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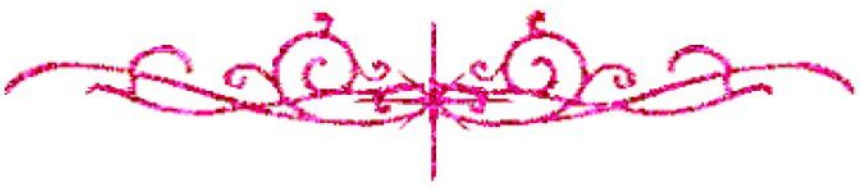

بالرسالة صفحات
لم ترد بالأصل

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Effect of Fins Material on the Performance of Stratified Chambers Gas to Gas Heat Exchanger with Porous Medium

A Thesis Submitted in Partial Fulfillment of the Requirement of the Degree of Master of Science in Mechanical Engineering

By
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B.sc. Mechanical Engineering, Mechatronics, 2012

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Cairo
2020

Examiners Committee

The undersigned certify that they have read and recommend the faculty of Engineering Ain Sham University for acceptance a thesis entitled “Effect of Fins Material on the Performance of Stratified Chambers Gas to Gas Heat Exchanger with Porous Medium”, submitted by Mohamed Medhat Hussein Khalil in partial fulfillment of the requirements for the degree of Master of Science in Mechanical Power Engineering.

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STATEMENT

This thesis is submitted as partial fulfillment of Master of Science degree in Mechanical Engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or qualification at any other scientific entity.

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Acknowledgement

First and foremost, I would like to thank God Almighty for giving me the strength, knowledge, ability and opportunity to undertake this research study and to persevere and complete it satisfactorily. Without his blessings, this achievement would not have been possible.

Special appreciation and thank goes to my thesis Supervisor Prof. Dr. Hussien Zaky Barakat. The door to Dr. Hussien Zaky Barakat office was always open whenever I ran into a trouble spot or had a question about my research or writing. He consistently allowed this research to be my work, but steered me in the right direction whenever he thought I needed it.

I would also like to thank the member of the supervisory Dr. Hamdy Ahmed Hussein Abotaleb for his support, knowledge, and assistance.

Special thanks to Dr. Hany El Sayed Abdel Haleem, Eng. Mai Elghabaty & Eng. Mervat Mohamed for the support and the assistance.

Finally, I must express my very profound gratitude to my parents for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them. Thank you

Thesis Summary

An experimental study was carried out to investigate the effect of fin material on the performance of stratified chambers gas to gas heat exchanger with and without porous media. The target of these experiments was to study the change of the rate of heat transfer under different hot and cold air stream rates, different porous material thicknesses and different hot air inlet temperatures. Using two different fin materials facilitate the investigation of the heat exchanger performance when using steel and aluminum fins. In additional to the heat exchanger performance in the absence of porous material and its presence is obtained. The determination of the optimum operating parameters to achieve maximum total heat recovery ratio is also investigated.

The test rig used in these experiments consists of the air supply system, flow and temperature measurement instruments, heating system with its control system and five heat exchanger chambers, each chamber provided with corrugated fins. The experimental study showed that using aluminum fins instead of steel fins had much improvement on the performance of the heat transfer rate. While adding the porous material to the heat exchanger chambers leads to improvement of the heat transfer rate on the expense of an increase in pressure drop.

In case of aluminum fins, the porous material thickness is 70 mm and the hot air stream inlet temperature is 400°C, the heat recovery ratio increased to 0.822, at 0.5 m3/min volume flow rate of the cold and hot air streams. While in case of steel fins with the same conditions of the hot air inlet temperature, porous material thicknesses and the volume flow rates of the cold and hot air

streams, the heat recovery ratio was 0.537. It is concluded that in aluminum fins case the heat recovery ratio increases by approximately 53% of the case of the steel fins.

Keywords:

Heat exchanger, aluminum fins, steel fins, porous material, heat transfer.

Nomenclature

$\dot{m}$	Air mass flow rate……	kg/sec.
$c_{p,c}$	Cold air specific heat capacity at constant pressure……	J/kg.K
$c_{p,h}$	Hot air specific heat capacity at constant pressure……	J/kg.K
$T_{c,i}$	Cold air inlet temperature…….	℃
$T_{c,o}$	Cold air outlet temperature……...	℃
$\bar{T}_c$	Average cold air temperature……...	℃
$T_{h,i}$	Hot air inlet temperature……..	℃
$T_{h,o}$	Hot air outlet temperature…….……	℃
$\bar{T}_h$	Average hot air temperature…..……...	℃
$H_{R.}$	Heat recovery ratio……...…	--
Q_h	Rejected heat rate by the hot air……...	Watt
Q_c	Heat recovery rate. Heat gained by the cold air……...	Watt
Q_{hc}	Rate of heat transfer from the hot air to the cold air……..	Watt
$\%Q_{loss}$	Percentage of heat loss…….	%

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