Numerical Solution of Transonic Flow of Steam With Non-equilibrium Phase Change Using Typical and Simplified Method

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Abstract

Simulation of transonic flow of steam with phase changes represents rather complex problem. One has to consider several simplifications to obtain flow model, which is computationally adequate. Typical current simulations are based on the solution of transport equations for the mixture and additional transport equations for the liquid phase. The creation of new droplets and the growth of already existing droplets is included in the form of source terms, which require a special treatment for time integration. The aim of this paper is to compare an alternative simplified method and a typical current method. The alternative simplified method uses no additional transport equations and the non-equilibrium phase change is included in a form of switch from the metastable state to the equilibrium state, i.e. switch from the zero to the equilibrium wetness. Although this simplified method cannot provide details about droplet size, it can still be interesting tool for the early stages of the turbine design. Both methods are based on the numerical solution of governing equations using a finite volume method. The typical method uses symmetrical operator splitting for time integration. The capability of simplified method with respect to typical method are discussed and presented by results of simulations of steam flow in nozzles and turbine cascades.

References

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