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Composite Materials Containing Textile Soundproofing

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Abstract

Pollution, in all its forms around us, suffocating us. It is absolutely necessary to a position in the fight against noise. Several variants are studied composite containing absorbent cloth, even textile waste. With increasing thickness of the material - the number of layers increases the efficiency of noise absorption. Materials with high specific gravity have good sound absorbing properties MF, and material type foam cell structure communicating spaces are very good at absorbing high frequency noises.

Key words: *noise absorbing composite materials, frequency, constant absorption.*

General

Noise is a complex sound, parasitic, unwanted (no information content), depending on the particular conditions of work and life, long-acting noise exceeding the limit of perception of auditory organ is a main factor and fatigue influences negative direct impact on our work and on health [1]. In terms of propagation and perception by humans, noise is characterized mainly by three physical quantities, namely:

- Frequency is perceived as a physiological parameter that means "height" sound (treble, bass, thin, thick). Audibility range is 16-16000 Hz (nine octaves) or 20 000 Hz, with high sensitivity in the range 2000-5000 Hz and perceptions intelligible to the human voice range 500-2000 Hz;
- Sound pressure or intensity from physiologically sound corresponds strength;
- Sound propagation speed depends on the medium (330 m/s in air, 1400 m/s in water and 6000 m/s in steel). In terms of harm, the noise is the (agent) that can physically threaten the health of the conditions determined by exceeded allowable limits [2].

Noise effects can be:

- Communication disorders in the labor process, the masking effect of the words (sound signals for communication);
- Psycho disorders (psychological and physiological, such as fatigue auditory deafness.

Occupational hearing loss is the most serious form of auditory organ damage generated by high frequencies and intensities of approx. 100 dB, an extended exposure time period [3]. Frequency hearing loss begins at approx. 4000 Hz and then progressing at lower frequencies.

The importance of hearing damage risk is given in Figure 1. I soundstage admissible curve marks for quality work with the appropriate concentration. The area between the I and II correspond to noisy environments but dangerous. The area between the II and III correspond to the risk of hearing loss from exposure to 1/2 hour and increases to 25% risk curve II. The area between the III and IV leads to increased risks of hearing loss of 50-80 %. Curve IV, above, leads to deafness work even in the case of accidental exposure.

Hearing loss caused by noise is the most common occupational disease declared in the European Union, accounting for about a third of occupational diseases. For workplaces where the daily personal exposure to noise above 85 dB (A) or where the maximum value of the unweighted instantaneous sound pressure exceeds 200 Pa, a mark must be provided by panels showing that the wearing of personal protective equipment against noise is compulsory. The panels must be located at the entrance zone and, if necessary, within them.

The maximum normalized (L 90/96 and NGPM 2002) are:

a) maximum permissible jobs daily exposure of 87 dB (A) in accordance with art. 594;
b) maximum (according to art. 596 NGPM/2002) on jobs and psycho-neuro demand increased and special daily exposure are: - Laboratory tests: 75 dB - office: 60dB - Creative Workshop: 50 dB.

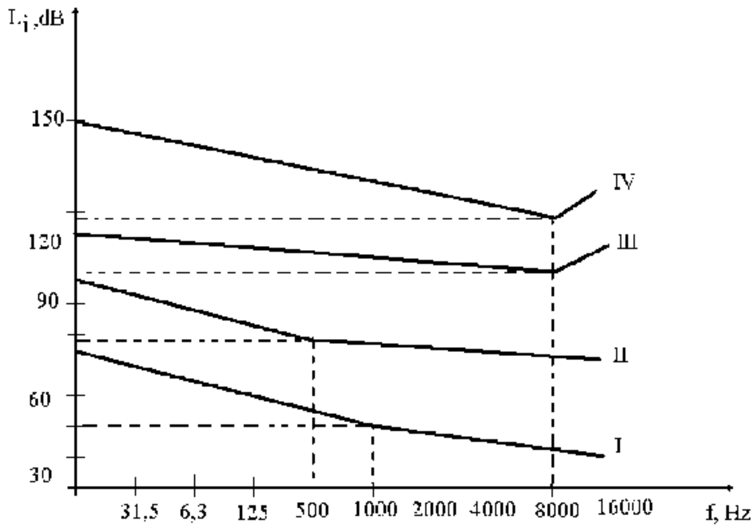

Fig. 1. The risk of hearing damage after Wisner and Javille

Composite Materials Soundproofing

In industry, noise production facilities comes from various equipment, namely, electric engines working bodies executing angular motion, rotation, translation, or compound movements. To create a working environment, studying technical methods to reduce noise: a) measures to combat noise at source - is achieved through design changes made - machinery or by adopting special attenuators devices, the choice of technical equipment under conditions comparable technology, priority will be given to those that produce the least noise; b) measures of noise isolation - is achieved by increasing the resistance of acoustic energy transmission environment, the most widely used solutions consist of the placement of acoustic screens or enclosures sound insulation of technical equipment; c) measures to combat noise at receiver - isolating personnel working in the area of healthy noises, best known solution is to use earplugs and use soundproof booths [4].

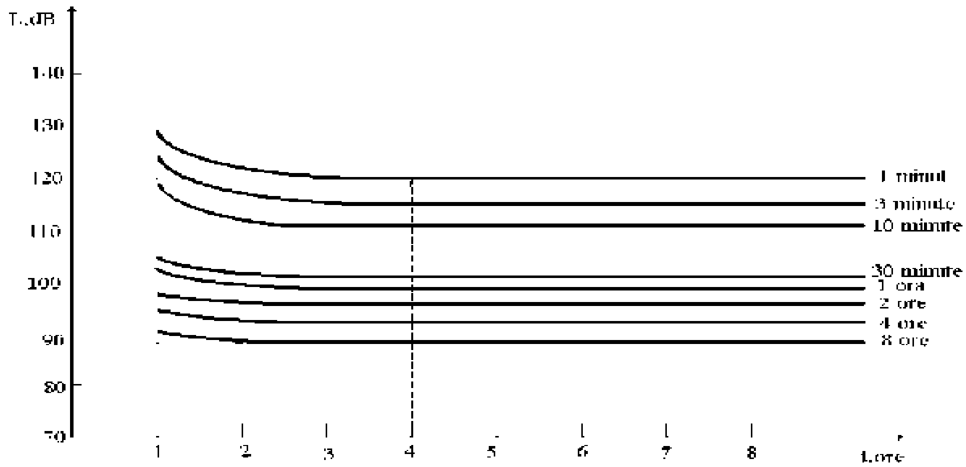

Fig. 2. Representing the harmful effects of noise depending on the duration and intensity of exposure

The goals of reducing the overall noise level can be achieved simultaneously for the entire frequency range, if the type of materials used for sandwich structure (sandwich) comprising at least one layer of porous sound-absorbing features (for medium-frequency noise and high), a layer of high specific weight that have sound-proof properties (low frequency noise), and a layer of vibration damping properties and structural noise.

Table 1. Performance requirements for composite structures [5]

Acoustic Parameter	**Symbol**	**U.M.**	**Frequency [kHz]**	
			0,4-1	1-4
Sound absorption coefficient	□	-	0,05÷0,20	0,20÷0,50
Noise attenuation	□L	dB	10÷20	20÷30

When treating the walls of sound-absorbing sheet and the carcass, the following materials were used:

Table 2. Soundproofing materials that make up the composite and their characteristics [6]

No. crt.	Name	Thickness, mm	Density, g/cm^2
1.	Impregnated textile type double Neterom superheavy	3	0.412
2.	Nonimpregnated textile " Intersin F "	3	0.135
3.	Synthetic leather "Heavy synapses"	1	0.392
4.	Rubber plate type CD x 60	4	1.194
5.	Textile waste Tefose plate type	13	0.168
6.	Polyurethan plate "Spumotin"	4.5	0.029
7.	Latex plate	13	0.13
8.	Cork macrocomposites	3	1.200
9.	Open-cell foam + film Al + ply	15	4.500
10.	High density PVC	1	1.400
11.	Low density PES foam with open pores	5	1.500

To characterize the properties of sound absorbing materials, it is necessary to specify quantitatively the degree of transmission of acoustic waves on the surface separating the two media and sound absorption [7, 8].

Acoustic reflection coefficient "r" is defined by the ratio of the flow of acoustic energy waves reflected sound wave energy flux incident on the separation surface between the two media.

Sound transmission coefficient T is defined by the ratio of the flow of acoustic energy waves transmitted and the energy flow of the acoustic waves incident on the separation surface between the two media.

Sound absorption coefficient occurs if the area of separation of the two media there is a dissipation of acoustic energy, when the amount of energy not absorbed is reflected is considered.

$$\alpha_i = 1 - \frac{\Phi_r}{\Phi_i} \tag{1}$$

where Φ_r – reflected acoustic energy flux; Φ_i – incident energy flux;

$$\alpha_{med} = \frac{\sum \alpha_i S_i}{\sum S_i} \tag{2}$$

Sound absorption equivalent area can be calculated by the relationship:

$$A = \sum_{i=1}^{n} \alpha_i S_i \tag{3}$$

where: S_i represents the area with / without sound-absorbing treatment i;

α_i - sound absorption coefficient of the surface S_i.

Reduce overall noise ΔL calculated with:

$$\Delta L = 10\,lg \frac{A}{A_0} \tag{4}$$

where: A is the equivalent sound absorption area after treatment acoustic;

A_0 - equivalent sound absorption area without acoustic treatment.

Sound absorption occurs within the area where noise can be characterized and constant absorption:

$$R = \frac{\alpha_m \cdot S}{1 - \alpha_m} \tag{5}$$

Parametric characterization and comparative analysis was made by assessing and analysis of the following parameters: one that indicates the overall noise reduction ΔL The average sound absorption coefficient α_{med} and absorption constant R.

Table 3. Summary of experimental data

No layers	Frequent [Hz]	250	500	1000	1600	2500
1 layer	ΔL	0.000	0.882	3.713	2.958	4.357
	α_{med}	0.061	0.075	0.144	0.121	0.167
	R	0.667	0.829	1.720	1.408	2.050
2 layers	ΔL	0.400	2.242	4.111	6.631	8.980
	α_{med}	0.038	0.103	0.158	0.283	0.485
	R	0.407	1.169	1.916	4.017	9.617
3 layers	ΔL	0.710	3.982	6.487	8.216	8.939
	α_{med}	0.052	0.154	0.273	0.407	0.481
	R	0.561	1.850	3.837	7	9.441
4 layers	ΔL	0.610	5.318	8.066	8.455	8.637
	α_{med}	0.071	0.209	0.393	0.430	0.448
	R	0.775	2.692	6.608	7.695	8.293

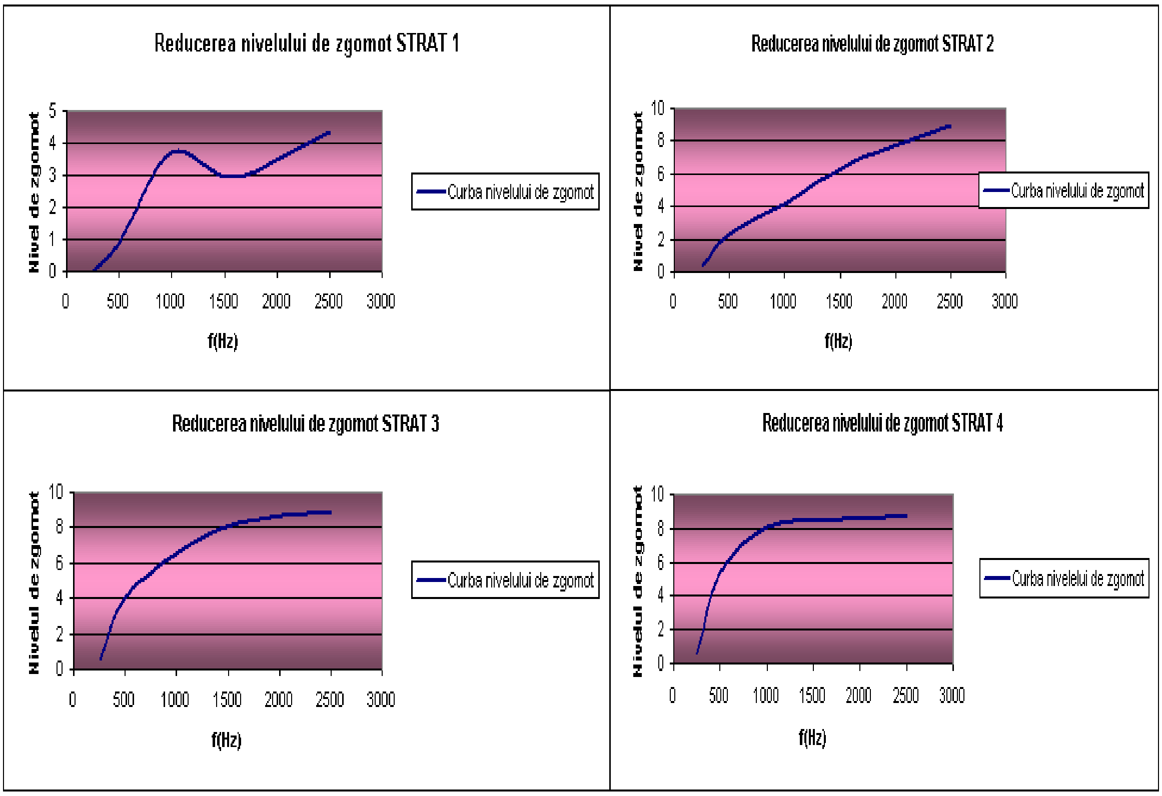

Fig. 3. Representing curves to reduce the noise level, the number of layers and frequency noise

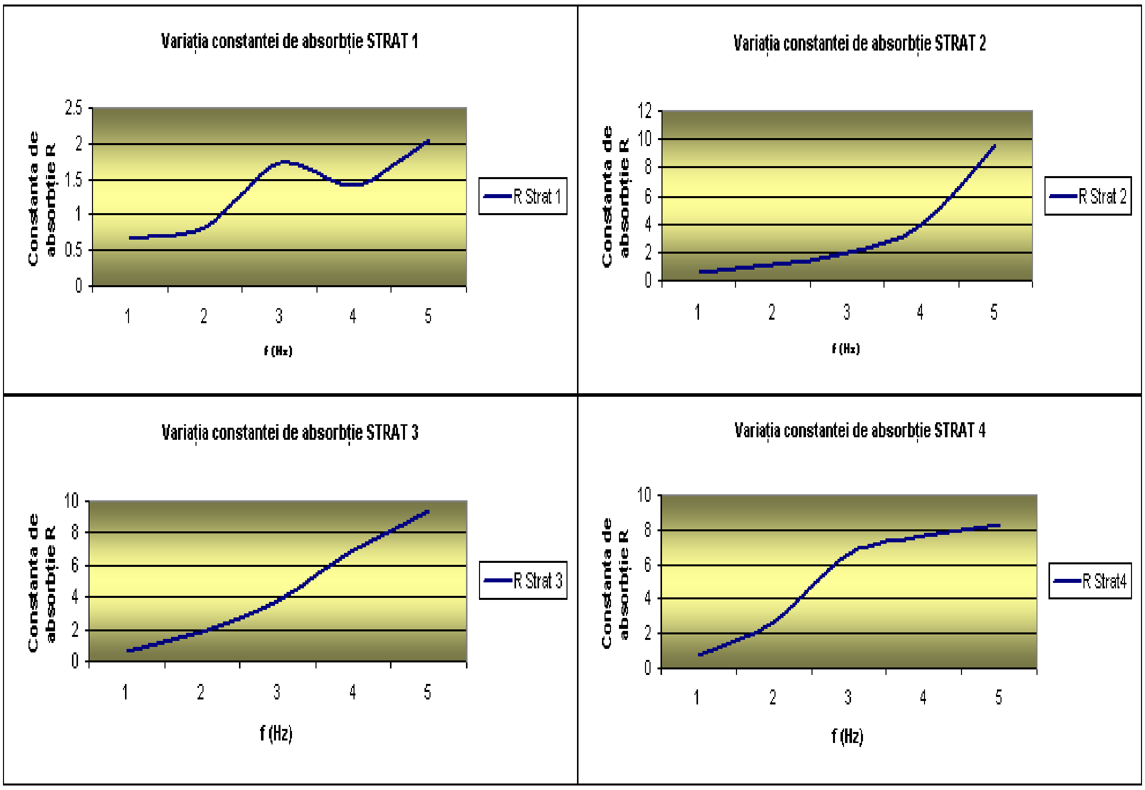

Fig. 4. Changes in the constant absorption frequency and the number of layers

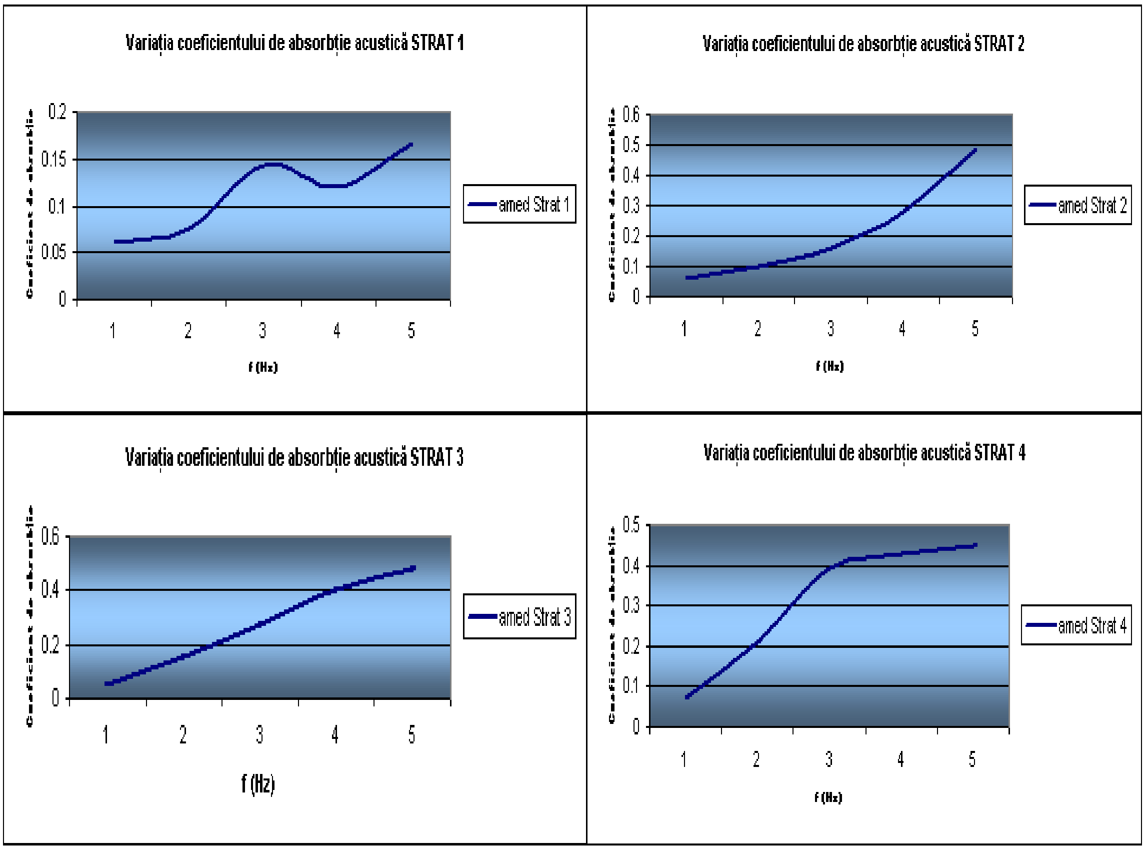

Fig. 5. The variation coefficient of sound absorption frequency, and the number of layers Variaţia coeficientului de absorbţie acustică, funcţie de frecvenţă şi numărul de straturi

Conclusions

With increasing number of layers soundproofing, insulation increases efficiency and sound absorption coefficient increases for the entire audible frequency range. This is supported both qualitative evolution, as well as quantitative, key parameters monitored. But there is a direct relationship between the values obtained and the frequency considered. Materials based on natural cork or cork macro-composites have good damping properties of structural noise. Absorption coefficient values, it can be appreciated that materials with high specific gravity (i.e. PVC) have good sound absorption at medium frequencies and material type foam cell structure with interconnecting spaces (low density polyurethane foam, polyester foam) are very good at absorbing high frequency noise. For high frequency noise ($f \geq 2000Hz$) ratio is significantly (up to 0.95) for all types of composite materials.

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Materiale compozite fonoabsorbante cu conținut textil

Rezumat

Poluarea, în toate formele sale, este peste tot în din jurul nostru, ne sufocă. De aceea este absolut necesar să luăm o poziție în lupta împotriva zgomotului. Sunt studiate mai multe variante de material compozit care conţine materiale absorbante, chiar şi deşeuri textile. Eficienţa de absorbție a zgomotului creşte odată cu grosimea mai mare a materialului - când numărul de straturi creşte. Materialele cu greutate specifică mare au proprietăți bune de absorbţie a sunetului MF şi cele cu structura de tip spumă cu spații de comunicare între celule, sunt foarte bune la absorbția zgomotelor de înaltă frecvență.