MACs of chemical compounds as a tool for assessing occupational exposure and risk in Poland

Jolanta SKOWROŃ, Małgorzata POŚNIAK

Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Czerniakowska 16, 00-701 Warsaw, Poland.

Risk assessment is the overall process of estimating the magnitude of risk and deciding whether or not that risk is tolerable or acceptable. The process of risk assessment is a systematic examination of all aspects of work to consider what can cause injury or harm, whether the hazards can be eliminated, and if not what preventive or protective measures are, or should be, in place to control the risks.

According to the Polish Labour Code, employers are legally obligated to provide workers with information about occupational health and safety risks. Maximum admissible concentrations (MACs) and the results of determining chemical compounds in workplace air are used for assessing occupational exposure and risk.

In Poland MACs for chemical compounds are established by the Interdepartmental Commission for Maximum Admissible Concentrations and Intensities for Agents Harmful to Health in the Working Environment. The Commission includes representatives of health and labour administration, various sectors of the industry, trade unions and research institutes specialising in occupational medicine and occupational safety.

MAC values refer to airborne concentrations of substances and represent conditions to which it is believed that workers may be exposed during their whole working life, without any adverse health effects on their health (also when retired) or that of the next generations, too. According to the type of biological effects, the following categories of MAC values are used:

- **NDS – MAC (TWA): MAXIMUM ADMISSIBLE CONCENTRATION:** the time-weighted average concentration for a conventional 8-hour workday and a workweek defined in the Labour Code, to which workers may be exposed during their whole working life, without any adverse effects on their health (also when retired) or that of the next generations.
- **NDSCh – MAC (STEL): MAXIMUM ADMISSIBLE SHORT-TERM CONCENTRATION:** The short-term exposure limit is an average concentration, to which workers may exposed without any adverse health effects if it does not last longer than 15 minutes and does not occur more than twice during a workday, at intervals not shorter than 1 hour.

- **NDS – MAC (C): MAXIMUM ADMISSIBLE CEILING CONCENTRATION:** Ceiling concentration, which because of the threat to workers' health or life, should not be exceeded even instantaneously.

MACs are based on information available from industrial experience, from experimental human and animal studies. For carcinogenic agents, the Commission has adopted the socially accepted risk at the level of 10^{-3} to 10^{-4}. Documentation on MAC values is published in the quarterly "Principles and Methods of Assessing the Working Environment". The health-based documentation for recommended exposure limits for each compound includes information related to physical and chemical properties, toxic effects on humans and laboratory animals, carcinogenicity, mutagenicity, teratogenicity, embriotoxicity, and effects on reproduction, mechanism of toxicity, combined effects, bases for proposed MAC values and biological tolerance limits, methods of determining the substance in workplace air and biological material, and also pre-employment and periodical medical examinations.

The Commission proposes to the Minister of Labour and Social Policy maximum admissible concentrations (MACs) of occupational exposure on the basis of health criteria and assessment of health risk with the use of the latest scientific data. Moreover, the Commission proposes methods of air sampling and analysis and, if there is sufficient data, also biological tolerance limits promulgated by the Minister of Health.

After the approval of the Minister of Labour and Social Policy, health standards are obligatory for all branches of the national economy. To date there are 441 MAC values for chemical substances and 19 for dusts (The Ordinance of the Minister of Labour and Social Policy on the maximum admissible concentrations and intensities of harmful to health agents in the working environment, *Dziennik Ustaw* 2002, No. 217, item 1833).

To help enterprises in assessing occupational risk, the Central Institute for Labour Protection – National Research Institute (CIOP-PIB) has developed an supporting tool: a Computer System for Hazard Registration and Occupational Risk Assessment, STER. The system helps to:

– Collect and analyse information about the workplace necessary to identify hazards: name (code) and location of the workstation and the number of people working at that workstation, description of the realised technological process and materials used, description of machines and other technical devices used at the workplace and basic instrumentation and equipment which are significant for occupational safety and comfort, description of basic activities

and the time of their performance (the so-called time keeping), identification of danger zones (with possible illustration);

- Assess risk connected with those hazards. The user of the system receives a suggestion of risk assessment for all agents most frequent at workplaces, such as, e.g., noise, mechanical vibrations, radiation, microclimate, harmful chemical substances and also mechanical agents causing accidents. For each of the identified and listed agents the system asks for the results of the measurement of the parameters characterising the exposure and after loading them it makes calculations necessary for comparing the results of the measurements with the admissible values set on the basis of legal regulations, standards or other sources currently in force. On the basis of the measurement data, the program makes it possible to develop a so-called agent measurement card stored in its database;
- Identify and properly document actions which should be taken as a result of risk assessment.

The system contains a database of Polish regulations and it automatically selects from that database admissible values for the indicated agents.

To estimate risk, a three-level scale has been accepted. Application of the three-level scale of risk assessment according to which risk can be defined as low, medium or high allows easy comparison of the assessment with the regulations in force. For chemical agents (except carcinogenic ones), risk is assessed as low if the worker's exposure does not exceed 0.5 MAC, as medium if it is higher than 0.5 MAC but it does not exceed that value, and as high if the health standards are not met. Risk connected with the presence of a carcinogenic agent in workplace air even if exposure is lower than a MAC is always assessed as high.

In every case high risk signifies lack of compliance with the requirements and medium risk means it is necessary to undertake economically justified actions in order to secure better protection of workers. If risk is defined as low, the protection measures in place can be considered satisfactory.

The system makes it possible to print a document registering all data characterising the analysed workstation, data necessary for risk assessment as well as the results of the assessment and recommendations concerning preventive actions with the indication of the date of their realisation and the name of the person responsible. The document is called an Occupational Safety and Health (OSH) Workstation Card. It is also possible to print other documents required by supervising and controlling institutions.

The computer-assisted system helps to register and document occupational risk assessment and all actions resulting from assessments. It is also a good tool for pro-active health and safety management.

In the case of harmful substances used in the production process, stored and handled data from their chemical safety data sheets can be used for their identification. Those sheets contain complex information about dangerous properties of individual chemical substances, the kind and scale of risk they pose and the rules of conduct related to them. According to the Labour Code, Art. 221, the use of chemical substances which do not have a chemical safety data sheet is inadmissible. Presently in Poland, CIOP-PIB publishes on a CD-ROM chemical safety data sheets for hazardous substances. They are developed by specialists from Polish research centres and institutions responsible for production, use, handling and neutralisation of chemical substances and for prevention and protection of health and human life. Chemical safety data sheets, prepared in CIOP-PIB are also introduced in this system.

The system of assessing occupational risk makes proper management of occupational safety and health possible in Polish enterprises which use chemical compounds in their technological processes. Reduction and elimination of chemical hazards in the working environment is the main task of that system.