Two-dimensional Darcy-Bénard Convection in a low aspect ratio cylinder

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1. INTRODUCTION & OBJECTIVE

The cylindrical counter part of the classical Rayleigh Bénard Convection problem has been mostly done with axisymmetry assumption ([1], [2], [3], [4]). The porous medium analog of the cylindrical Rayleigh Bénard Convection problem is known as Darcy Bénard Convection (DBC) problem. The classical DBC problem concerns very shallow cylindrical enclosures. These problems are mostly solved using isothermal boundary conditions and to the knowledge of the authors therse is no reported work with third type boundary condition on temperature. Such a boundary condition warrants the use of a numerical method or a semi-analytical method to solve boundary eigen value problems. This aspect is on focus in the present paper wherein the influence of Biot numbers on onset of convection is studied.

2. RESULTS & HIGHLIGHTS OF IMPORTANT POINTS

Two-dimensional classical Darcy-Bénard convection is studied in a cylinder using the Fourier - Galerkin procedure involving a Maclaurin series of 15 terms. The critical eigen value is obtained to an accuracy of four decimal digits. Comparison is made between the results of isothermal and adiabatic boundaries. It is found that the critical Darcy-Rayleigh number of adiabatic boundaries is smaller than those of isothermal boundaries. The problem has applications in energy storage devices.

REFERENCES

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