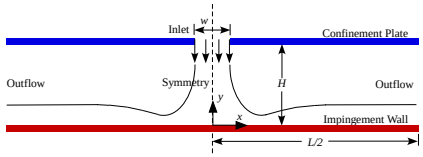
Heat Transfer Under Pulsating Impinging Jets

Pulsating Impinging Jets

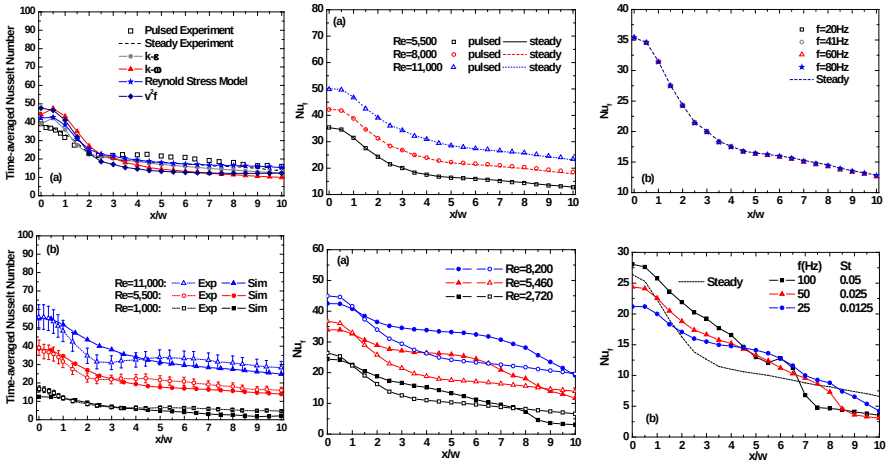
Pulsating impinging jets with the injection of flow pulsations have received increasing interest for their potential in heat and mass transfer. However, because of the complexity of flow structure and the non-linear dynamics in the boundary layer induced by pulsation, pulsatinghjet impingement flow and associated heat transfer has been a challenging problem and shown some intriguing aspects. The current study aims at the mechanism of the heat and mass transfer in the pulsating impinging jet.

Mathematical model

A numerical investigation is performed on a two dimensional pulsed turbulent impinging jets to examine the effect of temperature-dependent thermophysical properties along with sinusoidal and intermittent pulsations of the jet on the local Nusselt number distribution on the target surface.



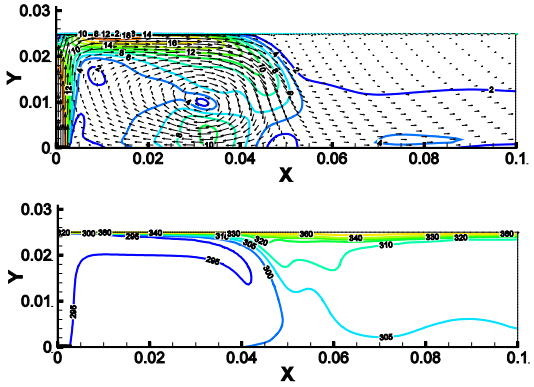
The effect of temperature differences, Reynolds number, frequency,and amplitude as well nozzle-to-plate distance are discussed for further understanding of the flow and thermal characteristics in pulsating turbulent impinging jets.



Heat Transfer Performance

The numerical results presented indicate no obvious heat transfer enhancement by single sinusoidal pulsation, while significant heat transfer enhancement due to intermittent pulsation of the jet flow can be found over a wide range of conditions.

Parametric studies show that increasing Reynolds number results in Nusselt number enhancement for both sinusoidal and intermittent cases, and increase of the frequency of intermittent pulsation can enhance the time-averaged local Nusselt number.



The observed effects of intermittent pulsation may be attributed to higher turbulence, larger vortices, increased flow entrainment and mixing promoted by flow instabilities as well as reduced instantaneous hydrodynamic and thermal boundary layers in the fluid in the flow domain.

The observed effects of the square-wave pulsation can be attributed to higher turbulence, larger vortexes, increased flow entrainment and mixing promoted by flow instabilities, reduced hydrodynamic and thermal boundary layers as well as the energy storage of surroundings.

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