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Numerical and Experimental Deformation Analysis of an EPP Component Subjected to Mechanical Loads and Temperature Gradients

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Expanded polymeric foams are increasingly adopted in industrial applications not only for energy absorption and impact mitigation but also for structural purposes. Their large strain elastic response in finite element (FE) simulations is commonly described using the Ogden–Hill hyperelastic model, typically calibrated on standardized specimens.

This work presents an experimental campaign carried out on commercial expanded polypropylene (EPP) components from the HVAC R sector. Two geometries were tested across a range of temperatures to capture the strong thermo mechanical dependence of the material. Tests were performed both under ambient conditions and inside a climatic chamber. Deformation fields were measured using three dimensional digital image correlation (3D DIC), applied to multiple regions of the components to obtain full field strain data. This measurement approach enabled a direct comparison between experimental results and numerical predictions obtained with the Ogden foam model.

The study evaluates the model's capability to reproduce the mechanical behavior of large, geometrically complex EPP components subjected to non uniform temperature fields. The results highlight both the strengths and the limitations of standard hyperelastic formulations when applied beyond specimen scale calibration.

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