

## Documents

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**Cooling of an isothermal surface having a cavity component by using CuO-water nano-jet**

(2019) *International Journal of Numerical Methods for Heat and Fluid Flow*, .

**Abstract**

**Purpose:** The purpose of this study is to numerically analyze the convective heat transfer features for cooling of an isothermal surface with a cavity-like portion by using CuO-water nano jet. Jet impingement cooling of curved surfaces plays an important role in practical applications. As compared to flat surfaces, fluid flow and convective heat transfer features with jet impingement cooling of a curved surface becomes more complex with additional formation of the vortices and their interaction in the jet wall region. As flow separation and reattachment may appear in a wide range of thermal engineering applications such as electronic cooling, combustors and solar power, jet impingement cooling of a surface which has a geometry with potential separation regions is important from the practical point of view. **Design/methodology/approach:** Numerical simulations were performed with a finite volume-based solver. The study was performed for various values of the Reynolds number (between 100 and 400), length of the cavity (between 5 w and 40 w), height of the cavity (between w and 5w) and solid nano-particle volume fraction (between 0 and 4 per cent). Artificial neural network modeling was used to obtain a correlation for the average Nusselt number, which can be used to obtain fast and accurate predictions. **Findings:** It was observed that cavity geometrical parameters of the cooling surface can be adjusted to change the flow field and convective heat transfer features. When the cavity length is low, significant contribution of the inclined wall of the cavity on the average Nusselt number is achieved. As the cavity length and height increase, the average Nusselt number, respectively, reduce and slightly enhance. At the highest value of cavity height, significant changes in the convective flow features are obtained. By using nanofluids instead of water, enhancement of average heat transfer in the range of 35-46 per cent is obtained at the highest particle volume fraction. **Originality/value:** In this study, jet impingement cooling of an isothermal surface which has a cavity-like portion was considered with nanofluids. Addition of this portion to the impingement surface has the potential to produce additional vortices which affects the fluid flow and convective features in the jet impingement heat transfer. This geometry has the forward-facing step for the wall jet region with flow separation reattachment in the region. Based on the above literature survey and to the best of the authors' knowledge, jet impingement cooling for such a geometry has never been reported in the literature despite its importance in practical thermal engineering applications. The results of this study may be useful for design and optimization of such systems and to obtain best performance in terms of fluid flow and heat transfer characteristics. © 2019, Emerald Publishing Limited.

2-s2.0-85071002187

**Document Type:** Article

**Publication Stage:** Article in Press

**Source:** Scopus