



Tournament of Young Naturalists

Problem №6 «Soundproofing»

Reporter: Bobrov Ilya

Task:

Sometimes it is necessary to reduce unwanted noise in a confined space. Try different ways to soundproof your room.

Goal: find an acceptable and effective way to soundproof a room

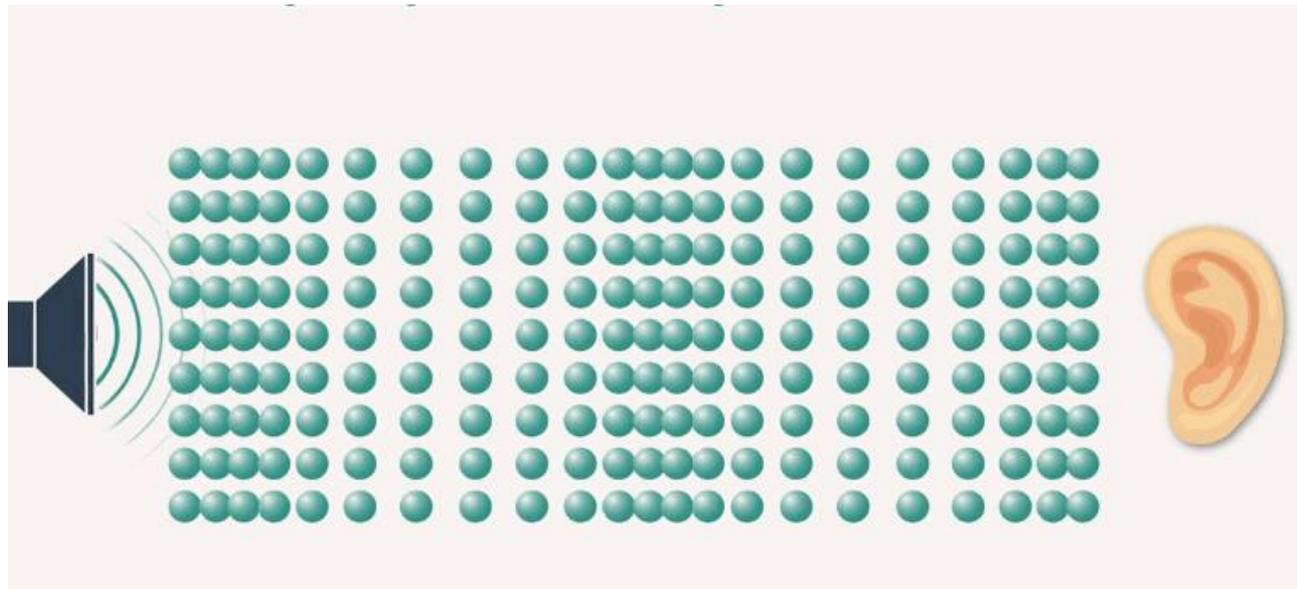
Tasks:

- 1. To study the physical nature of noise and the relevance of the problem of its reduction**
- 2. Create a room model for the experiment**
- 3. Assemble a stand for an experiment**
- 4. Carry out noise reduction measurements with various designs**

Sound is the vibration of particles of a medium perceived by the hearing organs.

The oscillating surface of the sound source causes changes in the pressure (density) of the surrounding air, propagating in all directions in the form of alternating areas of high and low pressure, called sound waves.

Upon reaching the ear, sound waves cause mechanical vibrations in the auricle, which are then converted into electrical signals of the nervous system and transmitted to the brain, interpreting them as sounds.

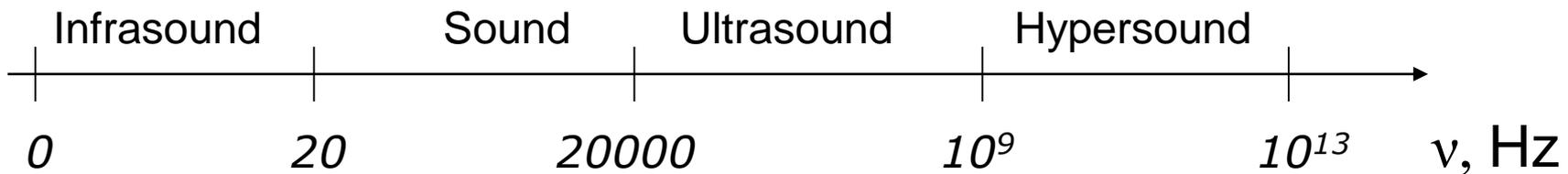


Sound characteristics

- The main characteristics of sound are volume and pitch.
- The volume mainly depends on the amplitude of the oscillations, and the height on the frequency.

Sound scale

- Infrasound
 - Sound
 - Ultrasound
 - Hypersound
- 0,001 – 20 Hz
 - 20 – 20 000 Hz
 - 20 000 – 10^9 Hz
 - 10^9 – 10^{13} Hz



Methods of struggle

- **Noise reduction at the source of its occurrence**
- **Sound absorption (use of materials from mineral felt, glass wool, foam rubber, etc.).**
- **Soundproofing. Soundproof structures are made of dense material (metal, wood, plastic).**
- **Installing silencers.**
- **Green spaces (reduce noise by 10 - 15 dB).**
- **Personal protective equipment (earbuds, headphones, helmets).**
-

Material Properties

- Sound-absorbing materials have a fibrous, granular or cellular structure and have varying degrees of stiffness.
- The angle of reflection of sound also affects the coefficient of sound absorption

Methods of struggle

- Shielding - installation of the screen, as a result of which a significant part of the noise is reflected back. (In our case, the screen is a wall)
- Sound absorption is a method that is used from the inside. The walls are lined with sound-absorbing material.

For wall cladding, I used egg boxes. They consist of pressed paper which has a fibrous structure. Also thanks to the fact that the box has a mesh building area sound falls surface more, which means higher sound absorption

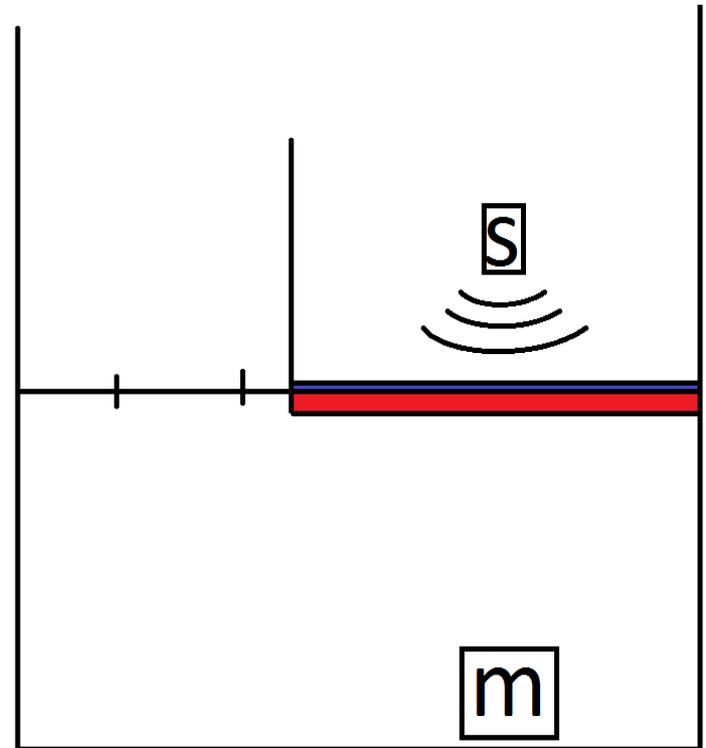


Experimental setup

- As a sound source, speakers connected to the phone were used. Measurements were taken for pure tones.
- - clear sound (tone) is the oscillation of one frequency.

- The receiver was a microphone connected to a laptop..
- The microphone converts sound vibrations into electrical vibrations, which are recorded by the sound card of the laptop and displayed on the screen in graphical form and numerical (average effective voltage value)

Experimental setup

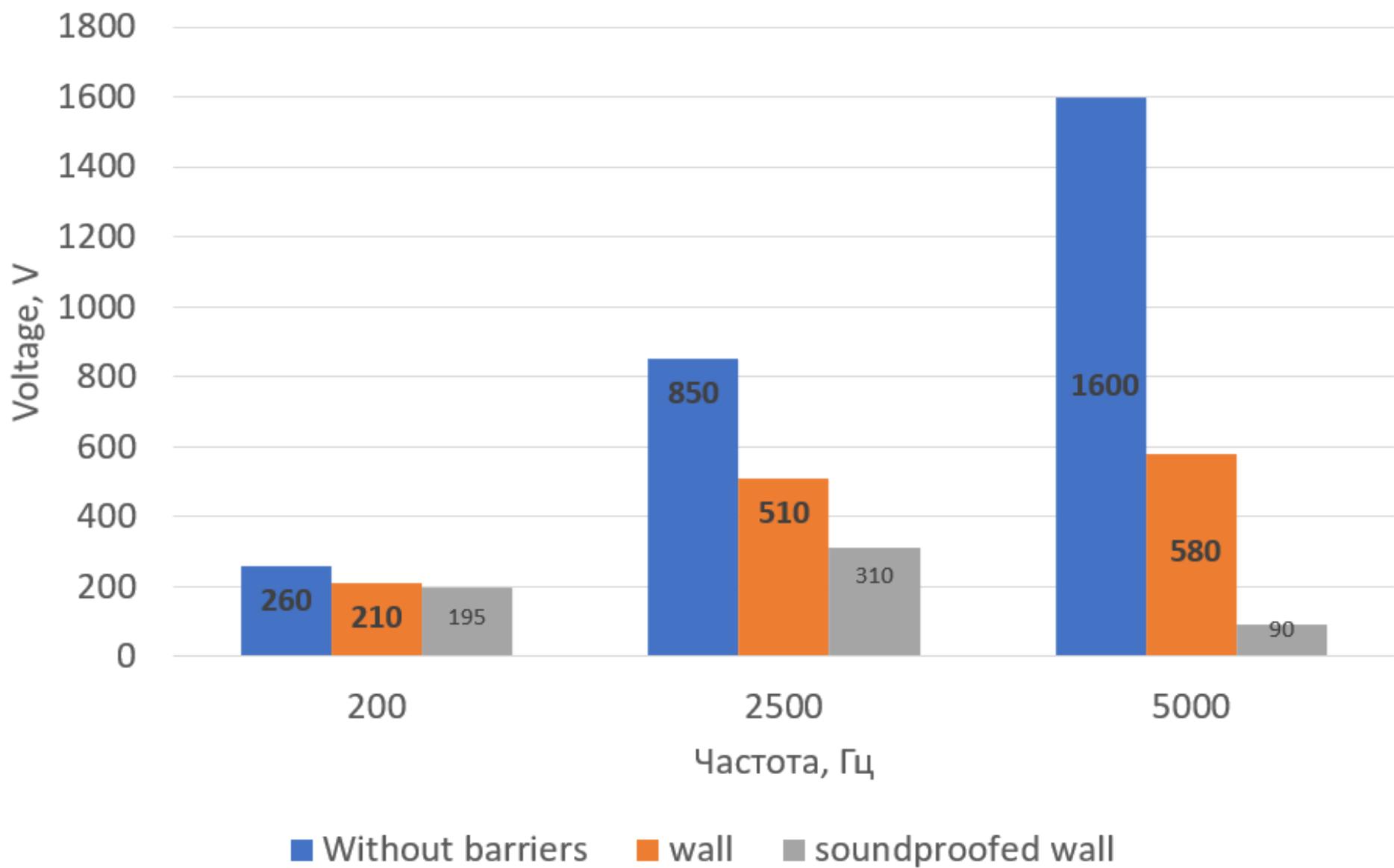


Experimental setup



Sound levels (in mV) depending on the sound source and obstacle

Frequency	U_0 mB (Without barriers)	U_1 mB (wall)	U_2 mB (soundproofed wall)
200 Гц	260	210	195
2500 Гц	850	510	310
5000 Гц	1600	580	190



Noise Reduction Rating

Volume is a subjective characteristic, as it depends not only on sound pressure (vibration amplitude), but also on

- sound frequency composition
- forms of sound vibrations
- conditions in which the listener is
- the time during which he listens to the sound

Noise Reduction Rating

- It is convenient to use non-linear units, decibels, to estimate the level of noise reduction..
- To express the value in decibels, we use the formula:

Materials and constructions are considered sound-absorbing if coffee.

Above 0.2

$$A=20*\lg(U/ U_0)$$

Noise Reduction Rating

Frequency	Without sound insulation, dB	Without sound insulation, dB	% how quieter it became
200 Hz	-1.86	-2.5	25,6%
2500 Hz	-4.44	-8.76	49,32%
5000 Hz	-8.81	-18.5	52,39%

Conclusion:

The design is lined with boxes of eggs can be considered sound-absorbing because coffee. Sound absorption 0.2 and more.

Low sound is absorbed worse than high.

Low frequency sound 25.6%, Medium frequency sound 49.32%, High frequency sound 52.39%
< I assume that if the installation was improved, it would be possible to achieve a result of + 2-5%. By taking the box without recesses on the side, as well as fixing them in another way.

Thanks for your attention!