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Solar Water Heaters

Introduction

This short document is aimed to help you understand what exactly are solar heaters, how they operate, what are the key considerations in choosing one and last but not the least, show some examples of a typical solar heater and their features that would be suitable regions with moderate temperature.

What is a solar heater?

A solar heater is a straightforward system that uses the heat from the Sun to warm up water or a HTF (heat transfer fluid) that in turn warms the water. Such heaters have been in existence for over 100 years due their engineering simplicity. However, as the topic of climate change has taken the center stage now, their use has become more attractive. Some typical uses of it are as follows:

Residential	Commercial	Industrial
Bathing, Swimming pool	Changing Rooms, Water parks, Cleaning, Car Wash, Laundromats, Restaurants, Hospitals, Hotels	Textiles, Chemicals, Food and Beverage, Automotive, Metal Coating, Cashew Industry

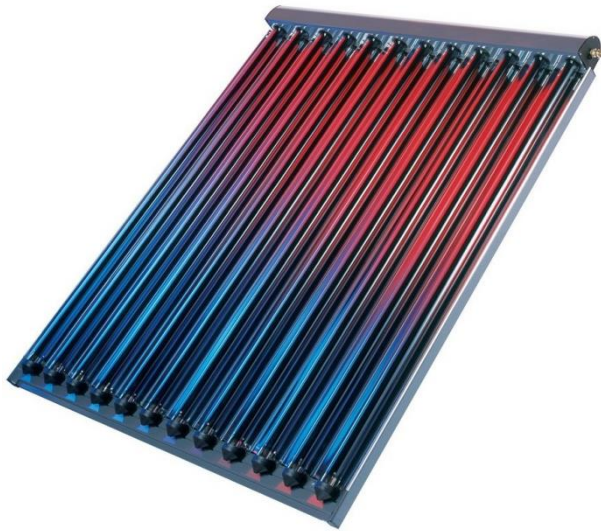
Components

There are 4 main components:

	Collector	Tanks	Pumps	Controller	Valves & Gauges
Use	Absorb sunlight and transfer the heat	Store the water and an optional HTF	Provide force to circulate water or HTF through the collector for heating	Energize the pump suitably	Measure key parameters of temperature, pressure for safety and operational purposes
Variants	Flat plate evacuated tube	Drainback Storage Expansion	PV DC	Basic Differential	Check Temperature Pressure Isolation Mixing Tempering Antiscald
Typical Dimensions/ Capacity	8 ft x 3 ft x	10- 40 gallons	0.8 ft x 0.7 ft x 0.5 ft	0.5 ft x 0.4 ft x 0.2 ft	Depends on type of gauge

There are many different configurations possible; the choice of design will depend on the purpose of the system, climate, space limitations and many other factors. The most complicated system is the anti-freeze system requiring propylene glycol as the anti-freeze agent, expansion tanks, temperature sensors, pressure relief and/or heat dumps.

Below are the pictures for typical components



Vacuum Evacuated Glass Tube Collector



Flat Plate Collector



Storage Tank

Water Pump



What are the different categories of heaters?

They can be classified in multiple ways largely depending on their collectors, mode of operation, or fluid characteristics.

By Collectors:

Flat Plate	Vacuum Evacuated Glass Tubes
Use a single piece absorption plate encased in a metal frame topped by glazed glass	Consists of a double walled vacuum insulated glass tubes encasing an absorption layer

By Mode of Operation:

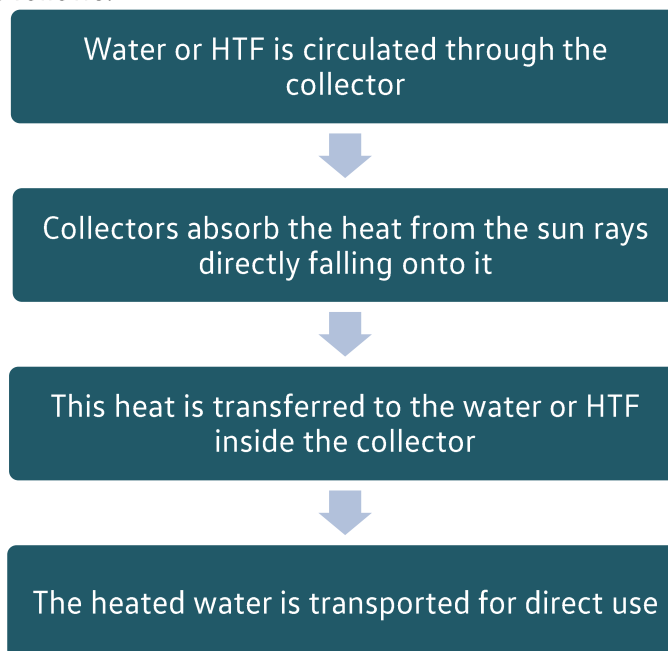
Active	Passive
Use a pump to circulate water or HTF through the collector	Use natural convection properties of water for circulation

By Fluid Type:

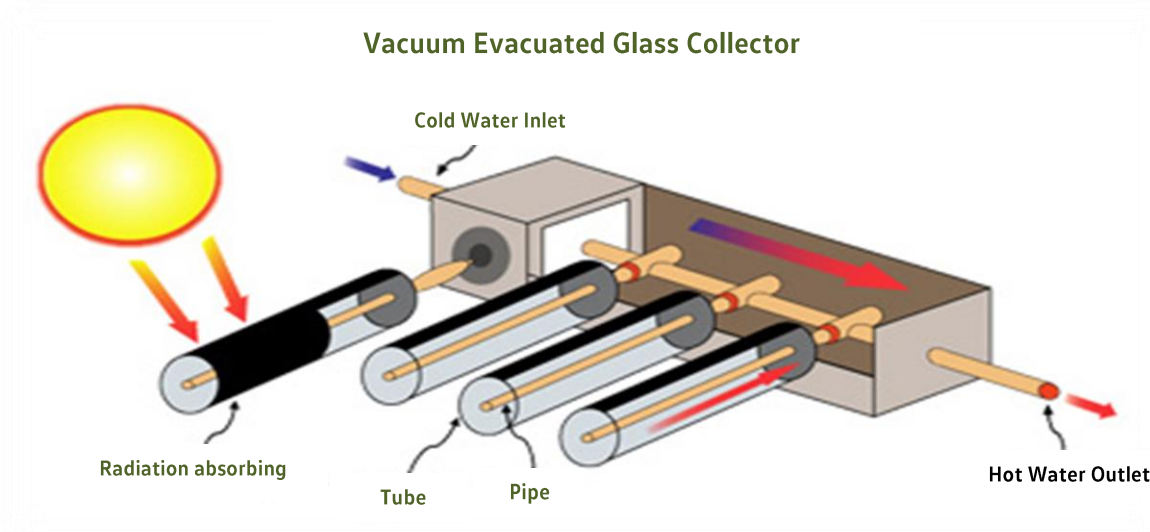
Direct	Indirect
Water to be used is heated directly	A heat transfer liquid is heated that in turns heats the water

How Does a Solar Heater Work?

The operation is as follows:



A graphical representation of the process is as follows:



What variants of solar heaters are available?

There are about 14 variants of a solar heater, each of which has its strengths and weaknesses in different climate conditions, plumbing structures and cost effectiveness.

The variants are as follows:

Collector	Circulation Mode	Fluid	Storage	Variant ID
Flat Plate	Active	Direct	Storage Tank	1
			Storage Tank + Drainback	2
		Indirect	Storage Tank	3
			Storage Tank + Drainback	4
	Passive	Direct	Integrated Collector Storage	5
			Thermosyphon	6
		Indirect	Thermosyphon	7
Evacuated Vacuum Glass Tubes	Active	Direct	Storage Tank	8
			Storage Tank + Drainback	9
		Indirect	Storage Tank	10
			Storage Tank + Drainback	11
	Passive	Direct	Integrated Collector Storage	12
			Thermosyphon	13
		Indirect	Thermosyphon	14

The key factors that need an in-depth analysis to find the best suited system for houses are:

1. Year round climatic conditions
2. Efficiency
3. Cost of ownership – Initial + Maintenance
4. Ease of transportation
5. Ease of installation
6. Typical roof structures
7. Average daily water consumption
8. Electricity tariff
9. Current installation of any electric water heater

Sample Water Heaters

Below are some systems popular for residential use:

1. Vacuum Evacuated Glass Tube Direct Passive

Capacity:

100-300 liters per day

Key Features:

- a. Suitable for hard & low TDS water sources
- b. Easy fitment for various roof types
- c. Gravity feed system
- d. HCFC Free
- e. High density insulation for heat retention
- f. Electrical filament as backup
- g. Cu-Ni-Al selective coating for high absorptivity & low emissivity



2. Flat Plate Direct Passive System

Capacity:

100-500 liters per day

Key Features:

- a. HCFC free polyurethane Insulation
- b. Simple concrete free installation
- c. Suitable for flat, sloped or tiled roofs
- d. UV resistant exterior

