

## Selected Perspective Methods of Research of Barrier materials Resistance against Permeability of under interest Toxic Substances

Pavel Otrisal\*

NBC Defence Institute of University of Defence, Czech Republic

### Introduction

Determination of resistance materials protection properties used for Armed Forces Chemical Corps (CCs) and any other Rescue Brigades specialists individual protection forms basic demands for their evaluation and possibilities of improvement within a respect of a reduced amount of financial resources which are detached into a nations Ministries of Defence budget. A paper deals with selected methods used for study of the resistance against toxic compounds permeation within the Czech Armed Forces and marks possible trends of individual protection branch development with the application based on QCM (Quartz Crystal Microbalance) detection. Is this method suitable for testing of barrier properties of materials used in Individual protection or we can rely on the standard methods working on chemical detection principle?

Testing of protective suits is done in the Czech Armed Forces in a stage of their development thus at the time before their establishment into the armament. However, nowadays we have to rely on typical chemical methods which are not employable in any case of chemical threats. Measurement of resistance has been performed entirely for CWAs in the recent time. New suits, however, have to be tested beyond CWAs also for chemical compounds enumerated in a Czech State Norm for an appropriate type of suits. Testing for Chemical warfare Agents (CWAs) which results from the Military Technical Institute in Brno [1] methodology uses a two-stage chemical reaction between sulfur mustard and indication treatment agents. Hygroscopic cellulose paper colored by the Kongo red color (pH-indicator) is used as a mustard indicator within this methodology. The paper is activated after its exsiccation with CNITI-8 chloramide [*N*-chlor-*N*-(2-tolyl) benzamide]. An indication principle lies on CNITI-8 chloramide reaction with sulfur mustard. During this reaction comes to release of hydrogen chloride which changes an alkali form of the acid basic indicator to acid one. It is done with a change of the Kongo red color which alternates from red color into the blue one by the way of the azo-hydrazone tautomerism. Indication paper is in a direct contact with a measured isolative folio. The blue-change reveals in a place of CWA penetration. A moment of a threshold amount of CWA (0,005 mg.cm<sup>-2</sup>) penetration is signalized with the first visible blue spot which has an average of 1 mm. Testing is very simple and there is quite no need to use complicated devices. Because the testing is done with real CWA reached results are representative and inform about real tested materials protective properties in face of CWA. During this measurement is necessary to catch the first moment of tested chemical compound penetration on an under-side of tested material which is a basic disadvantage. It is very difficult from the point of view observer's psychical condition. Moreover, it is significant to detach minimally one person from a CCs unit organizational structure for permanent observation of chemical compound penetration which can decrease overall CCs unit operational capabilities.

For testing of constructive materials resistance within TICs the equipment of PIEZOTEST has been developed and experimentally used. It is a piezoelectric device, which has a sensor made from quartz. This one works as a quartz crystal microbalance, so called QCM detector. A thin polymer layer is coated on the detector. In this layer study both CWAs and Toxic Industrial Materials (TICs) permeated through study polymer into an area of the QCM detector material are caught. The detector is able to measure weight changes very sensitively namely with nanogram exactness. The weight additions of pollutants in a detector polymer layer reveals piezoelectric crystal working frequency grow which is evaluated as an objective quantity. After recounting of QCM detector working frequency on particular concentration enables to construct dependence of that concentration on time. After that it is possible read the value of breakthrough time for the tested chemical compound. After finishing a particular measurement there are a lot of possibilities how to assess data. You can either simply put it into a software enables you to draw a chart or to use a more sophisticated software to evaluate under interest concentrations.

In order to answer a question mentioned above there are some advantages of QCM detection. Among the most important one belongs to:

- Possibility of measurement executing for a wide scale CWAs and TICs, including unknown liquids chemical compounds;
- The measurement objectivity. Gained results are not influenced by a man's perception limit. The exactly measured physical value is received. This value does not allow not clear interpretation;
- Measurement can be performed for theoretically arbitrarily long breakthrough times of any barrier material either established into the armament of CAF CC or materials designated for people protection against chemical contamination effects, including both so called predatory material and IPE provided in a framework of Host Nation Support;
- Automatic measurement of observed values after preparation and launching of measurement devise in a form of a simple software tool connected with a common commercial personal computer;

\*Corresponding author: Pavel Otrisal, NBC Defence Institute of University of Defence, Czech Republic, E-mail: [pavel.otrisal@unob.cz](mailto:pavel.otrisal@unob.cz)

Received December 20, 2011; Accepted December 20, 2011; Published December 23, 2011

Citation: Otrisal P (2011) Selected Perspective Methods of Research of Barrier materials Resistance against Permeability of under interest Toxic Substances. J Def Manag 1:e102. doi:10.4172/2167-0374.1000e102

Copyright: © 2011 Otrisal P. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

- Possibility of dynamic permeation assessment for the couple of chemical compound-tested material;
- Work within a range of low voltage. It calls only for lower demand on a vehicle electric set during the action in field conditions;
- Relatively low a purchase price of a complete measurement equipment;
- Relatively high stamina against damage with the exception of the QCM detector;
- Single-valued and simple measurement results assessment;
- Good reproducibility of tests;
- It is an experimentally unpretentious method which is manageable after a short practical skill;
- Possibility to measure not only isolative but also permeable materials with the only change of measurement cell parts;
- Possibility of a results big amount receiving. Theoretically a non-limited number of measurements cells in one period of time can be used;
- Possibility of the cell arrangement while keeping of the same technical and applied and program equipment;
- Experimentally easy managed program equipment with no extra high demands related to the work with used application-programme equipment;
- Possibility of usage of permeation cells different types in dependence on a character of measured material.

The employment of QCM detector seems to be a very effective way how to provide information to operational commanders related to use barrier materials quality in current time. Information concerning the fact that isolative barrier materials still protects either entirely or only partly provide informational support to commanders for realization of high-quality decisions belonged into the area of either protection against WMD or Chemical Support.

#### Reference

1. Methods of Military Technical Institute of Protection, Brno (CZ), Individual and Collective Protection. Determination of Breakthrough time of protective materials contaminated by either drops of Gases of Sulphure Mustard in Static Conditions (Methods of MIKROTEST) In Czech.