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Department of Hygiene, Medical University of Lublin
Clinic for Occupational Diseases, Institute of Agricultural Medicine in Lublin

ALICJA WÓJCIK, ZBIGNIEW JOPEK, ZDZISŁAW BRZESKI,
ANDRZEJ BORZĘCKI

Hazards occurring at work-stands in a cement industry plant

Work environment created by man can be a health hazard through the influence of many different harmful factors, including physical, chemical and biological ones. Harmful factors may act separately but in work environment there usually appear groups of factors. The probability of health consequences, resulting from interaction of harmful effect of several factors, increases together with an increase in their concentration or intensity at work-stands and decreases as a result of decrease in work exposure. Appearing disorders in body functions that are caused by harmful work conditions contribute to an increase in the incidence of educational and paraeducational diseases. For many years in the structure of educational diseases incidence, the main place was occupied by the following disease entities: occupational hearing damage, infectious and invasive diseases, chronic bronchopathy, pneumoconiosis, skin and mucous membrane diseases and vibration disease. They make up about 90% of overall incidence (5,7,8,10).

In prevention of negative effects of work exposure to harmfulness of the work-stand, environmental and biological monitoring is of great importance because it enables control of occurring hazards. Among physical factors, essential problems are noise, mechanical vibration, dustiness and lighting.

The aim of the study was an attempt to evaluate the dimension of hazards resulting from indirect and direct exposure to harmful factors of workers from a selected cement industry plant.

MATERIAL AND METHODS

The research was carried out between 2001 and 2003 at work-stands in the departments with different levels of arduousness in the plant – Grupa Ożarów S.A. – Departments: Production, Repairs, Mechanical, Stores, Energetistic, Rail Transport and Unloading, Motor Transport, Automatics, Packing, Mining. Work conditions in the plant depend on various factors typical of each department and particular work-stands. With respect to the production profile of the studied plant, factors evaluated at work-stands were: noise level, mechanical vibration, dustiness and lighting. The measurements were taken at the Institutional Laboratory of Environment Protection. The noise measurements at work-stands were taken with an individual dosimeter of type D-20 acc. PN-01307. The evaluation of mechanical vibration was done through doing measurements of general and local vibration with the help of the meter VC-3 with the converter PD-10 according to current standards: PN- 91/N-01352, PN-91/N-01353, and PN-91/N-01354. The dustiness measurements were taken with an individual dosimeter AP-2, AP-2A with a polypropylene filter Fibro-37 and Fibro-25. The content of free crystalline silica in the dust was denoted according to PN – 91/Z-0401804. The lighting measurements were taken on the basis of defining the average value of lighting and its uniformity. The interpretation of the results was done on the basis of standards: PN-84/E-02033, PN-84/E-02035. The lighting measurements were done with a luxometer of type L-20.

RESULTS

The results of the measurements of physical factors at work-stands are shown in the subsequent tables. Evaluating the exposure to noise of the studied population, no exceeding of permissible standards was found, except for single work-stands in 2001 (Table 1).

Table 1. The highest values of noise intensity at work-stands between 2001 and 2003

Department	Work-stand	Values of noise level (dB)		
		equivalent	maximum	peak
2001				
Production	inspecting operator	88	-	-
Packing	operator of sack cement loading	-	114	-
Mechanical	inspecting operator	-	114	-
	tool fitter	-	114	-
	machine fitter	-	114	-
Motor transport	machinist of loader no 5	-	114	-
Mining	crusher operator	-	114	-
Production	inspecting operator	-	114	-
Mechanical	tool fitter	-	120	-
	machine fitter	-	120	-
2002				
Automatics	assembler of control system and AKP	84	-	-
Mechanical	machine fitter	84	-	-
	repair fitter	84	-	-
Rail transport and unloading	unloading operator	84	-	-
	machinist	84	-	-
Mining	machinist of bulldozer-ripper TD 25 C no 2	84	-	-
	machinist of bulldozer-ripper TCD 221 no 1	84	-	-
Automatics	assembler of control system and AKP	-	113	-
Mechanical	machine fitter	-	113	-
	repair fitter	-	113	-
Rail transport and unloading	unloading operator	-	113	-
	machinist	-	113	-
	machinist	-	-	120
2003				
Production	inspecting operator	84	-	-
	inspecting operator and foreman	84	-	-
Production	inspecting operator		113	-
Production	inspecting operator		-	125

NDD (the highest permissible values) of noise:

equivalent L_{Ex8h} – 85 dB
maximum L_{AMax} – 115 dB
peak $L_{C\ peak}$ – 135 dB

In the studied departments exceeding of permissible standards for concentrations of total and respirable dust containing free crystalline silica was not found. The highest values of the studied dustiness, being within the boundaries of mandatory standards are shown in Table 2. Exposure to

mechanical vibration was within permissible standards and single exceedings were recorded in 2002–2003.

Table 2. The highest values of total and respirable dust concentrations at work-stands between 2001 and 2003

Department	Work-stand	Dust containing crystalline silica 2 ÷ 50%		Cement dust	
		total dust mg/m^3	respirable dust mg/m^3	total dust mg/m^3	respirable dust mg/m^3
2001					
Mining	operator of spread bridges	3.95	-	-	-
Mining	crusher operator	-	0.96	-	-
Packing	operator of cement loading	-	-	5.88	0.88
2002					
Motor transport	machinist of loader no 5 in clinker hall	3.77	-	-	-
Motor transport	driver of technological car Bielaz no 48	-	0.85	-	-
Packing	operator of cement loading in packer hall (no 1)	-	-	5.03	-
Packing	operator of cement loading in packer hall (no 3)	-	-	-	1.73
2003					
Mining	crusher operator	2.59	-	-	-
Rail transport and unloading	operator of dry cement unloading	-	0.61	-	-
Packing	operator of cement loading in packer hall (no 1)	-	-	4.40	-
Packing	operator of cement loading in packer hall (no 1)	-	-	-	1.53

NDS of dust containing 2 ÷ 50% free crystalline silica:
Total dust - 4.0 mg/m^3
Respirable dust - 1.0 mg/m^3

NDS of Portland cement dust:
Total dust - 6.0 mg/m^3
Respirable dust - 2.0 mg/m^3

(NDS = the highest permissible values)

In 2002 the highest exceeding of standards for general vibration was recorded at the Mining Department – work-stand – bulldozer TD 40B operator (1.24 times permissible values). At the Department of Motor Transport – work-stand – driver of a technological car Bielaz no 33 (2.11 times permissible value and 1.20 for local vibration).

In 2003 standards exceedings occurred: • for general vibration at the Department of Motor Transport – work-stand – driver of a technological car Bielaz no 30 (1.05 times permissible value). •for local vibration at the Department of Motor Transport – work-stand – driver of a technological car Bielaz no 29 (1.31 times permissible value). Illumination of work-stands complied with the requirements of hygienic standards (Table 3).

Table 3. Results of measurements of artificial lighting at selected work-stands in Grupa Ożarów SA in 2002

Place of measurement	Average value of lighting intensity (L_x)	Lowest permissible value of lighting intensity (L_y)	Lighting uniformity (E_{min}/E_{av})	Lowest permissible value of lighting uniformity
Mining Establishment				
Technological way from base to excavation	12.0	5.0	0.67	0.3
Main crossing of way to excavation	5.2	5.0	0.73	0.3
Excavation on level II of northern wall	3.1	2.0		
Work field of loader CAT 988F no 2	22.3	20.0		
Work field of loader CAT 988F no 3	23.0	20.0		
Energetistic Department				
Pump hall	129	100	0.71	0.4
Deslagging device	107	50	0.79	0.4
Water conditioning hall	98	50	0.87	0.4
Boiler hall	127	100	0.82	0.4
Hydraulic workshop	228	200	0.68	0.65
In head's room	335	300	0.66	0.65
In master's room	269	200	0.99	0.65
Fitters' dressing-room	123	100	0.69	0.4
Stokers' dressing-room	166	100	0.63	0.4
Stair passage from ground floor to second floor	69	50	0.64	0.4
Canteen room	120	100	0.77	0.4

DISCUSSION

Evaluation of occupational hazards is the foundation for identification and liquidation of dangers to health and life of working population. Work protection aims at creating optimal work conditions from the point of view of hygiene and work medicine, ergonomics, physiology and work psychology. In the sphere of preventive actions, so-called primary prevention is of key importance in work protection of workers. It may be defined as using all available methods and means preventing occurrence of negative health consequences resulting from unfavourable conditions of work environment. Since 1999, there has been a considerable, gradual fall in the number of recorded cases of educational diseases; the incidence profile of these diseases has changed; there has been a fall in the number of acute and chronic occupational poisonings; there has been a fall in the number of diagnosed pneumoconioses and cases of vibratory syndrome. Occupational hearing damages have still an important position, which makes noise the main detrimental factor in work environment. In 2000 in Poland, 144 people out of 1,000 employed were working in conditions of danger, 61% of this danger being related to work environment. The main detrimental factors occurring in work environment are physical factors such as noise, dustiness and vibration. During this year these factors were the cause of 40% of the recorded occupational diseases, out of which half are cases of occupational hearing damage (2,6,9,10).

W ó j c i k and co-authors studied the size of the hazards resulting from exposure to selected physical and chemical factors in a selected motor industry plant. Exceeding of the highest permissible standards was recorded at many work-stands of the plant (11). Z a w a d z k a conducted studies among people exposed to noise and 69% of workers were exposed to noise over 85 dB.

She evaluated the level of workers' awareness and knowledge concerning exposure to noise. It was found that 88% of workers are aware of working in exposure to harmful influence of noise, but only 69% of the studied define their work as harmful and arduous (12). Evaluating exposure of a population working in the studied plant to noise, no exceedings of permissible standards were recorded except for single work-stands in 2001. In the work environment among harmful factors are industrial dusts because of pneumoconiogenic and carcinogenic activity of free crystalline silica. In 2001, occupational diseases of the respiratory system made up 22% of all diagnosed cases of occupational diseases. Pneumoconioses make up more than half of all occupational diseases diagnosed in mining (9). In selected departments of the studied industry plant no exceedings of permissible standards of dustiness were recorded. One of many physical harmful effects of work environment is mechanical vibration. A consequence of prolonged exposure to vibrations may be development of a complex disease process called a vibratory syndrome. Harazin and co-authors studied the numbers in men population in Poland who were occupationally exposed to the influence of local vibration and on the basis of the obtained results it was stated that this number amounted to 15 thousand workers in 2000 (3,4). Affelska-Jercha and co-authors studied the condition of skeletal system in a 36-person group of bus drivers. The obtained results allowed recording a considerably lowered bone density with 30% of the studied, and symptoms of osteoporosis were diagnosed with one person (1). In the studied industry plant it was found that in some cases there were exceedings of standards concerning general and local vibrations.

Health situation of working population is being shaped by organisation and conditions of work environment. Thanks to very well qualified work safety and hygiene service, identification of dangers occurring in work environment of the studied plant allows constant hygienic evaluation of work conditions and to a considerable extent contributes to reduction of occurring factors. Regular studies allow evaluation of risk factors and supervision of the state of health of working people.

CONCLUSIONS

1. Air dustiness at the studied work-stands of the plant was within the boundaries of mandatory standards.
2. The level of exposure to noise at the work-stands did not exceed permissible values, except for single intensities.
3. Exposure to mechanical general and local vibrations was within the boundaries of mandatory standards, except for single exceedings.
4. Lighting intensity of work-stands complied with requirements of hygienic standards.

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SUMMARY

The studies were conducted at selected work-stands in departments with different levels of arduousness, in a cement industry plant – Grupa "Ożarów" S.A. The studies evaluated the level of physical factors of work environment: dustiness, noise, mechanical vibrations and lighting, influencing directly and indirectly the working population. The measurements were taken at the Institutional Laboratory of Environment Protection according to mandatory Polish Standards (PN). The level of exposure to noise did not exceed permissible values except for single exceedings in 2001. Air dustiness at work-stands was within the boundaries of mandatory standards. Exposure to mechanical vibration, except for single exceedings, was within the standards. Lighting of work-stands complied with requirements of hygienic standards.

Zagrożenia występujące na stanowiskach pracy w zakładzie przemysłu cementowego

Badania przeprowadzono na wybranych stanowiskach pracy wydziałów o różnym stopniu uciążliwości zakładu przemysłu cementowego Grupa „Ożarów" SA. Oceniano poziom czynników fizycznych środowiska pracy, jak zapylenie, hałas, drgania mechaniczne oraz oświetlenie, oddziałujących pośrednio lub bezpośrednio na populację pracującą. Pomiary wykonano w Zakładowym Laboratorium Ochrony Środowiska według obowiązujących Polskich Norm. Poziom ekspozycji na hałas nie przekraczał wartości dopuszczalnych z wyjątkiem jednostkowych przekroczeń w 2001 r. Zapylenie powietrza na stanowiskach pracy było w granicach obowiązujących norm. Narażenie na drgania mechaniczne z wyjątkiem jednostkowych przekroczeń zmieściło się w granicach norm. Oświetlenie stanowisk pracy spełniało wymagania norm higienicznych.