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A SOLAR WATER HEATER FOR REMOTE COMMUNITIES

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Introduction

The RADG has been developing a solar water heater suitable for use in remote areas. The original inspiration for this project was to provide hot water for remote Aboriginal communities. It was felt that a regular and plentiful supply of hot water would encourage showering and laundering and hence improve personal hygiene.

Electric, fuel burning and solar water heaters are currently used in some communities. Solar water heaters are attractive for remote areas because they stand alone i.e. they require no external fuel source. Wood has traditionally been used as a fuel by Aboriginal people, but in permanent communities the demand on this resource may have a large impact on the environment. Solar water heaters can help to reduce this demand.

Conventional Systems

Conventional solar water heaters used in remote communities are subject to the following problems (Walker 1984):

- freezing causes fracture of the copper tubes;
- servicing of cracked tubes or other failed components is not readily available within communities;
- glazing is smashed by rocks;
- absence of electricity to boost supply on overcast days;
- Aboriginal people find difficulty relating to that technology in a meaningful way;
- the quality of water in remote areas leads to a rapid build-up of deposits in the copper tubes, resisting flow or causing complete blockage;
- the volume of hot water generated is sometimes insufficient for a given usage pattern;
- contractors have sometimes installed the equipment incorrectly.

Some of these problems can be solved by modifying conventional solar heaters. With an indirect system, draw off water only passes through a heat exchanger placed in the storage tank. The closed collector/tank loop can be filled with clean water plus anti-freeze and anti-corrosion additives.

Alternatively, scaling can be reduced by fitting galvanic or magnetic filters. Both of these solutions add to the cost and complexity of the system.

The RADG Solar Water Heater

The aim of the RADG in developing a solar water heater was to overcome the problems of conventional systems in a simple and cost-effective way. To this end various prototypes were built (Anda 1988) largely using plastic materials.

Plastics are attractive in this application because they are cheap, lightweight, easy to work with and generally more resistant to corrosion, scaling and freezing than metals are. Limitations in using plastics include long term weatherability, mechanical properties at elevated temperatures and the range of plastic products and forming processes available in W.A..

The latest prototype is a low pressure, semi-glazed, thermosyphon system. The absorber of this prototype is made from an extruded ethylene-propylene-diene-monomer section (manufactured for swimming pool heating) mechanically joined to cPVC header manifolds. Glazing is in the form of clip on acrylic panels and collector insulation is polystyrene foam. The storage tank consists of a 180 litre polyethylene tank insulated with polyethylene and polystyrene foam encased in a metal jacket. A float valve reduces the water pressure to a low level.

All of the materials used in the construction of this system are relatively less expensive and readily available. The system is supplied in kit form to be constructed on site by community members. This should enable communities to maintain the system and repair it if it breaks down.

These systems are currently being built at the Remote Area Technology Centre in Pundulmarra College (Port Hedland) and are supplied with the Remote Area Hygiene Facility developed by the RADG. A chip heater developed at the Centre for Appropriate Technology (Alice Springs) is used in conjunction with the solar heater to assure a year round supply of hot water.

Testing

Several prototypes have been developed and tested by the group in different parts of W.A.. Testing of an earlier unglazed prototype made from Solar Batts (manufactured for pool heating) has been carried out in Perth and Newman (Anda 1988). Final tank temperatures reached in September were typically 40'C in Perth and 50'C in Newman. Testing of the latest prototype will be conducted at Murdoch University.

Future Developments

Research is now being conducted into developing a class A solar water heater for remote areas. Class A is a mode of operation in which the water delivery temperature at the hot outlet remains above 57'C under a specified load condition (AS2984 1984). Design for operation at mains pressure will also be considered.

The reasons for developing a high temperature/pressure system are:

- the risk of Legionella contamination in potable hot water stored below 55'C (O'Connor 1989);
- the low rate of water flow from shower heads;
- Aboriginal peoples may desire an urban type system.

To produce water at high temperatures during periods of low ambient air temperature and radiation requires a well insulated collector (i.e. fully glazed). However, during prolonged periods of high temperature and radiation, a well insulated collector may reach very high temperatures (up to 150'C) under thermal stagnation conditions.

Plastics capable of operating at such high temperatures include fluoroplastics, polysulphones and polyamides (Birley et al 1988). These plastics are generally expensive and not readily available in W.A.. For these reasons a high temperature safety device is being considered to restrict the collector temperature to under 100'C. This device may be along the lines of variable glazing or venting. Restricting the temperature to this level will allow a much wider range of plastics to be used including high density polyethylene, polypropylene, polycarbonate, polybutylene, glass reinforced polyester and EPDM (Madsen & Goss 1981, Lenel & Mudd 1984). Many of these plastics are cheap and readily available in W.A..

Apart from high temperature, the materials must also be able to withstand mechanical stress (due to high water pressure), UV radiation, water, oxidation and weathering. Suitable plastics and forming processes are currently being assessed with the aim of building and testing a high temperature/pressure prototype in the near future.

Conclusions

The RADG has developed a durable plastic solar water heater for remote communities. It is easy to transport and can be constructed on site by community members. Testing of earlier prototypes has shown that good performance can be achieved using plastic materials. Development of a high temperature/pressure system is currently underway.

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