EXPERIMENTAL AND NUMERICAL INVESTIGATION ON THE EFFECTS OF JET REYNOLDS NUMBER AND NOZZLE-PLATE SPACINGS ON SINGLE ROUND AIR JET IMPINGEMENT HEAT TRANSFER

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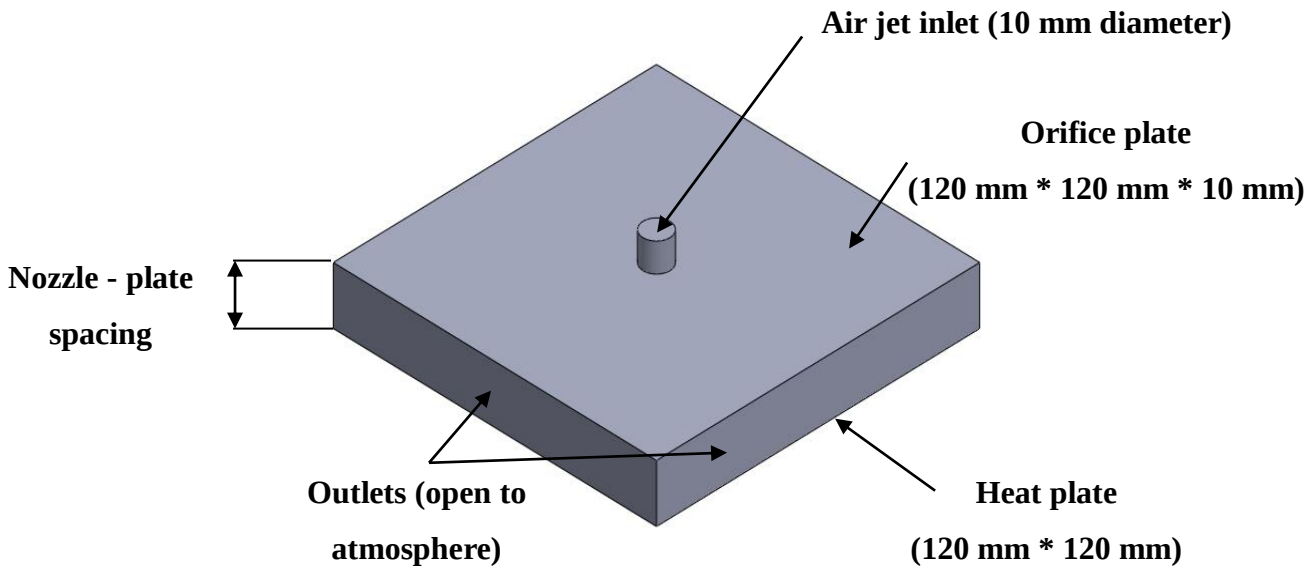
Abstract

Jet impingement provides an effective means for high heat/mass transfer and it has been widely applied in various industrial processes such as cooling of gas turbines and electronic components, processing of food, drying of textiles and wood and so on. In this study, the effect of jet Reynolds number and nozzle-plate spacing on the single round air jet impingement heat transfer rates will be studied both experimentally as well as numerically.

Problem definition

A steady, incompressible, air jet at 306 K is being issued through a 10 mm diameter orifice plate attached at the bottom of a plenum chamber on to a 120 mm * 120 mm flat heat plate which is placed at a certain distance from the orifice plate. It is required to cool the heat plate which is producing a uniform heat flux of 3472.22 W/m^2.



Tested parameters in the present study

Jet Reynolds number : 8000, 16000, 24000

Nozzle-plate spacing : 10 mm, 20 mm, 30 mm

Aim

- Investigate the effect of jet Reynolds number and nozzle-plate spacing on heat transfer characteristics experimentally as well as numerically.
- To plot the Nusselt number distribution along the length of the heat plate during jet impingement at different jet Reynolds number and nozzle-plate spacing.
- To obtain the velocity, pressure, turbulent kinetic energy and Nusselt number contours.

Computational tools

Modeling	FreeCAD	
Meshing	snappyHexMesh utility in OpenFOAM	
Processing	OpenFOAM (version 6)	
	Turbulence model	K-omega SST
	Solver	buoyantBoussinesqSimpleFoam
Post processing	ParaView 5.6	