18th International Conference
ENGINEERING MECHANICS 2012
Svratka, Czech Republic, May 14 – 17, 2012

pp. 194–195
Paper #126

MACRO-MECHANICAL PROPERTIES OF NANOTEXTILES ON PLGA BASE – TENSILE STRENGTH

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Abstract: *The paper presents the results measured during the macro-mechanical study of properties of nanotextiles based on poly-(lactide-co-glycolite) acid (PLGA). These nanotextiles are extensively used in biomedicine and many other applications, and therefore it is important to reach a certain level of mechanical properties so that they can be used properly. Very easy and cheap method, so called passportization, can be utilized for investigation of nanotextile microscopic properties. For the testing of macro-mechanical properties it is possible to use common testing methods like in case of textiles and membranes (e.g. water vapor barriers). The results of tensile strength related to the width of tested sample are presented in this paper. Finally, certain aspects limiting the use of common testing methods (especially nanotextile weight per unit area) are discussed.*

Keywords: ***nanotextiles, nanofibers, mechanical properties, tensile strength, PLGA.***

1. Introduction

Macro-mechanical properties are lately investigated even in case of nano-materials. The following text is specifically focused on nanofibre materials based on polymers and their macro-mechanical properties. The tested nanotextiles were spun using "NanoSpider" technology (Elmarco Ltd.) that works on principle of needleless electrospinning. Using this technology it is possible to produce nanotextiles with the width of up to 4 meters (Li et al., 2002). The resulting fibers have typical thickness from tens to hundreds of nanometers. The mechanical test of nanotextiles can be performed using conventional testing techniques (Andrady, 2008). For the macro-mechanical testing there were used nanotextiles based on Poly-(lactide-co-glycolite) acid (PLGA).

2. Experimental methods and samples

The PLGA based nanotextiles were spun in the Center for Nanotechnology in Civil Engineering, at the Faculty of Civil Engineering, Czech Technical University (CTU) in Prague. This center uses the Elmarco NS Lab 500 S. The PLGA solution for electrospinning was prepared as 2.3% concentrate where 0.23 g of PLGA were stirred with 4 ml of dimethyl chloride and subsequently 6 ml of dimethylformamide were added. The nanotextile samples with the length of 40 mm and width between 21 and 25 mm were cut out from the PLGA based nanotextile. The nanotextile layer was subsequently carefully separated from the polymeric support textile (spunbond). The samples' weights per square meter were determined from their dimensions and weights. The ends of tested samples were strengthened by a paper tape to prevent damage of the PLGA nanotextile. The tensile strength tests were carried out on LabTest 4.100SP1 device at the Faculty of Civil Engineering of CTU in Prague. The measuring range was set to 50 N maximum where the accuracy exceeds 0.1 % (at 2 N force).

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3. Experimental results

The resulting forces were unified by dividing them by the width of the sample (N/m). For the weight per square meter of 3.1 (± 10 %) g/m^2 the resultant force reaches 7.4 E-5 (± 10 %) N/m. The results were determined as the arithmetic mean of 6 measurements.

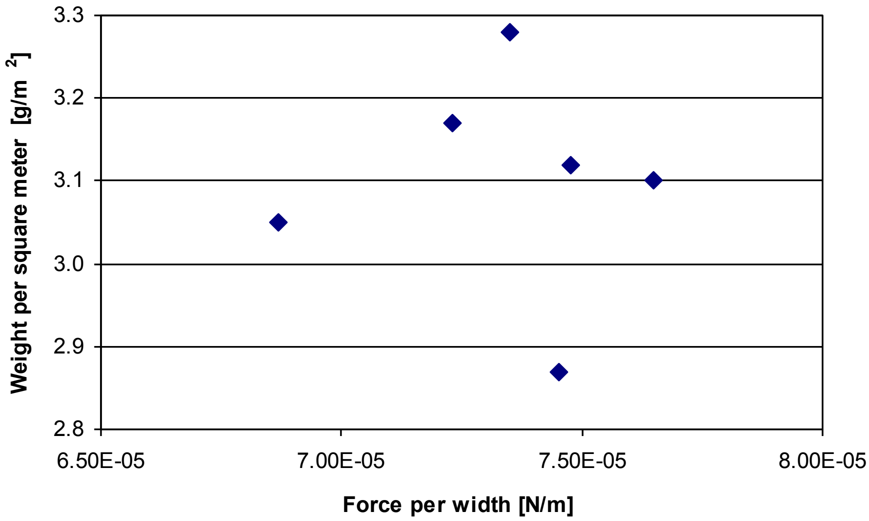

Fig. 1: Measured results of tested PLGA nanotextile samples

4. Conclusions

The nanotextile tensile strength testing showed the feasibility of such a testing. There are certain critical aspects limiting the testing of nanotextiles on common equipment (pull test devices). From the practical point of view it is possible to work with polymeric nanotextiles that have weight per unit area more than 1 g/m^2 (Krňanský et al., 2011). Working with nanotextiles with lower weight per unit area is very complicated because of the nanofibre surface tension when the nanotextiles tend to wrap up. Other aspect is the treatment of the nanotextile sample ends that must be strengthened before fastening in the clips. In the next step, it is proposed to move the nanotextile testing into micro-level, e.g. using AFM (Atomic Force Microscopy) and nanoindentation devices (Tesárek & Němeček, 2011), and finally compare the results obtained in macro- a micro-level.

Acknowledgement

This outcome has been achieved with the financial support of the Grant Agency of the Czech Republic (P108/12/0891 - Nucleation on strongly curved surfaces of PLGA nanofibers) and the Czech Technical University in Prague (SGS12/110/OHK1/2T/11 – The use of nanotechnology in construction).

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