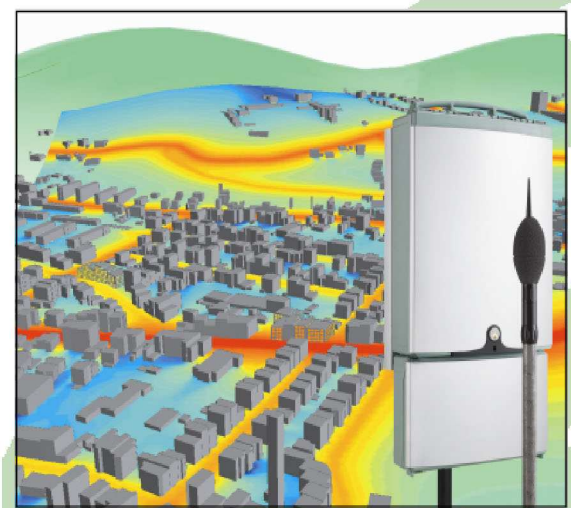


SOUND AND VIBRATION Consultancy & Management



Today protecting the environment and sustaining the future of human beings are some of the greatest challenges worldwide. Ever-increasing societal needs and population pressures demands new solutions. Sound and vibration issues are on the top of the environmental agenda. Industrialisation, dense urbanisation and increasing needs of transportation of people and goods generate sound and vibration which impact the environment, communities and human health. Brüel & Kjær can assist industries, trade and public and regulatory agencies in evaluating the range of environmental impact—providing the basis to make informed responsible decisions. Experience, technical expertise, current computer modelling techniques, and measurement procedures are applied to assess current conditions, make recommendations for mitigation, or work with clients at the design phase to save money by addressing environmental acoustics and noise at the outset of a project. Brüel & Kjær and Enviro Consult offers strategic partnership for an improved environment and better human health.

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ASPECTS CONCERNING THE DYNAMIC BEHAVIOR OF A ROTOR-
FOUNDATION SYSTEM

DYNAMIC RESPONSE OF TOWER CRANES UNDER SEISMIC ACTIONS.
CASE STUDY

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VIBRATIONS OF A BAR

ACOUSTICAL MATERIALS – SOUND ABSORBING MATERIALS
MADE OF PINE SAWDUST

EVALUATION OF ABSORPTION COEFFICIENT OF BIODEGRADABLE COMPOSITE
MATERIALS WITH TEXTILE INSERTS

COMPARISON BETWEEN THE NLMS AND THE NLMF ADAPTATION ALGORITHMS
APPLIED ON VOLTERRA FILTERS FOR NONLINEAR ACOUSTIC
ECHO CANCELLATION

NUMERICAL SIMULATION OF REAL CONTACT BETWEEN TWO BODIES

ON THE ANOMALOUS DOPPLER EFFECT

THE SERB-SITON SOLUTION FOR ISOLATION TO NOISE, SHOCK, VIBRATION
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ON THE ASSESSMENT OF THE VERTICAL VIBRATION BEHAVIOUR
OF A RAILWAY VEHICLE

Evaluation of Absorption Coefficient of Biodegradable Composite Materials with Textile Inserts

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Abstract: - The paper focuses on experimental evaluation of acoustic properties of biodegradable composite materials with textile inserts used in products with protective role in urban habitat. To determine the absorption and reflection coefficients, the samples made from biodegradable composites were tested by means of impedance tube Bruel&Kjaer type 4206 A, with frequency range between 100-3200 Hz. It was noted that the tested specimens show a high absorption coefficient for frequency range 800 – 2800 Hz. Based on experimental results, the composition of tested materials will be improved to obtain a good absorption of low frequencies.

Keywords: - absorption, reflection, composite, frequency, impedance tube

1. INTRODUCTION

Sound absorption is one of the most important acoustical properties which characterized the porous materials used in products with sound insulation role as sound barriers, walls, road surfaces.

In accordance with type of materials and products, range of frequencies, applications, the measurement methods of absorption coefficient varied: impedance tube method, ultrasound method, extended surface method, guard tube method or reverberant room method [6,7,8]. One of the widely used methods to determine the sound absorption coefficient is the internationalized standardized impedance tube method [4,5,9, 10].

2. PROBLEM FORMULATION

In this study were used green and biodegradable materials, found as inserts of wood (flakes or fibers) and textiles (wool or jute) and binders as wheat flour, clay or ecological acrylic copolymers as can be seen in Figure 1 [3]. In the first stage, these types of materials obtained as agglomerated structures

were formed in wooden molds. Some of them were tested to determine the density and thermal conductivity coefficient and others were prepared for measurements of sound absorption coefficient.



Figure 1. The raw materials used to obtain the biodegradable composites

The samples for impedance tube were cut in specimens with diameter 63.5 mm (Figure 2). The characteristics of composite materials are presented in Table 1. The differences between samples consist

of quantities of raw materials or type of binders which conduct to more or less compaction of particles.



Figure 2. The agglomerated structures with different composition

Table 1. Characteristics of agglomerated structures

Code	Content and amount	
	Inserts, in g	Binders
A1	Wood flakes 150 g, Wool 150 g	White acrylic copolymer (Paint)
L1	Wood flakes 150 g, Wool 150 g	300 g Clay solved in water 400ml
L2	Wood flakes 150 g, Wool 150 g	400 g Clay solved in water 600 ml
L3	Wood flakes 150 g, Wool 150 g	600 g Clay solved in water
G5	Wood flakes 150 g, Wool 150 g	600 g Gyps solved in water
G12	Wool 50 g	1000 g Gyps solved in water

The base of these materials is represented by wood flakes and wool. The binder and the quantity of binder composition differ. All samples were obtained in the same laboratory conditions including the same pressure parameters.

3. EXPERIMENTAL METHOD

To determine the absorption coefficients, the set-up measurement chain presented in Figure 3, was used.

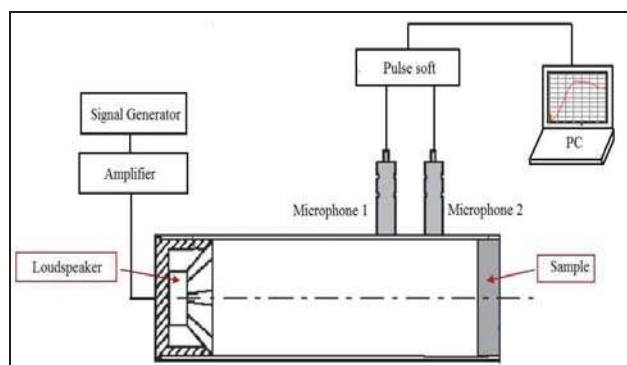


Figure 3. The experimental set-up

First it was prepared the equipment without samples in order to configure the microphones and calibrate them using the calibration function from Pulse soft [1,2]. Then, each sample was inserted into tube properly and started the measurements (Figure 4). The noise generated connected to amplifier and tube filter emitted the set signals. The emitted signal and reflected signal were captured by microphones and transmitted to Pulse hardware and displayed with Pulse soft.



Figure 4. During the measurements

The input data from project set-up are presented in Table 2. The values from Table 2 are established automatic by soft in preparation stage.

Table 2. The input data

Tube	Characteristics
Type	Medium
Microphone Spacing:	0.0318 m
Distance to Sample from Mic. 2	0.0635 m
Distance to Source from Mic. 1	0.37 m
Diameter:	0.064 m
Lower Frequency Limit:	100 Hz
Centre Frequency (Hz):	1600
Generator	
Waveform:	Random
Signal Level:	1.414 Vrms
Pink Filter:	Off

Due the influence of environment on the accuracy of measurements in situ, the most important parameters are presented in Table 3. All measurements were performed in the same environment conditions.

Table 3. Environment Parameters

Environment	Values
Atmospheric Pressure:	1035.00 hPa
Temperature:	28.00 °C
Relative Humidity:	46,00%
Velocity of Sound:	347.89 m/s
Density of Air:	1.195 kg/m ³
Characteristic Impedance of Air:	415.8 Pa/(m/s)

4. RESULTS AND DISCUSSION

The sound absorption coefficient indicates how much of the sound is absorbed in the actual material and varied in accordance with frequency. In Figure 5 is presented the variation of sound absorption coefficient with frequency, in case of different materials. It can be noticed that the composition of tested materials influence the sound absorption. The sample A1, L1 and L2 are characterized by high absorption for frequency range between 1000 – 3200 Hz. The sample L3 and G12 have a relative low absorption coefficient, with mention that the range of frequency is more wide, beginning from 500 Hz (sample L3). Comparing the results with other materials (wood, concrete, a.o.) the absorption is similarly with fiberglass or perforated metal. [http://www.sae.edu/reference_material/pages/Coefficient%20Chart.htm]

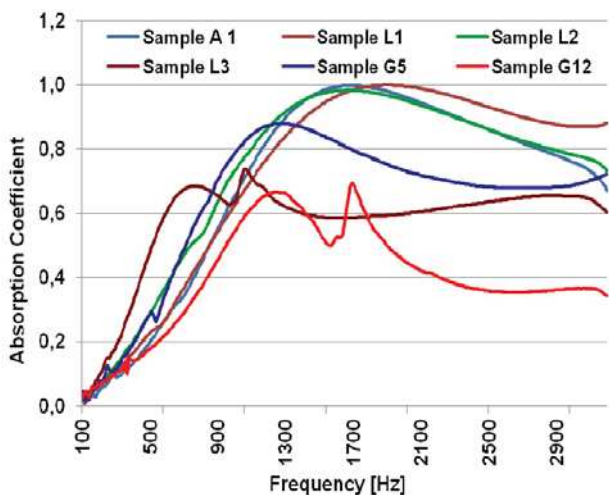


Figure 5. The comparison of sound absorption coefficient for different materials

The comparison of reflection coefficient for tested materials is shown in Figure 6. The most reflective materials is the composite wich contain gyps (samples G5 and G12). From the acoustical

behaviour point of view, the samples can be grouped in two types: samples A1, L1 and L2 present low values of reflection coefficient, especially around 2500 Hz; the samples L3, G5 and G12 are characterized by the same behaviour for frequency range between 100 – 1600 Hz. At 2500 Hz, these recorded a high reflection compared to the other groups of samples.

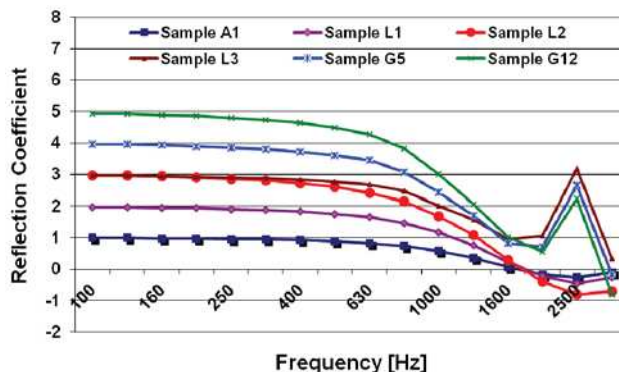


Figure 6. The comparison of sound reflection coefficient for different materials

In Figure 7 are presented the chart of impedance ratio. It can be noticed that the samples L1, L2, L3 and G5 are characterized by the same impedance ratio, comparing to the other ones which are placed up (G12) or below (A1).

At low frequencies, the differences between values of impedance ratio are more obviously. With increasing of frequency, the impedance ratio decreases and tends to the zero.

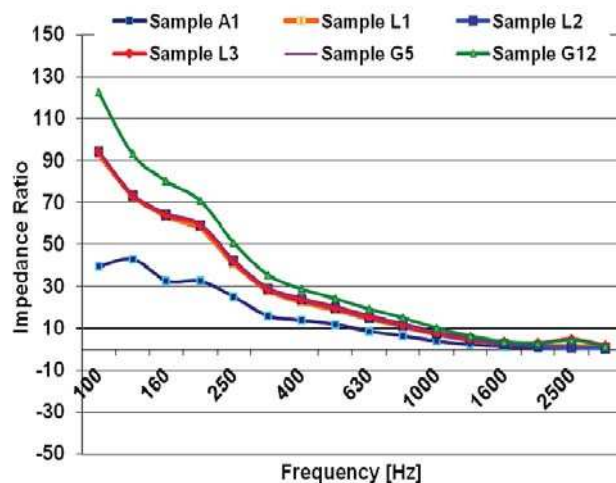


Figure 7. The comparison of impedance ratio in case of tested materials

5. CONCLUSIONS

The experimental investigation aimed to determine the acoustical properties of new materials obtained by waste textile and wood residues. These materials were designed in order to assure a good

acoustic and thermal insulation. It was tested six types of material. The composition of binder makes the difference between samples. Concerning the sound absorption coefficient, the sample A1 (white acrylic copolymer), L1 and L2 (Clay solved in water), G5 (Gyps solved in water) presents a very good sound absorption. The other ones recorded a lower value of absorption coefficient versus frequency. This behavior can be explained by nehomogeneity of particles or uneven distribution of binder. The paper is a part of more extensive research which aim is to obtain a sandwich panels with potential application in sound barriers structure.

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REFERENCES

- [1] Bratu M., Ropotă I., Vasile O., Dumitrescu O., Muntean M., *Research on the absorbing properties of some new types of composite materials*, Romanian Journal of Materials 2011, vol. 41 (2), pp. 147-154, ISSN 1583-3186
- [2] Bratu, P., Dragan, N., Vasile, O., *Experimental studies of sound absorption coefficient of composite materials used for acoustic treatments of the cabins*, The 11-th International Congress on Automotive and Transport Engineering CONAT 2010, Proceedings – Volume III "Automotive Vehicles and Environment", ISSN 2069-0401, pag. 177-184
- [3] Cosereanu Camelia, Lazarescu Constantin, Curtu Ioan, Lica D., Sova Daniela, Brenci Luminita, Stanciu Mariana Domnica. (2010). *Research on New Structures to replace Polystyrene used for Thermal Insulation of Buildings*, in *Rev. Materiale Plastice, MPLAAM* 47 (3) 2010, Vol. 47, nr. 3 –septembrie 2010, Bucuresti Romania, ISSN 0025/5289, pp.341-345
- [4] ISO 10534-1:1996 Acoustics – Determination of sound absorption coefficient and impedance in impedance tubes – Part 1: Method using standing wave ratio
- [5] González J.; Machimbarrena M.; Pérez A.; Lorenzana T (2001). *Medida directa de la impedancia acústica de distintos materiales*. (Tecnicaústica'2001). Octubre 2001. La Rioja, España
- [6] Krautkramer, J., Krautkramer, H., (1990), *Ultrasonic Testing of Materials*, 4th ed., Springer Verlag
- [7] Lemaitre, J., Chaboche, J.L., (1994), *Mechanics of Solid Materials*, Cambridge University Press, NY.
- [8] Stanciu M. D., Cretu N., Rosca C., Curtu I. (2008). *Experimental research on the influence of wood species upon the frequency response of the lignocelluloses plates from the guitar construction*. Romanian Journal of Acoustic and Vibration, Vol V, Nr. 1, June 2008, ISSN 1584-7284, pp. 3-10.
- [9] Sung Soo Jung, Yong Tae Kim, Yong Bong Lee. (2008) *Measurement of Sound Transmission Loss by Using Impedance Tube*. Journal of Korean Physical Society, Vol 53, No. 2, August 2008, p. 596 – 600
- [10] Vasile O., *Attenuation of the acoustic energy for absorptive muffler*, Annual Symposium of the Institute of Solid Mechanics and Session of the Commission of Acoustics, SISOM 2011, 25-26 May 2011, Bucharest, Romania.
- [11] http://www.sae.edu/reference_material/pages/Coefficient%20Chart.htm
- [12] <http://www.silentroads.nl/index.php?section=measurements&subject=absorptionmeasurement>