

The controlled use of chrysotile asbestos in Ukraine

Українада хризотил-асбесттің бақылау қолдануы

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Мақалада бақыланбайтын жағдайда асбестқұрамды шанның әсері қолқа-өкпелік және ісік аурулардың даму қауіпін тудырады. Аурудың дамуының негізгі себебі ағзаның компенсаторлық мүмкіндігінен жоғары мөлшерде адамның тыныс алу жолдарында асбест талшықтарының жинақталуынан болады. Өз кезегінде мақала авторлары Украинаның асбестцементті өнеркәсібінің кәсіпорындарында жүргізілген зерттеулер хризотилдың қауіпсіз қолдану мүмкіндіктері бар екенін дәлелдейді.

В статье показано, что в неконтролируемых условиях влияние асбестосодержащих пыли увеличивает риск развития бронхолегочных и онкологических заболеваний. Условием развития заболевания является накопление в органах дыхания человека волокон асбеста в количествах, превышающих компенсаторные возможности организма. В свою очередь авторы статьи отмечают, что исследования, проведенные на предприятиях асбоцементной промышленности Украины, свидетельствуют в пользу возможности контролируемого безопасного использования хризотила.

The main consumers of chrysotile in Ukraine are asbestos cement and asbestos technical enterprises. It should be noted that Ukraine neither mines nor mills asbestos. Asbestos-consuming industries import the raw from the Russian Federation and Kazakhstan. The annual volume of import is 85–100 thousand tons. It is important to stress that Ukraine uses only chrysotile that belongs to the serpentine group of asbestos and has physico-chemical properties and, respectively, biological effects quite different from those of amphiboles (crocidolite, anthophyllite, amosite) that were widely used in many countries during a long time in the past [1, 2].

As is known, asbestos is one of the most important non-metallic minerals. Thanks to its unique properties it has been used for over 100 years in thousands of commercial products. It should be noted that until 1970s asbestos was uncontrollably used worldwide, especially in the developed countries, almost in all industries — over 3,000 asbestos-containing products are known to date. This has led to an increase in asbestos-related disease incidence and mortality rates for workers and general population and, consequently, to the ban on all types of asbestos in some European countries. Differences between amphiboles and chrysotile as well as different historical patterns of the use of asbestos in different regions have been neglected.

The majority of well-known epidemiologic studies conducted abroad considered amphiboles or their mixtures with chrysotile. Thus, it is impossible and wrong to attempt to extrapolate data used for assessing health effects of amphibole asbestos in Western Europe and the U.S. to the situation in Ukraine without conducting domestic epidemiologic studies due to significant differences between these groups of fibrous minerals and spheres of application of asbestos [3, 4].

In 2005–2007 researchers of the Institute for Occupational Health of NAMS of Ukraine studied health effects of labor conditions in workers of the Ukrainian asbestos cement industry in order to obtain reliable data on health risks from current exposures to chrysotile. Neither clinical nor epidemiologic data confirmed cases of occupational cancer diseases in workers of the asbestos cement industry of Ukraine. These study results prove feasibility of the safe use of chrysotile with regulated dust exposures [5, 6].

Nowadays in Ukraine dust concentrations in the workplace air are measured using a gravimetric method (maximum permissible concentrations range 2 mg/m³ to 10 mg/m³ depending on the percentage of asbestos fibers) whereas in the EU, the U.S. and some other countries the control is exercised based on the asbestos fiber count [7, 8].

As for the study results obtained for the Ukrainian asbestos cement industry using the gravimetric method, we found that both the maximum short-term and average shift permissible concentrations were exceeded and the mass fraction of asbestos at major workplaces was 50 to 100 %. At workplaces of the asbestos dosing operator both average shift and maximum short-term concentrations of asbestos dust were 1.6 to 14.0 times higher than maximum permissible concentrations; of warehouse operators and operators of the sheet-forming machine — 1.2 to 5.2 times higher. As for operators of electric bridge cranes, 8-hour asbestos dust concentrations at their workplaces were 1.6 to 4.0 times higher than the MPC.

It should be emphasized that the highest dust concentrations were registered during manual loading of asbestos and transferring it to the conveyor (at the workplace of the asbestos dosing operator).

The issues of regulating chrysotile dust in workplace air have certain specificity. As is has been already noted, in the countries of the European Union the control is based on asbestos fiber counting. The advantage of this method is the possibility to regulate and control the fibrous component of dust. Moreover, in many cases establishing the percentage of fibers in dust is technologically difficult. Here it is critical to note that there exists no universal coefficient that can be used to calculate the mass portion of asbestos in dust based on the fiber count and vice versa even though it is possible to determine the ratio between count and mass concentrations at some workplaces under constant conditions of dust formation.

In order to bring measurements in accordance with the international practice an interdepartmental testing laboratory has been set up in the Institute for Occupational Health of NAMS of Ukraine to measure airborne asbestos fibers. During the research done by the Institute concentrations of respirable chrysotile fibers in workplace air (f/ml) in the asbestos cement industries of Ukraine were established.

The findings showed that at three Ukrainian asbestos-cement factories the lowest concentrations of respirable chrysotile fibers were found in the workplace air of the operator of the sheet-forming machine (0.02 to 0.14 f/ml). It is obvious that these values are within strict international standards (0.1 f/ml for all types of asbestos in the USA). A rather favorable situation was also noted at the workplace of the operator of the electric bridge crane (0.02 to 0.26 f/ml).

Yet, concentrations of respirable chrysotile fibers at the workplace of the asbestos dosing operator were as high as 0.09–1.0 f/ml. It should be emphasized that this workplace is the most hazardous at the enterprises of the asbestos cement industry where hoppers are still used. This issue requires urgent attention.

Although at the majority of workplaces in the Ukrainian asbestos cement industry chrysotile fiber concentrations are within strict international limits, it should be considered that this conformity involves considerable material expenditures and financial costs and is scientifically unfounded. On the other hand, material resources could be directed to other activities that might be more important, efficient and expedient from the point of view of occupational safety and health (information and training programs, more frequent hygienic control, improved medical surveillance, etc.).

Based on substantiated standards for chrysotile asbestos set in other countries of the world as well as results of domestic hygienic, clinical and epidemiologic studies, we believe it is expedient to establish the standard of 1.0 f/ml for chrysotile asbestos fibers in the workplace air [6, 9].

In combination with the ban on amphibole asbestos this limit is quite adequate and contains a safety margin. This very value of 1.0 f/ml was recommended by the World Health Organization in 1989, before the global economic war involving businessmen, scientists, and officials at all levels started.

In accordance with item 10 of the WHO Global Plan of Action on Workers' Health 2008–2017 and item 10 of the Parma Declaration on Environment and Health the Institute for Occupational Health of NAMS of Ukraine has developed draft State Sanitary Regulations and Standards, *The use of chrysotile and chrysotile-containing materials*. These sanitary regulations envisage control of asbestos fiber concentrations in the workplace air. They also establish requirements for occupational safety at civil enterprises that use chrysotile asbestos and chrysotile-containing products, for health protection of the population exposed to industrial emissions of such enterprises, and for the current system of hygienic assessment of industrial data and manufactured products in accordance with the current Ukrainian legislation and with account for the international experience, i.e. provisions of ILO Convention 162 on Safety in the Use of Asbestos, ILO Recommendations № 172, and ILO international rules of safety in the use of asbestos.

This control shall be exercised according to requirements of the method of testing No. 081/12–0673–10 dated 09.03.2010, *Asbestos counting in the workplace air and ambient air by optical microscopy*, developed by the Institute for Occupational Health of NAMS of Ukraine. It is recommended to study patterns of asbestos fiber distribution in the workplace air twice a year (during the warm and cold periods) and after all types of repair and maintenance.

According to DSP-201–97, *State Sanitary Rules of protection of ambient air of populated areas (from contamination with chemical and biological agents)*, asbestos fiber concentrations in the ambient air of populated areas in Ukraine shall not exceed 0.06 f/ml [10]. The studies conducted by the Institute for Occupational Health of NAMS of Ukraine showed that the concentration of chrysotile in the streets of Kyiv was 0.04 f/ml. Thus, concentrations of chrysotile fibers remain within permissible limits despite heavy traffic, ongoing repairs, and demolition of buildings.

This can be explained by the fact that in products of the domestic asbestos cement and asbestos technical industries chrysotile fibers are encapsulated in the cement matrix that prevents their release in the environment under the influence of natural and anthropogenic factors. Over the last 30 years studies of chrysotile fiber release from asbestos-cement products have been conducted worldwide. According to Russian experts, for example, emissions of chrysotile fibers from asbestos cement roofing materials under the influence of natural and anthropogenic factors are negligible. Seasonal temperature fluctuations, contamination of ambient air with aggressive gases, and the service life of buildings do not affect the intensity of asbestos release from asbestos cement materials in indoor air of residential and public buildings as well as in ambient air. Concentrations of respirable fibrous particles in indoor air of public buildings were 2 to 20 times lower than the maximum permissible concentration of asbestos dust in ambient air [11].

German studies of fiber release from chrysotile cement roofing showed low emission levels regardless of minor surface damages. In Austria comparative studies of asbestos concentrations in areas with and without chrysotile cement roofing have demonstrated no statistically significant correlation between the use of chrysotile cement materials and ambient concentrations of chrysotile fibers [12].

At the same time it is impossible to successfully plan actions for elimination of asbestos-related diseases without a comprehensive preventive evaluation of introducing available asbestos substitutes in various industries in accordance with Article 10 of ILO Convention 162.

It is particularly important to emphasize that no conclusions have been drawn so far about the lack of sufficient data for health risk assessment and even potential hazard identification with respect to the majority of fibers, such as carbon, cellulose, polyethylene, PVC, polypropylene, graphite, and magnesium sulfate fibers and graphite whiskers. This, in its turn, hampers the prediction of long-term health effects of the production and use of these fibers. It is, therefore, necessary to conduct a comprehensive in-depth study of asbestos substitutes and their biological effects in particular.

We hope that implementation of all these measures will help improve labor conditions in the asbestos industry and preserve health of workers and population.

References

1. *Virta R.L.* Asbestos: Geology, mineralogy, mining, and uses // US Geological Survey Circular, 1255-KK, 2002. — 28 p.
2. http://www.atsdr.cdc.gov/asbestos/more_about_asbestos/what_is_asbestos/
3. *Batrip P.W.* History of asbestos related disease // Postgrad. Med. J. — 2004. — Vol. 80. — № 9. — P. 602–610.
4. Toxicological profile for asbestos / Agency for Toxic Substances and Disease, Registry Division of Toxicology/Toxicology Information Branch. — 2001. — 441 p.
5. *Kundiyeu Yu.I. et al.* Hygienic characteristics of labor conditions of workers of major professions in asbestos cement industry of Ukraine // Occupational Medicine and Industrial Ecology. — 2008. — № 3. — P. 21–27.
6. *Chernyuk V.I. et al.* Is it possible to use chrysotile asbestos safely? The experience of Ukraine. — Kyiv, Ukraine. — 2008. — P. 36.
7. GOST 12.1.005–88, SSBT. General sanitary and hygienic requirements for workplace air.
8. http://www.who.int/occupational_health/topics/asbestos_documents/en/index.html
9. Substantiation of hygienic standards for harmful chemical substances in various environments on the basis of a systematic approach. Methodical instructions CF 1.1.5.-88-02: Official Publications (zatv. Decision of Chief state sanitary doctor of Ukraine 12.04.2002 p., № 14). — K., 2002. — 40 p.
10. DSP-201-97 «Public health rules for the protection of atmospheric air of population aggregate (from contamination of chemical and biological substances)».
11. *Kovalevsky E.V.* Concentrations of natural and man-made mineral fibrous particles in indoor air of non-production facilities // Occupational Medicine and Industrial Ecology. — 2004. — № 1. — P. 10–15.
12. *Rödelsperger K.* Measurement of inorganic fibrous particulates in ambient air and indoors with the scanning electron microscope // IARC Sci. Publ. — 1989. — № 90. — P. 361–366.