

Numerical study of free convection to an array of inline cold horizontal cylinders above an adiabatic floor

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Abstract

In many refrigeration, air-conditioning and freezing equipments free convection accrues between horizontal pipes or tubes and a floor placed over them... Single cold cylinder close and over a floor is not analysis yet, although many studies have been done for a single tube surrounded by infinite fluid.

In the present analysis, steady state two-dimensional laminar free convection heat transfer to an array of inline horizontal, isothermal, cold cylinders located above a nearly adiabatic floor is studied numerically.

To carry out the numerical computations the governing equations of laminar natural convection are solved using the OpenFOAM software in a wide range of Rayleigh numbers from 10^3 to 10^6 . The case study involved a modification of icoFoam by adding mass force to the momentum equation and including the temperature equation as a passive scalar.

The contour plot of flow stream lines and isothermal lines are obtained for different cylinder position Which show the cold plume flow downstream strikes to the floor and divides into two parts. Each part moves horizontally away from the cylinder over the floor.

Results shows the finite space between the cylinders and the floor (L/D) cause the flow pattern changes from obtained pattern for pipes in an infinite medium. also, by decreasing the space ratio S/D , the boundary layer of neighboring cylinders combine and form a developing flow between the cylinders. These leads to Results, indicate that the variation of average heat transfer coefficient of the cylinder, highly depends on L/D and S/D . Attempt is made to propose a new correlation for heat transfer coefficient for a single cold horizontal cylinder placed close on an adiabatic floor.

KeyWords: free convection, modeling, floor distance, space ratio