A Brief History of Solar Water Heating

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Introduction

Our sun emits a vast amount of energy every second of every day. In fact, for the sun itself, the concept of day and night and the time as we conceive it doesn't exist. It is always radiating energy and always has more of the same. In this sense the concept of renewable energy applies best to the sun. Although scientists argue that one day all that would stop, we can be sure that it will continue to radiate and support life on earth and perhaps other planets for millions or even billions of years to come just like it did for billions of years past.

Heating water for bathing must have been a necessity ever since humankind existed. We know that as early as 6 million years ago, our ancestors new how to start a fire. In addition to cooking they must have used fire to heat water. A popular and easy way was to heat stones in a fire then dump them in what might look like a bath tub or a small pond that could be man-made or naturally occurring (**Figure 1**).

Figure 1. An artist representation of ancestors heating water with stones

We must wonder whether humans relied more on solar energy before they invented ways to create fire. It is possible they invented enclosures such as by carving a tree bark and laying it directly facing the sun and waiting until it is warm for bathing or washing. It is also possible they invented some natural product to coat this enclosure and even insulate it for better performance. There are unlimited possibilities that man will seek for comfortable living.

Since about 10,000 years ago clay was invented. Certainly by then people were able to heat water in large clay pots using wood fire. Hot water became easier to achieve. The copper age starting about 5000 years ago brought further conveniences to water heating. Our ancestors were able to heat water in metal pots and move them around freely. A practice that is still popular even today in poor and remote areas of the world and while camping out (**Figure 2**).

Figure 2. Heating water using wood fire and metal pots

The Dawn of Modern Day Solar Energy: The batch solar collector

Not long ago and towards the end of the nineteenth century, the USA witnessed the birth of modern solar systems with the first patent recorded in 1891 in the state of California. Soon it was reported that almost a third of homes in some Californian cities were equipped with solar water heaters. This new solar system was called the batch system or bread box. The idea was simple: to trap a tank of water in an insulated box fitted with a glass window facing the sun. The designers thought they would allow the sun rays to enter through the glass but the insulated box will trap as much of the heat as possible. Although the wooden box was popular with some homeowners and particularly among solar energy enthusiasts, the system had limited success and slowly disappeared as a viable commercial level solar system.

Figure 3. The batch solar system

The Flat Plate Collector System

It took about 40 years for the batch system to make it to Florida and later to South America. By that time the batch system gave way to the more sophisticated flat plate collector. A new concept emerged where a solar system is composed of 2 parts compared to the one part design of the batch collector. This time there is the collector which basically collects the sun's energy and the tank which stores the energy for immediate or later use. Figure 4 shows a picture of a modern flat plate collector system.

Figure 4. A modern flat plate collector system.

In this system the collector absorbs and retains most of the heat impacting it. The hot water in the collector moves upward into the storage tank through a natural process called Thermosiphon. This process represents the natural tendency of hot water to rise to the top leaving cold water at the bottom in any

fluid enclosure. The tank is well insulated and keeps water hot at least until the next morning and beyond. The piping connecting the tank and collector are routed in a fashion that allows hot water from the top of the collector to flow up to the upper part of the tank while cold water from the lower part of the tank enters the lower inlet of the collector replacing the hot water that has risen. This process continues as long as the collector is receiving energy from the sun and it is at higher temperature from the tank making sure that any extra energy it receives it diverts into the tank. A cold water storage tank is usually situated above the solar system and replaces the exiting hot water from the top of the solar tank for home use with cold water at the bottom of the solar tank (Figure 5).

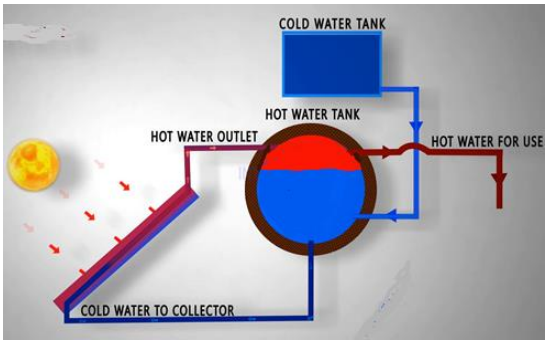

Figure 5. Basic operation principle of the flat plate collector system

Inside the flat plate collector

The flat plate solar collector is a rectangular box filled with technological features. Starting with the high transmissibility glass that allows more of the sun rays to pass through. Behind the glass is a network of copper pipes embedded in an absorbent copper plate coated selectively to absorb solar energy. The whole box is sealed tight while the back is well insulated. The heat that enters the collector is only allowed to heat the water in the pipes. These pipes are connected directly to the solar tank through the collector outlet where all the heat is passed to the tank (Figure 6).

Figure 6. Inside a modern flat plate collector

The Decades of Solar Energy Stagnation

The invention of the flat plate collector gave solar water heating a great boost that lasted until the beginning of World War II. Unfortunately, the dependency of many weapons on copper created a severe shortage of this metal hurting the solar industry with its newest design of flat plate collector. Utilities companies added to the misfortune of solar industry by offering incentives for homeowners to use electric heaters. These two reasons caused a major blow to the proliferation of solar energy for few decades.

The solar industry did not spring back until the oil embargo of the seventies and the following skyrocketing oil prices. Again a big boost came from the United States when the federal government and some states gave incentives and tax breaks for solar installations. Startup solar companies sprang up to cope with insatiable demand for renewable energy products at affordable prices. This temporary spike was killed also overnight when in the US, the Reagan administration stopped all solar incentives in 1986 causing a sudden termination of almost all technological developments.

The solar industry proved again that it was an economic and environmental necessity beyond government regulations. While advancements in flat plate collectors surfaced again after the almost fatal blow of policies that encouraged the use of fossil fuels, a new breakthrough technology in solar thermal heating appeared. The new comer that is still dominating the solar water heating today was the solar vacuum tube collector.

The Vacuum Tube Collector

The solar vacuum tube is itself a collector. It takes several vacuum tubes to make a sizable unit depending on the size of the tank. This vacuum tube is a technological wonder that made solar water heating so affordable and so efficient. The technology is not in principle complicated although it is very expensive to manufacture. Factories that invest in this multimillion dollar business rely on high volume production and must secure across the border customers.

The vacuum tube consists of two concentric glass tubes sealed on both sides with air drawn out from the empty space to create a total vacuum. The vacuum acts as a perfect insulator and this is the biggest advantage of the vacuum tube. The coating is applied to the outside of the inner tube where water sits. The coating is called 3 target because it is composed of 3 layers each with a particular purpose (Figure 7). The outermost layer ensures that incoming sun rays are not reflected back to the atmosphere, the second layer is for maximum absorption, the third and innermost layer ensure that all sun rays are reflected into the water in the tube. Manufacturers of the vacuum tube boast efficiencies of around 95%. This makes this collector the most efficient tool to convert the energy of the sun into hot water.

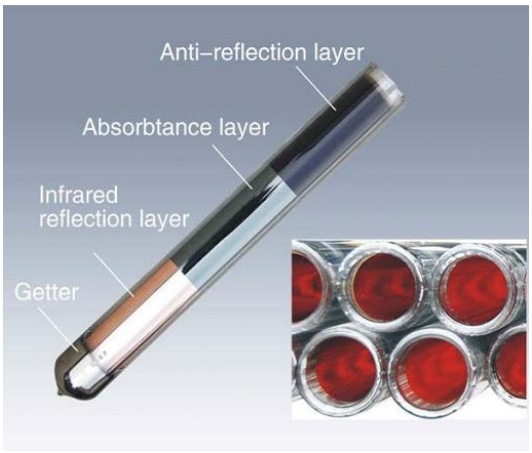

Figure 7. The solar vacuum tube

Today's Solar Hot Water Use

The vacuum tube discussed above represents the latest advances although it only represents the simplest and most economical version. Home owners have varying design requirements and have different budget limitations. The systems discussed here are only simple examples of what is available in today's solar hot water systems. These systems went from being a luxury item for rich countries in the beginning of the twentieth century to an essential item that exists in every single home in many countries and expected to spread even further to be used inside every home in the world. A look at this crowded building complex shows the popularity of solar heating in some areas and how it has become as important as having a TV and satellite dish (Figure 8).

Figure 8. Solar systems and Satellite dishes competing for space on Turkish rooftops