LIST OF FIGURE

.

Ň

Fig. No.	Title	Page No.
Fig.1.1	Worldwide use of solar thermal energy	1
Fig.1.2	Psychometric Chart-In the above, the blue region shows the "Thermal Comfort Zone"	. 4
Fig1.3	Schematic diagram of an absorption cooling system	9
Fig.1.4	Schematic drawing of a solar driven absorption cooling system	10
Fig. 1.5	A typical desiccant cooling system	12
Fig.1.6	A solar thermal driven ejector cooling systems	12
Fig.1.7	Layout of adsorption cooling	14
Fig.1.8	Adsorption refrigeration cycle	14
Fig.1.9	Solar powered Rankine cycle operated cooling system	14
Fig.1.10	ClimateWell recommended solar cooling system in a nursing home	18
	Italy	
Fig.1.11	Schematic of a single TCA unit	19
Fig.1.12	Water vapour pressure above the solution for varying mass fractions	21
	of sorbent and solution temperature (Tsol). (Measurement made by	
	ClimateWell using the solution as shown in the TCA are shown as	
	filled squares	
Fig1.13	LiCl Solubility line	21
Fig1.14	Commercially available ClimateWell absorption chiller	. 23
Fig1.15	Schematic of the two barrels and the plumbing unit (without	25
	covers).	
Fig.1.16	Charging process	25
Fig.1.17	Dicharging Process	26
Fig.1.18	ClimateWell 10 Heating	27
Fig.1.19	ClimateWell 10 Charging Performance	28
Fig.1.20	ClimateWell 10 discharging (or) cooling performance	28

Fig.1.21	ClimateWell 10 heating performance	28
Fig.1.22	Control system box with flow meter, load cells and temperature	29
	sensors' connectors	
Fig.2.1	Different Zones of a single storey house	37
Fig.2.2	External/Internal cooling loads	40
Fig.2.3	TRNSYS interface to estimate overall cooling load to the building	42
Fig.2.4	Comparison of zone 1 temperature with ambient temperature when	43
	the room is unconditioned	1
Fig.2.5	Total cooling load & Latent energy gain of zone 1	43
Fig.2.6	Comparison of zone 2 temperature with ambient temperature when	44
	the room is unconditioned	
Fig.2.7	Total cooling load & Latent energy gain of zone 2	44
Fig.2.8	Comparison of zone 3 temperature with ambient temperature when	45
	the room is unconditioned	
Fig.2.9	Total cooling load & Latent energy gain of zone 3	45
Fig 2.10	Comparison of zone 4 temperature with ambient temperature when	46
	the room is unconditioned	, ,
Fig.2.11	Total cooling load & Latent energy gain of zone 4	46
Fig.2.12	Comparison of zone 4 temperature with ambient temperature when	47
	the room is unconditioned 5	
Fig.2.13	Total cooling load & Latent energy gain of zone 5	47
Fig.2.14	All zones temperature when the rooms are unconditioned	48
Fig.2.15	Total cooling load & Latent energy gain of all zones	48
Fig.2.16	Comparison of different zones max. & average cooling load	49
Fig.3.1	Schematic diagram of one barrel with the main component	50
Fig.4.1	Different TYPEs of cooling system in terms of temperature	63
Fig.4.2	TRNSYS interface of the complete solar cooling system	65
Fig.4.3	Schematic diagram of the solar cooling system	66
Fig.4.4	Collector Energy gain at 0.02 kg/m2.sec	71
Fig.4.5	Collector Energy gain at 0.025 kg/m2.sec	71
	iv	

Fig.4.6	Collector Energy gain at 0.035 kg/m2.sec	71
Fig.4.7	Arrangement of thermocouples inside the storage tank	73
Fig.4.8	Average temperature of each thermocouple point is tabulated and	74
	graph is plotted against reading time	
Fig.4.9	Cooling tower simulated outlet temperature corresponding to dry	76
	bulb and wet bulb '	
Fig.4.10	Simulation of CW 10 chiller with other subsystem of the cooling	78
	system	

v

LIST OF TABLES

.

Table 2.1	Building Wall Material	39
Table 2.2	Zone Area and Volume	39
Table 2.3	Zone wise Cooling	49
Table 4.2	Cooling tower identified parameters values	77

Content

List of Figure

List of Tables

Chapter 1: Introduction	
1.1 Renewable energy	3
1.2 Thermal comfort	3
1.3 Solar Cooling	4
1.3.1 Solar Cooling Systems	5
1.3.1.1 Electricity driven solar refrigeration systems	5
1.3.1.2 Solar thermal driven cooling systems	7
1.3.1.3 Rankine Cooling	14
1.4 Refrigerant	15
1.5 History of Solar Cooling With Absorption Chillers	17
1.6 Basics of ClimateWell Absorption Solar Chiller	18
1.7 Commercial ClimateWell absorption Chiller	22
1.8 Advantage and Difficulties	30
1.9 Dynamic Simulation	30
1.10 TRNSYS Simulation Program	31
1.11 Objectives of the Thesis	32

Chapter 2: Transient System Simulation (TRNSYS) analysis of multizone building to estimate cooling load in the solar cooling system

2.1 Description of Type 56 (Multizone Building)		
2.2 Selection of Site	35	

2.3 Methodology	
2.3.1 Selection of Zones from the Ground Floor Plan	. 36
2.3.2 Building Orientation	37
2.3.3 Building Material	3,8
2.3.4 Surfaces or Building Envelope (U-Values)	39
2.3.5 Air Exchange through Ventilation (Or) Infiltration Air	40
2.3.6 Internal Gain	40
2.4 Calculation and Simulation of the Building Cooling Load demand	

Chapter 3: Mathematical modeling and Thermodynamic analysis of the "CW 10 absorption solar chiller" unit and controller function

	3.1 Mathematical Description of the Absorption Chiller	50
	3.1.1 Condenser	51
	3.1.2 Initial Condition during Charging Of Reactor	52
	3.1.3 Calculation of Q'_{Cv} , Q'_{Rv} and Internal Flow Rate	52
	3.1.4 Desired Outlet Temperature during Discharge	54
	3.1.5 Reactor Mass and Temperature Calculations	55
	3.1.6 Temperature change due to the dissolution at reactor top	56
	3.1.7 Condenser Calculations	57
	3.2 Controller Model Description	58
	3.2.1 General Description	58
	3.2.2 Mathematical Description	58
	3.2.3 Control of Swaping	58
	3.2.4 Swapping Strategies	59
	3.2.5 Status of Barrels	60

ι.

Chapter 4: Design and analysis of the components of the solar cooling systems

4.1 Solar-Thermal Cooling System Concepts	61
4.2 Subsystems of the Solar-Thermal Cooling System	61
4.3 TRNSYS Model of the Solar-Assisted Cooling System	64
4.3.1 TRNSYS Components Used In the Model	66
4.3.2 Control Strategy	67
4.4 Solar-Assisted Cooling System Design Methodology	64
4.5 Cooling Tower Performance with CW 10 Requirement	. 75
4.6 Results and Discussion	77
Chapter 5: Conclusion	
5.1 Conclusion	79
5.2 Limitations	80
5.3 Future Work & Recommendations	80
References	82

References

.

Appendix

Appendix A

-

Appendix B