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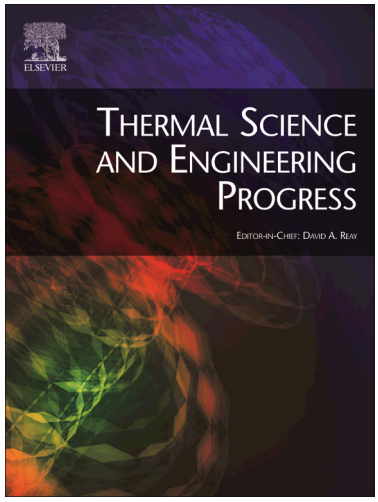

Plenum-to-plenum natural convection heat transfer within a scaled-down prismatic modular reactor facility

Salman M. Alshehri, Ibrahim A. Said, Muthanna H. Al-Dahhan, Shoaib Usman

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Plenum-to-plenum natural convection heat transfer within a scaled-down prismatic modular reactor facility

Salman M. Alshehri [1,2], Ibrahim A. Said[3,4], Muthanna H. Al-Dahhan[1,3], Shoaib Usman[1*]

[1]Mining and Nuclear Engineering Dept., Missouri University of Science and Technology, Rolla, MO 65409-0170
[2]National Center for Nuclear Technology, King Abdulaziz City for Science and Technology, Riyadh, Saudi Arabia 11442- 6086
[3]Chemical and Biochemical Engineering Dept., Missouri University of Science and Technology, Rolla, MO 65409
[4] Chemical Engineering Department, Faculty of Engineering, Alexandria University, Alexandria, Egypt

* Corresponding author: usmans@mst.edu

Abstract

Multiphase Reactors Engineering and Applications Laboratory (mReal) at Missouri University of Science and Technology (S&T) has developed a natural convection heat transfer test facility with one riser and one downcomer between two plena to investigate loss of flow accident scenario (LOFA) for a prismatic very high temperature reactor (VHTR). Using advanced heat transfer coefficient probe and T-thermocouples (1.6 mm), this paper reports the effect of the outer surface temperatures of the upper plenum and downcomer channel (278.15, 288.15, 298.15, and 308.15 K) on the intensity of natural circulation during LOFA with helium at 413.685 kPa. The results showed that there is a reduction in the centerline temperature of ~10.14% and inner wall surface temperatures of ~7.4% along the riser channel with decreasing upper plenum and downcomer temperatures from 308.15 K to 278.15 K. A reversal in the direction of heat transfer is observed close to the exit of the riser channel (Z/L =0.773) for outer surface temperature 288.15, 298.15, and 308.15 K due to the end effect. It is worth mention that, the negative signals of heat fluxes are observed along the downcomer channel for all operating conditions, which confirms heat removal from helium and a downward flow along the downcomer channel, hence establishment of natural circulation. The results also showed a gain in the values of heat transfer coefficients along the riser channel with decreasing the outer surface temperature which is consistent with the literature. In comparison to the literature with air as coolant, the current results showed the role