بسم الله الرحمن الرحيم

شبكة المعلومـــــات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

﴿ قـــسـم ﴾

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون آية تغيرات

يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of
15 – 25c and relative humidity 20-40 %

بعض الوثائق الأصلية تالفة

بالرسالة صفحات

لم ترد بالأصـــل

Mansoura University
Faculty of Engineering
Mechanical Power Engineering Department

FREE CONVECTION HEAT TRANSFER IN AN INCLINED ANNULAR POROUS MEDIUM.

Thesis
Submitted in Partial Fulfillment of Requirements For The Degree of Master in Mechanical Power Engineering.

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ABSTRACT

Experimental study was carried out for the steady laminar natural convection of air in an inclined annulus porous medium, with constant heat flux heated inner cylinder and an isothermally cooled outer cylinder. The primary objective of the study is to show the effect of the inclination angle of the annulus and the porosity on the heat transfer characteristics. The geometrical parameters of the annulus are: diameters of 21/45mm, gab width δ=12mm, length L=492mm, and an aspect ratio (length/gab width) A=41. The annulus is filled with spherical beads of diameters d=6.35, 3.97 and 3.11 mm with porosities of 0.45, 0.43 and 0.42 respectively. The operating parameters are: generated heat energy $4 \leq Q \leq 324$W with heat flux $0.123 \leq q \leq 11.16$kW/m^2, Rayleigh number $10 \leq Ra \leq 550$ and inclination angle $0 \leq \theta \leq 90°$.

This study showed that the behavior of free convection heat transfer in an inclined porous annulus is completely different from that in a horizontal or vertical one. The inner surface temperature increases with the increase of distance from the bottom of the annulus. For high inclination angles $\theta \geq 45°$, high heat flux $q \geq 2.5$kW/m^2, input power $Q \geq 81$W, a drop in the local temperature in the longitudinal direction followed by an increase is observed near the midsection, indicating the existence of two cells of flow inside the annulus.

For non-vertical annulus, a peak temperature with a minimum value of local Nusselt number Nu_l occur at ϕ=150°, where ϕ is the angular coordinate measured from the bottom edge of centerline, indicating the occurrence of flow separation near ϕ=150°. The peak temperature decreases with the increase of inclination angle θ and vanishes at θ=90° making uniform temperature distribution on the inner wall along the angular direction. With the increase of inclination angle θ, the inner cylinder mean temperature $\bar{t}_i$ and maximum temperature t_{imax} decrease indicating the increase of convection part of heat transfer. The conduction regime occurs for Ra≤40. For Ra>40, mean Nusselt number and the coefficient of heat transfer h increase as Ra increases and with the increase of the inclination angle θ. The existence of the porous media causes a greet reduction of the inner cylinder wall temperatures. With the increase of porosity, the conduction heat transfer coefficient decreases and the convection heat transfer coefficient increases. Mean Nusselt number Nu increases with the increase of the porosity and it is correlated with the inclination angle, Rayleigh number and Darcy number as follows:

$$\mathbf{Nu=1.497+3.18x10^{-4}(0.695+\sin\theta)Ra+5.35x10^{-7}Da^{0.515}Ra^{2}}$$

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