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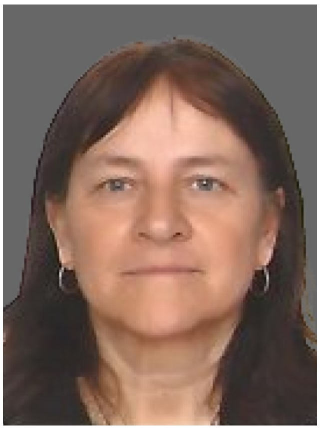

Topic of the Speech:
Air Permeability and Breathability Evaluation of Textile Layers

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Dr. Dana Kremenakova is Associated professor at the Department of Material Engineering, Faculty of Textile Engineering, Technical University of Liberec, Czech Republic. She is working in the field of Textile Sciences, especially textile materials and technology. She is focusing mainly on thermal transport properties and barrier properties of fibrous structures, development of special metrology, prediction of geometrical and mechanical properties of fibrous assemblies, modelling of textile structures in line fibre – yarn – fabrics, prediction of thermal comfort, optical and mechanical properties of side emitting polymeric optical fibres and their application in textile structures. She has published 8 books (author and co-author), in Scopus are indexed 114 documents, 487 citations and h-index 10. She is a co -author of 2 international patent, 3 national patents and 5 utility issues.

She was a member of the research team or coordinator of about 20 research projects. She is guarantor and lecturer of the subject "Nanotechnology in the Textile Branch" within the study program WE-TEAM Erasmus Mundus Joint Master Degree (AUTEX).

ABSTRACT SUBMISSION
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Air Permeability and Breathability Evaluation of Textile Layers

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ABSTRACT (NO MORE THAN 500 WORDS:)

On the one hand, the face mask protects against the penetration of viruses from the wearer or from the environment to the wearer, but on the other hand it prevents natural breathing. Air consumption in liters per minute (so-called minute ventilation) is 8 to 10 l/min at rest in both non-sporting and sporting populations. Under load, air consumption increases to a maximum of 120 l/min, for a trained person it can be up to 180 l/min. ISO/TS 16976-1 specifies the metabolic rate for various types of work from industry to firefighting or rescue operations. The average value of oxygen consumption in l/min for the most demanding task was 3.55 ± 0.27 l/min. Due to the proportion of oxygen in dry air (20.93%), the human body's ability to absorb oxygen (2% to 5%), and the tendency to hyperventilate when the body is stressed, it is known that the human body can use up to 160 l/min of air (maximum air flow according to the CE standard EN 149:2001 + A1:2009). According to the CE standard, the maximum pressure difference during exhalation is 300 Pa. A pressure difference of 100 Pa and higher corresponds to breathing discomfort according to our tests.

The methodology for measuring the breathability of textile layers is based on measuring the air permeability of textiles according to ČSN EN ISO 9237. The air permeability of porous textile layers and sandwiches is discussed and different approaches for its prediction are proposed.

Air permeability is measured as a function of the pressure difference in the interval from 100 to 300 Pa. The air permeability values must be recalculated to the area of the nose and mouth (approx. 350 mm^2), and thus obtain the breathability. According to the Darcy and Karman-Kozeny model, it is possible to assume a linear dependence of air permeability/breathability on the pressure difference (valid for the mentioned low values of pressure differences). From the measured data, regression equations (straight lines passing through the origin) can be found corresponding to breathability in liters per nose and mouth area per minute depending on the pressure difference. The basic characteristic of breathability is then the slope of the regression line passing through the origin. Using regression equations, pressure differences corresponding to different respiratory loads can be found, thus determining the level of breathing discomfort for given textile layers.

The proposed methodology was tested on a number of different types of textile structures and sandwiches composed of them. Nonwoven polypropylene layers composed of a combination of microfibers and nanofibers were used in the sandwiches, and breathability was monitored with respect to their surface weight.

It has been shown that a suitable combination of the mentioned textile layers can be used to prepare a face mask prototype that can have breathability from the level of a commercial mask to the level of a commercial respirator.

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