TESTING THE RESISTANCE OF THE PROTECTIVE CLOTHING AGAINST CHEMICAL AGENTS IN ORDER TO ASSESS THEIR CONFORMITY

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ABSTRACT: *The technology development resulted in solving numerous aspects of industrial hazard. Nevertheless, new hazards arise and a number of risk factors are represented by chemical hazards.The chemical products production growth determined the increase in the number of the units where these hazards can appear, during the production, storage, handling and transport activities. Hazard assessment for handling these products, for professional diseases and consequences is required both for workers and environment protection.The European Union initiated the Council Directive 89/686/CEE regarding the harmonisation of the legislation from Member States related to protective clothing, in order to provide safe products in European Union.Within the project "Technologies for testing the resistance, permeation and the degradation of the protective clothing against chemical agents in order to assess their conformity" has been developed a test bench for determining the resistance of the protective clothing at the chemical liquid penetration, according with the requirements of SR EN ISO 6530 standard.*

KEYWORDS: personal protective equipment, chemical agents, conformity assessment, tehnology

1.INTRODUCTION

The technology development resulted in solving numerous aspects of industrial hazard. Nevertheless, new hazards arise and a number of risk factors are represented by chemical hazards. This is important due to the gravity of the consequences (professional disease hazard) and the influence over the social relationships and over the indirect cost of the finit product. Increased production of chemical products determined the increase in the number of units where may occur these risks during the manufacturing, storage, handling or transport. The risk assessment of such products, the health hazards and their

The assessment of chemical risk due to hazardous chemicals should take into account the following information: chemical properties of substances, the concentration, the work conditions in the presence of such agents, duration of the exposure to chemical hazardous, etc.

In accordance with the Decision no. 1218 of 6 September 2006 the employer must ensure that the risk to safety and health in the work process induced by a hazardous chemical agent is eliminated or minimized. Is compulsory to abide the chemical agents from the work environment occupational exposure limit-values or workers tolerable biological limit-values in order to maintain the chemical agents concentrations at the lowest level possible [2].

When the presence of the hazardous chemical agents in the workplace is established, the employer must assess consequences is necessary both to protect workers and the environment.

Risk assessment for every work place is the main objective of the work of prevention the occupational accidents and diseases. Depending on the nature of the risks embedded in human activity they can affect both directly the personnel involved in the work system and non-participating persons or the environment. The range of risks embedded in human activity, the risk from chemicals, justified by the results of the statistics, show that accidents caused by chemicals occupies a significant place.

any risk regarding the workers health and safety from the presence of the chemical agents, taking into account:

a) their hazardous properties;
b) information provided by the supplier relating to safety and health of workers (FTS);
c) the level, type and duration of exposure, taking into account all possible routes of exposure;
d) the conditions under which the work is performed in the presence of such agents, including their quantities;
e) the national occupational exposure limit values or biological limit values
f) the effect of preventive measures taken or to be undertaken;
g) the conclusions resulting from health surveillance already made when available.

The employer must ensure that personal protective equipment is in accordance with the appliable laws in relation

to the design, production and delivery, taking into account workers health and safety.

Romania, as European Union member, took over the European Directives into national law. Thus emerged the Government Decision no. 115 of 5 February 2004 on the establishment of the essential safety requirements of personal protective equipment and conditions for placing on the market, which transposes the Council Directive 89/686 / EEC of 21 December 1989 on the harmonization of the provisions relating to individual equipment protection and Decision no. 809 of 14 July 2005 amending the Government Decision no. 115/2004 [1].

In the work process, the workers may be exposed to risk factors that can lead to accidents and occupational diseases. Starting from this reality it was developed the concept of protection of labor which is defined as a set of activities aiming to ensure the best working conditions in the work process, protection of life, health and safety of both workers and others participating in the work. In the Romania occupational safety is regulated by Law no. 319 of July 14, 2006 - Health and Safety at Work Act [5].

The manufacturer must provide the information in the technical documentation of the measures which he adopted to ensure the compliance of the personal protective equipment with the essential requirements for workers health and safety.

The essential health and safety requirements define the results to be achieved or hazards that must be taken into account, but does not specify or predict the technical solutions for this. They are also formulated so as to assess the compliance with these requirements, in the absence of harmonized European standards or if the manufacturer chooses not to apply the standards. This flexibility allows manufacturers to choose the most appropriate way to meet the requirements.

Personal protective equipment is regarded as being in compliance with the essential safety and health requirements if the CE marking is affixed and the manufacturer is able to submit a declaration of conformity. CE marking is a symbol that confirms that all relevant conformity assessment procedures have been completed and it is a statement by national market surveillance authorities.

Personal protective equipment may be placed on the market and commissioned only if they comply with the all the essential safety and health requirements.

Conformity assessment procedures with the requirements of different categories of equipment depends on (fig. 1):

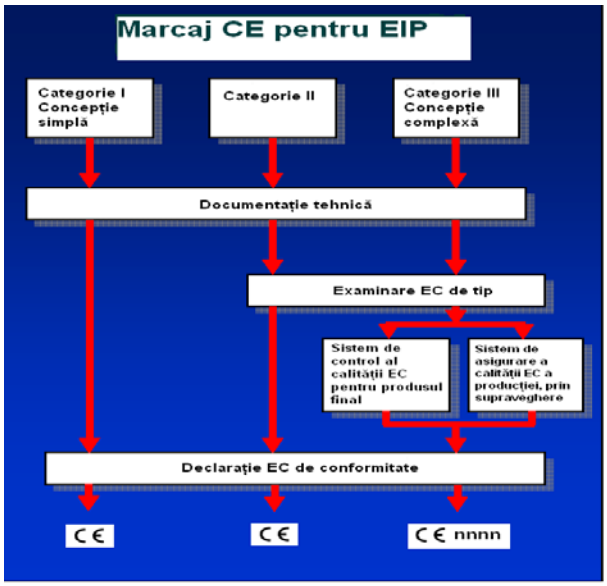

Fig. 1. Conformity assessment procedures with the requirements of different categories of equipment depending

1.1.Chemical protective clothing

Development of modern technologies also led to increased multilateral chemical hazards to which a worker is exposed. These chemical risks arise in sectors such as chemical, pharmaceutical, petrochemical industry and agriculture, where is required the use of protective clothing resistant to chemical, toxic gases and hazardous dust. The variety of hazardous chemicals has led to the necessity of developing a set of chemical protective clothing.

In the manufacture of protective clothing the used materials are selected according to the chemicals against it is desirable to be protected from. For this purpose the chemicals were divided into a number of classes of substances with the properties similar to penetration, permeation, and degradation of the material. For these effects have been developed and standardized test methods relevant with the appropriate levels of performance. It was also recognized that there is no material for the manufacture of protective clothing that protects against all chemicals. This has created new combinations that offer a wide range of protection [3].

Protective parties of such personal protective equipment must prevent properly the direct contact of dangerous substances (chemical, biological) with the skin or eyes. Personal protective equipment that protects against hazardous substances must have appropriate penetration and permeation properties, taking into account the risk and the tasks which they are designed for. Therefore, the representative chemical tests will give an indication to the user. The instructions of the test substance should be clearly specified, so that the end user can select personal protective equipment suitable for the task. The significance of these results (eg breakthrough time) must be explained in order to be clear for the user of personal protective equipment. On this basis the user will be able to evaluate the protection and protection time for its working position [4].

The development of the protective clothing showed a significant improvement over the past decades. From the use of protective clothing with some protective properties, to the

design of complex protection systems, multifunctional using modern materials and sophisticated manufacturing techniques was a long way to go. On the technical side, the requirements that must meet protective clothing became more complex. Thus, a combination of different requirements, such as protection, comfort and fashion and other functional properties has led to the development of modern protective equipment thereby ensuring to an improvement in the quality of life of worker health and safety.

These properties must be satisfied at least for the period of use indicated in the instructions.

In practice, all materials have limited time protection so warnings and instructions information is necessary and relevant. It is not possible to test the effectiveness of protection against all substances (or mixtures of substances) in all environmental conditions.

2.MATERIALS AND METHODS

In order to determine the resistance of materials to penetration by liquids was used EN ISO 6530: 2005 standard "Protective clothing. Protection against liquid chemicals. Test method for resistance of materials to penetration by liquids.

This international standard specifies a test method for measuring the penetration index, absorption and rejection the protective clothing materials against chemical splashes low volume liquid at low and high pressure.

To determine these parameters was performed an experimental stand (Figure 2) according to SR EN ISO 6530: 2004, composed of the following components:

- rigid gutter (1) semi-cylindrical shape with diameter of 125 ± 5 mm, length of 300 ± 2 mm and 45 ° inclination on which is placed absorbent paper of a thickness of from 0.15 to 0.20 mm, a transparent film (2) and the test specimen (3);
- rigid lid (4) of semi-cylindrical shape, with a length of 270 mm, an external diameter of 105 ± 5 mm and uniformly distributed mass 140 ± 7 g;
- syringe (5) attached to a hypodermic needle with a hole of 0.8 mm ± 0.2 10 ± able to provide 0.5 cm^3 liquid sample in a 10 ± 1 s;
- small glass (6);
- exactly balance 0.01 g;
- timer.

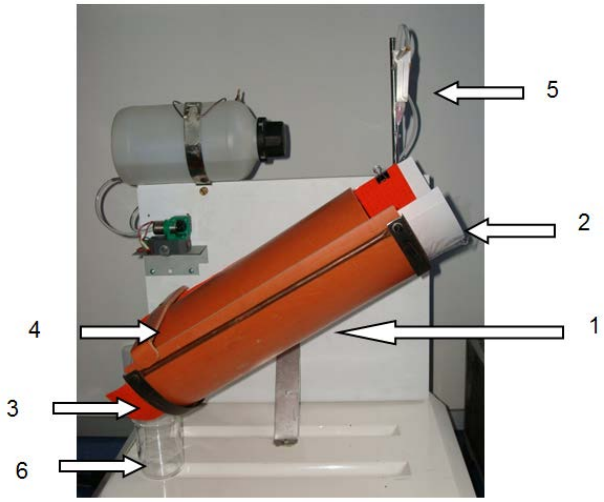

Fig. 2. Experimental stand for determining the penetration index, absorption and rejection the protective clothing materials against chemical splashes low volume liquid

For the experiment of the stand and method were sampled six samples (360 ± 2) mm x (235 ± 5) mm from antistatic materials (Figure 3,4,5) of different colors used in the manufacture of personal protective equipment. As test liquid was used 96% ethyl alcohol solution – with distilled water in a ratio of 1: 1.

Fig. 3. Sample 1

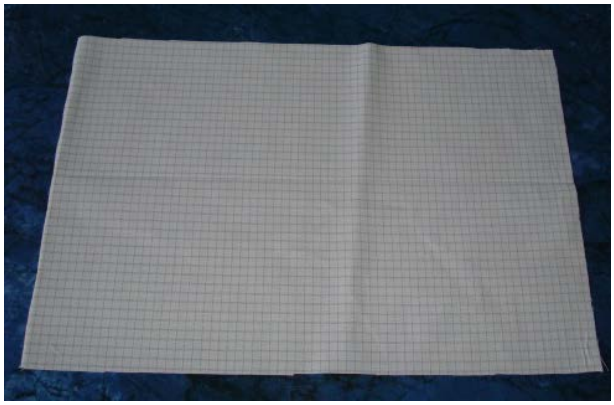

Fig. 4. Sample 2

Fig. 5. Sample 3

3.RESULTS

After conducting tests were obtained results listed i table no. 1.After the test the following were observed:

- for sample 1 - orange antistatic material with small grid:
  - the penetration index I_P varies between 37.6 and 67.1;
  - the rejection index I_R varies between 0.7 and 1.63;
  - the absorption index I_A varies between 24.7 and 36.2.
- for sample 2 - white antistatic material with small grid::
  - the penetration index I_P varies between 42.2 and 51.3;
  - the rejection index I_R is 0;
  - the absorption index I_A varies between 30.3 and 50.9.
- for sample 3 - white antistatic material with large grid:
  - the penetration index I_P varies between 37.5 and 57.4;
  - the rejection index I_R is 0;
  - the absorption index I_A varies between 33.1 and 43.5.

Table no. 1

No.	Sample	Test identification	Penetration index I_P	Rejection index I_R	Absorption index I_A
1.	***Sample 1***	Test no. 1	37,6	0,7	24,7
		Test no. 2	44,6`	1,63	30,0
		Test no. 3	45,6	0,7	28,4
		Test no. 4	67,1	0,8	36,2
		Test no. 5	62,8	0,7	31,3
		Test no. 6	58,7	0,9	33,1
2.	***Sample 2***	Test no. 1	51,3	0	45,6
		Test no. 2	46,1	0	50,9
		Test no. 3	42,2	0	33,3
		Test no. 4	43,4	0	34,0
		Test no. 5	45,3	0	30,3
		Test no. 6	43,3	0	30,8
3.	***Sample 3***	Test no. 1	37,5	0	33,4
		Test no. 2	54,2	0	40,4
		Test no. 3	53,1	0	31,8
		Test no. 4	52,5	0	43,5
		Test no. 5	57,4	0	40,6
		Test no. 6	57,2	0	33,1

Note: The difference of up to 100% of the sum of all indices was due to the evaporation of the solution under test, in the case of alcohol vapor and a large area (0.08 m2) in time from the test liquid discharge sample by weighing the specimen, filter paper + a transparent film and the glass used.

4.CONCLUSIONS

Personal protective equipment against hazardous chemicals should be evaluated on compliance with the requirements of Council Directive 89/686 / EEC which are implemented in the Government Decision no. 115 of 5 February 2004 on the establishment of the essential safety requirements of personal protective equipment and conditions for placing on the market and Decision no. 809 of 14 July 2005 amending Government Decision no. 115/2004.

For the conformity assesement of the personal protective equipment against chemical agents is necessary to determine the resistance of materials to penetration by liquids, so that it can be assessed the 3.10 requirement "Protection against dangerous substances and infective agents" of personal protective equipment, according to the directive.

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