

EXPOSURE OF WORKERS TO OCCUPATIONAL NOXAE

Simion Sorin^{1,*}, *Angela Călămar*², *Alexandru Simion*³, *Kovacs Marius*⁴, and *Toth Lorand*⁵

¹ NRDI-INSEMEX Petrosani, sorin.simion@insemex.ro

² NRDI-INSEMEX Petrosani, angela.calamar@insemex.ro

³ NRDI-INSEMEX Petrosani, alexandru.simion@insemex.ro

⁴ NRDI-INSEMEX Petrosani, marius.kovacs@insemex.ro

⁵ NRDI-INSEMEX Petrosani, lorand.toth@insemex.ro

Abstract. The discomfort caused by exposure in the work process to occupational hazards generates. In this regard, this paper examines how the nuisances generated by technological processes influence the activity of workers and the legislative framework for jobs in which these occupational hazards exceed the allowed limits. In order to monitor the exposure to occupational hazards, the team of the Toxicology Laboratory performed determinations for the main occupational hazards existing in the work environment to the beneficiaries, the method of determining exposure to toxins being the direct method with measuring devices with numerical display, in time respectively, taking samples and analyzing them in the laboratory. The methods of analysis are in accordance with the legal provisions in force, using devices (metrological verified) and certified methods of analysis. Following the determination of noxious substances, specific risk assessments, in accordance with the legislation in force applicable to the jobs, in order to assess their impact on the health status of the staff, respectively the employment in special / special / normal working conditions, s -drew the following conclusions: periodic determinations of occupational toxins must be widely used to confirm or refute their existence in the workplace, permanent medical monitoring performed by occupational medicine practices, in conjunction with determinations of toxins, to establish traceability of occupational diseases with exposure to the susceptibility to its occurrence.

1 Introduction

There is a lot of evidence that occupational exposure to noxae generated by production processes influences the activity of workers causing physiological disorders. Long-term exposure is associated with a number of health problems. Studies on the causality between exposure to occupational diseases and occupational diseases clearly show the adverse effects that are becoming more pronounced with increasing exposure time (years) and/or increasing level of hazards in workplace environments. Occupational exposure to noxae can be aggravating in the case of certain diseases being influenced by exposure to environmental

* Corresponding author: sorin.simion@insemex.ro

factors in residential areas affected by industrial and / or urban pollution, in which recovery takes place [1].

Occupational diseases can be defined as: "those conditions that occur as a result of practicing a profession/job, caused by harmful physical, chemical or biological factors, characteristics of the workplace as well as by overload of various organs or body systems in the process for work". [2]

In order to be considered an 'occupational disease' or 'occupation related disease', the disease(s) in question must be manifested as a result of practicing a profession/job, harmful physical, chemical or biological factors must be characteristic of the workplace (they must be identified and quantified according to legislation in force, following analyses performed in Toxicology Laboratories authorized by the Ministry of Health).

An important feature of the causal relationship between exposure to noxae and occupational diseases is the complex nature of factors that generate them, most often diseases are not caused by a single generating factor, but by a set of factors.

The working conditions are represented by the totality of factors present at a certain workplace, physiological factors, work environment factors, ergonomic factors, and characteristics of the work environment (the presence of professional noxae), respectively the psycho-social factors. When one or more factors present in the workplace have a negative effect on health and/or work capacity, they become occupational disease-generating factors, defined as occupational hazards. [2]

2 Materials and methods

In view of the above, the national legislation bringing under regulation the work environment provides for determination of the level of occupational exposure to physical and chemical hazards characteristic for workplaces.

The general framework of national legislation is provided by Law no. 319/2006 on safety and health at work, with subsequent amendments and completions, respectively GD no. 1425/2006 for the approval of the Methodological Norms for application of the provisions of Law no. 319/2006 on safety and health at work, with subsequent amendments and completions [3,4.]

The general legislation framework is complemented by a series of normative acts that regulate a series of specific activities (for example: surface or underground extractive industry, extractive drilling industry, activity on mobile sites, etc.), respectively normative acts on minimum safety and health requirements regarding exposure of workers to specific risks arising from their work (e.g. risks related to noise, risks related to exposure to biological agents at work, risks caused by exposure to asbestos, risks arising from vibrations, risks related to exposure in carcinogens or mutagens, risks arising from electromagnetic fields, risks related to presence of chemical agents, risks arising from artificial optical radiation, etc.). Determinations of occupational noxae performed by Toxicology Laboratories are used in the process of evaluation/re-evaluation of jobs ranked as special/particular conditions jobs, in order to quantify the degree of exposure to occupational risk factors, respectively to verify the effectiveness of technical-organizational measures taken in order to reduce/decrease the level of exposure to these noxae.

The method for determining occupational exposure is the direct method by using numerical display devices, in real time, respectively, taking samples and analyzing them in the laboratory. The analysis methods are in accordance with legal provisions in force, (metrologically verified) devices and certified methods of analysis being used.

The determinations of noxious substances were carried out in normal working conditions, the activity of workers taking place at normal working capacity, there being no interruptions in the technological work process.

The noxious determinations were performed observing the test procedures accredited by RENAR (Accreditation Certificate no. LI 374) respectively authorized by the Ministry of Health 149/2012 as follows:

- In order to determine noise parameters, in order to evaluate occupational exposure, the specifications of SR EN ISO 9612: 2009 Acoustics - Determination of occupational noise exposure - Engineering method were observed, the exposure limit values being those provided by GD no. 493/2006 on the minimum safety and health requirements regarding exposure of workers to risks of noise pollution, provides for maximum exposure limits for workers in relation to their work. The determinations were performed with integrative sound level meters and noise dosimeters.

- For the determination of vibration parameters, specifications of SR ISO 2631-1: 2001 Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 1: General requirements, using equipped vibration analyzers with accelerometers, the exposure limit values being those provided by GD no. 1876/2005 on minimum health and safety requirements regarding exposure of workers to risks arising from vibration, provides for maximum exposure limits for workers in relation to vibrations transmitted to arm or whole body.

- For the determination of concentration of dust in suspension, respirable and inhalable fraction, specifications SR EN 482: 2016 - Workplace atmosphere. General requirements for the performance of chemical agent measurement procedures were observed, exposure limit values being those provided by GD no.359 / 2015 for the amendment and completion of some normative acts in the field of occupational safety and health, using adjustable flow pumps, conditioned filters or analytical balances with five decimals (the method used being the respective reference gravimetric).

- Determination of gaseous components concentrations in the atmosphere of workplaces by gas analyzers with sensors (CO₂, CO), validated methods were used, the exposure limit values being those provided by GD no.359 / 2015 for the amendment and completion of some normative acts in the field of occupational safety and health, using gas analyzers with electrochemical sensors.

The results of determinations are materialized in the form of test/evaluation reports containing all the data required by the applicable standards (economic operator name, microclimate conditions, activity, deviations from the standard if applicable, recommendations, etc.) the primary data being archived to be accessed at any time, being protected from unauthorized changes.

Toxicological investigation involves knowing what the working conditions are and establishing the level of occupational toxins, while relating to the presence of occupational diseases caused by these noxae.

The purposes of noxae determinations are:

- general risk assessment of concerns upon health of exposed personnel;
- confirmation of a special situation (detection of an occupational disease, a technological change, etc.);
- periodic monitoring for presence of noxious substances for certain activities with high dynamics over time (determinations of noxious substances at a workplace when changing manufacturing technology, raw materials, etc.);
- checking the effectiveness of harm reduction measures [5,6]).

3 RESULTS

In order to monitor the exposure to occupational toxins, the team of the Toxicology Laboratory of INCD INSEMEX Petroșani performed determinations for the main occupational toxins present in the work environment for various beneficiaries that hold workplaces in particular/special conditions, according to Annex 3 of the Law 263/2010, respectively for economic agents that carry out activities likely to generate exposure to occupational noxious substances (normal conditions workplaces).

The method used for determining occupational exposure is the direct method with real time numerical display devices, respectively, taking samples and analysing them in the laboratory. Analysis methods are in accordance with legal provisions in force, metrologically verified devices and certified methods being used.

Risk factors present in a workplace, classified using the INCD PM method:

- Risk factors related to worker;
- Risk factors related to workload;
- Risk factors related to means of production;
- Risk factors related to work environment.

If for risk factors related to worker, respectively workload, technical-organizational measures can be applied, in case of risk factors related to means of production and work environment, measures for retrofitting / modernization of production facilities are necessary [7]. Workplaces are classified according to risks associated as follows:

- Special conditions workplace is the workplace where the degree of exposure to occupational risk factors present during normal working hours cannot be reduced, residual risk may lead over time to occupational diseases, to risky behaviours during work, with serious consequences for safety and health of workers at work.
- Work in particular conditions means the workplace where the degree of exposure to occupational risk factors present during normal work time can be reduced by technical-organizational measures, the residual risk leading to a decrease in occupational diseases having serious consequences for workers' safety and health at work, over time.
- Work under normal conditions means a workplace where the degree of exposure to occupational risk factors present during normal work hours cannot lead in time to occupational diseases.

To exemplify occupational exposure, hereafter we showcase the results of occupational noxae determinations (Table 1) in several industry workplaces. These workplaces are ranked as particular/special/normal conditions workplaces, according to regulations in force.

Table 1 Results of occupational noxae determinations

Workplace	Noise Exposure limit (87dB(A) [8])	Global vibrations Exposure limit (1,15 m/s ²) [9]	Breathable dusts from suspension Exposure limit (5mg/m ³)[10]	CO ₂ Exposure limit (9000 mg/m ³)[10]	CO Exposure limit (30 mg/m ³)[10]
Special conditions workplaces					
Steel industry (smelting scrap metal in electric furnaces)					
Electric furnace (EBT)	110.3	1.22	1.15	634	5.21
Steel treatment plant (LF)	92.3	1.09	0.16	398	1.24

Casting pot preparation sector	91.1	1.69	7.52	692	1.65
Steel vacuum installation	91.9	1.19	2.4	334	1.15
Continuous casting workshop	89.9	1.45	1.25	459	1.45
Particular conditions workplaces					
Surface extraction industry (1400 T rotor excavator)					
Booth 1	75	1.01	7.52	-	-
Belt 1	88	1.62	2.4	-	-
Electric house	69	1.25	1.25	-	-
Preparation B3 / B5	87	1.59	6.12	-	-
Rotating platform ARS	85	1.02	7.52	-	-
Trolley rotation platform	90	1.25	2.4	-	-
Normal conditions workplaces					
Automotive industry					
Sandblasting	85.9	0.25	2.16	-	-
Hydraulic presses	76.1	0.56	1.12	-	-
Eccentric presses	79.4	0.52	1.13	-	-

Exceeding the exposure level to these noxae generates, through individual and/or cumulative effect, a series of occupational or profession-related illnesses shown in table 2. This, the main occupational diseases and causal occupational factors, are:

Table 2 Occupational diseases and occupational diseases

Occupational disease	Occupational causal factors
Heart disease (HTA CICD)	Noise, vibration, temperature, increased caloric radiation, increased neuro-psyche overload
Respiratory disorders	Dusts, irritating gases, organic solvents
Hearing disorders	Noise, chemical noxae
Osteo-muscular joint disorders	Unfavourable microclimate, vibrations, increased effort, awkward posture, mechanical traumatic effect

In conclusion, the determination of exposure level to various occupational hazards provides useful information to prevention and protection services, whom based on this information implement action plans on reducing occupational exposure to physical and chemical risk factors. Implementation of measures to reduce occupational exposure must be corroborated with raising awareness of employees on usage of PPE and compliance with work instructions, because in these workplaces, activities are carried out in the presence of physical and chemical hazards, without the possibility of eliminating them because of the characteristics of activities [7].

4 CONCLUSIONS

Pursuant to determination of noxious substances, specific risk assessments, in accordance with legislation in force applicable to workplaces, in order to assess their impact on workers'

health, respectively in order to rank workplaces as special / particular / normal working conditions, the following conclusions stood out:

- Periodic determinations of occupational hazards must be widely used to confirm or refute their presence in the workplace. Monitoring the exposure to occupational hazards provides the basis for technical and organizational measures necessary for complying with limit values established by the applicable legislation and to establish the measures to reduce exposure to toxins.

- Permanent medical supervision performed by occupational medicine offices, corroborated with determinations of noxious substances, helps to establish the traceability of occupational diseases with exposure of the noxious substances susceptible to its occurrence.

- Determining the best methods to reduce exposure to noxious substances should not create additional risks for the worker (for example, the use of earmuffs should not mask safety signs, the use of exhaust equipment should not generate noise sources, etc.).

- Periodic reassessment of workplace risks, whenever necessary, in accordance with changes in the technological process (refurbishment, use of new chemicals).

- National legislation in force does not allow the placement of new jobs in special / particular conditions, the tendency being for the normalization of these jobs. This fact does not reflect the reality of national industry, newly created and / or existing workplaces, not properly evaluated, being excluded from being ranked as special and / or particular conditions, leading to social inequities, the same activity carried out in the presence of toxins being ranked differently. In order to solve these problems, it is necessary to re-evaluate all workplaces and rank them in a unitary way, taking into account only the results of determinations of noxious substances, risk assessments and occupational diseases.

In conclusion, economic operators who have jobs in special / particular conditions, must continue to modernize and optimize the production process to ensure greater protection for workers, by reducing / minimising exposure to occupational hazards. Given the specifics of activities carried out at workplaces in special / particular conditions, it is not possible for the production process to take place automatically (without direct participation of workers). Implementation of measures to reduce risk factors and occupational diseases can generate a low residual risk, which leads to a decrease in the number of occupational diseases, also reducing the severity of consequences on health of exposed personnel. The strategy for normalizing workplaces in special / particular conditions is influenced by several variables implementable through differentiated approaches, in the short, medium and long term, respectively: the financial effort required for refurbishment, the level of automation allowed by the activity, the degree of economic competitiveness, safety and health at work, etc.

It is recommended to continue research on working conditions in order to be able to modify / suggest changes of the legislation in force for ranking new workplaces in special / particular conditions, the tendency being to normalize these workplaces.

References

1. D. Angelica; K. Marius; T. Lorand, *Metal Int* **18**, 147 (2013)
2. N., Toma, *Manual of Professional Pathology*, Medical Publishing House, București, (1985)
3. Law 319/2006 Law on Safety and Health at Work
4. Guide - *Terms and notions of industrial toxicology and occupational psychology*, Ministry of Health - National Institute of Public Health, 2016
5. V. G. Dragos, D. N. Angelica, B. Constantin, *ENVIRON ENG MANAG J*, **7**, 443 (2008)

6. S. Simion; C. Vreme; M. Kovacs: Conference: 12th International Symposium Acoustics and Vibration of Mechanical Structures (AVMS 2013), *Exposure of workers to noise in mining industry*, (Timisoara, Romania, 2013)
7. S. Spiridon, S. Sorin: *Prevention and reduction of noise emissions from industrial mining processes*,(INSEMEX Publishing House, Petroșani, Romania 2008)
8. GD no. 493/2006 on the minimum safety and health requirements regarding exposure of workers to risks of noise pollution, provides for maximum exposure limits for workers in relation to their work.(2006)
9. GD no. 1876/2005 on minimum health and safety requirements regarding exposure of workers to risks arising from vibration, provides for maximum exposure limits for workers in relation to vibrations transmitted to the arm or the whole body.(2005)
10. GD no.359/2015 for the amendment and completion of some normative acts in the field of occupational safety and health (2015)