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TITLE: Compression Moulding Simulation of Recycled Long Discontinuous Fibre-Reinforced Thermoplastics.

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ABSTRACT:

Compression moulding of recycled long fibre-reinforced thermoplastics (r-LFTs) offers a promising approach to recover high mechanical performance, including specific stiffness, strength, and impact resistance due to minimum fibre attrition. The presence of long fibres with high aspect ratios in LFTs enhances load transfer efficiency and structural integrity. However, when fibre lengths exceed 10 mm, the process becomes more complex, as fibre entanglement, clustering, reorientation, and jamming can occur during moulding. These phenomena increase flow resistance, intensify structural heterogeneity, and hinder fibre dispersion, ultimately compromising part quality [1, 2].

This study aims to develop a physics-based process simulation framework to simulate and predict the behaviour of recycled long-fibre composites during the compression-moulding process. The framework builds upon and extends the reduced embedded formulation developed by Goudarzi et al. [3], in which fibres are represented as truss elements embedded within the polymer matrix. By statically condensing the fibre degrees of freedom, this approach significantly reduces computational cost, enabling the simulation of composite charges with over two million fibres, with straight and curved configurations, as illustrated in figure 1. The proposed extension will introduce fibre–fibre interaction effects as well as coupling between the elastic response of the fibres and the viscous behaviour of the polymer matrix. Fibre length distributions ranging between 1 mm and 20 mm will be treated as arbitrary inputs to capture the effects of prior processing steps, such as shredding and low shear mixing.

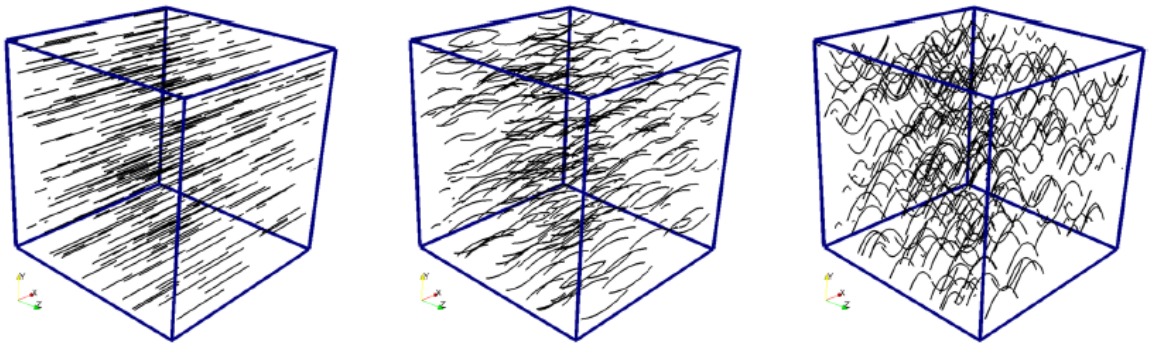

Figure 1: Fibre distribution of straight and curved fibres [3].

The expected outcome is a simulation framework which enables the prediction of long fibre reorientation and its effect on the viscosity and flow of r-LFT during moulding. This will provide new insights into how the fibre morphology and interaction can affect flow anisotropy.

Keywords: recycled composites, numerical simulation, fibre-reinforced thermoplastics, compression moulding, long fibres, fibre orientation, reduced embedded formulation.

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References

1. Ning, H., et al., *A review of long fibre thermoplastic (LFT) composites.* International Materials Reviews, 2019. **65**(3): p. 164-188.
2. Gandhi, U., et al., *Discontinuous fiber-reinforced composites : fundamentals and applications*. 2020, Munich: Hanser Publishers. xiv, 465 pages.
3. Goudarzi, M., H.J.M. Geijselaers, and R. Akkerman, *Efficient analysis of dense fiber reinforcement using a reduced embedded formulation.* Computational Mechanics, 2020. **67**(1): p. 1-15.