TASK39

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

Conceptual solar domestic hot water systems

INFO Sheet B12

Description:	*Conceptual workshop on solar domestic hot water systems with focus on the use of polymeric materials*
Date:	May 2015
Authors:	Dipl.-Ing. (FH) Christoph Reiter, Dr. Sebastian Brandmayr, Dr. Christoph Trinkl, Prof. Dr.-Ing. Wilfried Zörner Technische Hochschule Ingolstadt Institute of new Energy Systems (InES)
Download at:	http://task39.iea-shc.org/publications

Introduction

A workshop was held to identify concepts for solar thermal systems with polymeric collector suitable for further cost reductions of solar domestic hot water preparation and to show possibilities of the extended use of polymeric materials in the solar thermal system, including the solar circuit and buffer storage.

Background

In Reiter et al. 2011, an attainable cost reduction using polymeric collectors of about 50% was identified. However, the collector costs are only about 30–40% of the total costumer costs of the solar thermal system. As a result, the total cost reduction caused by new collector designs is about 20%. In contrary to that, the solar yield is smaller using these polymeric collector approaches with limited efficiency, for example, due to a non-selective coating. This condition compensates the economic benefit of polymeric collectors within standard solar thermal systems.

However, the components of pressurized state-of-the-art solar-thermal systems are configured for collectors facing temperatures up to 200°C and high pressure. The system set-up with many individual components, costly materials and the large installation effort result in high costs. According to the lower resistance of polymeric collectors regarding system pressure and especially temperatures, it will be possible to lower the technical requirements for the solar-thermal system. This enables further cost reduction in the system by fewer and cheaper components as well as an easier installation.

Solar Circuit

For the solar circuit two set-ups were identified. The first concept is close to the state-of-the-art set-up — a pumped, pressurized solar-thermal system with water/glycol as antifreeze. The copper piping in the solar circuit is replaced by polymeric pipes which are already used in heat distribution systems like floor heating. The cross-linked polyethylene (PE-X) pipes are bendable and can be easily connected by press fittings. Such piping system from the German manufacturer Roth Werke GmbH, for example, can be used permanently in pressurized circuits up to 95°C. Another piping system from the German manufacturer aquatherm GmbH on the basis of polypropylene (PP) is connected by heating element socket welding and allows a fluid

temperature of 90°C in the pressurized circuit. Both pipes are suitable for normal solar-thermal system operation, but the thermal loads during stagnation may cause problems.

The second concept is a drain-back system. The open, non-pressurized circuit on the basis of the polymeric pipes offers several advantages. The self-emptying system is frost-resistant and enables water as cost-effective and easy to handle heat carrier. Furthermore, components like the expansion vessel, air bleed valves and the pressure relief valve can be omitted. The missing pressure load also enables the use of volumetric absorbers and low material thicknesses.

Buffer Storage

There are several polymeric buffer storages on the market. For example, the storage *Thermotank Quadroline* from Roth Werke GmbH is made of PE with an expanded polystyrene (EPS) insulation. The versions with 325L and 500L are used for domestic hot water preparation in connection with solar-thermal systems. The storage is permanently resistant against temperatures up to 90°C and pressures up to 3bar. The internal heat exchangers enable the use of both solar circuit concepts—pressurized and self-emptying. **Fehler! Verweisquelle konnte nicht gefunden werden.** shows the polymeric storage with internal heat exchangers for domestic hot water and solar-thermal heat supply. For the use in a drain-back system, an external tank for the heat carrier of the solar circuit is necessary. Another approach is the non-pressurized buffer storage made of PP by the Spanish manufacturer BUNKSOLAR S.L. This storage is especially designed for drain-back systems. The solar circuit is connected directly to the storage volume. Thus, the buffer storage requires no additional drain-back tank. Suitable storage volumes of 250L, 400L and 500L are available and are premised for temperatures up to 85°C. Two heat exchangers are integrated for domestic hot water supply and the back-up heating.

Figure 1: Sectional view of Thermotank Quadroline (Roth Werke GmbH n.d.)

References

AQUATHERM GMBH *aquatherm blue pipe catalogue* [WWW] aquatherm GmbH. Available from: http://www.aquatherm-pipesystems.com/index.php?id=60&L=2 [Accessed: 19/05/2014].

BUNKSOLAR S.L. *Drain Back System* [WWW] BUNKSOLAR S.L. Available from: http://bunksolar.com/Drain-Back-System.html [Accessed: 21/05/2014].

REITER, C. et al. (2011) *Solarthermie2000plus: Kunststoffe in solarthermischen Kollektoren – Anforderungsdefinition, Konzeptentwicklung und Machbarkeitsbewertung*, Final Report BMU (0329285A), Berlin (DE), 2011.

ROTH WERKE GMBH *Downloads* [WWW] Roth Werke GmbH. Available from: http://www.roth-werke.de/roth-en/gedrucktes.htm [Accessed: 16/05/2014].