

عنوان مقاله:

Numerical Solution of Reacting Laminar Flow Heat and Mass Transfer in Ducts of Arbitrary Cross-Sections for Newtonian and Non-Newtonian Fluids

محل انتشار:

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خلاصه مقاله:

This study is concerned with the numerical analysis, formulation, programming and computation of steady, 3D conservation equations of reacting laminar flow heat and mass transfer in ducts of arbitrary cross-sections. The non-orthogonal boundary-fitted coordinate transformation method is applied to the Cartesian form of overall-continuity, momenta, energy and species-continuity equations, parabolized in the axial direction. The boundary conditions are also transformed accordingly. Applying a novel feature of the solution procedure, the contravariant velocity components are introduced into the transformed equations while the physical Cartesian velocity components are retained as dependent variables of the velocity field in the equations. The transformed equations are integrated over 3D control-volumes, followed by differencing the convective and diffusive terms by upwind and central-difference schemes respectively. A modified version of the SIMPLER algorithm is introduced in the solution procedure and a line-by-line TDMA algorithm is employed for the solution of discretization equations. A computerprogramme is developed for the generation of non-orthogonal grids corresponding to Patankar's B-type arrangement in the transformed plane. A general computer programme in FORTRAN is developed for the solution of flow, heat and mass transfer problems for laminar reacting flows in straight ducts of arbitrary cross-sections. The model and computer codes are validated by theoretical, experimental and numerical results from various sources. The computer programs are employed for studies in the analysis of hydrodynamics and heat transfer in the entrance regions of ducts of arbitrary cross-sections for Newtonian and non-Newtonian fluids and ultimately for simulation of production of polystyrene in arbitrary cross-sectional duct reactors.

کلمات کلیدی:

Boundary, Fitted Coordinates, Arbitrary Cross, sectional ducts, Reacting Flow, heat and mass transfer, Non-Newtonian Fluids

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