### **TABLE OF CONTENTS**

	Page
Dedication	-
Abstract	i-iv
Declaration	V
Certificate	vi
Acknowledgement	vii
Table of Contents	viii-xii
List of Tables	xiii-xvii
List of Figures	xviii-xxiv
Nomenclature	xxv-xxvii

# **Chapters:**

## 1. INTRODUCTION

1.1 Introduction	
1.2 Refrigeration systems	
1.2.1 Vapour compression refrigeration system (VCRS)	
1.2.2 Vapour absorption refrigeration system (VARS)	3
1.2.3 Absorption/vapor-compression cascade refrigeration system	5
1.2.4 Gas cycle refrigeration system	6
1.2.5 Ejector based refrigeration systems	8
1.2.6 Thermoelectric refrigeration systems	11
1.2.7 Thermoacoustic refrigeration systems	13
1.2.8 Metal hydride (MH) based refrigeration systems	14
(a) Regeneration process	15
(b) Refrigeration process	15
1.3 More on different VARS configurations	
1.4 Some desirable properties of refrigerant/absorbent pair used in VARS	
1.5 Refrigerant/ absorbent pairs used in VARS	
1.6 Exergy analysis and its importance in analyzing thermal systems	
1.7. Inverse analysis	
1.8 Single/multiple-objective optimization of thermal systems	35
1.9 Motivation and Research Objectives	35
1.10 Outline of the thesis chapters	39
Bibliography	

#### 2. LITERATURE REVIEW

2.1 Introduction	
2.2 Property models of some specific refrigerant absorbent pairs	
2.3 Alternate refrigerant absorbent pairs for VARS	
2.4 Water-lithium chloride (H <sub>2</sub> O–LiCl): a potential working solution pair	
for VARS	56
2.5 First law based energy analysis of VARS with various solution pairs	
2.6 Solar powered VARS	60
2.7 VARS driven by engine exhaust and other waste heat sources	
2.7.1 Engine exhaust heat driven VARS	64
2.7.2 GT and ST based VARS	66
2.8 Exergy analysis of VARS	
2.8.1 Exergy analysis of single effect VARS	67
2.8.2 Exergy analysis of double effect VARS	69
2.8.3 Exergy analysis of triple effect VARS	72
2.9 VARS performance analysis using H <sub>2</sub> O–LiCl as working solution pair	
2.10 Optimization studies on VARS	
2.11 Summary of the Review	
2.12 Scope of the present work	82
Bibliography	

## 3. MODELLING AND EXERGY ANALYSIS OF SINGLE EFFECT H<sub>2</sub>O–LiCI ABSORPTION REFRIGERATION SYSTEM

3.1 Introduction		98
3.2 Descript	ion of the single effect H <sub>2</sub> O-LiCl VARS	99
3.3 Assump	tions	99
3.4 Thermod	dynamic formulations	101
3.5 Results and discussion		103
3.5.1	Estimation of operating temperatures	103
3.5.2	H <sub>2</sub> O-LiCl VARS performance at estimated temperatures	106
3.5.3	Performance variation with $T_E$ at two different condenser	
	and absorber temperatures	111

3.5.4 Performance variation with  $T_G$  at two different condenser

and absorber temperatures	116
3.5.5 Performance comparison between H <sub>2</sub> O–LiCl and H <sub>2</sub> O–	LiBr
VARS	123
3.6 Summary	131
Bibliography	133
4. ENERGY ANALYSIS OF DOUBLE EFFECT	H <sub>2</sub> O–LiCl
ABSORPTION REFRIGERATION SYSTEM	S AND
<b>COMPARISON WITH H<sub>2</sub>O–LiBr SYSTEMS</b>	
4.1 Introduction	135
4.2 Description of the double effect absorption refrigeration systems	136
4.3 Modeling assumptions	147
4.4 Mathematical Modeling of the double effect VARS configuration	is 147
4.5 Validation	
4.6 Results and Discussion	
4.6.1 Effect of HPG temperature ( $T_{HPG}$ ) on performance of $G$	louble
effect H <sub>2</sub> O–LiCl VARS configurations	156
4.6.2 Effect of LPG temperature ( $T_{HPG}$ ) on performance of	double
effect H <sub>2</sub> O–LiCl VARS configurations	173
4.6.3 Effect of D on performance of the double effect paralle	el
and reverse parallel H <sub>2</sub> O–LiCl systems	175
4.6.4 Performance comparison between double effect $H_2O-I$	LiCl
and H <sub>2</sub> O–LiBr systems	185
4.7 Summary	186
Bibliography	189
5. EXERGY ANALYSIS OF DOUBLE EFFECT ABSORPTION REFRIGERATION SYSTEM COMPARISON WITH H <sub>2</sub> O–LiBr SYSTEMS	-
5.1 Introduction	191

5.2 Modelling Assumptions	192

5.3 Exergy based thermodynamic modelling of the double effect VARS		193
5.4 A brief summary of results presented in Chapter 4		194
5.5 Exergy based results and discussion		196
5.5.1	Effect of HPG temperature ( $T_{\rm HPG}$ ) on exergetic performances	
	of double effect H <sub>2</sub> O-LiCl VARS configurations	196
5.5.2	Effect of LPG temperature ( $T_{HPG}$ ) on exergetic performance	213
5.5.3	Effect of distribution ratio $(D)$ on exergetic performances	
	of the double effect parallel and reverse parallel systems	218
5.5.4	Exergetic performance comparison between the double effect	
	H <sub>2</sub> O–LiCl and H <sub>2</sub> O–LiBr systems	222
5.6 Summary		234
Bibliography		236

## 6. MULTI OBJECTIVE OPTIMIZATION OF DOUBLE EFFECT SERIES AND PARALLEL FLOW WATER-LITHIUM CHLORIDE AND WATER-LITHIUM BROMIDE SYSTEMS

	6.1 Introduction		237
6.2 Assumptions		238	
	6.3 System modelling		239
6.4 Genetic algorithm		241	
	6.4.1	Initialization	241
	6.4.2	Selection	242
	6.4.3	Cross-over	243
	6.4.4	Mutation	244
	6.4.5	Non-dominated sorting	244
6.5 More about the fitness function		247	
	6.6 Validation		248
6.7 Results and discussion		248	
	6.7.1	Optimized results of the double effect series configuration	249
	6.7.2	Optimized results of the double effect parallel configuration	259
	6.7.3	Comparison of optimized results between series and	267
		parallel configuration	

6.7.4 Comparison of optimized results with those prese	nted in
Chapters 4 and 5	271
6.8 Summary	274
Bibliography	276
7. CONCLUSION AND SCOPE FOR FUTURE WO	ORK
7.1 Conclusions	278
7.2 Scope of future work	285
Appendix	287

List of Publications	29	0