Abstract

Experimental and numerical investigations are conducted to study heat transfer coefficient around cylindrical shape bluff body subjected to constant heat flux at its outer surface and cooled by air steam flowing around it. The study covered positioning the cylinder in vertical, horizontal and 45° inclined angle with respect to the free air stream, with its axis in horizontal position parallel to the flow and Reynolds numbers ranging (8,900 - 48,000) for vertical, inclined and horizontal positions. Numerical approach is realized by conducting mathematical model of the problem and solving it numerically using a CFD Code FLUENT 6.3.26 after describing the mesh model using the Gambit 2.2.30. Three dimensional Cartesian coordinate system is considered in this study. The studied geometry is generated by using GAMBIT with dimensions of rectangular box L=127mm, W=130mm and H=129mm. The dimensions of heated cylinder is set identical to the experimental test H=90mm and R=17mm. Proper assumptions are based to solve the governed equations. The experiments are based on air as cooling fluid to investigate heat transfer coefficient around the heated cylinder. Constant heat flux is generated on the surface of the cylinder using proper electrical heater. The heat flux around the cylinder equal (5217, 5201 and 5284 W/m²) for vertical, inclined and horizontal positions respectively. Air flow is ensured around the heated cylinder at different velocities using proper test rig. Local heat transfer coefficients around the cylinder are investigated based on the heat flux measured.
value and the temperature differences between local cylinder surface temperature and the air stream temperature measured by thermocouples, and standard Pitot-static tube with curved junction (N. P. L standard) was used to measure air free stream velocity. The conducted comparison between the recent experimental results and those obtained from previous work showed reliable agreement. Where maximum error obtained from this comparison was 6.4% for vertical position.

References


A. H. Davis (1942), "Convective cooling of wires in streams of viscous liquid", Phil. Mag., 47 pp. 1057–1092


Forced Convection Heat Transfer around Heated Inclined Cylinder

- Y. A. Çengel (1998); Heat Transfer: A Practical Approach; McGraw-Hill, Boston, Massachusetts
- C. Sak, R. Liu, D. S. -K. Ting (2007); The role of turbulence length scale and turbulence intensity on forced convection from a heated horizontal circular cylinder; Journal of Fluid Mechanics, Vol. 31, pp. 279-289

Index Terms
Computer Science

Keywords
Forced convection  Circular cylinder  Cross flow  Experimental and Numerical Study