Numerical Study of the Effect of Orientation Angles on Combined Convection in a Cavity Contain Rotation Cylinder

Sana.M.Shrama[1], Falah A. Abood[2], Sana.J.Yaseen[3], Amani J. Majeed[4]*
{sanamech77@gmail.com, dr.falah.abood@gmail.com,
sana.yaseen@uobasrah.edu.iq, ammani.majeed@uobasrah.edu.iq}

Mechanical Engineering department , Basrah University / Basrah, Iraq[1,2,3]
Petroleum Engineering department, Basrah University / Basrah, Iraq[4*]

Abstract. This study examines the influence of a rotating cylinder on heat transmitted by mixed convection in an air-filled square space. The appropriate mathematical models for continuous, incompressible, 2-dimensional, laminar flows with Boussinseq's approach are solved numerically, where constant fluid properties have been used. The most important parameters examined are: the angular velocity (Ω = 0 - 1000) and the angle of inclination ($\Theta = 0 - 90^{o}$), the study has been carried out with the Rayleigh number ($Ra = 10^{4}$), the Prandtl number (Pr = 0.7). The results show that the streamlines are affected by the angular velocity, where the forced convection becomes dominant at high values of angular velocity. The rotation of the cylinder has an effect on the heat exchange between the walls of the cavity and the fluid. Finally the average Nusselt number is increased with increases of angular velocity and decreases as inclination angles change from horizontal to vertical position. A good agreement has been achieved by comparing the results of this work with other previous work.Keywords: Inclined square cavity, rotating cylinder, mixed convection, numerical method.

Nomenclature

Cp	constant pressure specific heat
g	gravitational acceleration
H	height (width) of the enclosure
k	thermal conductivity
Nu	Nusselt number
p	pressure
Pr	Prandtl number
r	radius
R	radius at the surface of the cylinder
Ra	Rayleigh number
Ri	Richardson number
T	temperature
u,v	Cartesian velocity components
x, y	Cartesian co-ordinates

Greek symbols

α	thermal diffusivity
μ	dynamic viscosity
ν	kinematic viscosity
ρ	density
ψ	streamfunction
Ω	angular rotational velocity
φ	inclination angle

IMDC-IST 2021, September 07-09, Sakarya, Turkey

DOI 10.4108/eai.7-9-2021.2314844