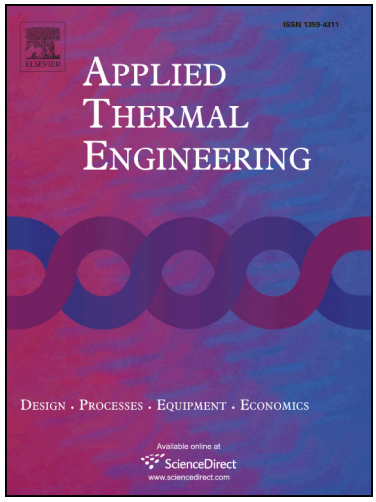

Role of distributed/discrete solar heaters for the entropy generation studies in the square and triangular cavities during natural convection

Debayan Das, Tanmay Basak

PII: S1359-4311(16)33085-X
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2016.11.042
Reference: ATE 9452

To appear in: *Applied Thermal Engineering*

Please cite this article as: D. Das, T. Basak, Role of distributed/discrete solar heaters for the entropy generation studies in the square and triangular cavities during natural convection, *Applied Thermal Engineering* (2016), doi: http://dx.doi.org/10.1016/j.applthermaleng.2016.11.042

Role of distributed/discrete solar heaters for the entropy generation studies in the square and triangular cavities during natural convection

Debayan Das, Tanmay Basak *

Department of Chemical Engineering, Indian Institute of Technology Madras, Chennai - 600036, India

Abstract

In the present age of energy crisis, various engineering and processing industries demand thermally efficient processes. The thermal efficiency is related with the entropy generation and the minimization of entropy generation of a process will lead to the significant energy savings. The distributed/discrete solar heaters convert the solar radiation directly into heat at an appreciable conversion rate. The present work involves the entropy generation minimization studies within square and triangular (type 1 and type 2) cavities subjected to discrete solar heating from the side walls involving five different distributed heating configurations (cases 1-4: symmetric heating, case 5: asymmetric heating) along the side walls involving various fluids with $Pr = 0.015$ and 7.2 for wide range of Ra $(= 10^3 - 10^5)$ and the optimal heater arrangement is also proposed along the side walls of the enclosures. The entropy generation terms involving thermal and velocity gradients are evaluated accurately based on elemental basis set via Galerkin finite element method. The total entropy generation rate (S_{total}) is found to increase with Ra and the average Bejan number (Be_{av}) is found to decrease with Ra indicating the increase in dominance of fluid friction irreversibility at higher Ra in all the cases. It was found that the discrete solar heating strategy involving the central positioning of the heaters along the side walls (case 3) within any cavity is optimal based on the reasonable heat transfer rate and lesser entropy generation at both Pr.

Key words: Natural convection; entropy generation; discrete solar heating; triangular enclosure; energy efficiency

* Corresponding author; Tel: 91-44-2257-4173; Fax: 91-44-2257-0509

Email addresses: debayan8221@gmail.com (Debayan Das), tanmay@iitm.ac.in (Tanmay Basak).