Proceedings of the ASME 2015 Power Conference
POWER2015
June 28-July 2, 2015, San Diego, California

POWER2015-49575

NUMERICAL INVESTIGATION OF A THREE-DIMENSIONAL LAMINAR MIXED CONVECTION FLOWS IN LID-DRIVEN CAVITY FOR VERY SMALL RICHARDSON NUMBERS

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ABSTRACT

Laminar mixed convection in a three-dimensional lid driven cavity is numerically investigated. The top lid of the cavity is moving rightwards with a constant speed at a cold temperature. The bottom wall is maintained at an isothermal hot temperature, while the other vertical walls of the cavity are assumed to be insulated. In this study the mass diffusion was not taken into account and the fluid used was air. The flow and heat transfer behavior is studied for various Richardson number ranging from 5×10^{-5} to 3×10^{-4} at a fixed Prandtl number of 0.71 through analyzing the local Nusselt number distribution at different sections inside the cavity. Lewis number Le is assumed to be unity and the buoyancy ratio parameter N is equal to zero. Computations were done using an in-house code based on a finite volume method. The results showed a good agreement with previous two dimensional studies, while the three dimensional study gives different results at different sections inside the cavity. It is observed that, the average Nusselt number "Av Nu" on top and bottom surfaces decreases for all sections inside the cavity with increasing Richardson number. A correlation was formulated for each section on both walls for "Av Nu" as a function of "Ri" with a maximum error of 7.3%.