OP-15-257

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THERMAL ANALYSIS OF THE POLYMER-MOLD INTERFACE IN THE INJECTION MOLDING PROCESS

M. Boutaous[a]*, R. El Otmani[a], F. Rousset[a], H. Benhadid[b] , P. Bourgin[c]

[a] *CETHIL, UMR 5008, CNRS, INSA Lyon, Université Lyon1 – F-69621 Villeurbanne, France,* [b]*Laboratoire de Mécanique des Fluides et d'Acoustique, UMR 5509, CNRS, Ecole Centrale de Lyon, Université Lyon1, INSA Lyon - F-69134 Ecully Cedex, France and* [c] *Ecole Centrale de Lyon, Université Lyon1, INSA Lyon - F-69134 Ecully Cedex, France*

** Corresponding author: mhamed.boutaous@insa-lyon.fr*

The filling phase of the polymer injection molding process is one of the most important steps in the whole cycle of injection. The control of this phase, involving several phenomena, leads to control the thermophysical properties of the final product.
The numerical simulation of this step needs a strong coupling between the Non-Newtonian rheological behavior of the non isothermal flow, the thermo-dependency of all parameters, and a pertinent tracking up of the polymer front evolution in the mold (air polymer interface). The front evolution is responsible for the fountain flow, which induces interfacial phenomena to be examined.
This paper attempts to cover the most important parameters controlling the filling stage. A finite element method was employed for the fully developed laminar flow of non-Newtonian, non-isothermal fluids. We introduce a new conservative level set method based on penalty approach, to accurately track the polymer-air interface in the mold.
A special attention is devoted to the analysis of the non-isothermal, non-Newtonian flow problem, which is exemplified using the solidification problem; the thermal contact resistance is taken into account in our model. Some illustrative results are presented, and an analysis is carried out in order to connect the final structure of injected parts to their thermo-rheological history. A new interpretation for the flow mark phenomena is suggested, based on the interfacial heat flux analysis.