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材料化学工程与纳米技术

GLS/GGLS/SUPG在三维注射成形充填模拟中的应用

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摘要

塑料注射成形充填模拟中，采用GLS(Galerkin/least-squares)法能实现速度、压力同次插值时稳定地求解速度场、压力场，在能量场方程的求解中采用GGLS(Galerkin gradient least-squares)/SUPG(streamline upwind/Petrov-Galerkin)法能得到稳定的温度场数值解，其中SUPG法抑制对流占优导致的数值震荡问题，GGLS法消除由于小扩散系数造成的虚假温度升高。由GLS法、GGLS/SUPG法建立的速度、压力、温度求解的稳定有限元计算格式，实现了对注射成形充填模拟。模拟结果表明，采用GGLS法，温度场模拟结果更加合理，由GGLS/SUPG法获得了充填过程中稳定、准确的温度场，并采用GLS法正确地模拟了熔体速度、压力及流动前沿。

关键词

注射成形 GLS GGLS SUPG 温度场

分类号

GLS/GGLS／SUPG method in 3D numerical simulation of filling stage of plastic injection molding

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Abstract

Velocity and pressure result in the filling pattern of plastic melt in injection molding.The temperature field plays an important role and should be simulated correctly and stably because it changes the viscosity significantly, which interacts with velocity and pressure.The GLS(Galerkin/least-squares) method based on the PG(Petrov-Galerkin) method was employed to solve velocity and pressure field stably when equal order interpolation functions were used for velocity and pressure field.The GGLS(Galerkin gradient least-squares) and SUPG(streamline upwind/Petrov-Galerkin) methods were combined to solve temperature equation in a stabilized way in which the SUPG method was used to prevent the oscillation caused by dominated convection, and the GGLS method was used to avoid pseudo-increase of temperature because of small thermal conduction.Numerical examples showed that the temperature results from the GGLS method were more reasonable than the classic Galerkin method.When the filling stage was simulated, the combined GLS/SUPG method gave a valid means for the stabilized and exact solution of temperature field, and at the same time,melt velocity, pressure and flow front could be exactly solved by using the GLS method.

Key words

injection molding GLS GGLS SUPG temperature field

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