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EVALUATION OF ACOUSTIC ATTENUATION OF COMPOSITE WOOD PANEL THROUGH NONDESTRUCTIVE TEST

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Abstract: *The paper presents the experimental results determined by means of nondestructive test concerning the acoustic attenuation of composite panels. The sample panel made of biodegradable materials like solid wood, wood flakes and woven inserts was studied in order to establish its practicable application. Based on ultrasonic wave propagation, the acoustic attenuation of the tested composite panel was determined. The results revealed that the investigated panel recorded a high value of the acoustic attenuation, assumed as a good acoustic insulation.*
Key words: *attenuation, ultrasound technique, composite panel, sound barriers, textile waste,*

1. INTRODUCTION

One of the nondestructive techniques used to determine the acoustic attenuation is based on the ultrasonic wave propagation. This method presents several advantages compared with the conventional ones, such as speed, versatility and lower cost. According to the purpose of research, the ultrasound technique has been used to investigate mechanical properties of wood (Bucur, 2006), defects of materials (Grimberg, 2009) resonance frequency, damping of materials(Mobley, 2009; Wrobel, 2007). The present paper focuses on the determination by a non-destructive method of the acoustic attenuation of the proposed composite panel used in ambiental design. The novelty of this study is both the combination between materials and the method.

2. MATERIALS

The sample studied in this paper is a composite panel made of wood chips and textile wastes. The panel is formed in a wooden box with the interior sizes of 650 x 180 mm and thickness of 36 mm filled inside with an agglomerated structure made of wood chips and unwoven textile inserts, compacted at a normal temperature (20-22ºC) and conditioned at a temperature of 40-50 ºC. (Cosereanu, 2010).

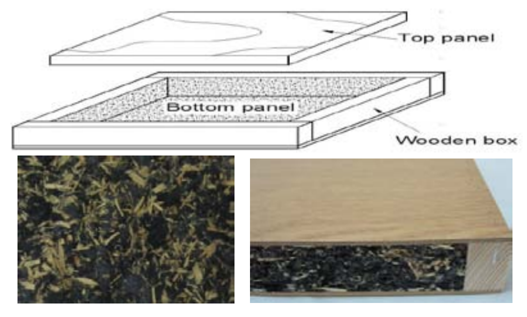
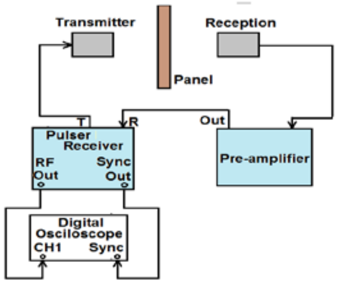


Fig. 1. The studied panel type sandwich made from wood and textile composite

The materials used in these structures are green ones and biodegradable, namely inserts of wood (chips or fibers) and textiles (wool or jute) and mineral binders as clay. The core of the sandwich structure is intended to be a light structure, easy to manipulate, easy to be cut at the required sizes, compact enough to not be damaged during the transport or when assembling it, easy to be mount on the exterior building walls and of course with similar thermal insulating properties as polystyrene has (Cosereanu, 2010).

3. EXPERIMENTAL SET-UP

In order to determine the acoustic attenuation, the transceiver method using the non-contact transducers made by NCG 100D25 ULTRANGROUP U.S. has been used, having the following features: 25 mm diameter, a central frequency of 100 kHz and the band width in the range of 1kHz – 35MHz. The transducers were coupled at a Pulser – Receiver 5077 PR Panametrics NDT USA connected with a digital oscilloscope Wave Runner 64Xi – LeCroy USA, which allows the measurement of time with an accuracy of 0.1ns (Grimberg, 2011).
The distance between the emission transducer and the reception remained at a constant value of 200 ± 0.1mm during the test and the measured temperature, air pressure and relative humidity in the room were as follows: temperature 28 ± 0.50C, pressure 755 ± 1torr (mm Hg col) and relative humidity of air 58 ± 1%. The principle scheme and the equipment are presented in Figure 2.



a)

b)

Fig. 2. Experimental set-up: a) test principle, b) the equipment

4. RESULTS AND DISCUSSION

First, the amplitude, the gain and preamplification of received signal without panel and than with panel between transducers (Table 1), was measured and recorded. Than, the data were insert in formulas to obtaine the value off attenation.

Cases	Amplitude U [mV]	Gain G[dB]	Preamplification PA [dB]	Amplification A=G-PA [dB]
Without panel	422 ± 12	-28	40	12
With panel	352 ± 16	39	40	79

Tab. 1. Values of received signals before and during the experiment

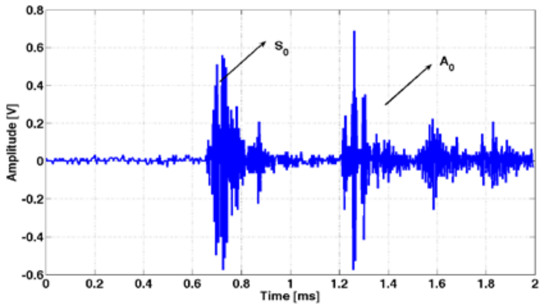


Fig. 3. The capture of signal on the osciloscop: a) without panel, b) with panel

The signal provided by the receiving transducer in the absence of the panel will be (Grimberg, 2009, 2011):

$$A_{without\ panel} = 20 \log \frac{U_{output}}{U_{input}} \quad (1)$$

Replacing the values in relation 1, the output amplitude is:

$$U_{output} = 10^{\frac{12}{20}+log422} \quad (2)$$

In the same way, it is calculated the received signal in the presence of panel, resulting that the output amplitude U is:

$$U_{output} = 10^{\frac{79}{20}+log352} \quad (3)$$

The acoustic attenuation α will be:

$$\alpha = \frac{U^1_{output}}{U^2_{output}} = -65.4\ dB \quad (4)$$

According to calculation, the composite panel has a good acoustic insulation (α=13.6).

Panel	Initial Noise Level [dB]	Determined Noise Level after [dB]	Attenuation α
Without panel	73,90	73,90	0
Glass	73,90	72,00	1,90
Brick	73,90	71,60	2,30
Perforated brick	73,90	71,30	2,60
Solid Wood	73,90	71,10	2,80
Acrylic 4 mm	73,90	70,90	3,00
Acrylic 8 mm	73,90	70,90	3,00
Studied panel	73,90	65,40	8,50

Tab. 2. Comparison of different materials attenuation

The experimental results were compared with the simulated ones. For simulation, the LIMA soft has been used. Starting with the real measured noise levels from the urban traffic, virtual panels from different materials were used to simulate the sound barrier. The noise level after interposing the panel was measured. In table 2 the comparison between different materials attenuation is presented.

5. CONCLUSION

The attenuation of studied panel is around 11.5% (from simulation) and 17% (from experimental test), compared with glass (2,6%), solid wood (3,8%) and acrylic (4,05%). Thus, the composite materials made of wood and textile wastes are recommended to be used both in civil and industrial structures, as well as in urban structures used to reduce the noise. Other advantages of these materials are: relatively low density, low cost and rich resource of raw materials. In a previous research, the thermal insultation of these materials was studied.

The future research plane is based on these experimental results because implies the integration of composite panels in complex structure as noise barriers in order to be tested in open area. This stage of research assumes more and expensive experiments due to the dimensions and complexity of structure, but will provide more realistic results about sound insulation properties of tested structures.

6. ACKNOWLEDGEMENTS

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