Guillermo Barrios del Valle <gbv@ier.unam.mx>

Invitation to review for Applied Thermal Engineering

1 message

Applied Thermal Engineering <em@editorialmanager.com> Mon, Aug 16, 2021 at 3:16 AM
Reply-To: Applied Thermal Engineering <support@elsevier.com>
To: Guillermo Barrios del Valle <gbv@ier.unam.mx>

Manuscript number: ATE-D-21-04291
A numerical study of heat transfer in bottom-heated and side/top-cooled liquid metal layers with different aspect ratios
Peng YU; Weimin Ma; Rubing Ma; Qiang Guo; Xiaoming Yang; Yidan Yuan

Dear Dr Barrios del Valle,

The above-referenced manuscript is under consideration for publication in Applied Thermal Engineering. To maintain our journal's high standards and given your expertise in this area, we would like to invite you to review this manuscript. Please find the abstract of the manuscript at the end of this email.

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We hope you will be able to review this manuscript. Thank you in advance for your help in reviewing this manuscript.

Yours sincerely,
Josua Petrus Meyer, PhD
Subject Editor
Applied Thermal Engineering

Abstract:
A liquid metal layer heated from bottom and cooled from both side and top can be encountered in industrial applications. A special interest is from safety design of advanced pressurized water reactors that adopt the so-called in-vessel melt retention (IVR) to mitigate severe accident risk. Quantification of heat transfer in a stratified melt pool in the lower head of a reactor pressure vessel (RPV) is of great importance to the qualification of the IVR strategy. The upper liquid metal layer of the stratified melt pool is heated by the lower molten oxide layer (with decay heat) underneath, and cooled by water outside the reactor vessel and by radiation or flooded water at the top. This is essentially a problem of natural convection and heat transfer in a liquid metal layer heated from bottom and cooled from both side and top. The present study is conducted to numerically investigate the heat transfer characteristics of such layer with an emphasis on the influence of the
aspect ratio (ratio of radius to height; R/H) of the liquid metal layer. Based on the numerical outcomes, three correlations of heat transfer coefficients (for downward, upward and sideward flows) are also developed to account for the impact the aspect ratio. The numerical simulation results show that, under the same Rayleigh number, the bulk temperature and the upward and sideward heat fluxes all increase with R/H, but the downward heat flux decreases with R/H. The Nusselt numbers in all directions decrease with increasing R/H, as a reduced cooling-heating area ratio due to increasing R/H

shall suppress the cooling efficiency and the convection. When R/H is larger than a threshold (~8), the heat transfer characteristics are no longer sensitive to R/H. Each correlation of heat transfer coefficient is developed as the product of two terms: a base correlation of heat transfer coefficient that is Ra dependent only, and an aspect ratio factor that considers the effect of aspect
ratio R/H. The developed correlations are compared with the numerical simulation results of cases with different aspect ratios and Rayleigh numbers, and good agreements achieved.

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