Report 201915 - 19-DB-17

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On request of
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Part I
Results

1 DB 17

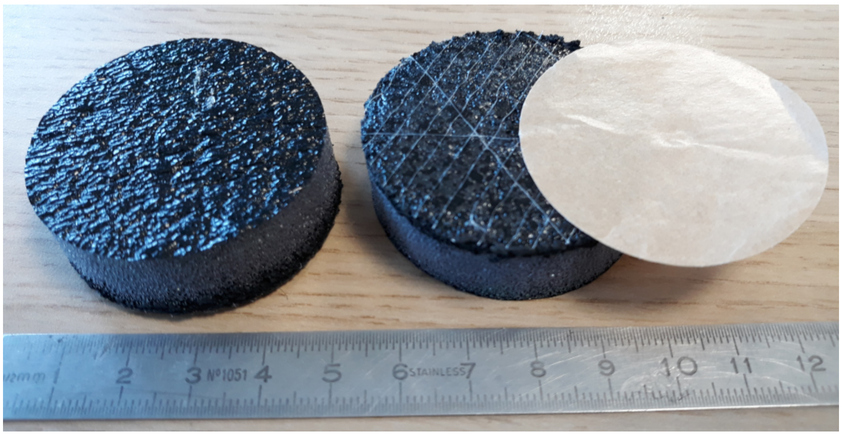

Figure 1: **DB 17** : Picture of material samples composed by a black screen (on top for left sample), a $\sim$ 12 mm-thick foam and a $\sim$ 3 mm-thick heavy mass with an adhesive layer covered by a paper (on top for right sample). The paper protecting the adhesive layer was removed for all tests.

1.1 Sound absorption in impedance tube

The figure below compares the sound absorption coefficient as measured in the impedance tube with the screen toward the sound incidence.

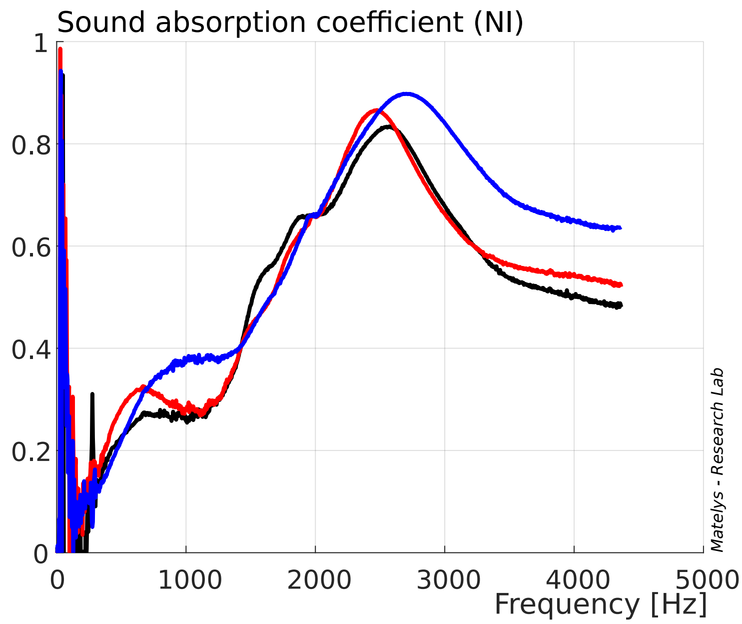

Figure 2: **DB 17** : sound absorption coefficient for plane waves under normal incidence.
Temperature : 23 °C
Ambiant pressure : 101 400 Pa
Hygrometry : 42%

1.2 Elastic behavior

The figure below shows the Frequency Response Function defined as the displacement on top of the material (acting as a spring + mass system) over the displacement imposed at the base of the material for uni-axial compression tests on three materials.

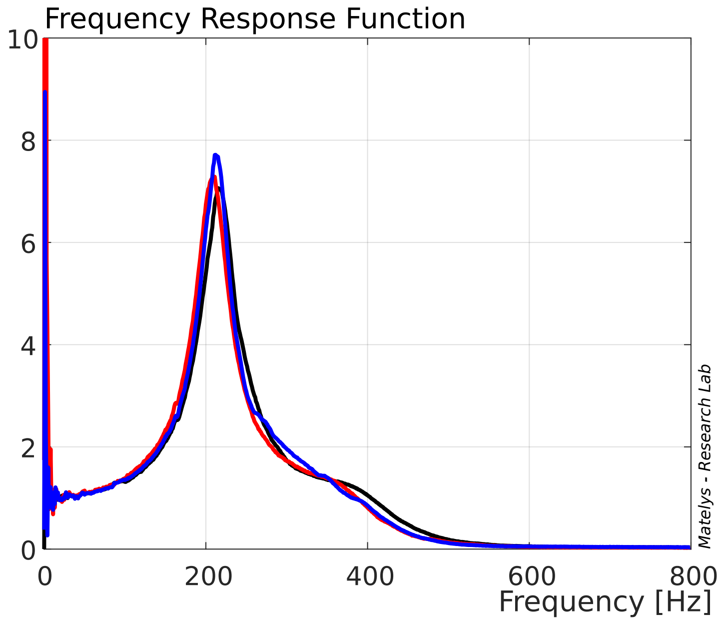

Figure 3: **DB 17** : Frequency Response Functions.
Temperature : 24 °C
Ambiant pressure : 101 450 Pa
Hygrometry : 43%

The resonance frequency for the three tested samples is 212 ± 3 Hz.
The damping loss factor, estimated using the -3 dB technique is : 0.17 ± 0.01

This frequency resonance is in the same order of magnitude compared to a rough computation of the resonance of a 12 mm-thick massive spring composed by material DB 20 with a top mass composed by 3 mm of material DB 21. As a reminder, material DB 20 has a Young's modulus of 121.2 kPa with a mass density of 28 kg.m^{-3} while the mass density of material DB 21 is 1 043 kg.m^{-3}. These values implies a spring-mass resonance of 280 Hz.

2 *Measuring the thickness of samples*

The thicknesses of material samples are manually measured using an electronic calipers with a precision of 0.01 mm. for material samples which do not have a perfect flat surface, the thickness precision is 0.1 mm.

3 *Acoustic measurements*

The acoustic measurements are done following ISO 10 534-2:1998 [1] with the impedance tube shown in figure 4.

[1] ISO 10534-2. Acoustics – determination of sound absorption coefficient and impedance in impedance tubes – part 2: Transfer-function method. *International Organization for Standardization*, 1998.

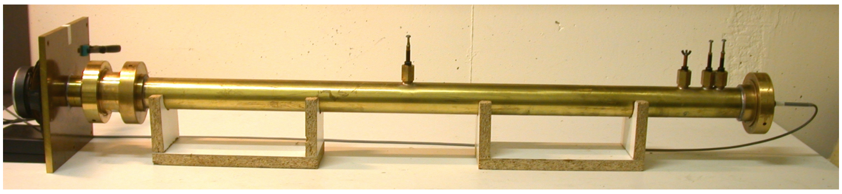

Figure 4: Impedance tube used for the acoustic measurements. Characteristics : length ≈1.2 m, ⊘ 46 mm, $f \in$ [250-4 500] Hz. Microphones 1/4″ Bruel & Kjaer 4187. Design and realisation ENTPE.

4 *Elastic Measurements*

The method used in this report is based on the study of the vibrations of a mass – spring system under an uni-axial compression test.

The measured Frequency Response Function (FRF) is defined as the ratio of the displacements of the top rigid mass to the base moving plate for a rectangular parallelepiped or cylindrical (with circular cross section) sample material (see Fig. 5). From a practical point of view, an accelerometer is used to determine the base plate displacement and a second one is used to determine the displacement of the top loading mass.

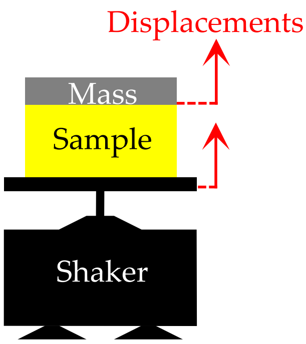

Figure 5: Scheme of the experimental setup used in the mass – spring resonance method.

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Material database

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