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Study of asbestos exposure in some applications of asbestos materials in the chemical industry

Abstract This study is designed to determine the effects of short-term asbestos exposure on workers in the production of asbestos gaskets and filter materials for technological equipment in the chemical industry. The workers from the "Cathode workshop", "Diaphragm electrolysis", "Polymers" Co., Devnja (12 operators) who operate the installation of asbestos diaphragms manufacture and installation of electrolysis cells, and the staff of the "Mechanical" shop of "Nephtochim" Co., Burgas, engaged in the cutting of gaskets made of pressed asbestos–polymer boards (6 workers), were studied. The hygienic normative standards and methodology for measuring and assessment of the asbestos exposure, used all over the world were applied: mean shift count concentration of respirable asbestos fibres; entire shift personal sampling (BSS 2200–85), PCOM light microscopy (BSS 16909–89). The level of asbestos exposure registered was in the range 0,04 to 0,38 f/cm³ for the operators in the "Diaphragm electrolysis" shop and for the staff in the "Mechanical" shop of "Nephtochim" Co. – from 0.04 to 0.43 f/cm³. The established concentrations are acceptable according to the requirements of the official hygienic threshold limit value (TLV) in Bulgaria (1 f/cm³), but because asbestos is a human cancerogen and there is tendency for regular revision with the intention of decreasing the hygienic TLV, the asbestos occupational exposure of these groups of workers cannot be accepted as safe. The statements made increase the necessity of dust control by technical preventive means and the medical control of the workers exposed to asbestos-related injuries.

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Introduction

Several properties found in asbestos materials make them valuable for use in chemical production, i.e., high resistance to aggressive agents, stability at high temperatures and pressures, non-combustion, insulation and filtration features. The following products: chrysotile, asbestos-textile products, pressed asbestos-polymer components, asbestos bands with Teflon coating etc. are used in the manufacture of fittings, couplings; insulation's for apparatuses and vessels for water steam, acetylene, solvents and other petroleum products; diaphragms for chlorine-alkaline electrolysis etc.

The production methods for mechanical treatment (cutting, polishing) and the consequent change of the product are accompanied by the release of asbestos fibers, for which specific fibrogenic and cancerogenic effects have been proved. In the chemical industry, dust removal operations are usually short-term (less than 3 h per working shift, and frequently not more than 30 min). Small groups of workers are engaged on these activities and they are not identified as a risk group in the asbestos exposure control system in Bulgaria.

The radical measures undertaken in the last two years to resolve the asbestos problem in the country (enforcing major hygienic requirements and restrictions at work with the material) [1] focus attention on the problem of occupational asbestos risk and the fact that there is no alternative safer material that can be used.

Aim of the study

The study is aimed at clarifying the significance of problems in relation to occupational asbestos exposure and the emission of asbestos dust in the ambient air during pro-

Table 1 Results from the determination of the asbestos fibres concentration

Enterprise	Technological operation	Concentration (C) of fine asbestos fibers f/cm³	Asbestos content in total dust (%)	Hygienic assessment K*
Polymers Ltd	Dosage and teaselling of asbestos	0.38	1.5	0.38
Polymers Ltd	Assembly of an electrolysis cell	< 0.1	–	< 0.1
Polymers Ltd	Cleaning of an asbestos warehouse	0.14	1.5	1.4
Neftochim Ltd	Cutting findings	0.43	4	0.43
Neftochim Ltd	Cutting of asbestos ropes	< 0.1	–	< 0.1

Key: $K^* = \frac{C}{TLV}$

duction manipulations with asbestos products in the chemical industry.

Study design and methods

In this study, workers in contact with asbestos from two chemical factories ("Polymers" Ltd., Devnja and "Neftochim" Ltd., Burgas) are included, as well as the organized emission sources as follows:

1. In the "Diaphragm electrolysis", Department, "Polymers" Ltd, Devnja, 12 operators from the "Cathodes" workshop, engaged in the production of asbestos diaphragms made of chrysotile asbestos material, were studied as well as those engaged in the installation of electrolysis cells and the organized emission source. The working procedures involving asbestos (teaseling, weighting) were performed automatically in a special installation, that provided reliable ventilation and filtration of the released air. Only the packaging of the material was carried out manually. Suction cleaning of the dust, deposited on the floor of the warehouse and work premises, was stipulated. The workers were provided with personal protective equipment for respiratory organs.

2. In "Neftochim" Ltd, Burgas, 6 cutters from the "Mechanical" department who were engaged in cutting out at band-saws fittings made of pressed asbestos-polymer boards, were studied. The processes performed by the use of universal drilling machines in partitioned areas in the Mechanical Department without local ventilation. The workers were provided with suitable personal protection equipment for respiratory organs. Dust deposited on the floor was wetted when cleaned, and the waste was packed in polyethylene bags for storage on landfill sites.

Measurements were taken of the average shift concentration of asbestos dust in the breathing zone of the operators in both processes and of the emissions from the organized source at the machine for teaseling the asbestos in "Polymers" Ltd, Devnja, during the period of 1 to 2 working shifts. The sampling was performed observing all requirements of BSS 2200–85 [2], BSS 16909–89 [3], BSS 172402–78 [4] and *EN 689/1995* [5]. Personal and stationary dust sampling devices of "Higitest" and "Guilian" types were used.

For the assessment of asbestos exposure, the standard parameter generally accepted all over the world [6] and in Bulgaria was applied: average shift count concentration of respirable asbestos fibers (with diameter (d) < 3 μm, lengths (l) > 5 μm and aspect ratio l/d > 3) with the threshold limit value (TLV) in Bulgaria 1 fiber/cm³ [7] and action level – 0.2 f/cm³ according to CD 91/382/EEC [8].

The asbestos emission is evaluated according to the index "mass fiber concentration" with TLV 0.1 mg/m³ [9].

The determination of the count concentration of asbestos fibers is performed by microscopic method, according to BSS 16909–89 [3], using a "Reichert" microscope with a magnification of 600 times.

In addition to the asbestos count concentration, the content of mass in the air of the work environment was studied. For the determination of the asbestos content in the dust of the air and its concentration in the emission, the infrared spectrometric gravimetric method was used [10].

The study was carried out in the "Chemical factors of the work environment and dust" laboratory in the National Centre of Hygiene Medical Ecology and Nutrition, Sofia in 1996.

Results

The results from the study (Table 1) show the presence of asbestos pollution in the air of the working environment and emissions from the manufactures studied.

The asbestos content in the dust in conditions of dust protection of the asbestos – machine (at teaseling the asbestos material) in "Polymers" Ltd, Devnja was reduced to 1.5%. In the working places without purification systems in "Neftochim" Ltd (cutting out the asbestos-polymer sheets) it was relatively higher at 4%.

The occupational asbestos exposure of the staff in both sites was acceptable in complying with the acting TLV in Bulgaria (below 0.5 TLV) but cannot be considered safe according to the stricter requirements of the EC Directives [6, 8]. For the operators of asbestos-machinery in "Polymers" Ltd and the cutters of asbestos-polymer boards in "Neftochim" the action level [8] is exceeded twice, imposing the need for additional measures for dust protection and prevention.

The content of fine asbestos fibers in the emissions from the organized source in "Polymers" Ltd is about 0.1 TLV.

Conclusions

The results of the study of the dust factor, related to the use of asbestos items in the petroleum-chemical and polymer production industries show the presence of acceptable levels according to the acting national standards for asbestos pollution in the work environment air and in the emissions from the organized source.

The level of asbestos exposure of the workers is below 0.5 TLV, which cannot be considered absolutely safe, particularly as the proved carcinogenicity of asbestos dust and the world trend to the revision and reduction of the threshold limit values.

In the particular productions the following additional technical-prevention measures for dust removal from the operations with asbestos materials must be undertaken: (a) using local suction devices at filtration of the output air in "Neftochim", Ltd for the cutting of asbestos-polymer sheets; (b) implementation of suction cleaning of the dust deposited on the floor and on the uncovered machines surfaces in "Neftochim", Ltd; (c) automation of cutting of the asbestos material when producing asbestos diaphragms in "Polymers", Ltd.

These findings recommend the implementation of hygienic controls of asbestos dust for such activities and medical check-ups for those workers exposed.

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