SOLAR WATER HEATING –

IT'S TIME TO UPSKILL #12: OVERHEATING SYSTEMS

By Ian Sumner

Ian Sumner's solar upskilling series continues in this issue. In the previous article, he looked at why solar water heating systems overheat, now he looks at how to manage overheating.

To summarise our last article (April/May 2008), overheating occurs when the heat supplied to the water is greater than the heat demand being drawn off. This can occur for numerous reasons: an oversized solar water heating system; reduced heating demand; low collector pitch; or the backup heating system switched on too often or left on continuously.

Overheating is also more of a problem with modern solar water heating systems which are more efficient than traditional systems. Therefore, good design is key to the reliability and performance of the system. A one size fits all approach should be avoided.

There are several methods that can be adopted to limit the potential for a solar water heating system to overheat. These are highlighted below.

Heat dumps and heat exchangers - There are various ways a heat dump can be incorporated in to an installation to reject excess heat, for instance, to swimming pools, or with external heat exchangers, to the environment. These circuits can either draw hot water from the cylinder to reject heat or, the heat from the solar collectors can be redirected to another heat sink such as shown in Figure 1 below.

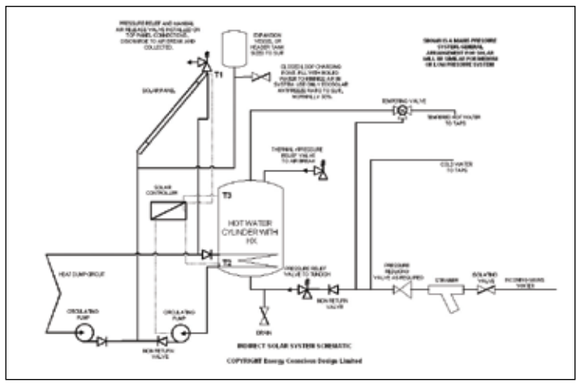

Figure 1: Mains pressure indirect solar system c/w heat dump circuit.

Installers need to be wary when installing indirect solar systems that utilise a glycol solution within the solar circuit. Glycols break down and become corrosive when subjected to air, sunlight, copper, and heat. So if a glycol based system overheats, the glycol will become corrosive and will require additional maintenance to ensure the long term reliability of the system. When EcoSolar tested one of the common glycols available in New Zealand, the glycol became concerningly corrosive in less than one year. Best practice now states that glycols should either be checked or replaced annually, which is one reason why installers are moving away from glycol based systems or are installing heat dump circuits on glycol based systems.

Drainback systems – There are numerous forms of drainback systems. Such a system is based upon the methodology that there is only water in the collectors when the pump is operating. When there is no heat to gain from the collectors or when the cylinder has reached its maximum set point storage temperature, the pump is switched off and the water drains from the collectors back into a receiver which is located a safe distance from the collectors.

Such systems are very dependent upon the resilience of the solar collectors to reliably manage high temperatures and the installer ensuring that the system is free draining. If the system does not drain, any water remaining in the collectors will be heated and quickly turn in to steam.

There are two forms of drainback system, direct and indirect.

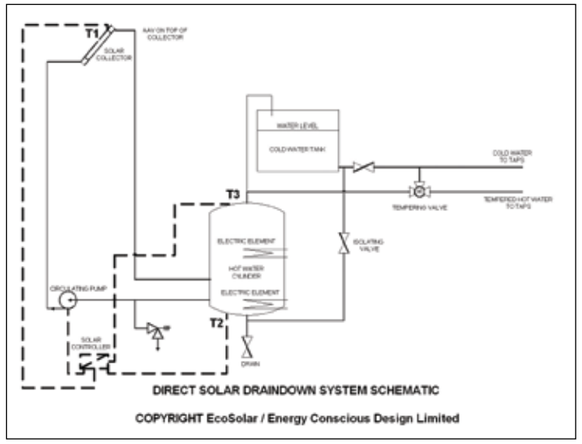

Figure 2: A direct solar drainback system. This is a low pressure system, where the collectors are placed above the cold water header tank feeding the hot water cylinder. This is a reliable and cost effective system, however the number of header tank based systems is reducing.

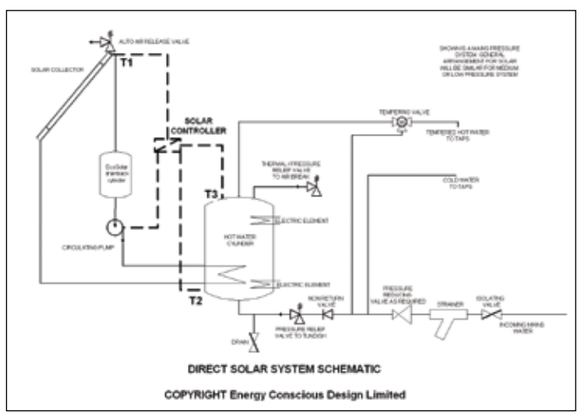

Figure 3: An indirect drainback system, which has separate stored hot water from the solar circuit. The solar circuit heats the stored water using a heat exchanger.

Figure 4: Modern solar controller able to operate heat rejection cycles during cooler periods of the day.

Shades – Shades can be installed on the collectors which close and shade the collector when the cylinder has reached its maximum temperature. These shades are commercially available. However, the shades will be exposed to New Zealand's harsh environmental conditions and so, whilst they are seen as an option in other countries, such installations here in New Zealand would require significant periodic maintenance.

Tracking systems – These are fairly common on photovoltaic solar installations (photovoltaic systems generate electricity rather than heat) where they are used to maximise the area of collector "seen" by the sun, thereby maximising their efficiency. However, whilst the technology is available it is expensive and is rarely used in thermal solar systems.

Heat rejection - Some solar controllers, such as the modern one shown in Figure 5 below, are able to utilise some solar collectors to reject heat back to the environment during cooler times of the day or at night. This is often the most cost effective method of limiting the effects of overheating and is a fairly common form of retrofit to homes. This option does have its limitations, as during the summer when systems can overheat from solar radiation collected in a single day, the system may not be able to reject excessive heat. However, it will limit the buildup of heat over several days or weeks such as when occupants go on long holidays especially in the cooler months of the year.

Figure 5. Modern solar controller able to operate heat rejection cycles during cooler periods of the day.

Energy Conscious Design and EcoSolar, in conjunction with several trade and professional industry associations, are in the final stages of preparing training sessions that will tour New Zealand; these training sessions are suitable for specifiers, designers and installers. Please contact Energy Conscious Design for dates and seminar locations.

Ian Sumner of Energy Conscious Design Limited and EcoSolar previously worked as a plumber. He subsequently completed a degree in building services design and has completed a thesis on trying to get solar hot water to be cost effective in the UK. He has local experience in solar system design and installation and is currently the only solar water heating system engineer accredited by the Solar Industries Association in New Zealand. Ian says, "This series of articles is intended to be an introduction to solar water heating only and I do not intend to provide specific design advice."

ENERGY EFFICIENCY

This article has been abridged. Further detail including three case-studies of overheating solar water heating systems – one a large new build home intended to be used as a bed and breakfast, the second a holiday home and the third, a solar system retro-fitted to an existing hot water cylinder - is included in the full article. This is available for download at the Energy Efficiency Interest Group in the members' area of www.masterplumbers.org.nz or from EcoSolar.

Ask for a free copy of the latest EcoSolar solar hot water installation guide, or send questions or requests for topics to be covered to ian@ecosolar.co.nz or 0800 ECOSOLAR (0800 32676527).