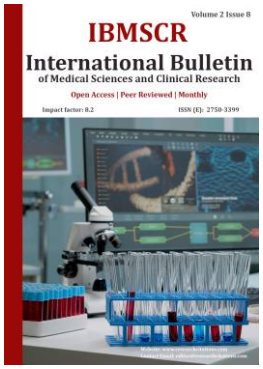

STUDY OF WORKING CONDITIONS IN COPPER PRODUCTION FACTORIES AND DETERMINATION OF HARMFUL FACTORS OF PRODUCTION

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Annotation. According to the scientific research data, as a result of studying the technological process of copper production enterprises, workers are exposed to harmful and dangerous factors during the day in the main workplaces, and among them dusty and gassed air, meteorological factors were found to be the leading ones. In addition, production factors can have different effects in the warm months of the year, that is, one will increase the negative effect of the other factor.

Material and methods. Dustiness of the air in the main workplaces - 180 (unit of measurement), Assessment of the gas content of the workplace air - 180 (unit of measurement), Measurement of noise and vibration levels - 180 (unit of measurement), Measurement of industrial microclimate parameters - 360 (unit of measurement) , measuring the weight of work and determining labor cost indicators. **Results.** It is known that when studying the effect of dust on the body, its small size has a great hygienic value. Because small ultramicroscopic dust enters the alveoli of the lungs and causes long-lasting respiratory disorders. When the dust dispersion was studied, the dust generated during the processing of rocks, 41.1% — smaller than 2 μm, 35.0%, — 2 to 5 μm, 16.6%, — 5 to 10 μm, and 7.3% — 10 and was found to be more than μm in size. Noise is a mechanical by nature of origin, wide-ranging, permanent influencing factor by spectral composition. The time of direct interaction of mining workers with noise is 6-7 hours in a 7-hour work shift. The highest level of noise was detected in drilling and blasting sections, and the highest spectral composition in the permanent workplaces of drillers is 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. Observed at frequencies of Hz. The microclimate conditions obtained in the main workshops showed that during the summer season, the average outdoor air temperature during the day ranged from 24.4 to 34.00C, relative humidity from 33.0 to 35.3%, and the air speed reached 0.97 m/s. The average relative humidity of the air varies from 30.3 to 30.9%, and the speed of air movement was 0.21-0.36 m/s. Since melting furnaces are a source of infrared radiation, the thermal radiation measured at workplaces has been found to rise from 1,665 to 1,385 W/m. Summary. The study of the working conditions of the main workplaces in the technological process of production workshops provided the basis for identifying harmful and dangerous factors in them. a high level of dustiness and gassiness was detected in the production workshops, and according to the hygienic classification of working conditions, it was assessed as "harmful" of class 3 from 1 to 2; due to physical factors production noise and vibration, a high level of mechanical noise was detected in drilling and blasting sections, and local vibration was detected in workers working in perforators, based on this, the occupational conditions were assessed as 3 class "harmful" from 1 to 2 chi levels. **Conclusion.** The study of the working conditions of the main workplaces in the technological process of production workshops provided the basis for identifying harmful and dangerous factors in them. a high level of

dustiness and gassiness was detected in the production workshops, and according to the hygienic classification of working conditions, it was assessed as "harmful" of class 3 from 1 to 2; due to physical factors production noise and vibration, a high level of mechanical noise was detected in drilling and blasting sections, and local vibration was detected in workers working in perforators, based on this, the occupational conditions were assessed as 3 class "harmful" from 1 to 2 chi levels. **Key words:** working conditions, air gasification, dust, noise, vibration, microclimate indicators.

The most important indicator of public health is the health of the working population, which determines the quality of labor resources, labor productivity, and the value of the gross domestic product. Maintaining and strengthening the health of the working population is one of the most important social reasons that must be addressed by the state policy, because the country's socio-economic development and national security depend on it (6,7,27,35). According to the experts of the International Labor Protection Organization (ILO), the mining and metallurgical industry is considered as a unique sector, in which workers are affected by harsh working conditions, harmful and dangerous production factors. (23,24,29,30). The working conditions of the employees of the copper production factory are characterized by a number of unfavorable production factors, mainly high levels of dust, aerosols with a fibrinogenic effect, strong noise, vibration and unfavorable microclimate, the severity of work, the levels of which significantly exceed hygienic standards.

Harmful and dangerous working conditions, occupational and production-related diseases, accidents and medical-social and economic damages caused by a high level of disability are one of the important problems of occupational hygiene and health. (12,13,14). In the Republic of Uzbekistan, great attention is paid to the protection of the healthy population, which especially applies to economic sectors with unfavorable factors of working conditions, which have a negative impact on the main contingent of workers. According to the statistical data of the Scientific Research Institute of Sanitary, Hygiene and Occupational Diseases, the level of occupational disease of workers in the metallurgical industry (per 10,000 people of working age) is significantly higher than in other sectors of Uzbekistan (9,15,16,17,21).

Due to the specific characteristics of work in production, physical and excessive stress, uncomfortable environmental factors, mining workers are a group with a high risk of developing various somatic and reproductive diseases. The state of their health affects the economic indicators of the factory, so it can be considered an important component of the productive power of society. (25,26,18,34). In the modern conditions of copper production enterprises, workers are affected by a complex of unfavorable production factors that determine the level and character of occupational disease. Failure to comply with the normalized operating modes of dust control means increases the amount of dust in the air at workplaces. 82.3% in underground works and 56.2% in open-pit mining belong to the 3rd class of various degrees of danger (18,19,20).

At the same time, the dynamic observations of various research and medical institutes show that the main unfavorable production factor in underground works remains dust, the formation of which is accompanied by the performance of all production processes. The level of dust emission depends on the geological conditions of the mine, the strength of the rocks, the conditions of formation, and the equipment used (3,4,5,8,27).The amount of dust in the work area is combine drivers and support operators of cleaning complexes can reach tens and

hundreds of mg/m3 (1,2,32,33). A comparison of the scientific literature data on the study of the working conditions of workers working in copper production enterprises with the prevalence of disease by disease classes and their levels may be pathogenetically related to the factors of the working environment.

The purpose of the study. Study of the technological process and working conditions in the main shops of the copper smelting and beneficiation enterprise, as well as identification of harmful factors of production.

Material and methods. In accordance with the set goals and tasks, comprehensive scientific research work was carried out in several stages in 2018-2022.At the first stage of the research, foreign and national literature, official statistical data, regulatory and legal documents related to the topic were studied, and the program, plan, goals and tasks of the research were formed. As a result, the observation object, units, subject and primary medical documents were selected, and research methods were determined.

In the second stage, it consisted of studying the technological process and working conditions in the main workshops of the copper smelting and beneficiation plant of the Almalyk mining metallurgical plant, as well as identifying the harmful factors of production (Table 1).

N*	Research name and types		All researching
1	Studying the technological process, working conditions and harmful production factors (12 workshops in total): - metallurgical shop - copper electrolysis plant - camphor shop - sulfuric acid shop - rare metals production workshop - a workshop for the production of wire and enamelled wire - grinding shop - energy shop - control measuring instruments and automation shop - air distribution workshop - repair of a mechanic shop	Assessment of the dustiness of the workplace air	180
		Assessment of the gas content of the air in the workplace	180
		Measure noise and vibration levels	180
		Measurement of industrial microclimate parameters	360
		Measuring degrees of illumination	180
		Measure the difficulty of work	180
		Labor consumption indicators	180

Comprehensive hygienic assessment of working conditions includes microclimate parameters - temperature, humidity, air movement speed, heat radiation, noise level in production; local and general vibration; air pollution of the working area with carbon aerosols and toxic substances; the severity and intensity of work involves learning;

Measurement of microclimate indicators was carried out in cold and hot periods of the year in accordance with the methodological recommendations of "Methodology for measuring microclimate indicators in workplaces" (Tashkent, 2013) and UzR SanQvaM No. 0324-16 "Sanitary-hygienic standards of microclimate of industrial buildings". In the hot season, the integral indicator (temperature index) of the WBGT-index was used to estimate the optimal and heating microclimate in industrial buildings. Determining the indicators of dust in atmospheric air according to UzR SanQvaM No. 0294-11 "Hygienic standards. Permissible amount of harmful substances in the air of the workplace (REM)" and State Standard No. 12.1.005-88 "General sanitary and hygienic requirements for the air of the workplace" (3, 4, 9, 15). It was carried out in accordance with the methodological recommendations of "Hygienic prediction of occupational disease of dust etiology depending on the amount of dust" (Tashkent, 2002).

When measuring harmful substances in the air of the working area, we perform assessment works in accordance with the "Methodology for measuring the amount of harmful substances in the air of the working area using gas and dust analyzers" (Tashkent, 2013) and UzR SanQvaM No. 0294-11, State Standard No. 12.1.005-88 was carried out.

The study of acoustic properties of continuous and intermittent noises, local vibration parameters in workplaces was carried out in accordance with the State Standard -12.1.050-86 "Methods for measuring noise in workplaces" (38). Hygienic evaluation of compliance with permissible levels of measured noise and vibration levels for permanent and non-permanent workplaces in industrial buildings. with UzR SanQvaM №0325-16 "Sanitary norms of permissible noise levels in workplaces" and UzR SanQvaM №0326-16 "Sanitary norms of general and local vibrations in workplaces".

The severity of labor and the intensity of labor processes were studied according to the stylistic recommendations "On the criteria for classification and evaluation of labor by severity and intensity" (Moscow, 1983) and "Evaluation of the severity and intensity of labor processes". (Moscow, 1987)

General assessment of working conditions by classes and level of danger was carried out in accordance with the decision of the Cabinet of Ministers of the Republic of Uzbekistan dated September 15, 2014 No. 263 "On further improvement of measures for the protection of labor of employees". UzR SanQvaM №0141-03 "Hygienic classification of working conditions by risk factors and labor process indicators of danger, severity and intensity".

Working conditions in workplaces were evaluated based on the results of instrumental measurement of production factors and sanitary-hygienic assessment, risk and risk classes were calculated for individual factors, and a general class was calculated for the sum of all factors in the workplace.

The following measurement tools were used for hygienic evaluation and metrological verification of factors of working conditions:

Microclimate indicators - Metioscope-M (relative air humidity, temperature, XXT), Air gasification indicator - Ecolab AR, Aspirator - High volume are air sampler Aircon-2, Noise and vibration level Precision Sound level meter (SC - 160), Illumination level - Illuminance meter

(Tes-1330A), electronic scales Analytical balance (Ohaus PAG214), stopwatch, measuring tapes were used.

Research results. According to the scientific research data, as a result of studying the technological process of the copper production enterprises, harmful and dangerous factors affect the employees during the day in the main workplaces, among them dusty and gassed air, meteorological factors were determined. In addition, production factors can have different effects in the hot months of the year, that is, one of them increases the negative effect of the other factor.

The dustiness of the air in the main workplaces showed that, taking into account silicon dioxide (SiO2) in its content, the highest indicators were set in the grinding workshops and exceeded the hygienic standards (rocks containing more than 10% silicon dioxide, in addition to lead, lime and other dusty materials). . When the dust dispersion was studied, the dust generated during the processing of rocks, 41.1% — smaller than 2 μm, 35.0%, — 2 to 5 μm, 16.6%, — 5 to 10 μm, and 7.3%

— 10 and was found to be more than μm in size. Thus, the dust found in workplaces consists mostly of ultramicroscopic dust. The concentration of dust containing up to 10% of free silicon dioxide in the main workplaces of the copper production enterprise was 7.2 mg/m3, and in the workplaces of drilling mechanics - 3.9-7.8 mg/m3. The occupational groups most often exposed to dust included: miners, OTM and GROZ machinists, drillers, drilling machinists. (table 2).

Amount of dust in the main workplaces and their hygienic assessment

Professional groups	Dust amount, mg/m^3			Class of working conditions
	Min-max	M (medium)	±δ	
Miners (dry).	91,3 ±24,8	34,88±10,7	10,18±4,81	3.2-3.3
Miners (with damping)	8,5 ± 3,4	4,3 ± 1,8	4,1 ± 0,8	3.1
Drills (with water spray)	5,6 ± 1,43	4,28 ± 1,36	4,14 ± 1,32	3.1
OTM, GROZ machinists	9,53 ±2,16	6,76 ± 1,86	4,76 ± 1,76	3.1
Drilling machinists	10,5 ± 3,1	6,75 ± 2,45	5,58 ± 1,85	3.1
OZR SanQvaM №0294-11 "HYGIENIC NORMS. PERMITTED QUANTITY OF HARMFUL SUBSTANCES IN THE AIR OF THE WORKING ZONE (REM)" — 4.0				

Thus, a group of grinders was found in the grinding workshop with the most harmful working conditions in terms of the level of dustiness of the working air (class 3.2 — 3.3). One of the main reasons for air pollution with dust is the fact that crushing devices, mills, elevators, bunkers are considered, and it is not possible to completely hermetically seal them.

Thus, the degree of dustiness of the air of the working zone of different professions during technological operations is not the same.

Effects of noise and vibration in workplaces

The mechanisms and devices used during technological processes in mining require the workers to be affected by noise and vibrations to varying degrees. The drivers of auto transports working in the mine are affected by a high level of noise. Taking this into account, noisy drilling is one of the leading factors of unpleasantness in production. Noise is a mechanical by nature of origin, wide-ranging, permanent influencing factor by spectral composition. The time of direct contact of mining workers with noise is 6-7 hours in a 7-hour work shift.

The highest level of noise was detected at the drilling and blasting sites, and the highest spectral composition was observed at the frequencies of 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz.

Production noise was determined at the permanent workplaces of vehicle drivers, masters of drilling rigs, and its total equivalent level was 14-21 dBA higher than the specified hygienic standards (class 3, level 2).

Thus, the level of sound pressure affecting drillers during the performance of the main technological operations in mines, the total equivalent levels and the levels by spectral composition are presented in table 3.

3-table

Level of sound pressure at workplaces of drillers

Equipment	Level of sound pressure by frequencies (Hz), dB									Equivalent level, dBA
	31,5	63	125	250	500	1000	2000	4000	8000	
O'BQ SAE-2E	98	102	102	101	100	105	104	103	96	108,5
O'BQ Boomer 128	95	94	96	97	94	92	91	90	89	103,5
PED CQ 2.2. 4/ 2.1.8 562 -96	107	95	87	82	78	75	73	71	69	80
Increase from RED	-	3	12	17	19	23,5	24,5	25,5	23,5	26

In the rest of the workplaces, noise did not deviate from the standards in terms of spectral composition and general equivalent level or increased insignificantly (class 3, level 1).

Noise tests have shown that the noise affecting the drivers of motor vehicles (excavators, mobile vehicles, drilling rigs) in mechanization work is equal to 89 dBA (3 class 1 level). In these workshops, the noise from drilling equipment increased to 94 dBA (class 3 2 level), dump trucks - 89 dBA (class 3 1 level).

In addition to noise, the vibration factor also affects workers. The vibration is included in the local vibration due to the fact that the personnel working with the perforators, drilling rigs are more exposed to the hands.

Observations showed that the local vibration indicators exceeded the RED by 3.4-7 dB at low and medium frequencies, and the overall vibration exceeded the RED by 3-13 dB.

Local vibration affects workers on average 21.4 -34.3% of the time during the shift. During the drilling process, if it lasts from 2 to 8 hours during the shift, its effect is manifested in 56% of cases.

The level of vibration depends on the work of the perforators that create it, and it is variable. The formation of vibration depends not only on the structural features of the perforators, but also on the drilling procedure, the strength of the soil layers, the compression strength, and the presence of vibration suppressing devices. Table 4. shows local vibration indicators when working with manual and telescopic perforators.**4-Table**

Indicators of local vibration when working with manual and telescopic perforators

Perforated strings	The level of vibration speed at geometric mean frequencies in dB on the octave path, Hz								Equiv. level, dBA
	8	16	31,5	63	125	250	500	1000	
PR -22	-	117	120	121	119	116	111	109	123,1
PR -27 (PP -54)	117	120	121	119	115	113	108	94	124,5
PR -30 (PP -63)	110	116	113	115	116	114	110	96	120,4
PT -29	-	112	110	108	106	106	107	105	114
PT -36	-	111	110	106	106	105	102	105	114,7
PED CQ 2.2. 4/ 2.1.8	115	109	109	109	109	109	109	109	112
Exceeding the PED	-	6,2	5,8	4,8	3,4	1,8	-	-	7,3

Vibration is considered to be transport-technological, and it is recorded from YQD: general (LF-7) - up to 22 dB, and local up to 7 dB.

The noise is constant, wide-band, up to 28 dB higher than YQD on all spectrums and up to 22 dB on evaluations. Spectral description of noise when working with different OTMs is presented in table 5.

5 table

Sound pressure level when working with OTM (according to measurement data with instruments)

Name of the device	Sound level pressure, dB, frequency, Hz									Evaluative level
	31,5	63	125	250	500	1000	2000	4000	8000	
LF -12	102	94	91	90	91	88	86	82	80	94
LF -7	110	108	112	100	106	96	101	98	97	112
RED SQ	107	95	87	82	78	75	73	71	69	80

2.2. 4/ 2.1.8. 562 -96										

Taking into account the climatic conditions of our republic, we have many hot days, and summer days are characterized by dry hot weather. The average annual air temperature is +13.20C, the maximum daytime temperature is +480C, and the minimum is 330C. Relative humidity does not exceed 20%. There is a constant north-easterly wind, which in turn creates a high degree of dustiness. During the work, workers are directly affected by meteorological conditions, and since the work is done in the open air, they face a heating microclimate in summer and a cooling microclimate in winter.

The average temperature of the air in open areas in the warm period is 39.40C, the relative humidity is 19%, and the air speed is 5.2 m/s.

Since all the work in the mines is done outdoors, the drivers are also exposed to the hot microclimate.

In addition, meteorological factors in production workshops and in individual workplaces are often very variable and depend on meteorological factors of the external environment, power of heat-dissipating sources in production rooms, heat-dissolving and heat-absorbing units. Also, the location of workplaces also depends on the presence of windows in workshops and their sizes.

The microclimate conditions obtained in the main workshops of AGMK in the warm period of the year showed that during the summer season, the average outdoor air temperature during the day is from 24.4 to 34.00C, relative humidity is from 33.0 to 35.3%, air speed is 0.97 m/s did

Due to the high speed of air movement in the cold period of the year, the average air temperature showed -18.70C. Air temperature in the workplaces of perforators and drillers varied from -26 to +100C during the cold period. It showed an average temperature of -80C with a relative humidity of 32% and an air velocity of 5.2 m/s. Accordingly, according to the hygienic classification, working conditions correspond to 3 classes and 3 levels.

Conclusion: Studying the working conditions of the main workplaces in the technological process of all shops of the copper production enterprise provided the basis for identifying harmful and dangerous factors in them. The following factors affect the body of workers in a production facility:

- a high level of dustiness and gassiness was detected in the production workshops, and according to the hygienic classification of working conditions, it was assessed as 3rd class "harmful" from the 1st to the 2nd level;

- due to physical factors production noise and vibration, a high level of mechanical noise was detected in the drilling and blasting sections, and local vibration was detected in the workers working in the perforators, based on this, the occupational conditions were assessed as 3 class "harmful" from 1 to 2 chi levels;

- drillers are exposed to local and general technological vibration while working on self-propelled drilling rigs (SDRs) used for drilling spurs.

- the amount of nickel, copper, cobalt, nitric oxide, sulfuric acid vapors from chemical factors in the air of the main professional groups was determined, of which the amount of copper and cobalt did not exceed the REM, but the amount of nitrogen oxide was found to be 2.96-4.8 times more than the REM;

- a mixture of copper dust, lime dust, and silicon-preserving dust affects the body together with sulfuric acid and metal vapors in the air of the workplace;

- professional groups participating in the copper enrichment work process, grinding workshops, flotation and flotation workshops, "Cu-Mo" concentrate selection and drying workshop, copper smelting and electrolysis workshop, as well as in intermediate processes, i.e. sulfuric acid workshop, refining workshop; it is recommended to give free milk and milk substitutes to workers of waste processing facilities (SanQvaM 0184-05);

References:

1.Abdurakhimov, B. A., Alikulova, D. Ya., & Avezova, G. S. (2018). Healthy worker mining industry. In EUROPEAN RESEARCH: INNOVATION IN SCIENCE, EDUCATION AND TECHNOLOGY (pp. 111-112).

2.Abdurakhimov, B. A., Tokhtaev, G. Sh. U., Safarov, Kh. Kh., & Ulmasov, J. M. (2023). PRINTSIPY PROVEDENIYA PHOTOCHEMIOTHERAPII AND DERMATOLOGY (REVIEW LITERATURE). Academic research in educational sciences, 4(2), 108-127.

3. Abdurakhimov, B., Khaitov, J., Safarov, X., & Ulmasov, J. (2023). Osobennosti zabolevaemosti rbotnikov predpriyati mednoy promyshlennosti.

4. Aleksandrova M.B., Volkova Z.V., Gurvich E.B. i dr. // Rukovodstvo po hygiene truda / Pod ed. P.F. Izmerova. - 1987. - S. 14-30.

5. Amanbekova, A.U. Dinamika razvitiya khronicheskikh pylevyx bronkhitov u shakhterov Karagandinskyo ugolnogo basseyna [Text] / A.U. Amanbekova, J.A. Eshmagambetova // Profession and health: materialy V Vserossiyskogo kongressa (October 30-November 2, 2006, Moscow). -M. : Delta, 2006. - S. 333-335.

6. Amanjol, I.A. Usloviya truda i sostoyanie zdorovya rabochikh gornoobogatitelnogo predpriyatiya [Text] / I.A. Amanjol, T.A. Tatkeev, J.J. Jarylkasyn // Profession and zdorove: materialy V Vserossiyskogo kongressa (October 30-November 2, 2006, Moscow). -M. : Delta, 2006. - S. 61-62. 66.

7. Askarova, Z.F. Zabolevaemost rabotnikov gorno-obogatitelnogo predpriyatiya po rezultatam uglublennyx meditsinskikh osmotrov/ 3. F. 140 Askarova, E. R. Shaikhlislamova, A. H. Khusainova // Medical work and industrial ecology. - 2008. - No. 5. - S. 19-23.

8. Boyarchuk I.F., Rakintsev Yu.M., Sinevskaya T.P. i dr. Sanitary-hygienic otsenka conditional work during repair of freight wagons. // Hygiene and sanitation.- 2001.- No. 6.- S. 40-41.

9. Bunina, T.V. Sovershenstvovanie kompleksnoy prophylactici i lecheniya poyasnichno-kresttsovyx radiculopathy u hornorabochix [Text] : avtoref. dis. candy. Med. nauk / T.V. That's it. -M., 2001. — 19 p.

10.Global action plan for health workers 2008-2017. - WHO, 2007.

11. Glotov N.V., Zhivotovsky L.A., Khovanov I.V. i dr. Biometrics. --P., 1982.

12. Zhukova T.V., Solovev M.Yu., Kalinina M.V. i dr. Hygienic aspects of diagnostic and individual health care. // Hygiene and sanitation.- 2001.- №5.- S. 77-79.

13. Kasimova, D. A., & Aburakhimov, B. A. (2018). SOVREMENNYE PODKHODY K PROFILAKTIKE PROFESSIONALNYX ZABOLEVANIY NA PREDPRIyATIYaX GORNORUDNOY PROMYSHLENNOSTI. In EUROPEAN RESEARCH: INNOVATION IN SCIENCE, EDUCATION AND TECHNOLOGY (pp. 52-54).

14. Magai M.P. Indicators of enzymatic activity in the tricarbonic acid cycle in the experimental living environment in the presence of electromagnetic radiation //Higienicheskie aspekti okhrany okurajyushchey sredy, kreplenie zdorovya i blagopoluchie naseleniya - prioritnye napravleniya zdrovokhraneniya Uzbekistana: Sb. Nauch. tr. nauch.-prakt. conf. s mejdunar. I fly. - Tashkent, 2014. -S. 89-92.
15. Mamatkulov, B., & Abdurakhimov, B. A. (2020). A SYSTEMATIC APPROACH TO MANAGING THE HEALTH AND RISK FACTORS OF MINING INDUSTRY WORKERS. Novyy den v meditsine, (4), 211-213.