Additive Manufacturing of Elastomers

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Motivation

Elastomer components are extensively used in engineering products, e.g., seals and hoses. With Additive Manufacturing (AM), they have a great potential to be produced faster for new applications or replacement of damaged parts. However, 3D printing of elastomers is still relatively under-researched and often limited to prototyping. Skilful material selection and optimisation of the printing processes could support the printing and use of elastomer parts in a viable way.

Objectives

- Physical understanding of the AM technologies and investigation of their suitability for the printing of elastomers;
- Analysis of the mechanical and thermal properties of 3D printed elastomers;
- Optimization of the 3D printing process.

Experimental data & process of the investigation

Test specimens are printed in the laboratory facilities with 3D printers from the FFF [1] and LAM [2] technologies. The mechanical characterization by means of uniaxial tensile, cyclic and relaxation tests as well as Differential Scanning Calorimetry (DSC) and Dynamic Mechanical Analysis (DMA) is carried out. Fig. 1 below shows the printing of a thermoplastic polyurethane (TPU) while Fig. 2 and Fig. 3 present some experimental results.

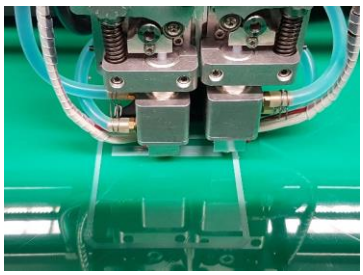

Fig. 1: Printing of a TPU in the x500 printer.

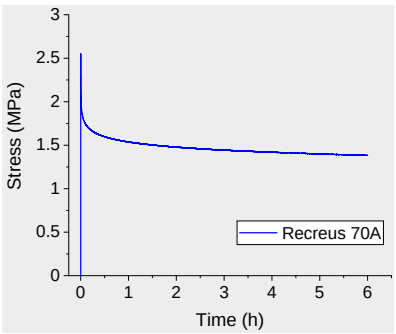

Fig. 2: Relaxation results for TPU Recreus Filaflex 70A [3].

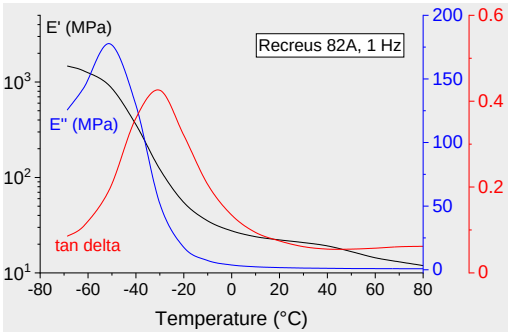

Fig. 3: DMA results for TPU Recreus Filaflex 82A [4].

The evaluation of the thermal and mechanical behavior contributes to a material database for commercially available 3D printed elastomers. This will assist in the pre-selection of elastic materials for technical applications, as well as in the identification of properties relevant for numerical analyses in FEM software.

Acknowledgment

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References

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[2] innovatiQ. (2023, February 06). *LiQ 320*. https://www.innovatiq.com/en/products/3d-printers/liq-320/.
[3] Recreus. (2023, February 06). *Filaflex 70A*. https://recreus.com/gb/filaments/6-31-filaflex-70a.html#/1-colour-black/2-diameter-175_mm/3-weight-500_gr.
[4] Recreus. (2023, February 06). *Filaflex 82A*. https://recreus.com/gb/filaments/9-684-filaflex-82a.html#/1-colour-black/2-diameter-175_mm/3-weight-500_gr.