CONTENTS

s et t	Page
Acknowledgement	а
Abstract in Thai	b
Abstract in English	С
List of Tables	f
List of Figures	g
Chapter 1 Introduction	1
1.1 Background and Problem Statement	1
1.2 Literature Review	2
1.3 Objectives	8
1.4 Expecting Benefit	9
1.5 Scope of Study	9
Chapter 2 Theory	10
2.1 Introduction to the New Desalination Technique Concept	10
2.2 Modeling of Solar Desalination with the Bubble Pump	13
Chapter 3 Experimental Setup	17
3.1 Description of the Operating System	17
3.2 The Bubble Pump Design	18
3.3 Experimental Setup	19
3.4 Problem during Testing	22
3.5 Expected Results from Experimental Investigation	22
Chapter 4 Results and Discussion	23
4.1 Bubble Pump Performance	23
4.2 Solar Desalination Unit	28
Chapter 5 Long Term Analysis	38

5.1 System Simulation of Daily Performance in each Month	38
5.2 Economic Analysis	45
Chapter 6 Conclusions	49
6.1 Effects of Parameters on the System	ДĢ
6.2 Correlations of Bubble Pump	49
6.3 Economic Analysis	50
References	51
Appendixes	53
Appendix A	54
Appendix B	56
Appendix C	67

LIST OF TABLES

	Page
Table 3.1 Descriptions of components in the system	20
Table 3.2 Descriptions of measuring instrumentation in the system	21
Table 4.1 Simulation and experiment results of the distilled water yield	32
Table 4.2 Simulation and experiment results of the average brine water rate	33
Table 4.3 Simulation and experiment results of the brine water salinity	33
Table 5.1 Simulating conditions for operating system	38
Table 5.2 Average days for months and values of n and $H_{ extstyle 0}$ by months	39
Table 5.3 Coefficients a_1 , a_2 , b_4 , and b_2 for main stations in Thailand	41
Table 5.4 The average max-minimum temperature in Chiang Mai province	41
Table 5.5 Operating Conditions of Economic Analysis	45
Table 5.6 Expenses on the testing material	45
Table 5.7 The yield and cost of distilled water production	47

LIST OF FIGURES

	Pag∈
Figure 1.1 Earth's water distribution	1
Figure 1.2 Schematic diagram of bubble pump technique	 -
Figure 1.3 Thermal and membrane desalination processes	3
Figure 1.4 Designed model of solar distillation system	ι <u>!</u>
Figure 1.5 Solar distiller with flat-plate reflection	5
Figure 1.6 Thermal distillation by bubble pump	5
Figure 1.7 Two stages thermal distillation by bubble pump	ć
Figure 1.8 Application of thermal distillation by bubble pump	7
Figure 1.9 Bubble pump technique for solar distillation	ε
Figure 2.1 Basic process of distillation	10
Figure 2.2 One of the solar thermal collector design	11
Figure 2.3 Bubble pump concept	11
Figure 2.4 Solar desalination by bubble pump technique	12
Figure 2.5 Calculation of distilled water rate	14
Figure 2.6 The process of finding the amount of brine water and its salinity	16
Figure 3.1 Diagram of the complete operating system	17
Figure 3.2 The bubble pump design	18
Figure 3.3 Schematic diagram of the experimental system	19
Figure 3.4 Components in the experimental setup	20
Figure 3.5 Measuring instrumentation	21
Figure 3.6 The explosion on the pipe of the solar collector system	22
Figure 4.1 The distilled water yield rate at the initial salinity of 3%	24
Figure 4.2 The distilled water yield rate at the initial salinity of 3.5%	24
Figure 4.3 The distilled water yield rate at the initial salinity of 4%	25
Figure 4.4 Initial salinity of 3%: verifying the model with experimental data	26
Figure 4.5 Initial calinity of 3.5%: verifying the model with experimental data	27
Figure 4.6 Initial salinity of 4%, verifying the model with experimental data	29
Figure 4.7 The case of the 3% initial calinity and the 60% reservoir level	29
Figure 4.8 The case of the 3.5% initial salinity and the 60% reservoir level	29
Figure 4.9 The case of the 4% initial salinity and the 60% reservoir level	30
Figure 4.10 The case of the 3% itial salinity and the 80% reservoir level	30
Figure 4.11 The case of the 3.5% initial salinity and the 80% reservoir level	31
Figure 4.12 The case of the 3% initial salinity and the 100% reservoir level	31

Figure 4.13 The case of the 3.5% initial salinity and the 100% reservoir level	33
Figure 4.14 The effect of initial salinity on the production yield	35
Figure 4.15 The effect of reservoir level on the production yield	36
Figure 4.16 Salinity of brine water from the solution with initial salinity of 3%	37
Figure 5.1 Flow chart for evaluating the solar radiation on tilting plane	42
Figure 5.2 Monthly distilled water yield at the initial salinity of 3%	43
Figure 5.3 Monthly distilled water yield at the initial salinity of 3.5%	44
Figure 5.4 Monthly distilled water yield at the initial salinity of 4%	44
Figure 5.5 The solar collector cost and the discount rate affecting	48
the production cost	