Effect of Temperature During The Preparation Process on The Mechanical Properties of Elastomer Blends

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The study focuses on the preparation of elastomeric compounds based on natural rubber (NR) and a filler – cellulose (CEL) at various temperatures ranging from 95 to 140 °C. The influence of mixing temperature and filler content on the mechanical properties of the elastomeric blends was examined. The filler content in the blend was 0 phr, 27.6 phr and 55 phr. The prepared blends were analysed for hardness, tensile strength, and elongation at break before and after thermo-oxidative ageing (TOA).

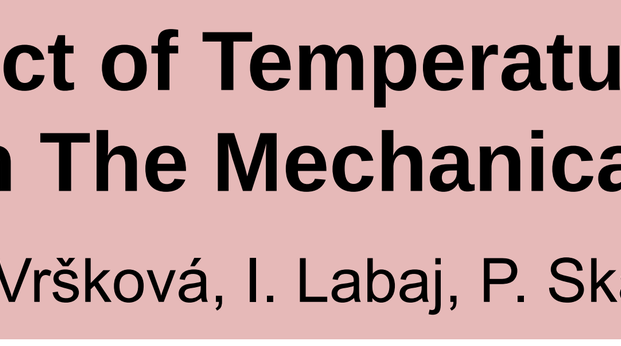

Fig. 1 Brabender Plastograph EC Plus – Measuring extruder 19/25 D

Elastomeric compounds were prepared in two-step by using laboratory mixer Plastograph Brabender type with chamber volume 80 cm^3 and 50 rpm (Fig. 1). The first mixing stage of the compounds was carried out from 95 to 140 °C , while the second stage was performed at 80 °C. For specification tensile properties of samples were used Universal Tensile Testing Machine – Autograph AG-X plus 5 kN. Hardness was measured by using Hardness tester IRHD.The thermo-oxidative aging test was carried out by using a thermostat set to 100 °C and 72 hours.

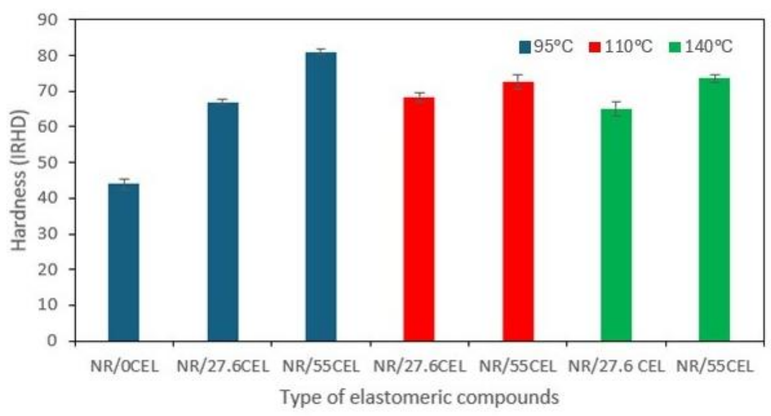

Fig. 2 Effect of filler amount (CEL) on the hardness of NR blend mixed in stage I at different temperatures before TOA

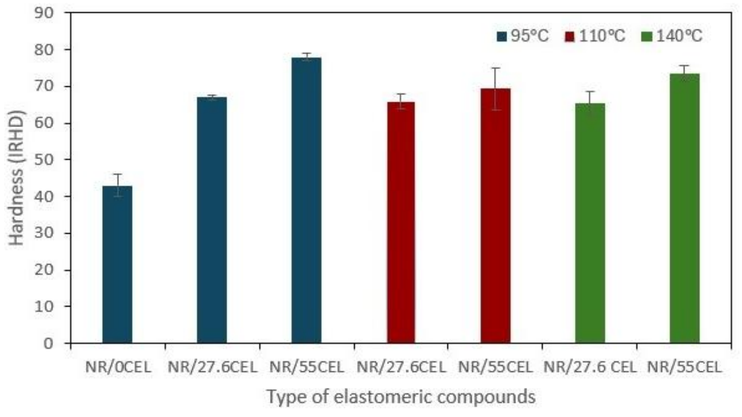

Fig. 3 Effect of filler amount (CEL) on the hardness of NR blend mixed in stage I at different temperatures after TOA

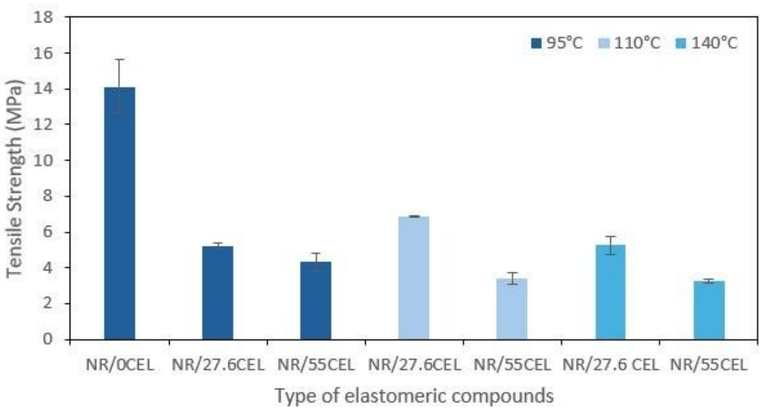

Fig. 4 Effect of filler amount (CEL) on the tensile strength of NR blend mixed in stage I at different temperatures before TOA

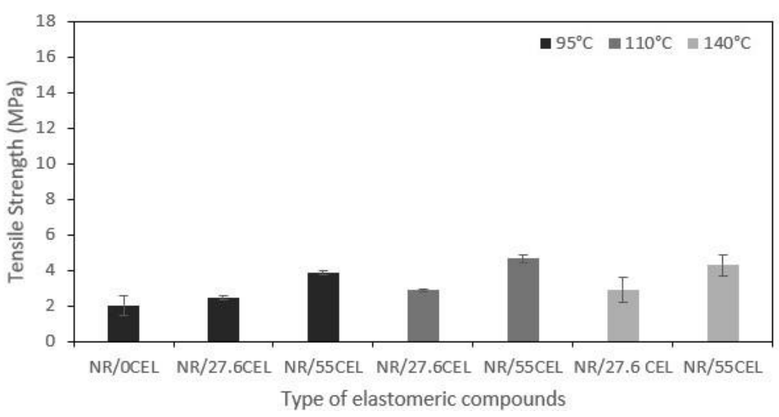

Fig. 5 Effect of filler amount (CEL) on the tensile strength of NR blend mixed in stage I at different temperatures after TOA

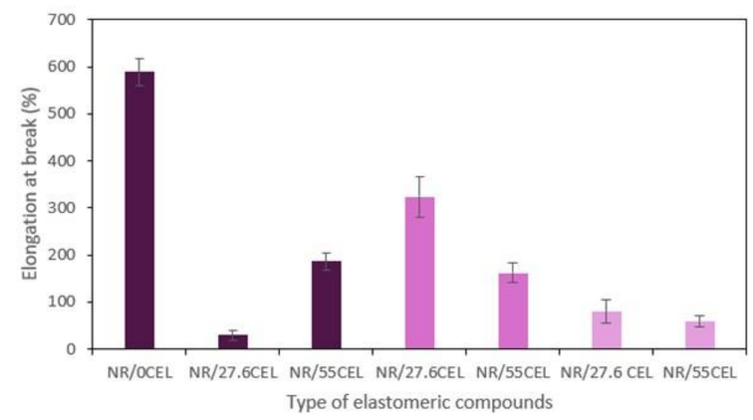

Fig. 6 Effect of filler amount (CEL) on the elongation at break of NR blend mixed in stage I at different temperatures before TOA

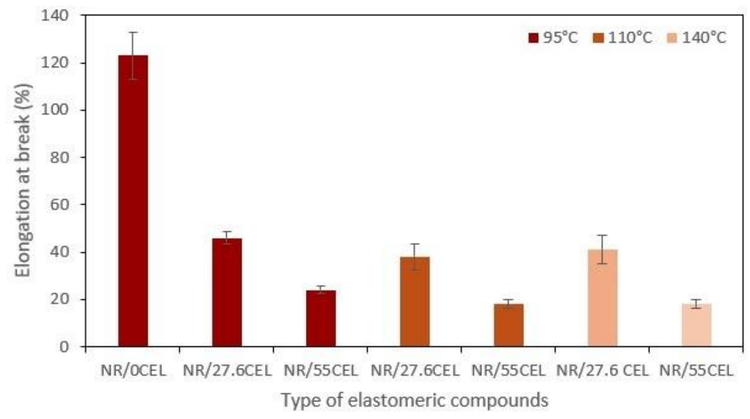

Fig. 7 Effect of filler amount (CEL) on the elongation at break of NR blend mixed in stage I at different temperatures after TOA

The results confirm that the initial mixing temperature significantly affects the mechanical properties of NR/CEL blends before and after thermo-oxidative aging (TOA). Before aging, the highest hardness was recorded at 55 phr and a temperature of 95°C. Higher temperatures (110°C and 140°C) led to a decrease in hardness due to cintensified matrix chain scission, resulting in a reduction of molecular chain length. The highest tensile strength and elongation at break were achieved at 27.6 phr and 110°C. After TOA, a decrease in hardness occurred in formulations with 27.6 phr filler. The tensile strength after aging increased with increasing mixing temperature. The elongation at break decreased after TOA, most significantly at 27.6 phr and 110°C. Based on the obtained results, the application of 27.6 phr of cellulose filler at an initial mixing temperature of 110 °C appears to represent the optimal processing conditions.

Program Integrated Infrastructure, co-financed by the European Regional Development Fund by the project: Advancement and support of R&D for "Centre for diagnostics and quality testing of materials" in the domains of the RIS3 SK specialization, Acronym: CEDITEK II., ITMS2014+ code 313011W442 and by Scientific Grant Agency VEGA 1/0265/24.

NAPLES, ITALY 30 JUNE-4 JULY
ACEX2025 NAPLES
18th International Conference on Advanced Computational Engineering and Experimenting

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