عنوان مقاله:

CRITERIA FOR PREDICTING TRANSITIONS IN FREE CONVECTION HEAT TRANSFER FROM ISOTHERMAL CONVEXBODIES IN FLUIDS WITH ANY PRANDTL NUMBER

محل انتشار:

پانزدهمین کنفرانس دینامیک شاره ها (سیالات) (سال: 1392)

تعداد صفحات اصل مقاله: 11

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خلاصه مقاله:

This article presents criteria for predicting transitions in free convection from isothermalconvex bodies in fluids with any Prandtl number. There are two transition phenomena whichoccur in free convection heat transfer over all range of Rayleigh numbers. One is thetransition from the region that has a thick thermal boundary layer where conduction heattransfer is dominant, to a thin thermal boundary layer in laminar flow where free convectionheat transfer is dominant (conduction-laminar transition). The second is the transition fromlaminar boundary layer to turbulent boundary layer (laminar-turbulent transition). Theproposed transition criteria has been obtained based on analytical method of Arabi who hasdeveloped a correlation to calculate free convection heat transfer from isothermal convexbodies in fluids with any Prandtl number. The results showed that for the laminar-turbulenttransition criterion, Grashof number correlated transition data better than the Rayleighnumber for different convex bodies. Furthermore, it was deduced that the laminar-turbulenttransition along a vertical surface in fluids with any Prandtl number took place in theneighborhood of Gr=109. In addition, for convex geometries other than a vertical plate, thetransition occurs at values slightly less than Gr=109. This was due to the surface properties ofconvex geometries, which help separation to occur sooner. The separation becomes a triggerto the faster laminar-turbulent transition mechanism which finally leads to fully turbulentflow. In the end, the present results for six geometries are compared with the availableexperimental data. Excellent agreement was found between the proposed model and availableexperimental data over a wide range of geometries and Prandtl numbers. This showed thatthe proposed criteria is powerful enough to predict the two transition phenomena in freeconvection heat transfer from isothermal convex bodies for a wide .range of geometries influids with any Prandtl number and all Rayleigh numbers

کلمات کلیدی:

Free Convection, Conduction-Laminar Transition, Laminar-Turbulent Transition, Transition Criteria, Grashof Number, Prandtl Number, Rayleigh Number and Convex Body