ON REVELATION OF ZONES OF INFRASOUND HARMFUL EFFECT ON MAN ORGANISM IN CONDITIONS OF ACTIVE INDUSTRY

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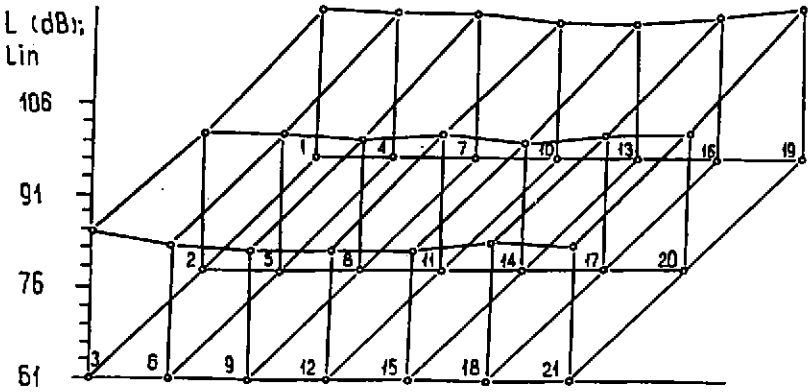
Atmospheric phenomena and active industry are known [1,2] to be accompanied by noise of low frequencies. In certain cases the noise is revealed [1] to have a harmful effect. It decreases a capacity for work, leads to irritation and tiredness. By means of a series of laboratory investigations we found out that in apartments and industrial premises there exist zones wherein the organism response usually regarded as unfavorable is observed, and zones of more comfortable stay [3,4]. Such a different reaction observed in the same premises is found out to depend on organism contact with spatial distribution of sound field energetic parameters [5].

While the experiments the workers of a big shop have been disposed regularly. Only part of them have complained that they had felt bad or the conditions had been discomfort able. All the complaints have come from those workers occupying the certain places, and disappeared after the place had been changed.

The measurements of low frequency noise were carried out in this shop with a regular spatial noise distribution in dB Lin. This distribution Fig.1 is obvious to be quite regular in space. Here it should be outlined that it is impossible to mark out the domains of harmful noise action within the consideration of only the sound pressure level effect on man. Just the opposite, all the worker of the shop are situated in the same noise conditions and expected to feel the same.



For to find out the active zones in active industry we chose the radiocomponents production shop. The job in the shop may be considered as monotonous intensive labour of mean intensity.

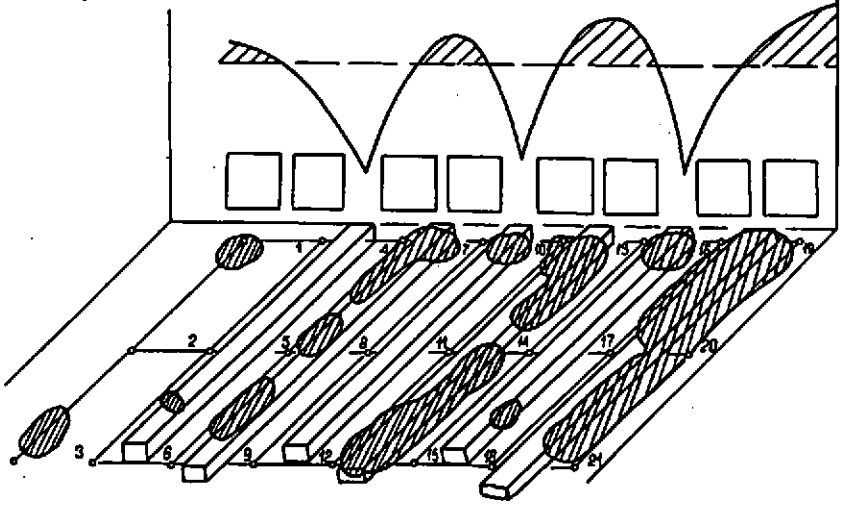
Analogy ously to the laboratory experiments we have

searched the active zones in the shop by means of blood vessel model [BVM]. This model permits to reveal the forced vibrations of blood vessel walls, synchronous to forcing infrasound vibrations.

A piece of elastic tube of 200 mm length and 4 mm diameter was used as BVM. The tube was cut into two equal parts, which were joined by glass U-tube of 20 mm length and 4 mm internal diameter. Two needle - shaped electrodes of stainless still were led in the glass tube towards its bend. The distance between the free ends of electrodes had to be 5-6 mm. The system was filled with physiological solution. The ends of tubes were clutched. The tube walls vibrations were registered by conductometric method.Reograph registered mainly the blood vessel section changes or blood velocity in it.

To transform the changes of pressure in a practically incompressible electrolyte into its velocity, a bubble was put into the space, between the electrodes. The bubble should have less than one third of the tube diameter and not touch the electrodes.

Moreover, the phsychophysiological experiments on determination of capacity for work in an hour after the work began and in an hour after the break finished have been carried out by means of the above - mentioned laboratory methods. The level of the capacity for work was determined by measuring of quasistationary potential between eminence of the first finger of palm (passive electrode) and the middle of forehead (active electrode). The ionometer with 20 MOM inlet resistance was used as a millivoltmeter. The measurements have been carried out three times, the workers staff has been changed partially. 93 persons took part in the experiment. Herein Fig.2. shows the scheme of the shop points of sound pressure measurements and the lines of tables with workers sitting face-to-face are drawn. Closed curve mark the zones with BVM reaction, i.e. only in these zones we have observed the signal of large amplitude from the millivoltmeter outlet.



All workers of the shop were examined on the level of capacity for work. The zones of this level decreasing are shaden. It is clear from Fig.2 that zones of BVM reaction and capacity for work decreasing coincide often.

Exactly these zones revealed from two experiments we call active noise zones. Preliminary evaluation of measurements results yields nearly 30 percents of the whole shop area being active zones.

The active zones are seen to have a spatial period. An approximate function with maxima coinciding with active zones has four maxima and three minima in the shop. It is not difficult to calculate that, as the distance between the opposite walls is 58 m, such an alternation corresponds to the standing infrasound wave of 12 Hz frequency.

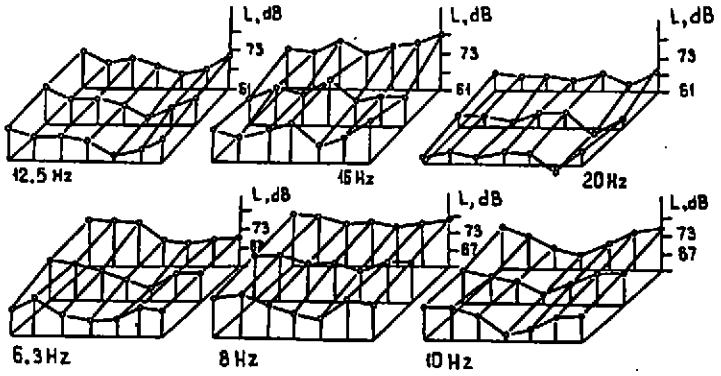
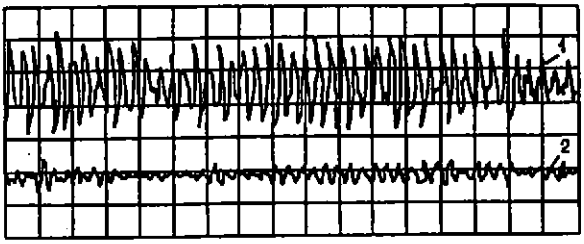


Fig.3 presents the spatial distribution of low frequency noise in 1/3 octave band in 6,3-20 Hz range. Analysis of these dependence yields existence of significant spatial inhomogeneity of noise field in the shop at different frequencies. Data from Fig.3 permit to suppose a frequency fastidiousness of a man organism perception on harmful noise effect. Thus the following conclusion is logical: the workers located in maxima of the pressure interference at 10-12 Hz are exposed to active noise effect, i.e. they are situated in active noise zones. The maximum of pressure is characterized from the acoustical point of view to have reactive intensity vector directed at it.



As BVM may be used as a sensing element for biologically active zone, we made an attempt of other shops and offices diagnosis. Fig.4 illustrates the outlet signals of BVM in two points of one premise: over the table of the plant director and in the opposite corner-over the council table. The Difference of reaction is obvious and it testifies to the active zone location where the director's table is situated.

From the above-said it follows that the sound pressure level cannot be the only criterium for determination of permissible level of low frequency acoustical noises. It is necessary to take into account the existence of biologically active zones where under the other equal conditions, the workers feel phsychoemotional discomfort and changes in blood vessel system. We believe our experiments in laboratory and shop are quite clear to demonstrate this.

By introduction of the notion of active noise zone in industry we offered the experimentally substantiated and quite unexpensive method of defense against infrasound. Certain sectors of industry must be functionally rearranged: put stores, shelves and other objects, which do not need permanent serving staff, into the active zone and planing the staff location outside these zones.

1.W.Tempest. Infrasound and Low Frequency Vibration. Academicpress 1976.

2.A.N.Ivannikov, S.V.Makeev, V.I.Pavlov. Experimental studies of the low frequency atmosphere acoustical noise above the ocean surface. Acad. Sci. USSR, Atmos. and Ocean Phys. (USA) 1991, v.27(4), p.97-107.

3.B.J.Fraiman, A.N.Ivannikov, A.N.Zhukov. On the influence of infranoise fields on humans. 6-th International Meting on Low Frequency noise and Vibration, Leiden 4-6 sept.1991,p.49-56.

4.A.N.Zhukov, A.N.Ivannikov, V.I.Pavlov, B.J.Fraiman. Infranoise in closed volumes, Fortschritte der Akustik, DAGA-91, Teil A, s.385-388.

5.A.N.Zhukov, A.N.Ivannikov, D.I.Kravchenko, V.I.Pavlov. Distinctive feature of energy fine structure of a sound field, Sov. Phys. Acoust.1989, 35(4), p.367-369.