Transient Multicomponent Mixture Analysis Based on ICE Numerical Technique For Simulation of an Air Ingress Accident in a HTGR

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Abstract

The transient multicomponent mixture analysis tool has been developed to analyze molecular diffusion, natural convection and chemical reactions related to air ingress phenomena during the primary-pipe rupture accident of a High Temperature Gas Cooled Reactor. The present toolsolves the one-dimensional basic equations for continuity, momentum, energy of the gas mixture, and mass of each species. In order to get stable and fast computation, the Implicit Continuous Eulerian scheme is adopted to solve the governing equations in a strongly coupled manner. Two kinds of benchmark calculations with Japanese inverse U-tube experiments have been performed. The present method based on the ICE technique runs faster by about 36 times for the simulation of the two experiments than the FLUENT5 does. The calculation results agree well within 10% deviations with the experimental data regarding the concentrations of gas species and the onset time of the natural circulation.