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TITLE: Experimental Characterisation and Numerical Simulation for Compression Moulding of Continuous and Discontinuous Fibre Hybrid Architecture Composites

AUTHOR(S): Hao Yuan[1], Michael Auinger[1], Muhammad Khan[1], Connie Qian[2]

AFFILIATION(S): [1]Warwick Manufacturing Group, University of Warwick, Coventry, United Kingdom, CV4 7AL; [2]School of Mechanical Aerospace and Civil Engineering, University of Sheffield, United Kingdom, S1 4DT

ABSTRACT: Compression moulding of hybrid architecture composites in a single-shot process combines the superior mechanical properties of continuous fibre composites and the high design flexibility of discontinuous fibre composites. Such process offers great potentials in weight saving and cost saving and can be particularly attractive to the automotive and the aerospace industries for applications where high volume and low cost are critical concerns. However, the confidence in adopting such processes is currently low due to lack of understanding of the processing behaviour of the materials, especially in a hybrid process, and consequently the lack of reliable simulation-based design tools.

This paper presents the development of a process simulation model for a hybrid compression moulding process combining continuous fibre prepreg and discontinuous fibre sheet moulding compound (SMC). Experimental studies were performed to characterise the compression behaviour of the prepreg and the SMC, as well as their interaction behaviour in a hybrid moulding process. Constitutive material models for the prepreg and SMC were subsequently developed from the experimental data and implemented in a process simulation model where the interaction properties at the prepreg/SMC interface, and the interface between prepreg/SMC and the tool surface were also derived from the experimental observations. The proposed process simulation model was verified using the experimental data in terms of compression forces, in-cavity pressures, and in-plane and out-of-plane deformations (See Figure 1).

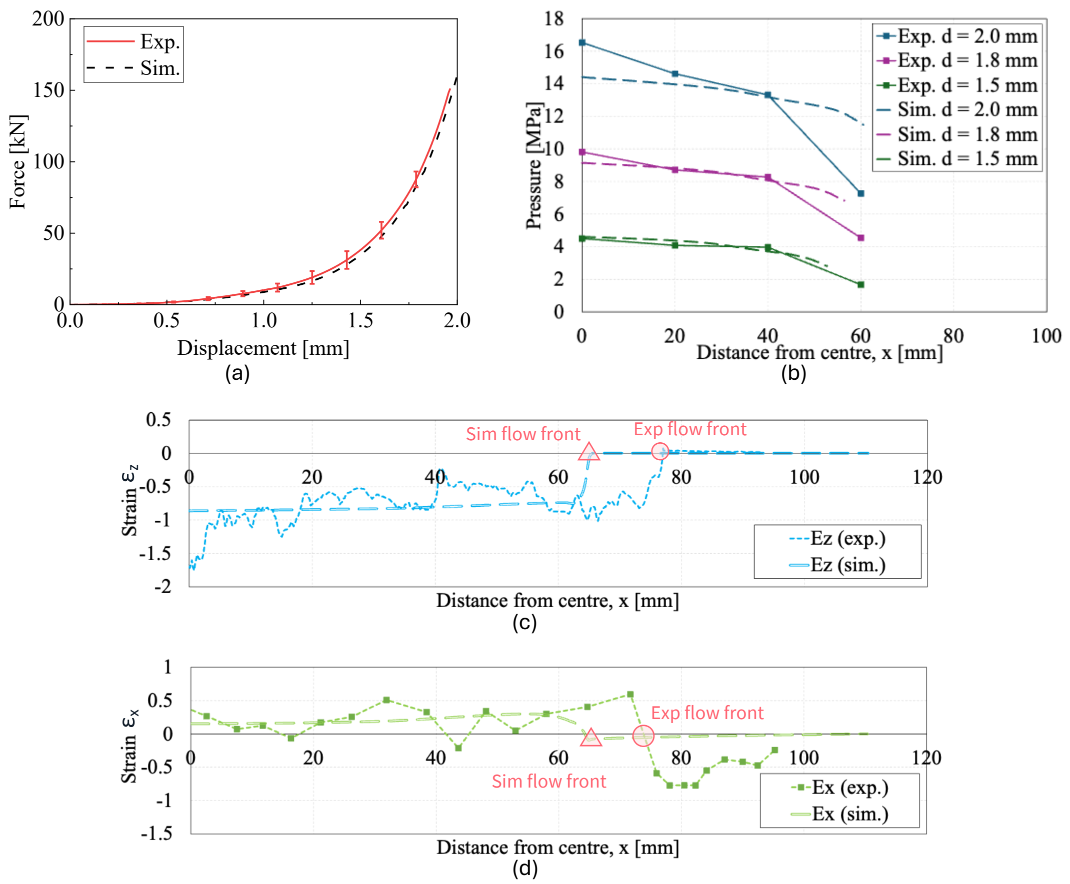

Figure 1: Comparison between the experimental and simulation results for the model validation study: (a) compression forces; (b) in-cavity pressures; (c) in-plane strains and (d) out-of-plane strains.