

## Fun solar - solar water heating

Contributed by Nick Parsons

You have probably all heard of solar water heating. You may know how it works, and you may like the idea of having it in your home. But then you check out the price (probably £2500ish if you ask the right firm) \*[but see below for information on grants and schemes] and decide that your interest in solar water heating will end there.

It doesn't have to!

You may not feel confident in your ability to build and install a full domestic solar water heating system, but most of us can, with very few problems, build a basic solar water heater for fun.

Firstly, a couple of points to remember:

- Solar water heating is nothing to do with solar electricity (photovoltaics, or pv). It won't generate any electricity, or charge your batteries, however hard you try(!), but it will provide lots of hot water and lots of fun.

- Solar water heating relies on one simple principle: DARK COLOURS ABSORB HEAT.

Secondly, let's play!

- Try laying out a black hose-pipe in your garden on the next sunny day. Make sure it's full of water, then sit back and wait. After a while - solar hot water!

- Have you got a cold frame or a greenhouse? Then try the same thing, but with the hose running through the frame or greenhouse. Feel the difference!

- Try trickling water over a black-painted corrugated iron sheet protected by glass or Perspex. Adjust the angle of the sheet to vary the temperature of the water.

So you have seen that, in clear sun, you can get pretty hot water, but you won't get very much without somewhere to store it, and you are probably losing the heat almost as fast as you collect it.

Lets get a bit more technical...

If you got the chance to try it, you will have noticed that the corrugated iron got very hot behind the glass, and the hose-pipe less so. Why? Well, in part, you are asking an awful lot of a 15mm hose-pipe to collect much heat, unless you are focussing the sun onto it. So what's the alternative? Increase the surface area onto which the sun can shine, so you don't just get this...

But this...

So you've got your pipe, and you know you need something to increase the surface area. What do you do now, and what can you use? Now it's time for a bit more fun...

First, build yourself a 'matrix' of copper pipe, like this...

The size will dictate how much hot water you will get. Approximately 1 sq metre is pretty good for a 'garden panel'. It will easily and quickly heat up 25 litres of water, for hand-washing, car-washing or to pre-heat the paddling pool for cold children. Honest, it really works!

The design shown is called a 'header and riser' system. It's made from widely-available plumbing materials, 22mm for the horizontals ('headers') and 15mm for the verticals ('risers'). This design, and the size of the pipework, means that the panel can be used in a thermosyphoning set-up. What's thermosyphoning? Contain your soul in patience, there's more fun in store before we get there. (Well I think it's fun, so humour me).

If you are confident about soldering, use soldered fittings. If not, use compression (bolt-up) fittings, or modern copper push-fit fittings (quick but expensive). DON'T use plastic - it can melt! For a 1m x 1m panel with 7 risers, you will need approximately:

7.5m of 15mm copper pipe

2m of 22mm copper pipe

12 x 22/15/22mm 'tees';  
 2 x 22mm elbows (90 degree bends)  
 4 x 22/15mm reducers.

Using the Blue Peter method of construction, you should either quickly progress from this...

to this...

to this...,

or find that you've just built a box-girder bridge out of cornflake packets.

So you've got your matrix. Now you need a heat-absorbing back-plate. Time for more fun and scavenging! My favourite (if not most efficient) back-plate consists of a pair of Sheffield road-signs (yes, I did ask!), to which the matrix is clipped. Alternatively, use a dead caravan (approx 1mm aluminium sheet) or a dead hot water cylinder. (And of course you can use new copper sheet [0.5mm] at about £29 per square metre.) These latter 3 are thin enough to allow you to form a channel into which the 15mm 'risers' can fit. Here's how you do it:

Cut the copper or aluminium into lengths which fit the entire length of each 15mm riser, fitting neatly between the fittings at each end. Do not be tempted to overlap the fittings, as this will hold the backplate away from the pipe at that point, reducing the efficiency of the heat exchange. Each piece should be about 150mm wide. (If you make them wider, you will, later, have difficulty finding suitably-sized clamps).

In a piece of wood at least 150mm x 50mm, rout a slot 16mm wide and approximately 15mm deep. Position the copper sheet with its mid-point over the centre of the slot, and place a length of 14-15mm steel bar above the slot. Hammer the bar into the slot, using a wooden block to keep the edges flat. The finished product is known as a 'fin'.

Ensure that the resultant groove on the fin is a good tight fit on the pipes. If you've used copper, you can solder the fin on for good metal-to-metal contact (this is where the clamps come in), or if you have used aluminium, apply a thin smear of silicon mastic or high melting-point grease, and 'snap' the fin onto the pipe.

Once you've got fins on all your risers, paint the matrix with heat-resistant matt black paint and install it in a box about 125mm (5") deep with a plywood back, approx 50mm (2") of insulation (NOT plastic foam - it can melt, as temperatures of 150 degrees C or more are possible if the panel runs dry) and foil over the insulation. The insulation will limit the amount of heat you lose out the back of the panel, and the foil will reflect any stray sunbeams that have not gone where you wanted them to in the first place! You'll need to drill 2 holes approx 16 - 18mm to accommodate the 'cold in' and 'hot out' pipes.

For glazing I find twin-wall polycarbonate (conservatory roofing) is a good compromise between cost & efficiency. Install it so that the bottom edge of the glazing overlaps the bottom edge of the box. That way, water does not collect and rot the box. The distance between the matrix and the underside of the glazing should be no less than 25mm (to avoid excessive heat loss from conduction) and no more than 40mm (to avoid excessive heat loss from convection).

If you chose to use the 'road-sign and pipe-clip' method described above, clip the matrix as tightly as you can to the aluminium sheet using copper 'saddle clips'. Then paint it all black and proceed as described above.

Now your panel is ready to go! You can test it by attaching some hose-pipe, filling it with water and facing it into the sun at an angle of about 45 degrees. Here's the health warning, because these panels regularly reach over 85 degrees centigrade at the hot outlet. Do not, under any circumstances, be tempted to fill the panel and then bung up the pipes (for example with corks), unless you really want to shoot something!

Of course you won't get much water from the panel alone. You will need some sort of storage vessel. This can be anything from a bucket to something more stylish. I use a standard plumbing header tank and a plastic brewers barrel with tank fittings on (pictured).

If you don't want to lose all your hard-won heat, you'll want to insulate it too.

I referred earlier on to thermosyphoning. This is what you are going to use to circulate the water round your panel. You don't need a pump, provided you can site your 'hot water cylinder' (or whatever you use instead) above the panel. Most sources suggest an ideal minimum distance of 600mm (2 feet) between the top of the panel and the bottom of the cylinder. You may get away with less. Experiment! That's half the fun.

Use the panel for fun, above all. Take it on camping trips, use it in the garden, shower with it after a hot day at the allotment, or heat up the kids' paddling pool! Show it to your friends, tell them that solar power really does work, and spread the word. Take it to your children's school, and show them the (renewable) future. If you want to, you can build a full-size (4 - 6 square metre) system for your house, or buy a commercially-made system, or just carry on having fun with what you've got.

And if you choose to be really different, you can even use solar water heating to help keep the frost off your seedlings! This set-up was produced as part of a training course at Pinfold Community Garden in Cudworth, near Barnsley.

The 3 hot water cylinders now have a slatted bench above them with insulation below and around it. Heat is collected on bright winter days and gently rises to seed trays above on winter nights.

We could not have done the Cudworth installation without the help of Darton (Barnsley) plumber and builder Dave Wilford. Dave was installing the LPG plumbing in the polytunnel when we first started the solar course, and took us under his wing, offering advice and masses of free labour. Thanks, Dave! If you live in the area and need a plumber or builder, contact Dave on 01226 386675 or 07931 2044815.

This is not a comprehensive guide to DIY solar, but a little taster to whet your appetite. It does not include measurements for the panel described, but the pictures will give you an idea. Written guides are available, and at least 3 organisations run courses to take you through the whole process. (details below).

Finally, I cannot stress too strongly the safety aspect. If you are not fully confident with soldering, don't do it without expert guidance. There's lots of scope for burning yourself (and setting fire to your immediate environment) if you're not careful. The copper fins can be very sharp, and the temperatures reached when the panel is in operation can be very high - even worse if the panel is facing the sun but not filled with water. The idea is to impress your friends, not to peel their skin off, so take care, and HAVE FUN!

The following organisations run courses on build-your-own solar water heaters:  
 SELF-HELP SOLAR (Heeley City Farm Energy Project and the Schools and Homes Energy Education Project in Sheffield). Telephone Nick Parsons on 0114 2505108 (energy@heeleyfarm.org.uk) or David Garlovsky on 0114 2499459 (david@pluggingintothesun.org.uk). Courses run in Sheffield or at your venue.  
 web-sites: www.heeleyfarm.org.uk and www.pluggingintothesun.org.uk

CENTRE FOR ALTERNATIVE TECHNOLOGY (CAT), Machynlleth, Wales. Telephone  
 Tel. 01654 705981 Fax. 01654 703605 Email courses@cat.org.uk  
 Web-site: www.cat.org.uk

LOW IMPACT LIVING INITIATIVE, (LILI), Redfield Community, Winslow, Bucks, MK18 3LZ  
 tel / fax: (01296) 714184 email: lili@lowimpact.org  
 web-site: www.lowimpact.org

CAT sells a guide to DIY solar water heating at £5.99 plus post & packing. LILI's guide is £7.50 and the Self Help Solar guide will be available next summer.

\*Grants for solar water heating: £400 grants available for domestic installations by approved contractors. www.clear-skies.org. Some local authorities and community sector groups may be running subsidised solar water heating schemes. Ask your local Energy Efficiency Advice Centre (EEAC) for details on 0800 512012

None of the information in this article is new! People have been exploiting the power of the sun for many years. Acknowledgements to all those people and publications which have filled my head with the right knowledge.

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