University of Victoria | Graduate Studies

Notice of the Final Oral Examination for the Degree of Master of Applied Science

of

YIFENG LIU

BEng (Northwestern Polytechnical University, 2011)

"Dead Volume Effects in Passive Regeneration: Experimental and Numerical Characterization"

Department of Mechanical Engineering

Tuesday, September 8, 2015
2:00 P.M.
Engineering Office Wing
Room 230

Supervisory Committee:
Dr. Andrew Rowe, Department of Mechanical Engineering, University of Victoria (Supervisor)
Dr. Rustom Bhiladvala, Department of Mechanical Engineering, UVic (Member)

External Examiner:
Dr. Aaron Gulliver, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:
Dr. Boualem Khouider, Department of Mathematics and Statistics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

The regenerator is the key component in magnetic cycles for refrigeration and heat pumping. It works as temporal thermal energy storage and separates two thermal reservoirs. Regenerators are typically made up of porous structures which may create complex flow pathways for the heat transfer fluid through the regenerator. The periodically reversing flow allows the thermal energy exchange with the packing material in the regenerators. The performance of such thermal devices depends greatly on the geometry of the porous structure, material properties as well as operating conditions.

This thesis is a study about the thermo-hydraulic properties of passive regenerators under oscillating flow conditions. The first part of the thesis presents a passive regenerator testing apparatus used to measure temperature distribution and pressure drop for various types of regenerators. Three kinds of loose spheres packed regenerator beds are characterized, and the regenerator effectiveness is evaluated. In the second part of the thesis, a numerical model is developed for the predictions of pressure drop and temperature field, and the theoretical findings are applied to experimentally obtained data to interpret regenerator performance. The dead volume is investigated quantitatively and considered to affect the regenerator performance adversely.