DETERMINING THE ABSORBTION COEFFICIENT OF SOUND-ABSORBING MATERIALS

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Abstract
*This paper describes methods and devices used to determine the characteristics of **α-** gypsum based building materials not included in the valid European standards. The laboratory device used to determine the absorption coefficient of gypsum and plaster sound absorbing material consisted of a simplified Knudt's tube in which the test plate was introduced while at one end a noise generating source (diffuser) was introduced. At the other end a microphone was placed for signal recording. A computer was used for signal generation and a second computer was utilized to record and process the signal. The results of the measurement data are presented so that one may see the diagram of the signal of reference, of the noise passing through the gypsum or of the sound absorbing material, corresponding to a given frequency. These results have highlighted the sound-absorbing properties of the modeling plaster with sound-absorbing properties throughout the entire frequency range studied.*

Key words: sound-absorbing panels, manufacture, mold, noise

INTRODUCTION

The determination of the absorption coefficient of gypsum-based construction materials required a measuring device consisting of:

- a Knudt's tube,
- noise-generating speaker,
- a microphone for signal capturing,
- a computer for signal generation, and
- a second computer for recording and processing.

The microphone - computer connection was made through an electronic data acquisition board while the noise generation was performed by the sound card of the second computer in MATLAB, by using the "*Generare_sunet_m*" specialized software, for the speaker.

The processing of the signal passing through the trial sample is acquired by a microphone and transmitted to the first computer via a NIUSB6251 data acquisition card (Darabont et al., 1998)

These signals are recorded from the microphone by using the MATLAB software, through specialized software called "*Achiziţie_semnal_m*". Subsequently, by using the "*Zgomote0*", "*Zgomote1*" and "*Zgomote2*" software, these signals are processed and completed by spectral diagrams.

MATERIAL AND METHODS

Figure 1 shows the schema of the device utilized during the process, and Figure 2 shows the device used to determine the absorption coefficient of gypsum and modeling plaster materials for sound absorbing panels.

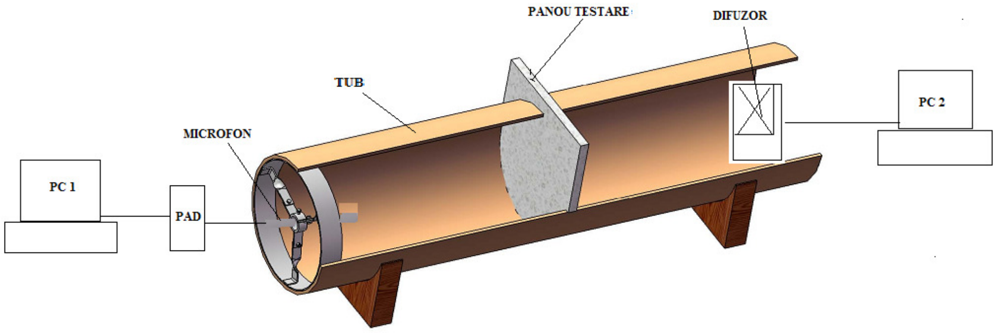


Fig. 1. Schema of the device used to determine the absorption coefficient of building materials

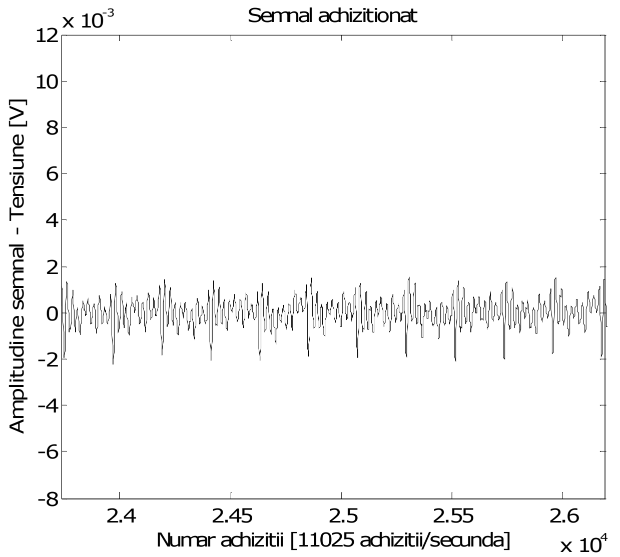
Fig.2. The device used to determine the coefficient of elasticity for building materials

The control tube is made of plastic, lined on the inside with velvet in order to minimize the sound reflections within the tube (Ungur, Mihaila, 2009).

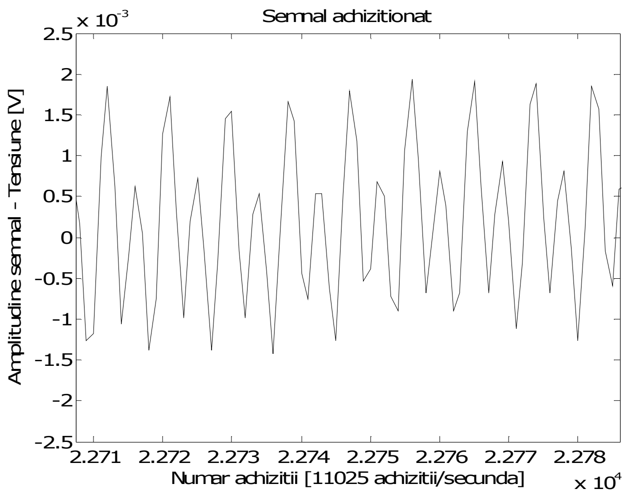
For the measurements, two panels were used: of gypsum and sound absorbing plaster. The results of the test are shown below.

RESULTS AND DISCUSSION

First of all, we shall present various forms of computer recorded signal and solved by using the "*Zgomote02*" software, utilizing the MATLAB software (fig.3).



50Hz signal form for gypsum



1250Hz signal form for gypsum

Fig. 3. Signal form at various frequencies used during tests

The results of the dynamic tests for the determination of the modulus of elasticity for gypsum and sound absorbing material using the dynamic device in fig. 2 are shown in the fig. 4 diagram (Ungur et al., 2008).

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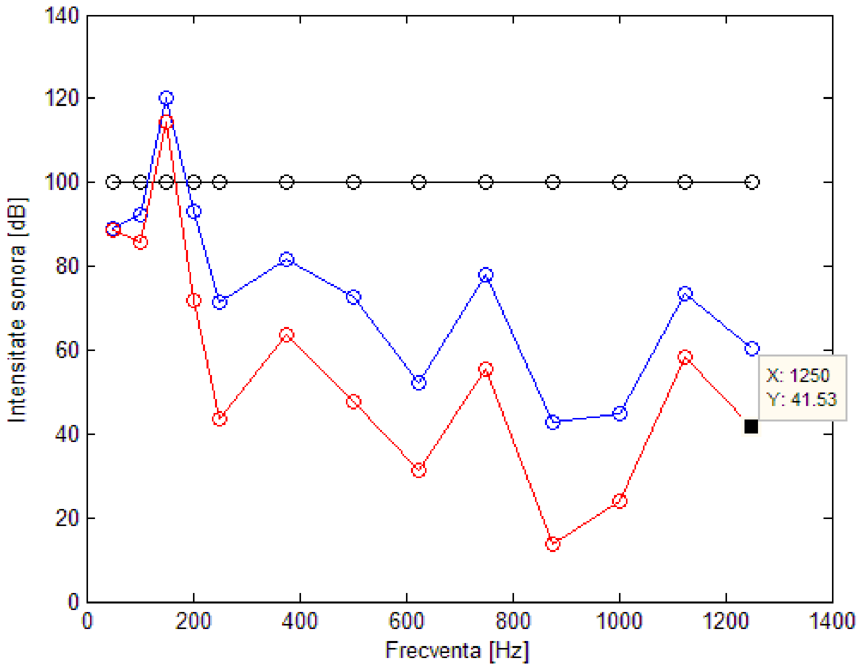

Fig. 4. Spectral diagram of sound through the tube compared to a sound of reference: Reference - Black Line, Plaster panel - Blue Line, Sound absorbing panel - Red Line

In order to determine the absorption coefficient of gypsum-based construction materials, the formula provided within will be used:

$$\alpha = 1 - \left(\frac{B}{A}\right)^2 \qquad (1)$$

Where: A-maximum wave amplitude and B-absorbed wave amplitude. In our case, A represents the amplitude of the wave passing through the tube without a material plate (Reference), and B represents the amplitude of the wave passing through the material plate inserted in the tube (gypsum, sound absorbing material).

Following the application of the formula to the obtained measurement data, the determined results were a series of values of the absorption coefficient of gypsum that is, sound absorbing material according to frequency, the values of which are shown in the Figure 5 diagram (Pantea I, 2007)

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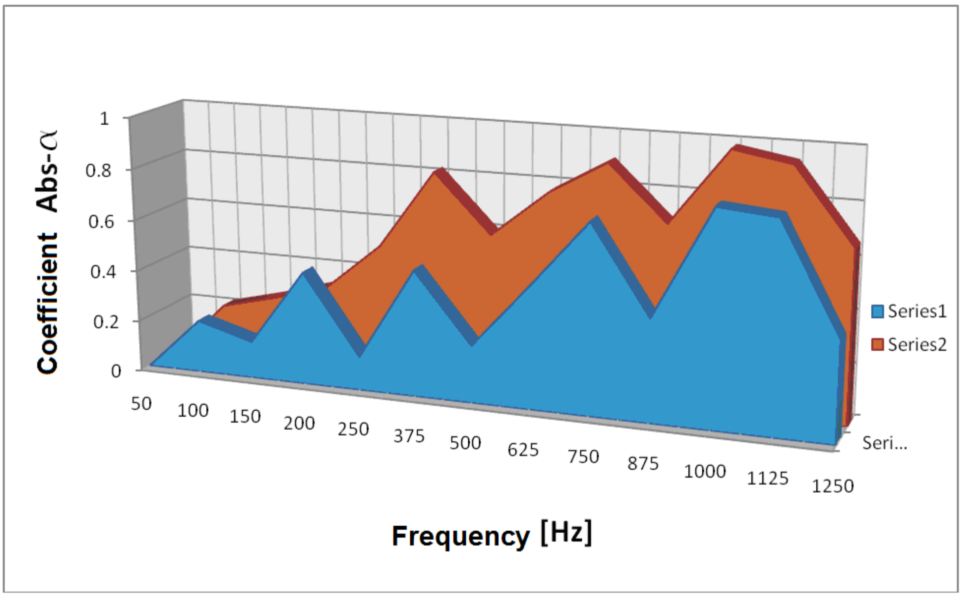

Fig. 5. Diagram of absorption coefficient for gypsum and sound absorbing material

Series 1-Gypsum, Series 2-Sound absorbing

CONCLUSIONS

The most important increases regarding the absorption coefficient of gypsum absorbing plaster were noted for the following frequencies, thus: 200Hz – a 285% increase, 375Hz - an 166% increase, 750Hz - a 75% increase and 1125Hz - a 71 % increase. In fact, these improvements of the absorption coefficient for sound absorbing material were 20% higher within the 200-1250Hz range.

In what concerns the gypsum, the highest value of the α-coefficient was 0.818 for 875Hz, respectively 0.798 for 1000Hz. Furthermore, gypsum had a good behavior within the 200-1250Hz range, with an average absorption coefficient $\alpha_{med} = 0.508$.

For the special sound absorbing plaster, the highest value of the α-coefficient was 0.981 for 875Hz and 0.942 for 1000Hz, respectively. Within the 200-1250Hz frequency range the average absorption coefficient $\alpha_{med} = 0.770$.

As a conclusion to these analyzes it can be said that the special sound-absorbing plaster possesses very good sound absorbing properties within the 200-1250Hz frequency range, especially when it comes to high frequencies, while the gypsum possesses a 52% lower average absorption coefficient as compared to the special sound absorbing plaster.

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