Solar Heating Basics

Part Two — Storage of Solar Energy

Tom Snyder

The amount of energy we receive from the sun in one day far exceeds what we can use. One simple solution to use this excess energy is store it. With photovoltaic modules or a wind generator, we store this surplus electricity in a battery system. With a solar panel, we store sun-heated water or air in a storage tank of water or rocks.

In *Home Power* #40 I described the basic solar heating panels — air and liquid — and how a DIY might build their own. But, solar panels without a storage system is like an electric car without batteries! In this article I will simplify some storage methods, present common pitfalls to avoid, and describe one of the cheapest and best methods I have ever used for storing heat in a tank of water.

Typical materials commonly used for storage of solar heat are those with a great amount of mass, such as cement, rocks, or water. Cement is usually only used in passive solar designs, while rock and water is used in active systems.

Rocks

If there is any doubt about rocks or cement storing solar heat, just feel a 300 pound boulder or a cement slab on a sunny afternoon. The ability to store heat is referred to as a substances' specific heat, and both water and rocks have a high specific heat because they have a large mass. During the early 1970's solar companies tried to develop a storage system using rock. A few of the biggest problems:

1. The amount of material was enormous! In some cases half the basement stored solar heat.

2. Moving heated air from the panel through the rock required the rock to be small, like pebbles, for more surface contact with air.

3. When house air was blown through the rocks to distribute the heat, this cooled the rocks and created the biggest problem — condensation and mold.

In this area of Iowa, few such storage systems were installed. One reason is that water stores more energy per pound.than any other substance (more specific heat) and doesn't take as much room in the basement, and second, no mold.

Water

Using water for storage of heat has many benefits. One of the best is that we can use this heat year round — you can take hot showers, as well as heating your home! Year round use is one of the economic reasons used to justify solar panels.

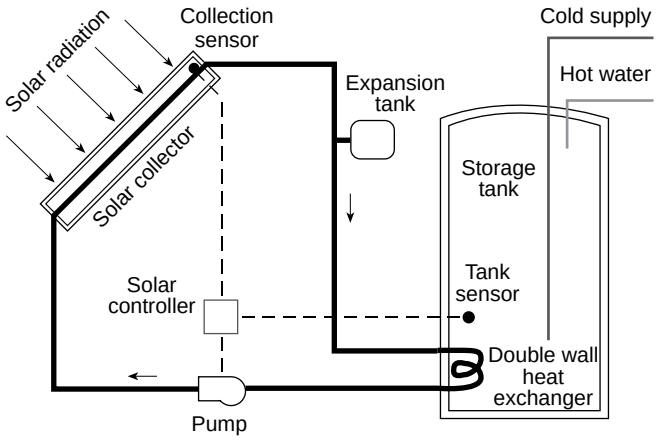

Figure A: Glycol heating with heat exchanger

Storage systems — pressurized or unpressurized

Pressurized

Domestic hot water (DWH) systems usually have a 40 to 52 gallon tank that is heated by natural gas or electricity. This is connected directly to the incoming.water supply as shown in figure A. This tank can be heated by a solar panel with a heat exchanger, either on the outside or inside the tank. The tank is still under pressure just like the original DHW. Figure B

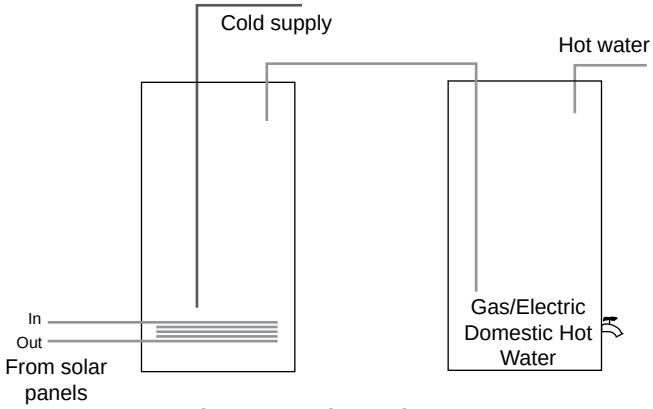

Figure B: Solar preheater

shows how more than one tank can be installed if space is available. For space heating as well as DHW, many tanks can be connected, but it does require a lot of time and planning. I have installed two heating systems this way, and would recommend using the unpressurized method.

Unpressurized

Figure C shows a tank of water (usually 250 gallons or larger) with a copper coil suspended in the top third for preheating the DHW. For one method on how to use the solar panels to heat this tank, consult HP#34. You can also use wood to heat the tank of water via a fireplace or woodstove! (HP#24 and #35). Figure C shows a typical system using solar and wood for both DHW and heat.

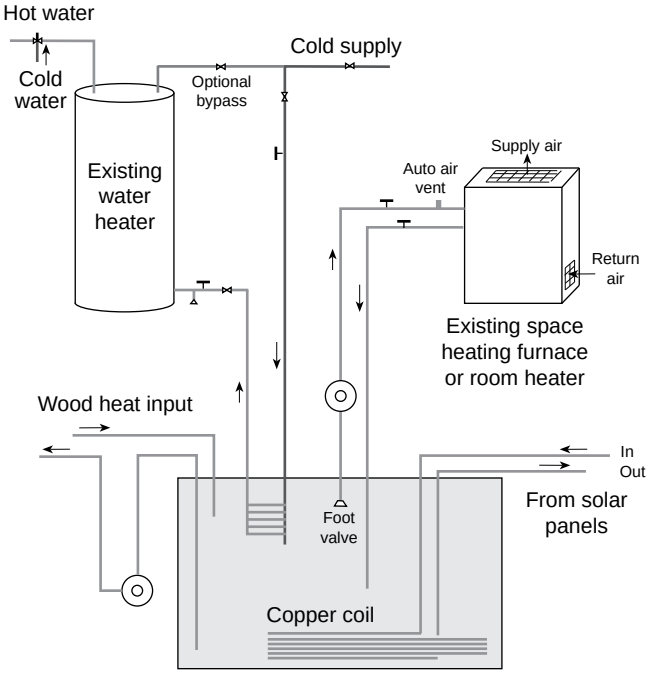

Figure C: Solar and wood for water and space heat

I believe that there is always a better and cheaper way of doing things. In some cases storage of solar heat was the second highest cost on a solar job. In one installation I saw, half the cost was in the storage tank alone. If the tank was labeled for solar storage, it could be $10 a gallon! These tanks were usually plastic of some type and were sometimes made in parts that could be assembled in the basement. Potential leaks did become a major problem.

A second choice for unpressurized storage systems that I liked was a wood box (yes, w-o-o-d) with a synthetic rubber lining made from EPDM. The idea is to keep the height at four feet (standard lumber dimensions) which also keeps the height of the water within reason. The wooden box is six foot long by 4 foot wide and constructed with 2x4 timber on 16 inch centers. The sides and bottom are insulated with fiberglass, and finished with 1/2 inch plywood with 3/8 inch bolts. The whole box is banded with 1/2 inch metal used by lumber yards to band together shipments of lumber on semis.

The EPDM liner is the same material used for seamless flat roofs on school buildings in the midwest. It is thick, durable, and has no temperature limit. The tank temperature can reach 210 degrees, you know! This was a real neat method until the cost of EPDM went out of sight. The cost of EPDM went from $1 a square foot to over $5 a square foot (approximately $200 to $1000). One solar job I just inspected a week ago had 1500 gallons of water in a wooden tank with a heavy swimming pool liner. This liner has one warning: limit 180°F!

My final, cheapest, most durable, and futuristic method is used stainless steel bulk milk tanks. Most of my systems became affordable and totally trouble free using these tanks. Farmers have many reasons for replacing 200–300 gallon tanks — they need a larger size, or the external cooling unit leaks freon — but never because the insulated tank leaks. These tanks are insulated, have lids that allow working in the tank, and have a hole in the top for installing all the plumbing from the solar panels, DHW, and heating system. These tanks are available from approximately $1 to $2 a gallon, used, from milk farmers in Iowa. They are so indestructible and neat looking, I suspect they will be recycled a third time as a hot tub.

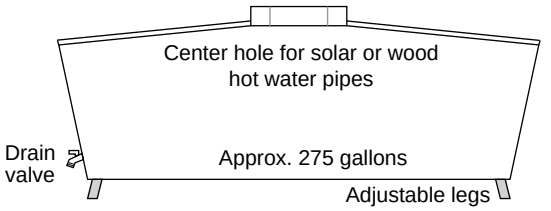

Figure D: Typical stainless steel bulk milk tank

As a parting thought: One customer looked at the bulk milk tank and got a concerned look on his face. Heat rises, right? Well, all the insulation is on the sides and bottom of this tank, right? How do we keep the heat in on the top? I suggested he turn the tank over!

Access

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