
Contents

Preface	vii
Chapter 1. Global Energy Context.	1
1.1. Global energy consumption	1
1.2. Solar energy development	5
Chapter 2. Thermal Solar Systems	11
2.1. High-temperature solar thermal	14
2.1.1. Parabolic concentrators	15
2.1.2. Tower plants	31
2.1.3. Cylindrical-parabolic collectors	36
2.2. Low-temperature solar thermal	69
2.2.1. Solar pool heating	73
2.2.2. Solar space heating	75
2.2.3. Domestic hot water	77
2.3. Solar panels.	82
2.3.1. Types of solar panels.	82
2.3.2. Solar collector efficiency	86
Chapter 3. Thermal Convexity Principle.	117
3.1. Single-phase fluid mixing	117
3.2. Fluid heat exchange through an isotherm surface	120
3.3. Heat exchange along a pipe crossing an isotherm compartment.	121
3.4. Solar receiver.	123
3.5. Heat exchange along a tubular heat exchanger	124

Chapter 4. Solar Water Heating Analysis	139
4.1. Thermal modeling of solar water heating	139
4.1.1. Collector model	139
4.1.2. Heat exchanger	143
4.1.3. Storage tank	146
4.1.4. Solar water heating global model	148
4.2. Solar position and radiation	149
4.2.1. Sun position	150
4.2.2. Solar radiation.	155
4.3. Simulation and discussion	158
4.3.1. Daily response to variation in solar radiation	159
4.3.2. Effect of the calorific fluid flow rate	161
4.4. Experimental results with a fixed solar collector.	170
4.4.1. Without consumption of domestic hot water.	170
4.4.2. With consumption of domestic hot water.	177
4.5. Experimental results with the solar tracker	181
 Conclusion	 193
 Appendix. Principles of Heat Transfer	 201
 References	 241
 Index	 247