UDC 620.17

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METHODS FOR DETERMINING THE PHYSICO-MECHANICAL PROPERTIES OF POLYMERS

The paper deals with design of methods for static experiment and dynamic experiment as low-cyclic tensile tests of polymer reinforcements for composites with using temperature chamber. For textile materials, DIN 53835-13 standard is defined [1] and according to mentioned standard the conditions are takes into consideration during the first 5 cycles.

The universal testing device Autograph AG-X plus 5 kN – Schimadzu with video-extensometer with test mode Control of software Trapezium X was used for experiments [2]. The calibration process is shown on the Fig. 1.

The design of method is on the Fig. 2, loading speeds are set to 250 mm/min for cycles and 50 mm/min for a pre-test by force value 2 N. The test consisted of ten cycles; every cycle is defined as loading to certain percent of elongation with pause 5 sec (measurement with stress relaxation). The loading speed of 150 mm/min (as the second method) was used to compare the results with loading speed of 250 mm/min. Special jaws for textile materials were used. The initial length between the jaws was 250 mm. The measured length (i.e. the distance between points for the video-extensometer) was approximately 150 mm.

The first tests for polyester were done upon selected positive temperatures (25 and 80 °C), see sample on the Fig. 3. Dependences of force on deformation obtained by video-extensometer are on Fig. 4.

The results will be use in computational modeling as inputs for calculations in relation to the material characteristics and parameters. The next research area of authors will be focused on the specific testing of polymers upon cyclic multi-axis (biaxial) temperature loading with special testing equipment called Arcan test (see Fig. 5) with temperature chamber allows the tests from -70 to + 180 °C and from +20 to + 80 °C it is possible change humidity from 30 to 95 %.

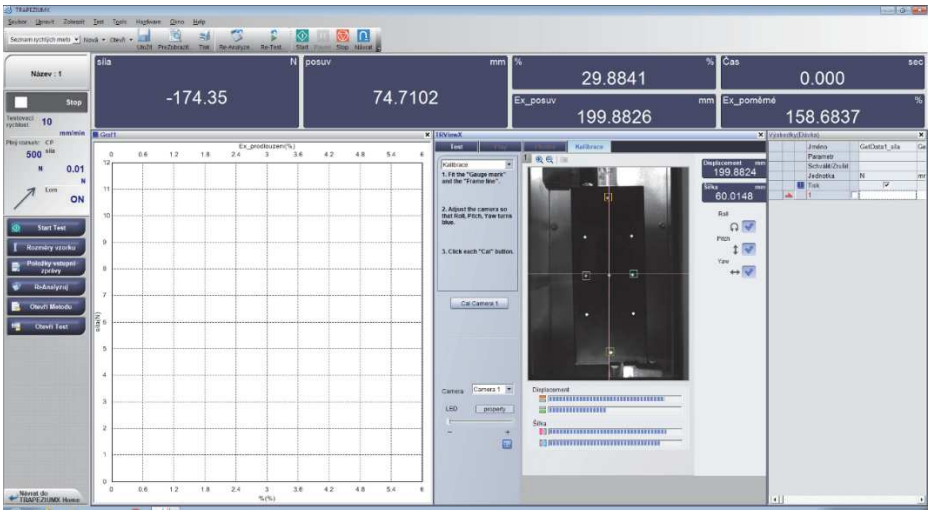

Figure 1 – Calibration process

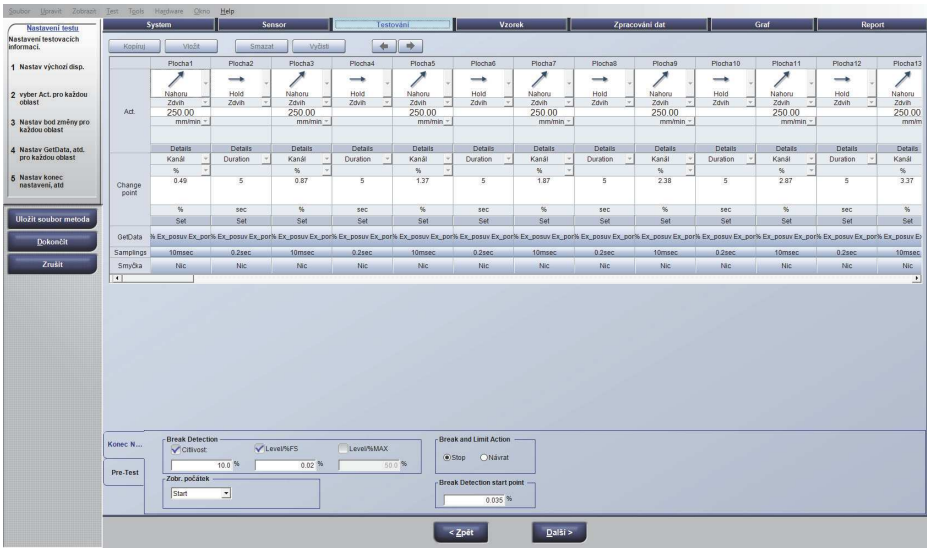

Figure 2 – Method design for cycle loading

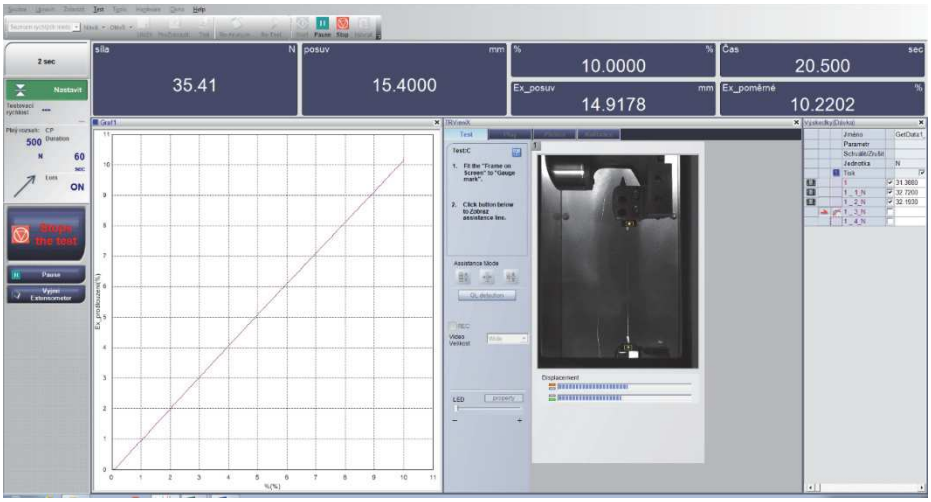

Figure 3 – Testing with temperature chamber

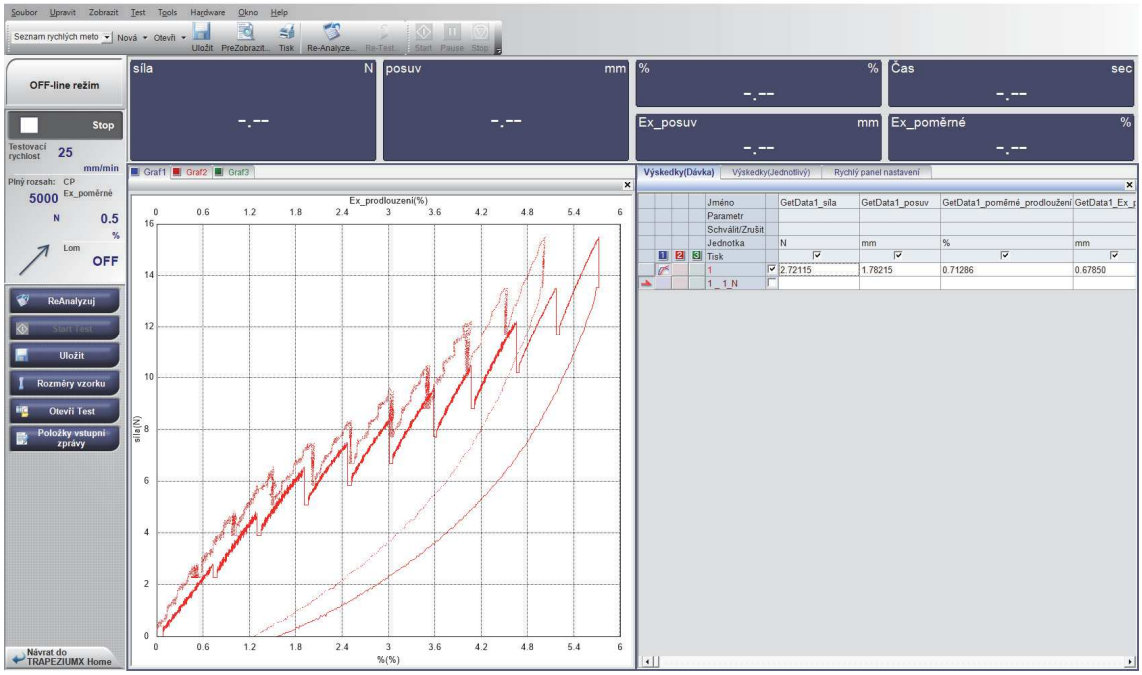

Figure 4 – Dependences of force on deformation (elongation)

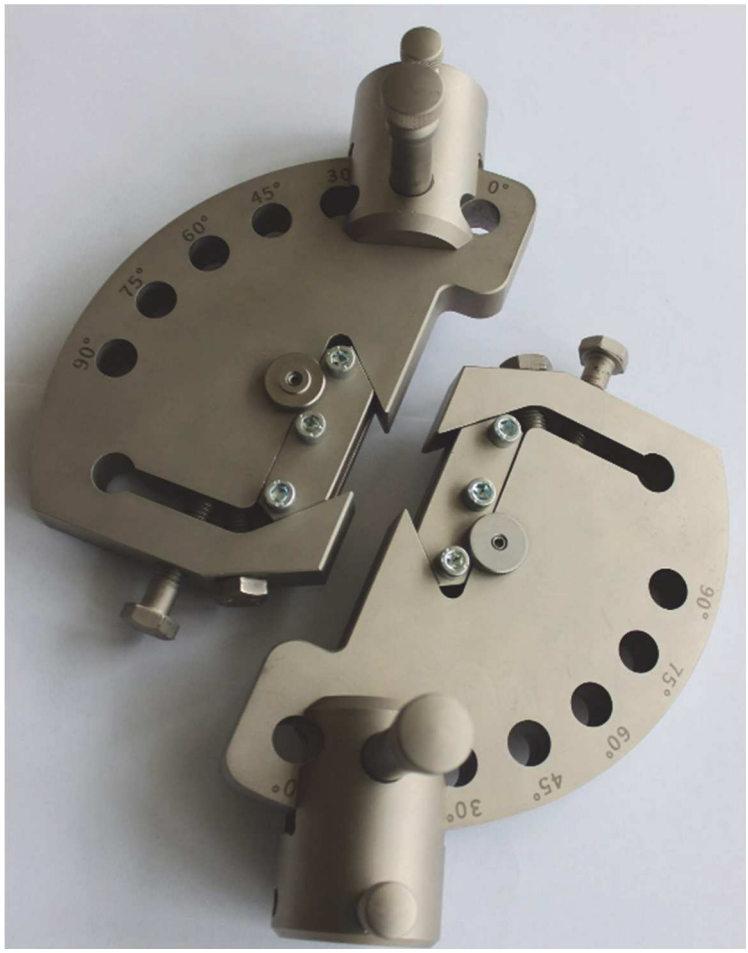

Figure 5 – Arcan test

Acknowledgement: This research work had been supported by the Cultural and Educational Grant Agency of the Slovak Republic (KEGA), project No. **KEGA 002TnUAD-4/2019**.

References

1. DIN 53835-13, Testing of textiles; determination of the elastic behaviour of textile fabrics by a single application of tensile load between constant extension limits. 1983.

2. KRMELA, J. Tire Casings and Their Material Characteristics for Computational Modeling. Scientific monograph. Czestochowa, Poland, 2017. ISBN 978-83-63978-62-4. http://krmela.wz.cz/kniha_obalka_en.png