The effect of modified cellulose on the selected mechanical properties and morphology of elastomer compounds

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This work focuses on the preparation and characterization of elastomeric compounds based on natural rubber filled with biopolymer filler. Pure cellulose (CEL) and surface silanized cellulose (CEL_{sil}) were used as fillers in the natural rubber (NR) matrix in content of 0; 30; 40 and 55 phr. Selected mechanical properties were evaluated on the prepared compounds, namely hardness, tensile strength and elongation at break. Scanning electron microscopy (SEM) was used to analyze the interfacial interactions between the filler and the elastomer matrix, as well as to evaluate the fracture surfaces of prepared compounds and morphology of the filler particles.

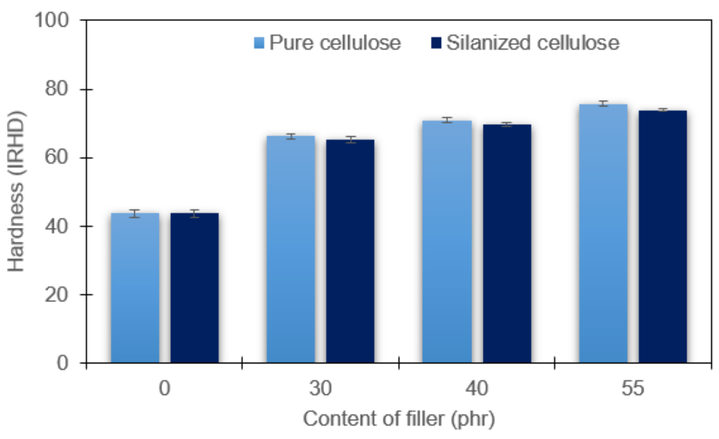

Fig. 1 Hardness of prepared elastomer compounds

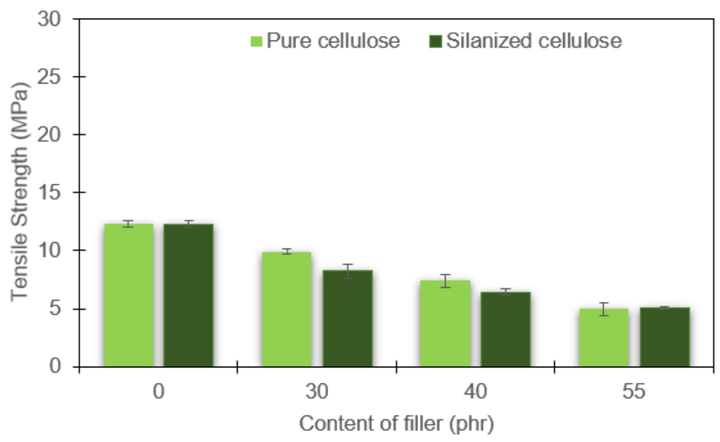

Fig. 2 Tensile Strength of prepared elastomer compounds

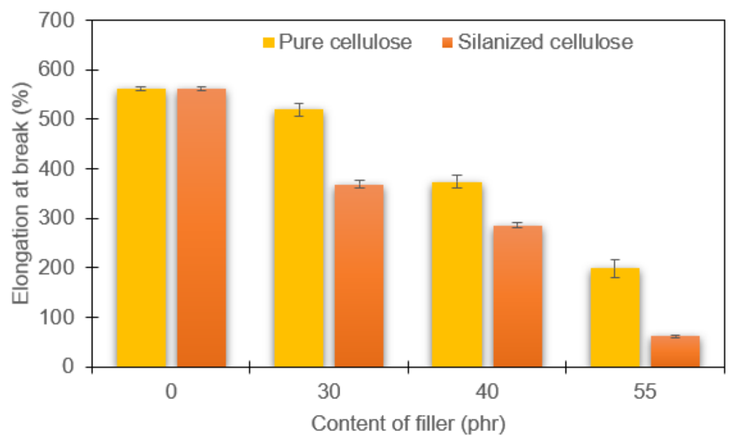

Fig. 3 Elongation at break of prepared elastomer compounds

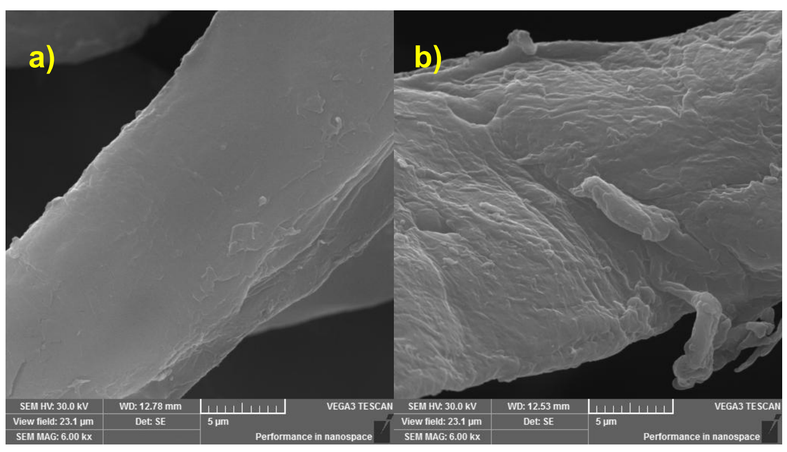

Fig. 4 SEM scans of fillers: a) detail of pure cellulose, 6 000 x mag. ; b) detail of silanized cellulose, 6 000 x mag.

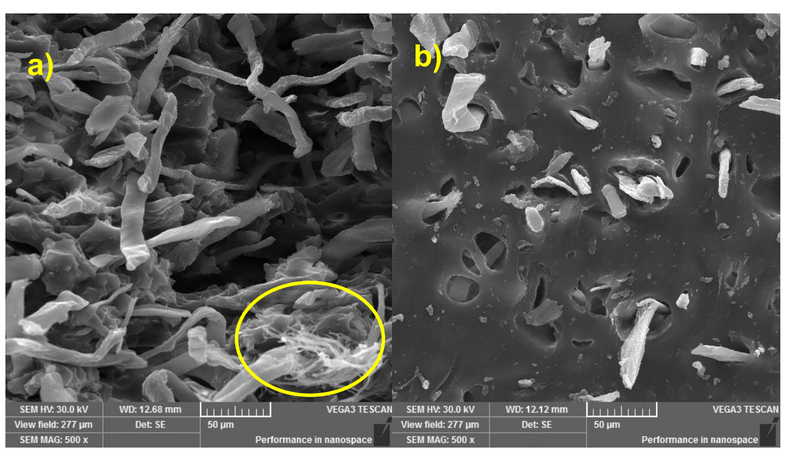

Fig. 5 SEM scans of elastomer compounds with CEL – 30 phr: a) fracture area after tensile test, 500 mag.; b) cross-section, 500 mag.

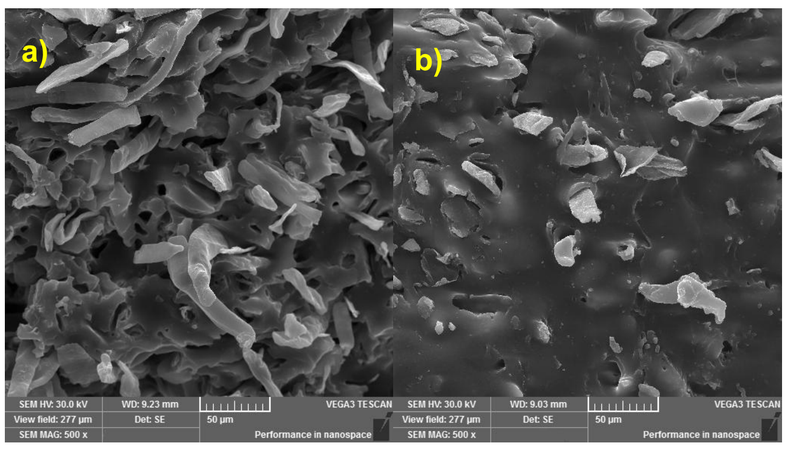

Fig. 6 SEM scans of elastomer compounds with CEL_{sil} – 30 phr: a) fracture area after tensile test, 500 mag.; b) cross-section, 500 mag.

Conclusion

The results of the study showed:

- With increasing filler content, hardness increased, which confirms the reinforcing effect of cellulose in the matrix, while silanization did not significantly affect the hardness values.
- Increasing filler content led to a decrease in tensile strength and elongation at break, which is related to a decrease in material elasticity due to a limitation of polymer chain mobility.
- SEM analysis confirmed the different morphology of the fillers – silanized cellulose showed a roughened surface and better incorporation of fibers into the matrix with a smaller occurrence of voids, which indicates improved compatibility and more intense interfacial interactions.

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.

29 JUNE - 3 JULY
ACEX2026
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