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HYGIENE ASSESSMENT OF NOISE LEVELS IN MAIN WORKPLACES IN THE PLASTICS INDUSTRY

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Abstract

Labour of workers of the main occupations of plastic products manufacturing is connected with complex influence of harmful factors, of which one of the leading ones is mechanical, inconstant, broadband noise with predominance of high and middle frequencies. At frequency of 500 Hz the high level was set at sawing operation 83,6±1,1 dB, at frequency of 1000 Hz - 80,8±0,37 dB, that on the average exceeds by 5 dB the normative value. Noise with predominance of high frequencies of 2000 and 4000 Hz was also determined during sawing in the chipper, respectively 83,6±0,68 and 86,4±0,93 dB, which exceeded the norm 73 and 71 dB taking into account the normative document. At frequency of 8000 Hz at MPL 69 dB the peak of sound pressure was revealed only at works, carried out near a crusher (88,2±0,37 dB), that is caused by poor-quality repair, unbalancing of separate units and mechanisms of machines, untimely lubrication and other reasons. In order to reduce the intensity of industrial noise its attenuation at the source of formation is of great importance: introduction of low-noise machines, timely repair of electric motors, constant provision of workers with personal protection means – “Earplugs”, timely passing of periodic medical examinations.

Keywords: Hygiene, Plastic Products Manufacturing, Unfavourable Working Conditions, Harmful Factor, Noise, Maximum Permissible Level, Preventive Measures

INTRODUCTION

It is known that modern plastic products mainly contain a polymer or several polymers, obtained by injection moulding, plasticisation, homogenisation of polymeric material [4, 7, 10]. Some mechanized and partially non-mechanized processes carried out manually are retained in the technological process. The main sources of noise inside the production shops of the objects under study are various machines, mechanisms, vehicles and other equipment. In the plastics producing industry, for example, machines and equipment work under a certain pressure and thus make a lot of noise [1, 2, 5].

Thus, when plastic products are produced a whole complex of harmful factors of industrial environment is formed, one of the leading ones is intensive noise, the level of which depends on used equipment, machines-crushers, their timely repair, availability of soundproof devices, etc. [3, 6, 8, 9]. In view of above-stated the purpose of the given work was hygienic estimation of levels of industrial noise taking into account stages of technological process with the subsequent development of actions for improvement of working conditions.

MATERIALS AND METHODS

Hygienic assessment of industrial noise was carried out in accordance with GOST 12.1.050-86 SSBT "Methods for measurement of noise in workplaces". Sound pressure levels were measured directly in production workshops, repeatedly during the working week.

For measurement of intensity and spectral composition of industrial noise, a noise meter was used. Sound pressure levels in the frequency range of 31.5-8000 Hz at working places were determined in dB.

Obtained results were evaluated by comparison with standardized values - maximum permissible level (MPL) according to HRAR Republic of Uzbekistan № 0325-16 "Sanitary norms of permissible noise levels in working places" (tab. 1) [8].

Table 1: Permissible sound pressure levels, sound levels and equivalent sound levels in workplaces in production halls and on factory premises

Type of work activity, workplace	Geometric frequency levels, Hz								
	31,5	63	125	250	500	1000	2000	4000	8000
To carry out all types of work at permanent workplaces in production facilities and on company premises.	107	95	87	82	78	75	73	71	69

RESULTS

The conducted research has shown that noise in the workplaces of production shops for the production of plastic products by origin belongs to mechanical noise, by spectrum - broadband, by time characteristic - constant.

Detailed study of technological process of the considered production, types of equipment, and its location in the workshops allowed us to reveal the main sources of noise, which are melting units and pipe aggregates, crushers. Noise generated by operation of equipment has a wide spectrum, the intensity of which depends on the number of simultaneously working machines, their technical condition and design.

In production workshop №2, where workplaces are equipped with melting units, the highest noise levels were registered at low and medium frequencies (125-1000 Hz). Research results showed that at frequency of 125 Hz the highest excess was 88.2±0.86 dB, while the norm is 87 dB according to SanPiN RUz № 0325-16 (Table 2). At frequency of 250 Hz the maximum excess of normative values was also observed in workshop № 2, during operation of smelter № 2 and in a separate room with crushing unit (84,6±0,51 dB) at MPL 82 dB.

At the next frequency (500 Hz), the high level was found when the sawmill was in operation, 83.6±1.1 dB with a standard MPL of 78 dB. Analysis of noise pressure at 1000 Hz revealed the highest excess of 80.8±0.37 dB, which on average exceeds the norm by 5 dB.

Noise with predominance of high frequencies of 2000 and 4000 Hz was determined at the sawmill operation, 83.6±0.68 and 86.4±0.93 dB, respectively, which exceeded the norm 73 and 71 dB taking into account sanitary norms. At the frequency of 8000 Hz with MPL of 69 dB the peak of sound pressure was detected only during the works performed near the chipper (88,2±0,37 dB) (Table 2).

When examining noise levels by workshop, taking into account all units and machines in use, it was determined that higher levels were found in production workshop No. 2 and the crusher. Thus, at a frequency of 250 Hz the maximum was observed in two melting machines (83.8±0.39 dB), while the noise generated in the crusher was insignificantly lower. At frequencies of 500 and 1000 Hz the noise level varied on the average within 3-4 dB, which was caused by poor repair, imbalance of separate units and mechanisms of machines, untimely lubrication.

Exceedance at high frequencies (2000, 4000 and 8000 Hz) was characteristic only for industrial noise, generated during the works carried out in the crusher. At the norms: 73 dB (2000 Hz) the maximum was 79.6±1.4, at 71 dB (4000 Hz) it was 82.0±1.7 and at MPL 69 dB (8000 Hz) it was 72.7±2.9 dB according to HRAR RUz No.0325-16 "Sanitary norms of acceptable noise levels in working places". (Table 3).

Table 2: Frequency response of occupational noise in the main workplaces in the plastics workshops (M±m), dB

Average frequencies in octave bands, Hz	Workshop №2		Workshop №4			Crusher			№1 Consumer Goods Department
	Smelter №2	Smelter №4	Pipe unit (at the beginning)	Pipe unit (in the middle)	Pipe unit (at the end)	Near the crusher	Jigsaw	Separate room with crushing unit	*Thermo-Moulding Machine*
31,5	91,6±0,51	91,6±0,51	86,8±0,58	83,6±0,24	82,2±0,37	97,8±0,68	96,8±0,73	91,6±0,51	82,6±0,24
63	88,8±0,97	88,8±0,37	82,8±0,37	80,4±0,51	79,6±0,24	88,8±0,37	89,2±0,58	88,8±0,97	80,0±0,32
125	84,6±0,51	85,8±0,37	79,6±0,51	77,2±0,58	76,4±0,24	87,0±1,4	88,2±0,86	84,6±0,51	76,4±0,24
250	84,6±0,51	83,0±0,32	77,0±0,32	74,4±0,24	73,4±0,51	83,2±0,37	83,2±0,37	84,6±0,51	74,0±0,32
500	81,4±0,40	81,6±0,40	74,4±0,24	71,2±0,37	69,8±0,37	83,0±1,3	83,6±1,1	81,4±0,40	70,2±0,37
1000	79,4±0,51	79,0±0,32	70,8±0,37	68,4±0,51	68,8±2,1	79,4±0,51	80,8±0,37	79,4±0,51	69,2±2,0
2000	72,4±0,24	71,4±0,51	68,0±0,71	66,4±0,51	63,4±0,51	82,8±0,86	83,6±0,68	72,4±0,24	64,8±0,66
4000	68,0±0,71	66,4±0,51	65,0±0,32	63,4±0,24	61,8±0,37	86,4±0,93	86,4±0,93	73,2±1,1	62,4±0,40
8000	65,2±0,37	65,6±0,40	63,8±0,37	61,8±0,37	60,2±0,37	88,2±0,37	64,8±0,66	65,2±0,37	61,0±0,32

Table 3: Frequency response of occupational noise in the main workplaces of plastic products manufacturing considering sources of generation (M±m), dB

Average frequencies in octave bands, Hz	Workshop №2 (smelter №2 + smelter №4)	Workshop №4 (pipe unit at the beginning + middle + end)	Crusher (near crusher + crusher + separate room with crusher)	№1 (Consumer Goods Department)
31,5	91,6±0,34	84,2±0,56***	95,3±0,78***^^^	82,6±0,24***^&&&
63	88,8±0,49	80,9±0,42***	88,9±0,37^^^	80,0±0,32***&&&
125	85,2±0,36	77,7±0,44***	86,6±0,66*^^^	76,4±0,24***^&&&
250	83,8±0,39	74,9±0,45***	83,7±0,29^^^	74,0±0,32***&&&
500	81,5±0,27	71,8±0,55***	82,7±0,60^^^	70,2±0,37***^&&&
1000	79,2±0,29	69,3±0,73***	79,9±0,31^^^	69,2±2,0***&&&
2000	71,9±0,31	65,9±0,60***	79,6±1,4***^^^	64,8±0,66***&&&
4000	67,2±0,49	63,4±0,39***	82,0±1,7***^^^	62,4±0,40***&&&
8000	65,4±0,27	61,9±0,44***	72,7±2,9*^^	61,0±0,32***&&&

Note: *- a significant difference to the workshop's performance №2 (*- P<0,05; **- P<0,01; ***- P<0,001);

^- a significant difference to the workshop's performance №4 (^- P<0,05; ^^- P<0,01; ^^^- P<0,001);

&- reliable difference from the performance of the crushers (&&& - P<0,001).

Table 4: Total spectral-spectral noise levels at the main workplaces in the plastics industry (M±m), dB

Average frequencies in octave bands, Hz	Production workshops		P
	Workshop №2 + Workshop №4 + №1 (Consumer Goods Department)	Workshop №4 + crushing unit	
31,5	88,6±1,2	89,7±1,1	>0,05
63	85,9±1,2	84,9±0,80	>0,05
125	82,3±1,1	82,2±0,91	>0,05
250	80,5±1,3	79,3±0,85	>0,05
500	77,7±1,4	77,2±1,1	>0,05
1000	75,9±1,4	74,6±1,1	>0,05
2000	69,5±0,94	72,8±1,5	<0,05
4000	65,6±0,70	72,7±1,9	<0,01
8000	63,9±0,59	67,3±1,8	<0,05

The analysis of spectral composition of total noise levels showed that in workshops №2, №4 and consumer goods department industrial noise was registered at frequency of 1000 Hz (75,9±1,4 dB), insignificantly exceeding MPL (75 dB). Besides, it was established that spectral characteristics of noise generated by equipment of workshop №4 and crusher unit reached the maximum sound energy at frequency of 4000 Hz. Thus, sound pressure level is 72.7±1.9 dB with the norm of 71 dB (Table 4).

Thus, excess of permissible noise levels at the main working places of plastic products manufacture is insignificant and its aggravation is possible in complex influence with other harmful factors, leading to changes in functional condition of working organism and early onset of industrial fatigue in dynamics of working day.

CONCLUSION

1) The work of workers in the plastic products industry is associated with complex exposure to occupational hazards, one of the leading ones being mechanical, constant, broadband noise with a predominance of high and medium frequencies.
2) At 500 Hz the high level was determined at jigsaw operation 83,6±1,1 dB, at 1000 Hz (80,8±0,37 dB), which on average is 5 dB higher than the normative value. Noise with predominance of high frequencies of 2000 and 4000 Hz was also determined during the operation of the saw in the chipper, respectively 83.6±0.68 and 86.4±0.93 dB, which exceeded the norm 73 and 71 dB considering the normative document. At frequency of 8000 Hz at MPL 69 dB the peak of sound pressure was detected only during works, carried out near the crusher (88,2±0,37 dB), that was caused by low-quality repair, unbalance of separate units and mechanisms of machines, untimely lubrication and other reasons.
3) To reduce the intensity of industrial noise, its attenuation at its source is of great importance: introduction of low-noise machines, timely repair of electric motors, constant provision of workers with personal protective equipment – “Earplugs”, timely periodic medical examinations (otolaryngologist, therapist, and neurologist) once every 2 years with obligatory audiometry according to the decree of the MH of RUz №200.

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