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EVALUATION OF INTEGRAL EXPOSURE ENERGY LOAD ON AURAL ANALYZER OF MINERS

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Translation of "Otsenka integral'noy ekspozitsionnoy energeticheskoy nagruzki na slukhovoy analizator u gornorabochikh", Vrachebnoye Delo, No. 2, 1974, pp. 44-45

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16. Abstract

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EVALUATION OF INTEGRAL EXPOSURE ENERGY LOAD ON AURAL ANALYZER OF MINERS

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The currently available methods do not make it possible to evaluate /44* the quantitative total noise load on each worker exposed to the effect of noise for individual time intervals and for the entire period of work for the occupation. Numerous studies have asserted that the degree of pronounced nature of occupational impairment in hearing and periods of its development depend mainly on the level of the influencing noise and time of its exposure. L. N. Shkarinov has come to the conclusion that the degree of harmfulness of noises depends on the magnitude of the influencing energy, and it is expedient to take as the main index of adverse effect of noise the magnitude of equivalent level that is equivalent to the influencing energy of stimulant.

Taking into consideration the cumulative ability of the damaging effect from the influence of the noise factor many authors propose evaluating the noise load with regard for exposure (A. P. Pronin; Schmidek et al.; Kryter et al.).

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*Numbers in margin indicate pagination in original foreign text.

The task of this work was to attempt to evaluate the individual exposure integral noise load on workers before the beginning of occupational illness, i.e., the development of impairment in hearing.

For observation a group was selected of 20 male miners whose age at the moment of illness was from 30 to 50. The occupational length of service by the beginning of illness in 7 workers was from 8 to 15 years, in 13--from 16 to 20 years. All the workers during the production length of service worked with drilling equipment and harvesters.

For retrospective evaluation of the total noise load before the moment of establishment of diagnosis of occupational disease in the workers the occupational anamnesis was revealed (period of work under conditions of noise, types of equipment generating noise, use of resources of individual protection from noise). The date of establishment of the diagnosis of occupational cochlear neuritis was set according to medical charts. The parameters of noise from equipment were measured with the help of a number 2203 instrument with set of octave filters number 1613 of the firm "Bryul' and K"yer." Data on the effectiveness of noise suppression of the resources for protection of the aural organs (FPP-III) were taken into consideration as corrections for the noise levels from the equipment. As a result spectral curves were constructed for the noise level for all types of equipment and the limit spectra and noise levels in db A were defined.

The exposure time of noise during the service life was defined by the calculation method, based on multiple-year data of time metering observations of the enterprises. The total monthly exposure of noise for the tunnelers

of the given enterprise is roughly 100 hours.

The summary exposure energy load during the occupational length of service was computed according to the following formula:

$$E_{\Sigma}^{w} = E_0 10^{\frac{s}{10}} \tau,$$

where E_0--threshold of perception of sonic energy equal to $10^{-12} w/m^2$; s--intensity of noise (in db); τ--exposure time of noise (in hours).

In order to evaluate the state of the aural analyzer with the help of the clinical audiometer MA-30 tonal threshold audiometry was carried out, and then the increase in tonal threshold was determined at frequency 500, 1000 and 2000 Hz (average speech range).

According to the cited formula a computation was made of the total exposure energy load during the entire occupational length of service until establishment of the diagnosis of occupational cochlear neuritis for each tunneler.

The distribution of patients according to the obtained load, as well as depending on the occupational length of service is presented in table 1, from which it is apparent that in the examined group of workers with the greatest length of service the maximum amount of total exposure energy load by the beginning of illness is about 6 kw x h/m^2. Here in 75% of the workers it does not exceed 4 kw x h/m^2 (on the average comprising 3.1 ± 0.5 kw x h/m^2).

TABLE 1. DISTRIBUTION OF PATIENTS ACCORDING TO TOTAL ENERGY NOISE LOAD AND OCCUPATIONAL LENGTH OF SERVICE (BY BEGINNING OF ILLNESS)

Summary energy load (in kw x h/m^2)	Length of Service (in years)			Total	
	5-10	11-15	16-20	Number of Observation	%
Up to 2	3	1	3	7	35
2, 1-4	-	3	5	8	40
4, 1-6	-	-	5	5	25
Total: Number of observations	3	4	13	20	
%	15	20	65		100

In workers with a long production length of service (16-20 years) the levels of summary energy loads varied in broad limits (from minimum amounts to 6 kw x h/m^2).

The shifts in the aural thresholds for the average-speech range measured at the moment of examination were compared with the corresponding calculated amounts of noise energy load also for the period of examination. The data presented in table 2 demonstrate that in the main mass of patients with integral noise load up to 6 kw x h/m^2 the increase in tonal threshold at the mean-speech frequencies was in limits 11-30 db, which corresponds to cochlear /45 neuritis with light and average degree of decrease in hearing. Based on table 2 a theoretical-informational coefficient was computed which was fairly high (r=0.77), which indicates the significant functional relationship between these indices.

TABLE 2. DISTRIBUTION OF PATIENTS ACCORDING TO TOTAL ENERGY LOAD AND INCREASE IN TONAL THRESHOLD IN AVERAGE SPEECH RANGE (FOR PERIOD OF EXAMINATION)

Total energy load (in kw x h/m^2)	Increase in Tonal Threshold (in db)			
	11-20	21-30	31-40	41-50
0-2	4	2	-	1
2, 1-4	4	3	-	-
4, 1-6	1	2	-	-
>6, 1	1	1	1	-
Total:				
Number of observations	10	8	1	1
%	50	40	5	5

Based on the available data the average monthly load was computed that comprises 16.5±2.1 w x h/m^2 (with computed standard 0.05 w x h/m^2), the mean daily load—about 0.8 w x h/m^2 (with computed standard 0.003 w x h/m^2).

Guided by the formula given above the technique for computing the equivalent noise level with the use of the concept of the time level, based on the average daily energy load a determination was made of the equivalent energy level equal to 99 db A, which exceeds the level permitted by the active norms (85 db A).

The data obtained as a result of the conducted work are preliminary. They make it possible to compile an idea on the order of magnitude of the total exposure energy load on the aural analyzer of miners with long length of service for the time that has passed from the beginning of work in the mine to the appearance of the occupational injury to the auditory organ.

Conclusions

1. The total exposure energy noise load of about 4 kw x h/m^2 obtained by miners in the examined group, on the average with a 15-year period of work, in 75% of the observations resulted in occupational injury to the auditory organ (cochlear neuritis).

2. The equivalent energy level of noise computed according to the data of total energy load for the examined group of tunnelers is roughly 99 db A, which significantly exceeds the permissible amount of 85 db A.

3. Between the integral exposure energy noise load on the aural analyzer in the degree of increase in the tonal threshold for the mean-speech range there is a correlation (r=0.77).

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