SOLAR WORLD
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Leaders in Solar Technology

Solar Water Heating | Solar Water Pumping
Solar Lighting | Wind Generators
Power Back Up | Swimming Pool Heating

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SOLAR WATER HEATING SYSTEMS – THE BASICS

Introduction

Solar heating systems are generally composed of solar thermal collectors, a fluid system to move the heat from the collector to its point of usage, and a reservoir or tank for heat storage and subsequent use. The systems may be used to heat domestic hot water, swimming pool water, or for space heating. The heat can also be used for industrial applications or as an energy input for other uses such as cooling equipment. In many climates, a solar heating system can provide a very high percentage (50 to 75%) of domestic hot water energy. In many northern European countries, combined hot water and space heating systems are used to provide 15 to 25% of home heating energy, in Africa particularly Kenya which lies on the equator, the percentage is nearly 75%.

Residential solar thermal installations can be subdivided in two kinds of systems: compact (thermosiphon) and pumped systems. Both typically include an auxiliary energy source (electric heating element or connection to a gas or fuel oil central heating system) that is activated when the water in the tank falls below a minimum temperature setting, hence, hot water is always available.

In order to heat water using solar energy, a collector is fastened to the roof of a building, or on a wall facing the sun. In some cases, the collector may be free-standing. The working fluid is either pumped (active system) or driven by natural convection or thermosiphon (passive system) through it.

The collector could be made of a simple glass topped insulated box with a flat solar absorber made of sheet metal attached to copper pipes and painted black, or a set of metal tubes surrounded by an evacuated (near vacuum) glass cylinder. A simple water heating system would pump cold water out to a collector to be heated, the heated water flows back to a collection tank. This type of collector can provide enough hot water for an entire family.

Heat is stored in a hot water tank. The volume of this tank will be larger with solar heating systems in order to allow for bad weather, and because the optimum final temperature for the absorber is lower than a typical immersion or combustion heater.

The working fluid for the absorber may be the hot water from the tank, but more commonly (at least in pumped systems) is a separate loop of fluid containing anti-freeze

and a corrosion inhibitor which delivers heat to the tank through a heat exchanger (a coil of copper tubing within the tank.). The tank is not pressurized and is open to atmospheric pressure. As soon as the pump shuts up, the flow reverses and the pipes are empty at the time when freezing would have occurred.

A passive system also known as a compact system consists of a tank for the heated water, a solar collector, and connecting pipes all pre-mounted in a frame. Based on the thermosiphon principle, the water flows upward when heated in the panel. When this water enters the tank (positioned higher than the solar panel), it expels some cold water from inside so that the heat transfer takes place without the need for a pump. A typical system for a four-person home in a sunny region consists of a tank of 150 to 300 liters and three to four square meters of solar collector panels. Flat solar thermal collectors are usually used, but compact systems using vacuum tube collectors are available on the market. These generally give a higher heat yield per square meter in colder climates but cost more than flat plate collector systems.

Solar heating thermal collectors

There are three main kinds of solar thermal collectors in common use: Formed Plastic Collectors, Flat Collectors, and Evacuated Tube Collectors.

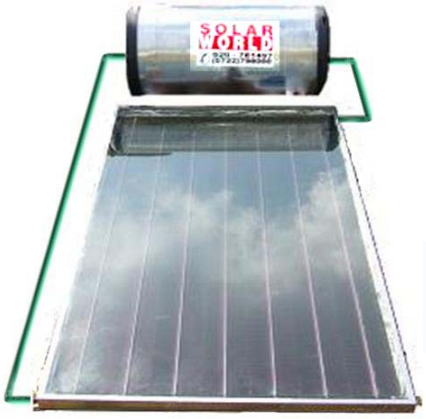
Formed Plastic Collectors *(such as polypropylene, EPDM or PET plastics)* consist of tubes or formed panels through which water is circulated and heated by the sun's radiation. They are used primarily for heating in swimming pools. In some countries heating an open-air swimming pool with non-renewable energy sources is not allowed, and then these inexpensive systems offer a good solution. This panel is not suitable for year round uses like providing hot water for home use, primarily due to its lack of insulation which reduces its effectiveness greatly when the ambient air temperature is lower than the temperature of the fluid being heated.

A *flat collector* consists of a thin absorber sheet (usually copper, to which a black or selective coating is applied) backed by a grid or coil of fluid tubing and placed in an insulated casing with a glass cover. Fluid is circulated through the tubing to remove the heat from the absorber and transport it to an insulated water tank, to a heat exchanger, or to some other device for using the heated fluid.

Evacuated tube collectors are made of a series of modular tubes, mounted in parallel, whose number can be added to or reduced as hot water delivery needs change. This type of collector consists of rows of parallel transparent glass tubes, each of which contains an absorber tube (in place of the absorber plate to which metal tubes are attached in a flat-plate collector). The tubes are covered with a special light-modulating coating. In an evacuated tube collector, sunlight passing through an outer glass tube heats the absorber tube contained within it.

Two types of tube collectors are distinguished by their heat transfer method: the simplest pumps a heat transfer fluid (water or antifreeze) through a U-shaped copper tube placed in each of the glass collector tubes. The second type uses a sealed heat pipe that contains a liquid that vaporizes as it is heated. The vapour rises to a heat-transfer bulb that is positioned outside the collector tube in a pipe through which a

second heat transfer liquid (the water or antifreeze) is pumped. For both types, the heated liquid then circulates through a heat exchanger and gives off its heat to water that is stored in a storage tank (which itself may be kept warm partially by sunlight). Evacuated tube collectors heat to higher temperatures, with some models providing considerably more solar yield per square meter than flat panels. However, they are more expensive and fragile than flat panels.



A 30 gallon solar water heating system

A 40 gallon solar water heating system

A 70 gallon solar water heating system