MODELLING THE EXTRUSION COOLING/CALIBRATION STAGE FOR COMPLEX THERMOPLASTIC PROFILES

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On the extrusion process, the very low thermal diffusivity of thermoplastics limits the maximum production rate and leads to the development of substantial thermal gradients during the cooling stage. As a consequence, the thermal stresses develop and can be frozen in the product, which will affect its mechanical performance in use. Therefore, the conditions in which the calibration/cooling stage occurs are particularly relevant, since they determine not only the production rate, but also the final properties of the extruded products. There are many parameters influencing this stage: polymer used, extrusion temperature, geometry of the extrudate cross-section, extrusion velocity, cooling water temperature, layout and diameter of the cooling channels, use of one or more calibrators in series, length of the calibrators, distance between consecutive calibrators, material of construction of the calibrator, among others. This makes the design process a difficult task, especially when dealing with complex cross section profiles, for which the support of a numerical modelling tool can be an important aid. The main objective of this work is to implement a 3D non-isothermal multi-domain numerical code, based on finite volume method, able to deal with unstructured meshes that can be used to aid the design of calibration/cooling systems. At the final stage the code should incorporate the major phenomena that take place during profile cooling, including the prediction of the developed thermal residual stresses.