time, in seconds, of the empty reverberant camera.
- T2 is the reverberation time, in seconds, of the reverberant chamber with the test sample;
- M1 and M2 are the coefficients of sound attenuation, in reciprocal meters, for the empty reverberant chamber and with the test sample, respectively. m is calculated in accordance with International Standard ISO 9613-1 using the climatic conditions of the reverberant chamber during measurement.

The value of m can be calculated from the attenuation coefficient, a, used in the International ISO 9613-1 standard according to the formula:

$$m = \frac{\alpha}{10 \log(e)}$$

4.4.Sound absorption coefficient.

In the case of samples that uniformly cover a surface (flat absorbents or a specific configuration of identical objects), the sound absorption coefficient is obtained by dividing A+ by the area s of the treated surface.

$$\alpha_S = \frac{A_T}{S}$$

When the sample is composed of several identical objects, the result can be given as the equivalent sound absorption area A of each element, and the result is divided A+ by the number of objects, n:

$$A_{obj} = \frac{A_T}{n}$$

4.5. Coefficient of practical sound absorption, ap.

Frequency-dependent acoustic absorption coefficient coefficient, based on measurements by one-third octave bands according to ISO standard 354, and calculated by octave bands according to the following formula:

$$\alpha_{pi} = \frac{\alpha_{i1} + \alpha_{i2} + \alpha_{i3}}{3}$$

where:

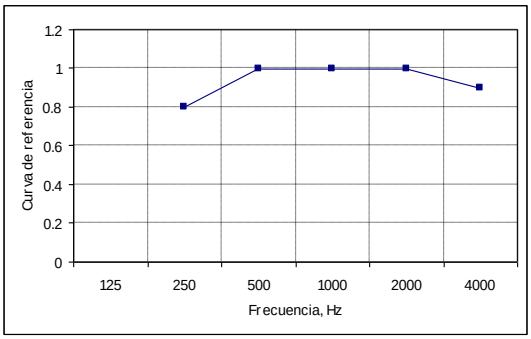
- α_{pi} is the coefficient of sound absorption practically for the octave band i
- α_{i1}, α_{i2} y α_{i3}, are the acoustic absorption coefficients of the third octave bands within the octave i

The average value is calculated up to the second decimal place and the result is rounded up by steps of 0.05 up to a maximum of α_{pi} = 1.00 for the rounded mean values> 1,00.

4.6. Weighted sound absorption coefficient, α_w.

Unique value independent of frequency, equal to the value of the reference curve at 500 Hz after displacement, as indicated below.A transference of the reference curve is made in steps of 0.05 towards the curve of values of the practical sound absorption coefficient, until the sum of the unfavorable deviations is less than or equal to 0.10. An unfavorable deviation occurs at a specific frequency when the measured value is less than the value of the reference curve. Only deviations in the unfavorable direction should be taken into account. The weighted acoustic absorption a, is defined as the value of the deference curve once displaced to the frequency of 500 Hz. The following table gives the original values of the reference curve:

Frequency (Hz)	Value of the reference curve
250	0,80
500	1,00
1000	1,00
2000	1,00
4000	0,90



4.7. Form indicators, L.M.H. Whenever acoustic absorption coefficient I practice α_{pi}, exceed the value of the reference curve once displaced by 0.25 or more should be added, in parentheses, one or several indicators of form.

If the excess absorption occurs at 250 Hz, the notation L is used. If the excess occurs at 500 Hz, the notation M is used. If the excess occurs at 2000 Hz or at 4000 Hz, the H is used.

4.8. Classification of absorbents.

The classification system given below is mainly designed for broadband applications. The unique value, aw, is used to calculate the acoustic absorption class according to the following table (Table B.1 of Annex B, informative, of the EN ISO 11654 standard.

Acoustic absorption class	α_w
A	0,90; 0,95; 1,00
B	0,80; 0,85
C	0,60; 0,65; 0,70; 0,75
D	0,30; 0,35; 0,40; 0,45; 0,50; 0,55
E	0,15; 0,20; 0,25
Unclassified	0,00; 0,05; 0,10

5. Trial uncertainty

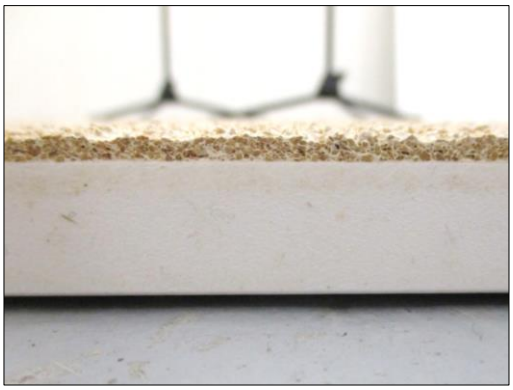
The uncertainty associated with the test has been calculated and is available to the petitioner. The expanded uncertainty has been calculated as the average uncertainty multiplied by a coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

For the weighted sound absorption coefficient α_w, the calculated expanded uncertainty is U (α_w)= ±0,058. For classification purposes consider U (α_w)= ±0,10.

6. Description of the Tested Sample

The main information of the test sample, provided by the petitioner, is gathered below.

Manufacturer	GARDENIA QUÍMICA, S.A.
Model / Reference	***ISOLATE***
Delivered by	GARDENIA QUÍMICA, S.A.
Date of Reception	10-07-2018
Sample Type	Projected natural cork of 2 mm thickness
Area of the sample, *S*	12,24 m^2 - 3,00 x 4,08 m
Thickness of the sample	2 mm
Composition	Waterproof membrane based on styrene acrylic resins in aqueous emulsion, natural cork and other additives. It is projected on a non-porous base of agglomerated board of wood particles with a melamine finish of 1000 x 1020 x 16 mm. The sample consists of 12 boards that form a grid of 3 x 4 boards.
Mounting	Sample placed on the floor of the reverberating room. Type I assembly according to EN ISO 354 Annex B.
Perimeter Frame	35 mm thick wooden slat
Sample assembly (performed by / Date)	Applus Laboratories – LGAI Technological Center 13-07-2018



Images 1 and 2: Details of the Isolate project

Images 3 and 4 Assembly of the test sample in the reverberating room

Image 5 Sample installed in the rehearsal room

7.Trial Concessions

Characteristics of the reverberating room			
Shape:	Paralelepiped	Total surface area (S_t):	238,1 m^2
Dimensions	7,835 × 4,956 × 6,271 m	Number of diffusers:	14
Volume (V):	243,5 m^3	Diffuser dimensions:	1,5 m^2

Ambient conditions of the reverberating room		
State of the room	Empty	With Sample
Temperature:	24,1 ºC	24,3 ºC
Humidity:	57,1 %	56,6 %
Atmospheric pressure:	1002,2 hPa	1002,3 hPa

8. Reverberation times and equivalent sound absorption area

The following table shows the reverberation times of the test room without the sample and with the sample, as well as the equivalent sound adsorption areas calculated.

Frequency (Hz)	Room reverberation time Empty T_1 (s)	Reverberation time with Sample T_2 (s)	Sound absorption area equivalent A_T (m^2)
100	18,33	16,54	0,2
125	14,48	13,98	0,1
160	12,22	11,74	0,1
200	12,13	11,18	0,3
250	12,37	11,25	0,3
315	11,76	10,28	0,5
400	10,64	8,64	0,8
500	10,58	8,39	1,0
630	9,85	8,08	0,9
800	9,40	7,79	0,8
1000	8,75	7,65	0,6
1250	7,83	6,99	0,6
1600	6,85	6,29	0,5
2000	5,97	5,51	0,5
2500	5,17	4,77	0,6
3150	4,33	4,02	0,7
4000	3,41	3,20	0,7
5000	2,72	2,59	0,7

9. Results

Measurement of acoustic absorption according to UNE-EN ISO 354: 2004

GARDENIA QUÍMICA, S.A.

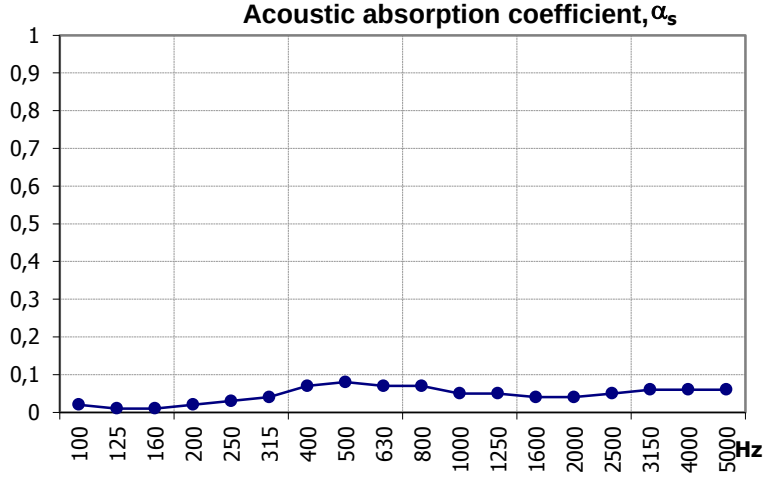
Tested Sample:

Projected natural cork of 2 mm nominal thickness with commercial reference ISOLATE

Sample area, S: 12,24 m^2 - 3,00 x 4,08 m

Trial date: 13-07-2018

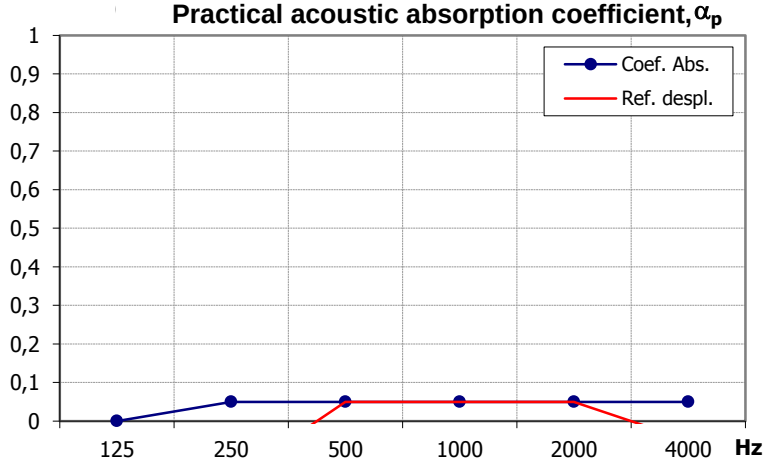
Acoustic absorption coefficient, α_s



Abs coefficient acoustics, α_s

Frec. (Hz)	α_s
100	0,02
125	0,01
160	0,01
200	0,02
250	0,03
315	0,04
400	0,07
500	0,08
630	0,07
800	0,07
1000	0,05
1250	0,05
1600	0,04
2000	0,04
2500	0,05
3150	0,06
4000	0,06
5000	0,06

Practical acoustic absorption coefficient, α_p



Coefficient abs. practical acoustic, α_p

Frec. (Hz)	α_p
125	0,00
250	0,05
500	0,05
1000	0,05
2000	0,05
4000	0,05

Weighted sound absorption coefficient (EN ISO 11654)

$\alpha_w = 0,05$

It is strongly recommended to use the unique evaluation index "Weighted sound absorption coefficient" (α_w) in combination with the curve of the complete acoustic absorption coefficient.

Classes of acoustic absorption according to aw (EN ISO 11654)
A (>0,85)
B (0,80 a 0,85)
C (0,60 a 0,75)
D (0,30 a 0,55)
E (0,15 a 0,25)
unclassified (<0,15)