SOUND ABSORBING CHARACTERISTICS PRESENTED BY THE NEW COMPOSITES OBTAINED AND EVALUATED

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The present paper addresses the methodology of obtaining new composites and the evaluation of the noise absorption characteristics possessed by them. The goal is to obtain new materials with sound-absorbing characteristics from waste recycling. Thus, it contributes both to the reduction of the amount of waste by recycling it, and also the reduction of the noise level from various rooms, by soundproofing them with the obtained composites. For each individual composite, the sound absorption coefficient is determined and an evaluation is made by interpreting the individual results obtained.

Key words: waste, noise pollution, composites.

1. Introduction

As a result of human activities within the process of economic and social development, numerous problems for human society have appeared at the global level, including: the different types of pollution and the effects of climate change.

Noise pollution, an important component of external environmental pollution, is a major problem for both developed and developing countries, as well as for underdeveloped countries. It becomes one of the main forms of pollution due to the fact that it affects the health of a large mass of people. The studies developed in the field show that the intensity of street noise and that of people's homes exceeds, most of the time, the maximum allowed values which leads to the appearance of cardiovascular and neuropsychiatric conditions and even a total discomfort of both the human and other living organism. People interpret noise differently, depending on a number of factors such as health or age, but all of them are negatively affected by the high intensity of sounds, even reaching the production of hearing trauma. At the level of the European Union, approximately 65% of the population is exposed daily to noises that exceed the thresholds allowed by law and that are produced in particular by urban transport, both underground and surface. The population of Bucharest is also affected by noise pollution, more than half of them carrying out

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their activities in environments that exceed the thresholds allowed by law. The measures to reduce noise intensity and the awareness of noise pollution and its effects are well regulated by national legislation, and the noise level is monitored daily [1 - 9].

One of the causes of the production and intensification of the phenomenon of climate change is represented by the constantly increasing amount of waste. The management of waste generated by human activities is an old problem, especially due to the fact that the methods of treating it by incineration or storage are not effective. Poor waste management, respectively, the treatment of waste by storing it in storage units called landfills, units that do not comply with the minimum requirements imposed by legislation, their discharge into watercourses and their uncontrolled burning generate a series of major risks both for the environment, as well as for the health of the population. The basis of a good waste management is the collection and separate transportation according to their material composition, and then the composting of plant residues or the recycling of other waste that cannot be submitted to the composting process [10 - 17].

Recycling of waste materials is an efficient and more environmentally friendly method, as waste is a source of new raw materials [18 - 23].

The new materials resulting from the waste recycling process can be used to obtain various composite materials with sound-absorbing properties.

Composites are materials with superior characteristics to those in its composition, being obtained by mixing two or more components. They appeared in the context of the need to replace the existing basic materials, ferrous or non-ferrous, materials that do not have the most optimal characteristics in terms of: methods of obtaining and taking, fields of use, costs or masses [24 - 25].

Composite materials have a great advantage, namely that they can be used in various fields, such as: sound insulation, thermal insulation, automotive construction, aerospace components. Composite materials have a great advantage, namely that they can be used in various fields, such as: sound insulation, thermal insulation, automotive construction, aerospace components. At the same time, composite materials have other advantages, such as: low energy consumption in the process of obtaining them, high temperature resistance and thermal stability, high shock resistance, superior vibration damping capacity, high coefficient for noise absorption, etc. [26 - 27].

Currently, there are numerous theoretical and experimental researches regarding the obtaining of new materials that have characteristics for noise absorption and the creation of a healthy climate for people and for the protection of the environment [28].

This work aims to identify optimal solutions for reducing the amount of waste by reducing the noise level until reaching the admissible thresholds provided for in the legislation, but also for obtaining new raw materials with superior characteristics.

2. Materials and methods

2.1. Description of the materials and methods used

Fig. 1. Preparation of the necessary materials for obtaining samples

Fig. 2. Samples obtained during the experiment

As part of the experiment, it was proposed to create biocomposites with sound-absorbing properties obtained from a mixture of waste, such as: sunflower shells, sawdust, walnut shells, pumpkin shells, thuja shells and cement/plaster, according to Figure 1.

Thus, during the experiment, 6 samples (Fig. 2) with a thickness of 20 mm, 6 samples with a thickness of 40 mm and 3 samples with a thickness of 60 mm were obtained, as follows:

- the 20 mm samples were obtained by mixing a waste from those mentioned above and a binder: cement or plaster;
- the 40 mm samples were obtained by mixing two different wastes from those mentioned above and a binder: cement or plaster;
- the 60 mm samples were obtained by mixing three wastes from those mentioned above and a binder: cement or plaster;
- matrices of 20 mm, 40 mm and 60 mm respectively a diameter of 63 cm were used to obtain the samples.

2. 2. Equipment used

The samples obtained during the experiment were evaluated by means of an interferometer tube called the Kundt Tube (Fig. 3.), composed of a microphone probe, a sample holder, a microphone, a speaker and a positioning device [29].

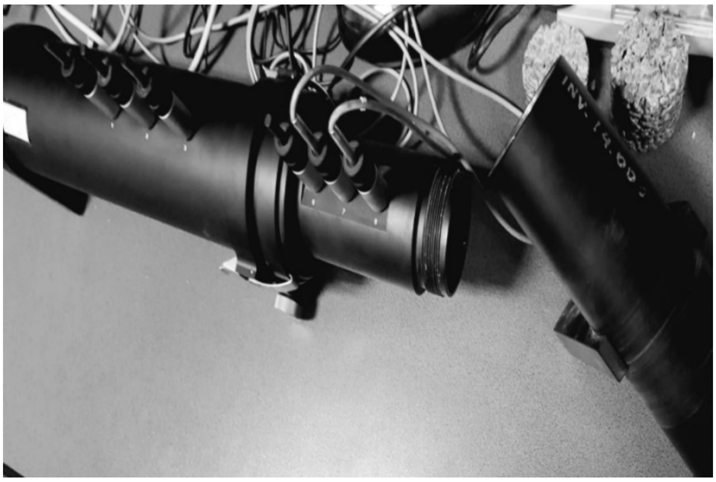

Fig. 3. Kundt tube

By means of the Kundt Tube, the value of the absorption coefficient was determined for each individual sample. The frequency range on which the sound absorption coefficient determinations were made for each individual sample is 0 - 3200 Hz. Data processing obtained by subjecting the experimental samples to the Kundt Tube were processed by means of the data processing system Bruel&Kjaer PULSE Platform type 7758 [30].

3. Results and discussions

The interpretation of the results obtained by the samples from the experiment is carried out by classifying them according to the absorption coefficient obtained, according to the table below (Table 1) [31]:

Table 1

Sound 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
No class	0,00; 0,05; 0,10

After subjecting each sample to the Kund Tube and processing the data obtained through the Bruel&Kjaer PULSE Platform type 7758 data processing system, the following values for the weighted sound absorption coefficient were obtained, illustrated in Figures 4, 5 and 6:

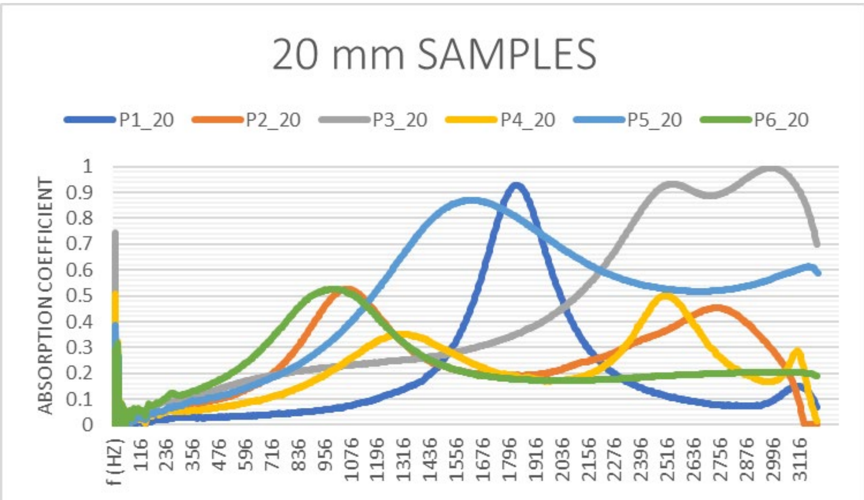

Fig. 4. Results for the 20 mm samples (Kundt tube)

After subjecting each sample to the Kundt Tube and calculate the weighted sound absorption coefficient $\boldsymbol{\alpha_w}$ (see calculation method from EN ISO 11564 [3]), the following results were obtained to determine the absorption coefficient:

- sample $\mathbf{P_1^{20}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\alpha_{w,1} = \mathbf{0,95}$, which places the composite material obtained in Class A of acoustic absorption;

- sample $\mathbf{P_2^{20}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,2}} = \mathbf{0,55}$, which places the composite material obtained in Class D of acoustic absorption;
- sample $\mathbf{P_3^{20}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,3}} = \mathbf{1,0}$, which places the obtained composite material in Class A of acoustic absorption;
- sample $\mathbf{P_4^{20}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,4}} = \mathbf{0,5}$, which places the obtained composite material in Class D of acoustic absorption;
- sample $\mathbf{P_5^{20}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,5}} = \mathbf{0,85}$ which places the obtained composite material in Class B of acoustic absorption;
- sample $\mathbf{P_6^{20}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,6}} = \mathbf{0,5}$, which places the composite material obtained in Class D of acoustic absorption;

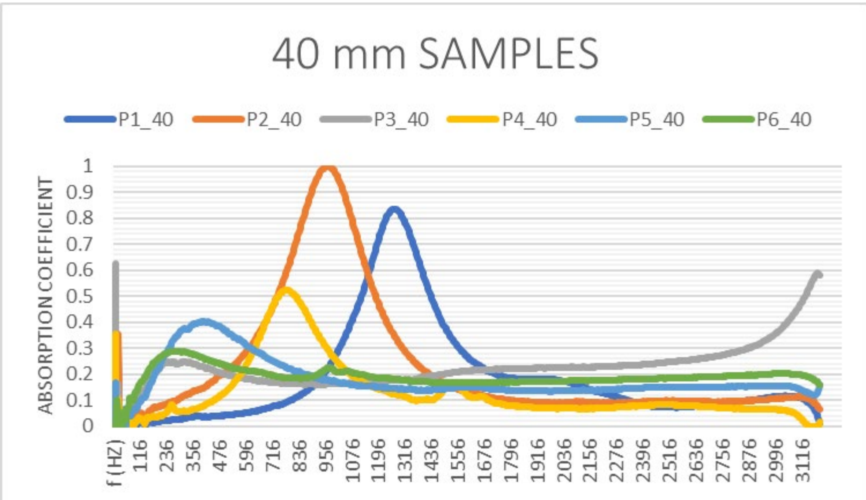

Fig. 5. Results for the 40 mm samples (Kundt tube)

- sample $\mathbf{P_1^{40}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,7}} = \mathbf{0,85,}$ which places the obtained composite material in Class B of acoustic absorption.
- sample $\mathbf{P_2^{40}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,8}} = \mathbf{1}$, which places the composite material obtained in Class A of acoustic absorption;

- sample $\mathbf{P_3^{40}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,9}} = \mathbf{0,6}$, which places the obtained composite material in Class C of acoustic absorption;
- sample $\mathbf{P_4^{40}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,10}} = \mathbf{0,5}$, which places the obtained composite material in Class D of acoustic absorption;
- sample $\mathbf{P_5^{40}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,11}} = \mathbf{0,4}$, which places the obtained composite material in Class D of acoustic absorption;
- sample $\mathbf{P_6^{40}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,12}} = \mathbf{0,3}$, which places the obtained composite material in Class D of acoustic absorption;

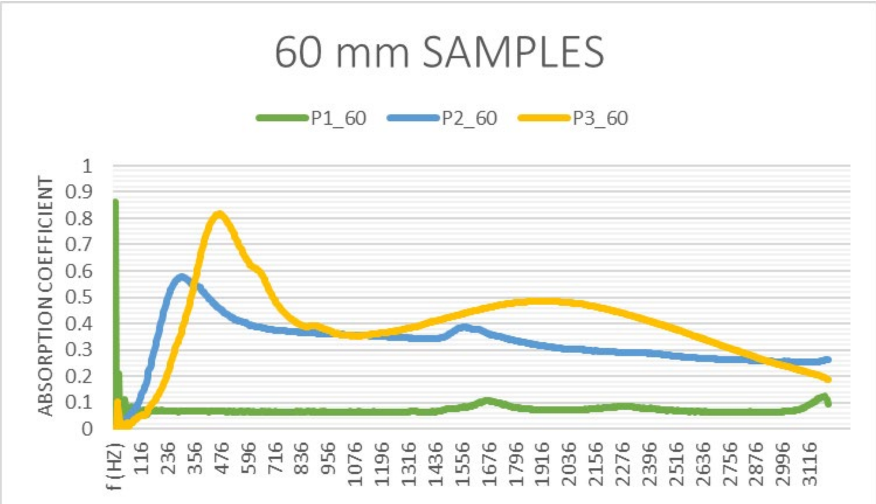

Fig. 6. Results for the 60 mm samples (Kundt tube)

- sample $\mathbf{P_1^{60}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,13}} = \mathbf{0,1}$ which places the obtained composite material in the category without class;
- sample $\mathbf{P_2^{60}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,14}} = \mathbf{0,6}$, which places the composite material obtained in Class C of acoustic absorption;
- sample $\mathbf{P_3^{60}}$ obtained, following experimental determinations, a weighted sound absorption coefficient $\boldsymbol{\alpha_{w,15}} = \mathbf{0,85}$ which places the composite material obtained in Class B of acoustic absorption.

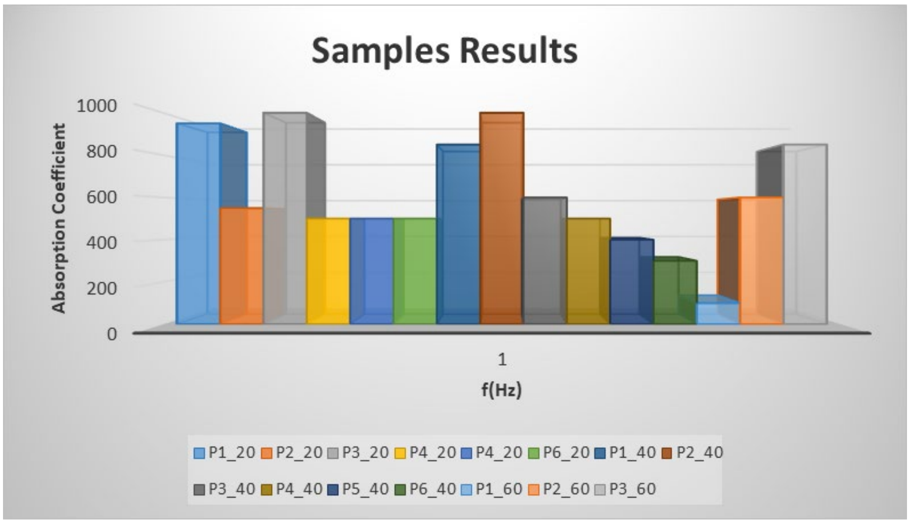

Fig. 7. Interpretation of Samples results (Kundt tube)

As can be seen from the interpretation of the results, the best were obtained by the samples $\mathbf{P_1^{20}}$, $\mathbf{P_3^{20}}$, $\mathbf{P_5^{20}}$, $\mathbf{P_1^{40}}$, $\mathbf{P_2^{40}}$, și $\mathbf{P_3^{60}}$. These samples belong to Classes A and B of absorption, according to the weighted sound absorption coefficient $\boldsymbol{\alpha_w}$.

The test results are illustrated in the graph below, for a better interpretation (Fig. 7.).

4. Conclusions

From the interpretation of the results obtained from the tested samples, it can be seen that a number of 6 samples belong to absorption classes A and B, depending on the weighted sound absorption coefficient $\boldsymbol{\alpha_w}$, which results in the fact that these composites can be use in the creation of boards for sound absorption in order to protect people, both at work and in their homes.

The results of the samples were influenced by the nature of the materials from which they were obtained, but also by their thickness.

Considering the positive results obtained, the development of research in the field with the use of other materials obtained from waste recycling is encouraged.

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