Validation of GAMMA-3D Using Inverse U-tube and HTTR-Simulated Air Ingress Experiments

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Abstract

One of the key safety issues for HTGRs is the air ingress accident following a guillotine-type break at the coaxial pipe between the reactor vessel and the heat exchange system. We developed a multi-dimensional GAs Multicomponent Mixture Analysis (GAMMA) in order to investigate molecular diffusion, chemical reactions, and natural convection related to the air ingress phenomena during the primary-pipe rupture accident. In the simulations of both simplified inverse U-tube and HTTR-simulated air ingress experiments, the predicted results follow the experimental ones consistently regarding the concentration changes of each species and the onset times of natural convection show a level of agreement within a 10% deviation from the experimental data. Small internal leaks in the HTTR-simulated test facility have been found to significantly affect the consequence of air ingress.

압력 방출 밸브 동적 거동 예측을 위한 수치 모사 방법
A Computational Method to Predict Fluid-Structure Interaction of Pressure Relief Valves

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요약

본 연구에서는 원자력발전소 압력 방출 밸브의 주요 성능 인자인 분출 (Blowdown) 및 채터링을 효과적으로 예측할 수 있는 전산 유체 해석 방법을 제시하였다. 밸브 디스크의 움직임을 계산하기 위해 6DOF (Six Degree OF Freedom) 모델을 사용하고, Chimera 중첩 (Overset) 격자를 사용하여 디스크 움직임에 따른 격자 재생성의 필요성을 제거하였다. 또한, 압축성 유동을 해석하기 위해 CFD-RC사의 CFD-Fastran을 사용하여 1" 안전 밸브의 동적 거동을 예측하여 본 연구에서 제시한 방법의 적용성을 확인했다.