Design of steam methane reforming Bayonet reactor for hydrogen production from natural gas using CFD model

Ngo Ich Son, Nguyen Duc Dan, 임영일†, 김우현[1], 서동주[1], 윤왕래[1]
한경대학교; [1]KIER
(limyi@hknu.ac.kr†)

A computational fluid dynamics (CFD) model for steam methane reforming Bayonet reactor (SMRBR) was proposed for hydrogen production from natural gas. The SMRBR included two domains: the combustor at the center for supplying the reaction heat demand and annulus reactor with a catalyst for steam methane reforming reactions. The realizable k-ε turbulence model and discrete ordinates (DO) method of radiative transfer equation (RTE) were employed to the CFD model. A volume-based catalytic reaction mechanism from a literature was adopted for the porous catalyst zone. Several designs of a sleeve located between the combustor and reactor for combustion gas discharge were evaluated to maximize the overall heat transfer coefficient. The CFD results were compared for different sleeve designs in terms of temperature, temperature uniformity, reactor wall heat flux, producer gas compositions, H2 production rate, and heat efficiency.