SCIENTIFIC FOUNDATIONS OF OCCUPATIONAL SAFETY IN THE TEXTILE INDUSTRY

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Abstract*. Occupational safety activities should be planned on the basis of management theory, which uses a systematic approach to develop goals, criteria, methods and controls. The methodology of the systems approach allows us to reveal the internal connections of the process being studied and determine the main management functions.*

For optimal planning of occupational safety measures in order to effectively use available resources, it is necessary to create a management system that, based on mathematical methods, provides information analysis, adoption and implementation of management decisions.

Keywords*: occupational safety, occupational diseases, sanitary and hygienic, human-machine-environment.*

Occupational safety management systems at the level of an enterprise, association, and industry will improve the effectiveness of the fight against industrial injuries, general and occupational diseases, and will ensure the achievement of the most favorable working conditions.

In general, a control system consists of a control object, a control body, information processing tools and means for implementing control decisions.

The purpose of the control system is to change the output parameters of the object in accordance with specified criteria or a control program. In this case, input and output parameters are recorded, which are used to identify the object, that is, to build a sufficiently adequate mathematical model that allows one to predict the values of output variables and develop the necessary control actions.

The life safety of industrial premises is defined as a system for preserving the life and health of workers in the process of work, which includes legal, socio-economic, organizational and technical, sanitary and hygienic, treatment and prophylactic, rehabilitation and other measures. Occupational safety is most often defined as a state of working conditions under which exposure to hazardous and harmful production factors on a worker is excluded or does not exceed the maximum permissible values.

As can be seen from the above definitions, “occupational safety” is a system in which physicians specializing in the diagnosis of occupational diseases, rehabilitation of workers who have suffered from exposure to hazardous and harmful factors during work, and determining acceptable levels of exposure to harmful factors must also work.

In addition, this system should involve lawyers, together with doctors, developing sanitary norms and rules, laws in the field of labor protection, economists, developing economic and insurance mechanisms that stimulate the provision of safe working conditions and compliance

with laws, norms and regulations, and of course, technical specialists developing organizational and technical support for safe working conditions.

What competencies should such specialists have? Because they work in a complex and interconnected human-machine-environment (HME) system, they must be competent in the individual components of the HME. Man is physiology, personal and group psychology. A machine is equipment and technology as sources of dangerous and harmful factors. The environment is the identification and control of harmful factors, ergonomics. In addition, occupational safety specialists are required to know the legislation in the field of labor protection, sanitary standards and safety rules; must understand the economics of security.

Based on the above, let us consider some issues regarding labor safety conditions. As we know Most production processes in the workshops of textile enterprises are accompanied by noise, the main source of which is technological equipment.

The highest noise levels in the textile industry are created during the operation of shuttle weaving machines of the AT-100 type. However, at present, these machines are being widely replaced with new, more advanced (including noise characteristics) equipment. Thus, the replacement of AT-100-5M shuttle machines at a worsted mill with automatic ones of the STB type made it possible to reduce sound levels at workplaces by an average of 9 dBA, or almost 2 times in volume.

The noise in workshops with pneumatic rapier weaving looms of the ATPR type is also approximately 2 times lower in volume than in workshops with shuttle looms. The replacement of AT-100 shuttles looms with ATPR type machines in one of the workshops of a weaving factory led to a decrease in the sound level by 8 dBA. In another workshop, the installation of ATPR machines with additional lining of the ceiling with sound-absorbing material made it possible to reduce the sound level by 13 dBA.

The experience of reconstruction of textile enterprises shows that the greatest effect of noise reduction can be achieved by applying a set of measures consisting of replacing strictly equipment with new, less noisy ones, installing it (to reduce structural noise in buildings) on vibration-isolating pads, and also by covering ceilings and walls with sound-absorbing material. This integrated approach makes it possible to reduce the noise level in weaving shops by 13 dBA, in certain frequency bands up to 15-16 dB (Table 1).

In order to assess working conditions, as well as the health-improving effectiveness of measures to introduce new, less noisy equipment, a study was carried out on the condition of the hearing organ of workers in weaving factories servicing shuttle looms AT-100-5M and pneumatic rapier ATPR-100-2.

A total of 261 workshops were surveyed (189 women and 72 men). Depending on the noise level in the workplace, they were divided into three groups: the first group (180 people) worked in noise conditions reaching 103 dBA, the second (26 people) - 95 dBA, the third (55 people) - 90 dBA. Workers from all groups performed identical maintenance work on automatic weaving equipment. The composition of the groups in terms of experience and age was the same.

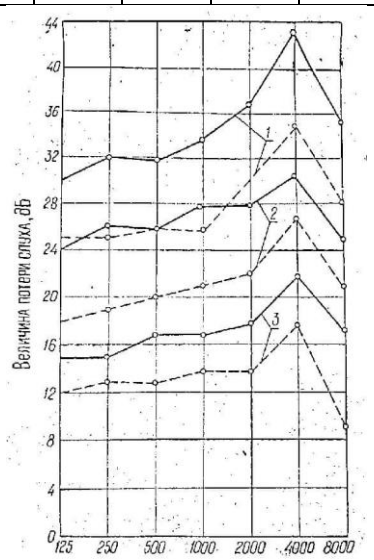
A study of the state of the auditory analyzer in workers of the first group showed that the average hearing loss at speech frequencies (arithmetic mean at frequencies of 500, 1,000 and 2,000 Hz) reaches 27 dB in women and 20 dB in men. The average hearing loss at a frequency of 4,000 Hz, which is a sign of occupational noise exposure, does not reach 40 dB, that is, in this area, workers only show signs of noise exposure on the organ of hearing. At the same time, it should be

noted that there is a clearly defined relationship between the magnitude of hearing loss and work experience (Fig. 1.).

Table 1

Noise levels in weaving workshops

Machine type: acoustic conditions in the workshop	Geometric mean frequencies of octave bands, Hz								Sound level, dBA
	63	125	250	500	1000	2000	4000	8000	
	Sound pressure levels, dB								
AT-100-5M Workshop without acoustic lining	95	96	96	95	98	98	96	91	103
ATPR -100-2; Same	90	92	92	91	90	89	87	84	95
ATPR-100-2; Workshop ceiling with acoustic cladding	83	85	88	89	85	83	81	78	90



Frequency Hz

Rice. 1. Dependence of the magnitude of hearing loss from work experience at the sound level at workers places 103 dBA (solid line – women, dotted line – men):

1 – work experience up to 5 years; 2 – from 10 to 15 years; 3 – over 20 years

In Fig. 1 shows that with work experience of up to 5 years, both women and men have mild hearing loss. As work experience increases, there is an increase in the magnitude of hearing loss, which reaches its greatest values in workers with more than 20 years of experience. At the same time, in women there was a decrease in hearing acuity at speech frequencies by 34 dB, at a frequency of 4,000 Hz by 43 dB, and in men by 27 dB and 35 dB, respectively.

Lower rates of hearing loss in men (assistant foremen) can apparently be explained by the fact that men, due to the specific nature of their work, spend up to 17% of the shift time outside the workshop, that is, in a quiet room.

It has been established that as work experience increases, the perception of low tones is impaired. With more than 20 years of experience, there is a drop in the audiogram curve at low frequencies in women up to 30 dB and in men up to 25 dB. In the literature, this phenomenon is explained by the simultaneous exposure of workers to noise and vibration. The data obtained are consistent with the results of studies by a number of authors [1-3].

Thus, the magnitude of hearing loss increases with increasing experience of working in noisy conditions. Significant hearing loss begins to develop in workers with 15 years or more of experience.

Workers of the second group service pneumatic piercing machines. The sound level in workplaces reaches 95 dBA. The noise of the machines is medium and high frequency.

Due to the fact that pneumatic rapier machines began to be introduced at enterprises relatively recently, an audiometric examination was carried out on a small group of workers with no more than 10 years of experience.

The research results showed that in this case, the amount of hearing loss increases with work experience. With up to 5 years of work experience, this value at speech frequencies is 13 dB for women and 11 dB for men. A comparison of similar indicators for workers in the first and second groups made it possible to establish that hearing loss in the second group is less pronounced than in the first (the amount of hearing loss is 3-4 dB less). Thus, improving conditions as a result of replacing old noisy equipment with new, less noisy equipment allows you to obtain a noticeable health effect.

Workers of the third group service pneumatic rapier machines located in workshops whose ceilings are lined with sound-absorbing material. As already noted, the sound levels in the workplaces of this group are lower than those of the first and second. The surveyed group consisted of workers with up to 5 years of experience. This is due to the short service life of such workshops. Workers in the third group have approximately the same amount of hearing loss at speech frequencies and at 4000 Hz. This can be explained by the fact that a set of measures used to improve working conditions made it possible to reduce high-frequency noise in the workshop, which is the most harmful to auditory function and is of great importance in the development of occupational morbidity.

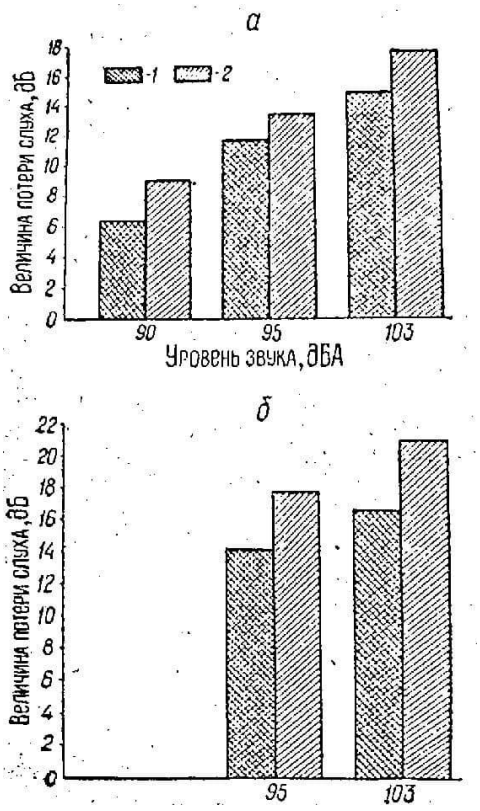
Based on the results of the studies, diagrams were constructed of the dependence of average hearing loss at speech frequencies on noise intensity and length of service (Fig. 2).

From Fig. Figure 2 shows that as the noise level in the workshops decreases, the amount of hearing loss among workers decreases. The difference in hearing loss at speech frequencies between the first, second and third groups is 4 dB in women and from 3 to 5 dB in men.

In addition, a comparison of Fig. 2, a and 2, b shows that for all groups, hearing loss also depends on work experience. Thus, with a noise level of 103 dBA, in women with up to 5 years of experience, the hearing loss reaches 17 dB, from 5 to 10 years - 21 dB, and in men they are respectively 14 dB and 17 dB, etc.

The results of the study made it possible to distribute workers according to the degree of hearing loss at speech frequencies, depending on the length of work and the intensity of noise affecting them. In workers of the first and second groups with up to 5 years of experience, a slight decrease in hearing is observed at speech frequencies, that is, degree I hearing loss, while workers in the third group have only signs of the effects of noise on the hearing organ. With increasing experience of 5 to 10 years, the magnitude of hearing loss increases in men of the first and second

groups and in women of the second group, but only slightly. Women in the first group experience moderate hearing loss (grade II). With more than 15 years of work experience, women in the first group have significant hearing loss, that is, degree III, and men have degree II.



Sound level, dBA.

Fig 2. Dependence of average hearing loss values at speech frequencies from the sound level at working places with work experience of up to 5 years (a) and from 5 to 10 years (b): 1 – men; 2 – women

Table 2

Percentage (of the total number of persons in the group) distribution of subjects by degree of hearing loss

Degree of hearing loss	Group of subjects					
	first		second		third	
	and	m	and	m	and	m
Signs of noise impact on hearing	1	5	6	40	74	70
I degree	26	50	81	40	26	thirty
II degree	38	40	13	20	-	-
III degree	35	5	-	-	-	-

In table Figure 2 shows the distribution of subjects in each group according to the degree of hearing loss at speech frequencies as a percentage.

From the table 2 It can be seen that in the third group, the majority of those examined (74% of women and 70% of men) have only signs of noise exposure, and there is no hearing loss of degrees II and III.

Thus, reducing noise at workplaces in weaving shops from 103 dBA to 90 dBA eliminates the possibility of significant hearing impairment in workers at speech frequencies and leads to a significant improvement in working conditions.

To take timely measures to prevent significant hearing loss among workers servicing automatic looms of the AT-100 type, it is necessary to conduct periodic audiometric examinations.

Conclusions

Workers servicing shuttle looms with a sound level of 103 dBA, with work experience of up to 5 years, have I degree hearing loss at speech frequencies, from 15 years and above - III degree.

The amount of hearing loss depends on the length of time a worker spends a shift exposed to noise. A 17% reduction in the time spent in noise with a level of 103 dBA reduces the amount of hearing loss at speech frequencies by 3 dB for up to 10 years of work experience and by 6-7 dB for over 10 years of work experience.

Workers servicing pneumatic rapier machines with a sound level of 95 dBA have I degree hearing loss with up to 10 years of work experience.

Reducing production noise in workshops from 103 to 90 dBA made it possible to reduce the amount of hearing loss in workers at speech frequencies by 8 dB, and at a frequency of 4,000 Hz by 12 dB. This indicates the significant health-improving effectiveness of measures to replace old weaving equipment with the simultaneous use of sound-absorbing cladding for the ceilings of weaving workshops.

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