Considering Manufacturing Induced Inhomogeneity in Structural Material Models (VMAP)

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1 Introduction

The ITEA VMAP project aims to gain a common understanding of and interoperable definitions for virtual material modelling in Computer Aided Engineering (CAE). Using industrial use cases from major material domains and representative manufacturing processes, new concepts will be created for a universal material exchange interface for use in virtual engineering workflows. [1]
In the VMAP consortium with nearly 30 partners, 4a is focusing on injection molding of plastics. Two sub use cases – namely impact behavior of fiber reinforced thermoplastics and structural behavior of foamed parts - are presented in this contribution.

2 Structural foaming

CELLMOULD® is a process developed by WITTMANN BATTENFELD to manufacture structured foam parts through direct gas injection with physical foaming agents. Structured foam components feature a compact shell with a foamed core. CELLMOULD® lightweight technology enables the production of extremely light, highly rigid parts without sink marks, see more [2].

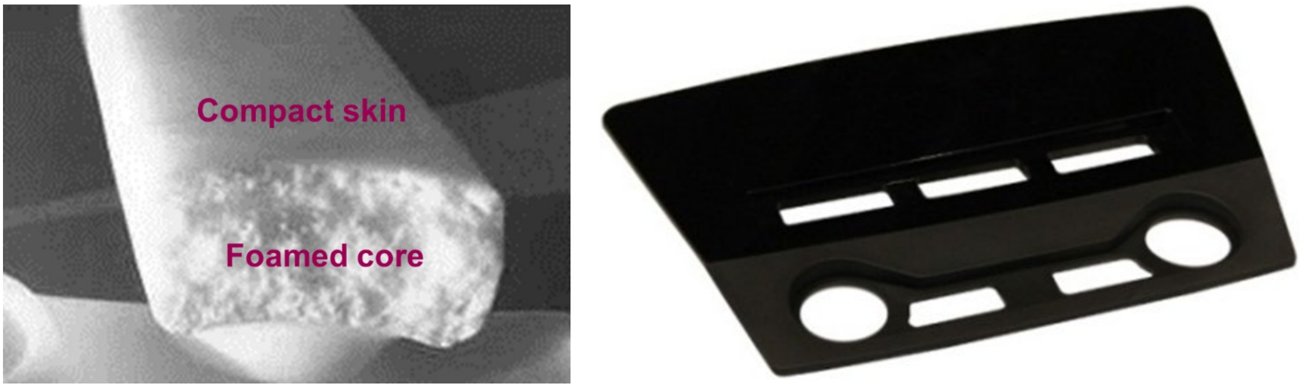

Fig.1: left – foamed structure, right – investigated demonstration part "radio mask".

Based on material characterization for tensile, bending and puncture tests, the influence of the structural foaming was researched. A first simple approach by scaling the material card was used to describe the foamed thermoplastics. In future the whole simulation process chain from injection moulding to structural simulation will be considered. First results to consider the foam locally will be shown in the present contribution.

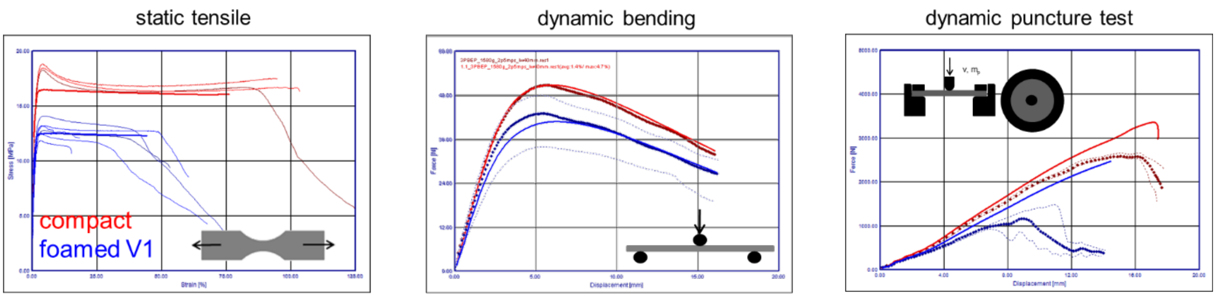

Fig.2: PP-T10 material modelling with ****MAT_SAMP-1*** – (red) compact material (blue) foamed

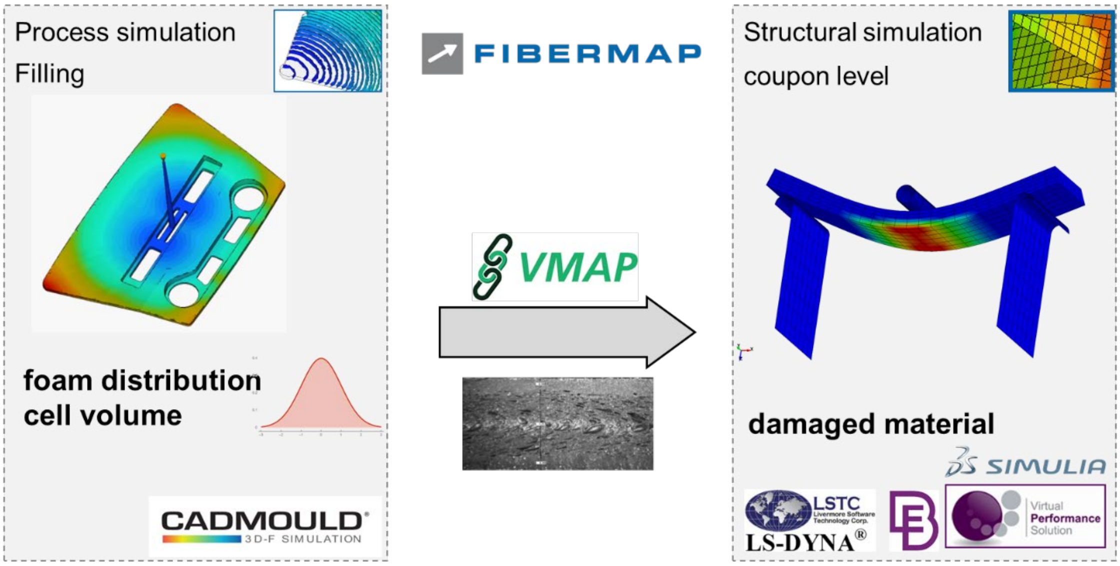

Fig.3: Outlook - VMAP interface for structural foaming (research in progress)

3 SFRP – Short fiber reinforced plastics

This case study is an automotive part, a so-called sleeve kindly provided by Hirtenberger Automotive Safety GmbH & Co KG. The filling simulation was done with Moldex3D® and the resulting fiber orientation was mapped with FIBERMAP™. In the keyword file the orientation was covered by using ***ELEMENT_SOLID_ORTHO***. The real part was tested in a fall tower, force-displacement was measured, a high-speed camera recorded the failure development of the component. Fig. 4 shows the test results as well as a simulation comparison between the approach using an isotropic material model ***MAT_024** and the integrative approach with a fully anisotropic material model. Using an isotropic material model, the part fails on a completely different location.

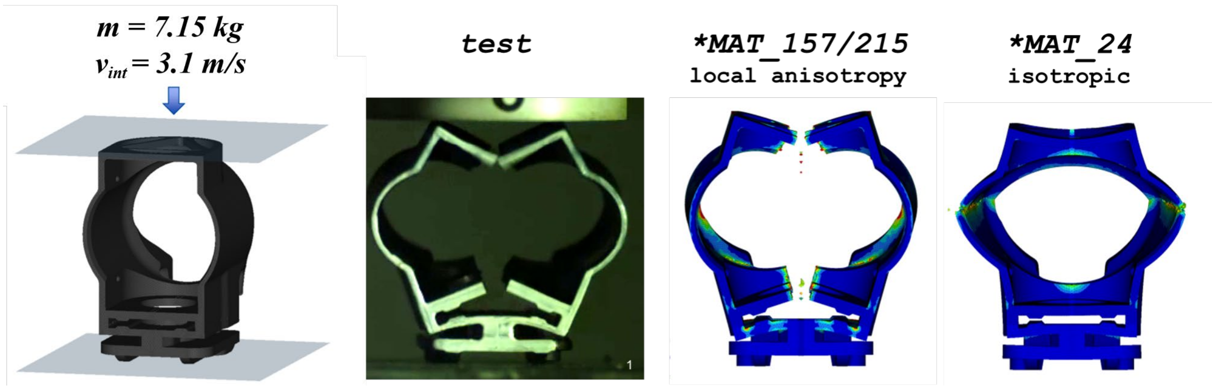

Fig.4: Results of the case study “sleeve” presented in [3][4].

Source:

4 Literature

[1] http://vmap.eu.com/

[2] Pühringer F., Wittmann Battenfeld: Schaumspritzgießen 2.0; 4a Technologietag 2016

[3] Reithofer P. et al.: *MAT_4A_MICROMEC; 15th International LS-Dyna® Users Conference, Detroit 2018

[4] Steinberger R., et al. Hirtenberger Automotive Group: Considering the Local Anisotropy of Short Fiber Reinforced Plastics, European Dynaforum, Salzburg 2017