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MODELING THE INJECTION MOLDING PROCESS UP TO FINAL MORPHOLOGY

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The conditions under which polymers solidify during processing are very different from those which can be analyzed by standard characterization apparatus. Under processing conditions cooling rates may be as high as hundreds K/s and pressures can overcome one thousand bars; furthermore, it is well known that during flow or soon after it the crystallization rate may increase of orders of magnitude and can give rise to morphologies which can not be achieved under quiescent conditions.

Data of pressure evolution during injection molding and of morphology distribution in the injected object with iPP are analyzed. The polymorphic crystallization kinetics of the material are carefully characterized in a wide range of cooling rates and pressures. Also the effect of flow on nucleation density and growth rate is analyzed by optical microscopy experiments carried out during flow.

Simulations of the full injection molding process are carried out adopting: 2D-energy balance including accumulation term, transversal conduction , convection along the the flow path, heat generation due to both flow and polymorphic crystallization kinetics; variable heat transfer coefficient at mold wall; a solidification criterion based of amount of total crystallinity.

The comparison with data of pressure evolution during the process is good and reproduces the effect of injection flow rate, holding pressure and mold temperature. Also main characteristics of final morphology are reproduced by the simulations. The relevance of a process oriented characterization is pointed out all throughout.