

## Infrasound hazards for the environment and the ways of protection

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### Abstract:

The aim of this work is to clarify the effects of infrasound on the environment and its sources. The article describes infrasound characteristics; the differences of the audible range of sounds and different effects on the environment are indicated. The paper identifies the potential and existing infrasound sources researched, their characteristics and the reduction potential of their impact on the environment.

**Key words:** Infrasound, impact on the environment, the ways of reduction

### Introduction

The impact of infrasound on the individual and other environmental organisms has been studied insufficiently, but in most cases it is negative. It is identified that some low-frequency sounds or infrasound are of negative action: sound at the frequency of 37 Hz causes cardiac, pulmonary and stomach disorders; due to frequently heard 16 Hz frequency the activity of the stomach gets disturbed. It is notable that we can feel very low and high sounds, beyond the limit of hearing, with all the body, like mechanical vibrations, heat and the like. Sounds, with the frequency lower than 16 Hz, are harmful to the individual, causing the unjustified fear, anxiety, fatigue, “sea” disease symptoms, and may be harmful to eyesight and become the cause of the serious health disorders. Especially dangerous is infrasound at the frequency of 7 Hz, since this sound, generating frequencies, close to characteristic frequencies of the organs of our body, may disturb the heart or brain activity.

Machines, natural sources storms, earthquakes, hurricanes, etc. generate infrasound. While going by car at the speed of 100 km per hour, the strong inaudible sound at the frequency of 16 Hz is generated. Therefore, it is possible to state that long travels are very tiring. It is difficult to hide away from some infrasound properties, since according to its wave structure it has the quality to go round the occurring barriers and propagates far away. In this paper we shall study certain aspects of infrasound effects and possible measures for its reduction.

### Impact of infrasound

**Fauna.** Animals, while sensing infrasound better than the individual, start behaving anxiously before an earthquake. A phenomenon of a “sea voice” is known; it induces infrasound and has a negative effect on the environment. This phenomenon is caused by the wind blowing above the crests of sea waves. The consequences of this phenomenon we find when clarifying the wreck of a good number of ships in the sea, since they become

clarified after some or several years with the members of the crew who died due to unknown reasons. Due to the above mentioned properties of infrasound, many animals sense the approaching storm earlier than the storm itself approaches.

Animals feel the manifestations of infrasound in advance, approximately 10-15 hours before the storm. It is possible to judge about this from the following observation of scientists:

- jelly-fish hurries to hide deeper;
- dolphins sail behind the rocks;
- whales put out to the open sea;
- penguins lie down on the snow, flattened to the earth.

**Impact of infrasound on the individual.** Infrasound affects people biologically, when its frequency (7-8 Hz) coincides with the alpha rhythms of the brain (flows of certain frequency). The frequency of sounds of 18-19 Hz coincides with the resonance frequency of eyes; therefore it may cause optical illusions. This may be very dangerous when driving the means of transport and the like.

When conducting research of the impact of infrasound on the environment, it was established that infrasound waves may cause the feeling of fear and anxiety. Infrasound of 120 dB (and stronger) is very dangerous to the human organism; in addition, infrasound waves may ruin or damage the constructions of buildings. At the present moment, the infrasound weapon of mass destruction has been created, the operation of which is based on the inducement and use of powerful infrasound vibrations (frequency of 16 Hz). Infrasound waves affect the central nervous and digestive system, cause pain of the head and internal organs, and interfere with the rhythm of respiration. Giddiness, vomiting, loss of consciousness, and blindness may become manifest. Infrasound also has an effect on human consciousness (the individual fails to control his actions), arouses the feeling of horror, which sometimes is the cause of death. Table 1, on the basis of research of scientists, shows the impact of infrasound of certain intensity on the individuals.

Table 1. Degree and volume of the impact of the intensity of infrasound

Degree of infrasound impact	Infrasound power level(dB)	Infrasound impact
I (fatal)	>185	Pulmonary alveoli get ruptured
II	140 - 172	The individual may endure 2 min.
III	120 - 145	The reaction time becomes longer, it is difficult for him to concentrate
IV	< 120	The individual feels fatigue more quickly, sea sickness signs appear

### Infrasound sources and the problem of reduction of their propagated noise.

Reduction of sound power level of the sources, emitting the low-frequency sound (infrasound), is a complicated process, depending on many factors, and sometimes is even impossible (natural phenomena). Therefore, to reduce the impact of infrasound on human beings and environment by already known methods is a complicated process. This may be explained by the fact that infrasound waves are very long (from 20 to 300 metres) and the energy generated by sounds dies out weakly with the distance. In addition, waves of those sounds propagate spherically and rather far away; low-frequency sound may propagate in big spaces.

If we start raising the problem from the closest, surrounding us infrasound sources, primarily, we will mention the sources which surround us in the living environment (nature). When a storm strikes, we hear the howling of wind, the rustling of tree leaves and sea waves (see Fig. 1, 2, 3 and 4). However, those sources contain also inaudible sounds (infrasound), which, together with the audible sound, propagate in the surrounding environment and fauna. Those sounds have a different effect comparing to audible sounds.



Fig. 1. The sound source – wind



Fig. 3. The sound of earthquakes



Fig. 2. The sound of thunder (lightning)



Fig.4. The rustling of sea waves

**Infrasound in the production environment.** In the production environment, in workplaces and around them we hear sounds, e.g. from metal in the metal processing smitheries, where the workers experience unpleasant feelings – nausea, sickness.

In the different spheres of production, the compressed air is used and for their generation air compressors are employed. Air compressors, depending on their construction, together with vibrations radiate low-frequency noise and vibrations, which regenerate infrasound.

Just because of this, it is necessary to study properly, to evaluate and carry out an analysis of the sounds (infrasound) from the low-frequency sources. Here two moments are of a special importance. Firstly, to clarify the reasons for emergence of vibrations and sounds, and, secondly, the distribution of those parameters while propagating into the environment (the surrounding space). Such and similar questions and factors requiring the solution are quite numerous.

Acoustical scientists of the world focus a considerable attention to infrasound and are concerned with its consequences, but it should be noted that today (already in the 21<sup>st</sup> century) manufacturers and constructors allocate inconsiderable attention to those issues. For that purpose, it is necessary to draw attention of the management of the local authorities and of health care institutions.

It is not enough to develop the norms of hygiene, whereby the permissible limits of infrasound are defined. Here, there is also no adequate evaluation, in the indicated norms, the impact of sound frequency and intensity on separate groups of people and in the exclusive cases, e.g., at the interval of frequencies from 8 to 16 Hz, there are frequencies of separate tones, constituted separately, the impact of which becomes manifest at the considerably lower level of sound force. When going deeper to this problem, quite a number of questions and uncertainties arise, which are not based on scientific research. It is necessary to speed up the research concerning the impact of infrasound on human health and environment and to foresee in parallel the measures for their reduction.

**The ways of noise and infrasound reduction.** It is possible from the commonly known measures for noise reduction to develop the measures for reduction of low frequency (infrasound) sound. We have been studying for many years the ways of low-frequency noise reduction by means of screens, possessing special elements [1, 2, 3]. One of such improved screens is shown in Fig. 5.

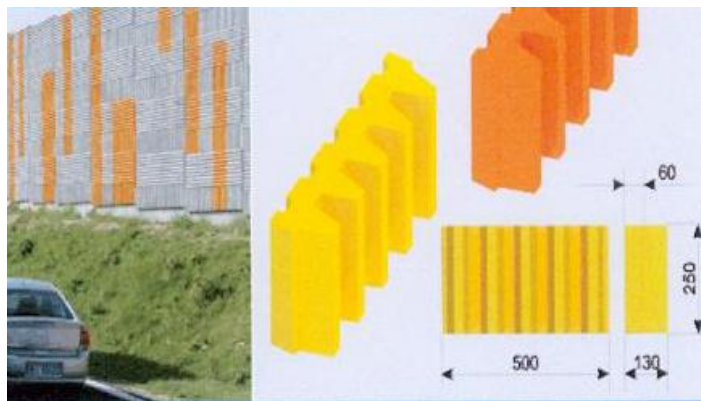


Fig. 5. The complicated screen with special elements

This screen may be used for infrasound reduction, after calculating the parameters of the elements attached. Those elements are located in the front part, facing the wave of the propagating sound. In order to calculate those elements at a certain interval of frequencies, it is necessary to have the precise information on the parameters of that sound. Therefore, in any case, when designing the sound screens, we must possess the information about the sound (the characteristics) of the sound we would like to reduce. Sound-level reduction by screens depends on the materials used, on their sound absorption coefficient, on the density of materials, on the height, length and distance of the barrier to the noise source. With the use of our methods developed [1, 2, 3], we may calculate the parameters of screen elements and select the materials, from which those screens and their elements should be manufactured.

**Individual measures against noise.** In case no opportunities exist to reduce noise by constructional and technical means to the noise level permissible by the hygiene norms, it is necessary to use the individual noise-reducing means. As an example, we shall indicate the individual noise reducing means of two purposes:

- The individual headphones for professional musicians

Those means of individual protection are manufactured with the use of the most sophisticated technologies, and the efficiency of noise reduction is studied.



Fig. 6. Headphones used by musicians

Using such headphones any outside sound does not penetrate into the ear, does not irritate the ear and does not harm it.

- Another purpose of the application of individual means is in the sphere of production, at workplaces (see Fig 7)

Such headphones are commonly used by the drivers, excavatormen, tractor-drivers, crane attendants and other staff working in similar working conditions. The indicated types of headphones reduce the sound level and duration, combining their impact with other means of protection.



Fig. 7. Headphones for noise reduction at production workplaces.

## Conclusions

1. While studying low-frequency sounds, which are propagate from various sources, it was established that audible low-frequency sound is accompanied by infrasound with various frequency intervals within the limits from 1 – 20 Hz.

2. It was established that infrasound while propagating in the environment has a negative impact not only on the individuals, but also on the fauna.

3. For infrasound reduction, the already known noise reduction means are good for sound reduction, but those means should be calculated according to infrasound characteristics.

## References

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## Infragarso kenksmingumas aplinkai ir apsisaugojimo būdai

### Reziumė

Darbo tikslas - nustatyti infragarso poveikį aplinkai ir jo šaltinius. Straipsnyje apibūdintos infragarso savybės, nurodyti jo skirtumai nuo girdimo diapazono garsų ir skirtingas poveikis aplinkai. Įvardyti galimi, esami ir tiriami infragarso šaltiniai, jų charakteristikos ir poveikio aplinkai mažinimo galimybės.

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