SL 7.13

Analysis and Optimisation of the Polymer Wire Die-Drawing Process

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In this paper we use finite element simulations to analyze the polymer die-drawing process to make it commercially viable. In conventional wire drawing process using conventional conical dies, the strain rate and strain are maximum at the die-exit where the stress state in the material, now oriented, is predominantly tensile in nature. This leads to the fracture of the material at the die-exit at high drawing speeds. The flow of polymer in profiled dies is analyzed by FE simulations where the strain and strain-rate are controlled along the die-length. The different aspects for the design of profiled dies are considered in detail. It has been shown by the FE simulations that profiled dies can be constructed to reduce the strain rate at the die-exit. Therefore, the possibility of fracture is reduced enabling the process to be speeded up.
The fully coupled thermo -mechanical FE model has been validated against die drawing experiments and has been used to study the different aspects of die-design. The performance of the conical and profile die designs is compared experimentally under identical drawing conditions for the specific case of die drawing of polyoxymethylene wire.