بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأفلام قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of 15-25- c and relative humidity 20-40%

بعض الوثائق الاصلية تالفة

بالرسالة صفحات

لم ترد بالاصل

MANSOURA UNIVERSITY
FACULITY OF ENGINEERING
MECHANICAL POWER ENG DEPT

AUGMENTATION OF FREE CONVECTION HEAT TRANSFER THROUGH CYLINDRICAL ANNULUS

THESIS
Submitted in Partial Fulfillment of The Requirements
for the Degree of Master of science
In
Mechanical Engineering
By

Eng. Yahia Zakaria Hassan Youssef

Supervisor
By
Associate Prof. Dr.

Ahmed Abd El-Razik Sultan
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Supervision sheet

Researcher Name: ***Yahia Zakaria Hassan Youssef***

Thesis Title: **AUGMENTATION OF FREE CONVECTION HEAT TRANSFER THROUGH CYLINDRICAL ANNULUS**

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ACKNOWLEDGEMENT

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The author wishes to express his deep gratitude to his supervisor, ***Associate Prof. Dr. Ahmed Abd El- Razik Sultan*** for supervising this work. His continuous sincere advice, and guidance, which has mad the completion of this work possible.

The author also wishes to express his deep gratitude to ***Dr El-Shafie Beder Zidan***, Faculty of Engineering Mansoura University for his encouragement and continued help during the presentation of this work.

Acknowledgement is also extended to all the team of Mechanical Power Engineering Department, refrigeration and air condition laboratory staff and the members of the workshop of the Faculty of Engineering Mansoura University and everybody contributed with his effort to the success and completion of this work.

Finally thanks to my parents and my prayers to ALLAH to give the benefit of this work to the spirit of my mother

At the end of this effort I would like to say El Hamdod to ALLAH the great and mighty.

ABSTRACT

In the present work, natural convection heat transfer through vertical cylindrical annulus is experimentally investigated. The inner cylinder is heated electrically with constant heat flux, while the outer one is subjected to ambient air. The out side Rayleigh number was varied between 80 and 1500 throughout this investigation. The aspect ratio is 50 while the radius ratio is 1.5. The annular gap is provided with helical-wire-coil rings wound around the outer surface of the inner cylinder as an augmentation device. The helical-wire-coil rings used are made of copper wire of different wire diameters. The wire is coiled around rods of different diameters in order to have helical-coils of different outside diameters. The helical-wire-coils are then wounded around the inner cylinder of the annulus in the form of rings with constant longitudinal distance along the axis of the annulus (ring pitch).

The effect of coil pitch, ring pitch, coil diameter and wire diameter are investigated, therefore four groups of experiments are conducted in this work. In the first group, the effect of coil pitch on the heat transfer rate is studied. Thecoil pitch is ranged from 0.897 to 2.393 mm while the other configuration parameters are kept constant. The second group of experiments are concerned

with the effect of ring pitch on the heat transfer rate, in which the ring pitch was varied from7.54 to 23.75 mm. The other parameters discussed in this work are kept constant. The data collected in the third group of experiments is concerned with the variation of coil diameter from 5.2 to 9.6 mm with other configuration parameters are kept constant. In the fourth group of experiments the effect of variation of the wire diameter on the heat transfer rate is discussed. In this case the wire diameter was varies from 0.45 to 1.35 mm with other configuration parameters are kept constant.

From the present experimental work the following conclusions were drawn:

1- The temperature field in the annulus is influenced by the variation of wire diameter, coil diameter, coil pitch, ring pitch and heat flux. This results in an enhancement of heat transfer rate.

2- The use of helical-wire-coil rings on the outer surface of the inner cylinder of the annulus provokes three modes of heat transfer to act simultaneously to transfer heat between the inner and outer cylinder of the annulus. The convective heat transfer due to the disturbance caused by the rings the radiative heat transfer due to the high surface area of the ring compared to the surface area of the inner cylinder (area ratio of as much as 8.87), the high emissivity of the ring material ($\varepsilon = 0.75$) and the conductive heat transfer due to contact between the inner and outer cylinders of the annulus via ring material, and due to the increase of the effective thermal conductivity of the system.

3- The heat transfer rate increases with the increase of both coil diameter and wire diameter and decreases with the ring pitch. While it has a peak value in the coil pitch range.

4- Relative to the smooth bare annulus without rings on its inside cylinder, the use of helical-wire-coil rings has resulted heat transfer enhancement by as much as 8.25 times.

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