11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

CHALLENGES IN ACCURATE WARPAGE SIMULATION OF INJECTION MOLDED PLASTICS

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Key Words: *Injection Molding, warpage, Multiphysics Problems, Computing Methods.*

Polymer injection molding simulation has been widely used in industry as a tool for providing in-depth validation and optimization of plastic parts and associated injection molds. An accurate warpage prediction can identify where warpage might occur and optimize part and mold design, material choice, and processing parameters to help control part deformation.

Injection molding process involves complicated transient heat transfer mechanisms, a phase change and time-varying boundary conditions during filling, packing, cooling and ejection stages. Warpage is caused by variations in shrinkage throughout the part, which is largely determined by the varying pressure and temperature history coupled with the frozen layer growth. Due to complexity of material properties, geometry of the part and the physics of the process, various assumptions are made to simplify the mathematical model used for simulation.

This paper reviews nearly every aspect of injection molding simulation and their impact on warpage results: material modeling and characterization, finite element meshing, cooling simulation, filling and packing simulation, fiber orientation simulation, micromechanical modeling, crystallization modeling, shrinkage modeling and structural response simulation. Challenging issues such as in-mold shrinkage, mold deformation, corner-effect, solidfication criterion and stress relaxation are also addressed.

REFERENCES

[1] R. Zheng, R.I.Tanner and X.J.Fan, *Injection Molding: Integration of Theory and Modeling Methods*, Springer, 2011.
[2] Z.Fan, R.Zheng, H.Yu, F.Costa and P.Kennedy, Warpage Simulation of injection Molded Plastic Parts. WCCM, Beijing, China, 2004.
[3] Z. Fan, R. Zheng, P. Kennedy, H. Yu, A. Bakharev, Warpage Analysis of Solid Geometry, SPE ANTEC Proceedings, Orlando, Florida, USA, 2000.
[4] Z. Fan, B. Lin, F. Costa, X. Jin, R. Zheng and P. Kennedy, Three Dimensional Warpage Simulation for Injection Molding, SPE, Chicago, USA, 2004.
[5] Z. Fan, C. Kietzmann, S. Ray, F. Costa, P. Kennedy, Three Dimensional Simulation for the Injection Overmolding Process, WCCM, Venice, Italy, 2008.