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EFFICIENT CALIBRATION OF A CRYSTALLIZATION MODEL FOR INJECTION MOULDING SIMULATION USING SURROGATE MODELLING

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The computational costs of injection moulding simulations have been increasing in the past years due to higher complexity of the embedded models. This is especially problematic in case of using such simulation models for optimization routines or uncertainty quantification. One way to overcome this challenge is by having a surrogate model, also known as a metamodel, of these high-fidelity simulations, which provides a cheaper way to perform these types of analyses. These metamodels can play an important role in the case of the injection moulding of semi-crystalline polymers to model the flow-induced crystallization process. To date, most commercial software do not take explicitly polymer crystallization into account leading to various errors in the fill predictions as well as the calculation of warpage and shrinkage. This is mainly due to the common complexity of the models used to describe crystallization and the challenging respective model parameter identification process at injection moulding conditions.

To close this gap, we propose the use of a simple thermo-mechanical crystallization model developed by Poitou et al. [1] in the framework of irreversible thermodynamics to describe the flow-induced and quiescent crystallization of an unreinforced semi-crystalline thermoplastic material during injection moulding. In addition, the crystallization model is implemented alongside crystallization-dependent viscosity, PVT and solidification models in the commercial software Autodesk® Moldflow® Insight 2021 using the Solver API feature. The model parameters are identified using a calibration scheme that employs a surrogate model for the optimization. The focus of this work is to present the fill predictions as well as the calculated pressure fields using the calibrated model parameters in comparison to those measured during the actual injection moulding of a POM part with different process conditions.

REFERENCES

[1] A. Poitou, A. Ammar, Y. Marco, L. Chevalier, and M. Chaouche, Crystallization of polymers under strain: from molecular properties to macroscopic models. *Computer Methods in Applied Mechanics and Engineering*, vol. **192**, no. 28–30, pp. 3245–3264, Jul. 2003.