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Hazard estimation for the chosen work stands in metallurgical industry

The working environment with its artificial character and production activity may be the source of many hazardous, detrimental and harmful agents. Considering mutual dependence between the man and the work performed we can see that the decisive, and at the same time the most vulnerable of its links, is the man whose work, ultimate in the safety aspect and optimal in organism's strain and productivity aspects, is conditioned by his psycho-physical capabilities. Defined work stands are the source of many physical, chemical and biological agents, having high influence on the health of the employees. The agents may occur in various constellations, frequently provoking interaction. The exceeding of the binding quotas for particular parameters of the agents poses the risk of imbalance of the organism's homeostasis, which in the end may lead to a sequence of pathological changes in human body. Exposure to discomfort and detrimental agents of the working environment after many years of employment inevitably leads to appearance of professional and para-professional illnesses. The professional risk is essential in an assessment of harmful effects on health. Carrying out the analysis of professional risk is the basis for identification and suppression of the dangers for the employees' health (2, 4, 5, 6).

The target of this work was to assess the professional risk connected with harmful physical and chemical agents appearing on work stands in metallurgy-related factory.

MATERIAL AND METHODS

The research was conducted in Huta Ostrowiec in the Press, Rolling-mill minor, Steel plant and Thermic finish sections. It involved an assessment of work conditions through measuring of the physical agents parameters of the premises microclimate, noise exposure, dust density and the chosen chemical agents: carbon monoxide, manganese and iron. The measurements were taken at the Environmental Research and Air Pollution Laboratory of the steelworks. The marking of the thermic strain based on the assigning the figures for WBGT indicator was with the use of measurer for the complex measurement in analyses of various kinds of environments (moderate, cold and hot), according to PN-85/N-8011. The measure of noise level was taken with the use of the measurer for sound intensity, IM-10 type, according to PN-81/01306. The marking of the dust density on work stands was conducted through measuring of the entire and respirable dust, with the use of the method of individual dose-metry, according to PN-91/Z-04030/05 and PN-91/Z-04030/06. The concentration of carbon monoxide measured with the indication method, the use being made of tube detectors, produced by Faser =

Tarnowskie Góry. The marking of nitric oxides was done with tube detectors NO +NO_2 Głównego Instytutu Górnictwa (Mining Major Institute). The manganese measurement was taken with colorimeter method according to PN-75/Z-04101, and iron according to PN-78/Z-04066/03.

RESULTS

The outcome figures of the premises' microclimate parameters according to WBGT indicator are shown in Table 1. In the sections under scrutiny the exceeding of the binding WBGT level was found on many stands. The highest figures were noted in the Press section on the 8000T smith press stand – 31.9°C. The analysis of the resulting figures for dust density on many stands showed exceeding of the binding hygiene norms. The highest concentration of the entire dust was noted in the Rolling-mill minor section on the leader's stand (11.14 mg/m^3) and the highest concentration of the respirable dust on the stand of the vapour expulsion operator in the Steel plant section (Table 2). The highest figures for the noise level in the working stands are shown in Table 3.

Table 1. Microclimate conditions of the premises in the examined sections (the highest WBGT levels)

The place of measurement	WBGT value
Section: the Press 8000T press production socket smith	31.9
Section: Rolling-mill minor Rollerman – initial group	29.0
Section: Steel plant. Quantitative. No.4 Kiln zone	28.3
Section: Thermic finish No.14 Kiln platform	30.7

The maximum binding norm for WBGT indicator at metabolism of 200–260 w/m^2 is 26°C
The maximum binding norm for WBGT indicator at metabolism of 130–200 is 28°C

Table 2. The entire and respireable dust concentration on the work stands (the highest figures – mg/m^3)

The place of measurement	The entire dust	The respirable dust
Section: the Press, Material operation division welder	8.14	2.17
Section: Rolling-mill minor, rolls division The leader of the rolls	11.14	2.0
Section: Steel plant. Kiln division No. 4 Kiln moulder Vapour expulsion operator	11.12 6.21	1.87 3.26
Section: Thermic finish Hardener	2.66	0.74

NDS for the dusts containing free crystal silica from 2–50% is: for the entire dust – 4.0 mg/m^3, for the respirable dust – 1.0 mg/m^3

In the Press section were noted the highest figures for the equal noise level – 105.2 dB. On the Messer blow-pipe burning stand, and the highest figures for the maximum sound level were noted in the Rolling-mill minor section on the Finish machine operator stand – 360 Mg. Cutting tool – 112 dB. Concentration figures for the chemical substances under scrutiny: carbon monoxide, nitric oxides, manganese and iron on the stands in the inspected sections did not show any exceeding of the binding quotas, except for a single exceeding of manganese on welding lock-smith stand – 0.88 mg/m^3.

Table 3. Level of noise intensity on the stands in the examined sections (the highest figures – dB)

The place of measurement	Equal sound level	Maximum sound level
Section; the Press Operator of Masser – multi-blowpipe machine Burning with Masser blowpipe	105.2	109.0
Section: Rolling-mill Operator of finishing machines – cutting tool 360 Mg	94.0	112.0
Section: Steel plant Foundry room and RC Steel pourer – the leader	96.0	111.0
Section: Thermic finish Finish division – selector with disk repair Kiln room division – hardener	90.0 78.0	99.0 100.0

DISCUSSION

The health of working population is conditioned by many factors, among which the essential role is played by the working environment conditions and the type of performed tasks. The diversity of the factors with simultaneously varying levels of exposure is accompanied by the occurrence of various ailments. In the process of prevention from the negative effects of professional hazards connected with harmful working environment the crucial part is played by the environmental and biological monitoring, enabling control over the appearing hazards. The problems of hygiene and work medicine are tied with the working conditions especially in the sections of high danger and harm risk. To these belong the sections of, among others, Foundry, Metal finish and Forge. From the sanitary-hygienic point of view the important factors are microclimate conditions, dust density and noise (8, 14). Detrimental microclimate conditions may lead to thermic discomfort, thus influencing productivity. With the exposure to heat and the resulting effects it is important to determine the binding norms of heat stress, understood as the mixture of environmental conditions, individual factors and the strenuousness of the work. Gliński focuses attention on the technical and organisational methods of microclimate shaping in working environment (3). In the examined factory the exceeding of the binding WBGT quotas was noted on many stands and it could have been influencing thermo-regulatory processes conditioning health and the positive frame of mind. From the working environment factors the most detrimental one is intensive noise. In the place of work where the intensity of sound stimuli and their frequency is high, and the time of exposure prolonged, it comes to the reactions surpassing the physiological range – the overload is developing to reversible and then to irreversible (1, 11, 15). The examined factory was found to exceed the binding quotas for the noise level on certain stands.

Being one of the greatest hazards for human health, dust pollution may be the cause of serious diseases. The type and course of the pathological processes is dependent on the concentration, size of the particles, chemical content, physical-chemical properties and the time of exposure to the pollution. The dust containing free crystal silica is a factor commonly considered etiological with the anthracosis. Rabenda scrutinised the risk of professional illnesses, including anthracosis, for the foundry workers and the influence of exposure to the cumulated those of dust on the illnesses of bronchi and anthracosis. The relative risk of anthracosis for foundry workers throughout the period of 27 years increased in the apprentice group of 16–20-year olds, the second turn noted after 26–30 years (12–13). Matczak conducted his research among welders of hard-melting steel, using methods of hand electrode welding. The fumes were found to contain a considerable amount of iron – 23.6%, magnesium – 3.1%, zinc – 4.8% and small quantities of copper – 0.2% and lead – 0.3%. The exceeding of the summary exposure occurred with 46% of the examined. In the groups of welders under scrutiny more

than average number of cases were noted of the respiratory system diseases, including prolonged bronchitis (10). Estimating the exposure of the welders to the fumes elements she discovered correlations between the concentration of fumes in the breathing zone of the welders and the concentration of iron, manganese, zinc, copper and lead (9). Lewczuk et al. conducted a 3-4–time research during 10-year period on groups of workers from FAMAK factory, among others lock-smiths, welders and founders exposed to noise and production dust containing among others manganese, nitric oxides and small amounts of silica. In the examined population an increased levels of manganese and methemoglobulin were found, together with hypertension, gastric ulcer and bronchitis (7).

The analysis of the dust density on the work stands in the examined sections of the factory showed the exceeding of the norms for the entire and respirable dust levels on many stands. The assessment of the exposure to chemical agents did not show toxic hazard that would lead to pathological processes.

Identification of the hazards appearing in the working environment of the metallurgy-related factory, qualitatively and quantitatively, owing to the highly qualified safety and work hygiene staff enables a constant estimation of the hygienic working conditions and adds to limiting the detrimental effects of the appearing agents on the working population. Strict monitoring regimes for the working environment results in an improvement in both organisational and medical prophylactic activities.

CONCLUSIONS

1. In the examined sections of the metallurgy-related factory the microclimate factors exceeded the binding norms.
2. The exposure to noise exceeded the maximum binding norms in relation to the equal sound levels.
3. Dust density on the examined stands exceeded the binding norms.
4. The concentration figures for chemical compounds are within the boundaries of the binding hygienic norms and do not pose toxic hazards.

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SUMMARY

The research has been carried out on the chosen work stands of various strenuousness level in metallurgical industry. Microclimate conditions were estimated, together with noise exposure, dust density and the exposure to the chosen chemical agents, among others carbon monoxide, nitric oxides, manganese and iron. The analysis of the resulting figures showed exceeding of the binding quotas of Wet Bulb Globe Temperature (WBGT) indicator for some stands, leading sometimes to thermal discomfort. The exposure to noise exceeded NDN coefficient for equal sound levels. Dust density on the stands did not exceed binding quotas. The concentration of chemical agents did not exceed the norms, except for single exceeding of manganese, and does not constitute toxicity hazard.

Ocena zagrożeń występujących na wybranych stanowiskach pracy zakładu przemysłu hutniczego

Badania przeprowadzono na wybranych stanowiskach pracy zakładu przemysłu hutniczego o różnym stopniu uciążliwości. Oceniano warunki mikroklimatyczne, hałas, zapylenie oraz narażenie na wybrane czynniki chemiczne, m.in. tlenek węgla, tlenki azotu, manganu i żelaza. Analizując uzyskane wyniki, wykazano przekroczenia dopuszczalnych wartości wskaźnika WBGT na niektórych stanowiskach, prowadzące niekiedy do dyskomfortu cieplnego. Ekspozycja na hałas przekraczała wartości NDN w zakresie równoważnego poziomu dźwięku. Zapylenie na stanowiskach pracy było w granicach obowiązujących norm. Wartości stężeń związków chemicznych nie przekraczały dopuszczalnych normatywów, z wyjątkiem jednostkowego przekroczenia manganu, i nie stanowią zagrożenia toksykologicznego.