

TABLE OF CONTENTS

LIST OF FIGURES	17
LIST OF TABLES	19
NOMENCLATURE	21
1 INTRODUCTION	24
1.1 Microchannel Heat Exchangers.....	25
1.2 Literature Review and Background	27
1.3 Motivations and Research Objectives.....	31
1.4 Thesis Organization	33
2 FIN2D MODEL.....	36
2.1 Fin2D Heat Exchanger Model.....	36
2.1.1 Heat exchanger discretization	36
2.1.2 Governing equations	37
2.1.3 Numerical Solution	39
2.2 Case Study Definition	40
2.3 Numerical Verification of the Fin2d Model.....	41
2.4 Fin2D Solution for the Case Study.....	46
2.5 Analysis of the Segment-by-Segment ε -NTU Modeling and Effect of Classical Assumptions.....	51
2.5.1 Comparison of Fin2D model against ε -NTU approaches.....	53
2.5.2 Analysis of classical assumptions with Fin2D model.....	55
2.6 Conclusions.....	59
3 FIN1Dx3 MODEL	62
3.1 Fin1Dx3 Heat Exchanger Model	63
3.1.1 Heat Exchanger Discretization.....	65
3.1.2 Governing Equations	67

TABLE OF CONTENTS

3.1.3	Numerical Scheme.....	74
3.1.4	Solution Methodology	80
3.2	Model Validation	83
3.2.1	Microchannel condenser validation	84
3.2.2	Microchannel gas cooler validation.....	86
3.2.3	Impact of parameter φ on predicted capacity	88
3.3	Simplification of Fin1Dx3 model: Fin1D	89
3.4	Conclusions.....	90
4	NUMERICAL COMPARISON OF MODELS	93
4.1	Comparison among different developed models: Fin2D, Fin1Dx3 and Fin1D	94
4.2	Comparison with other authors' approaches.....	97
4.3	Conclusions.....	101
5	SIMULATION STUDIES.....	105
5.1	Simulation methodology and case study description	106
5.2	Number of refrigerant passes.....	108
5.3	Influence of the fin cuts.....	110
5.4	Influence of aspect ratio for a serpentine gas cooler.....	112
5.5	Conclusions.....	114
6	CONCLUSIONS	117
6.1	Global Conclusions	117
6.2	Contributions and publications	121
6.3	Future work	123
7	APPENDICES.....	127
7.1	Appendix A: Matrix coefficients for both continuous fin and cut fin....	127
7.1.1	[B] for continuous fin.....	128
7.1.2	[B] for cut fin.....	134

TABLE OF CONTENTS

7.1.3	[C] for continuous fin.....	136
7.1.4	[C] for cut fin.....	140
7.2	Appendix B: Experimental data used for validation of model	141
7.2.1	Gas cooler	141
7.2.2	Condenser	144
	REFERENCES	147