TASK39

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

Fully Polymeric Thermosiphon System

INFO Sheet B7

Description:	*Three different concepts of thermosiphon systems using polymeric materials are introduced and compared in terms of costs*
Date:	May 2015
Authors:	Andreas Piekarczy, Karl-Anders Weiß
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Introduction

While the development of fully polymeric collectors is proceeding very well, one of the major questions to address is the integration of polymeric collectors into existing systems. Considering the large number of thermosiphon systems sold worldwide, in many regions the focus should be on the development of cost-efficient thermosiphon systems. Comparing the actual market situation, the requirements on a thermosiphon system from the consumers point of view can be summarized: low investment costs, small systems for easy modular expansion and direct usability.

Application and system design

Mounted on a flat or tilted roof top, the thermosiphon system consists of a storage tank and a collector and is generally used for the preparation of domestic hot water. Unlike in pumped systems, the water circulates due to density differences between heated and cold water, called natural convection. Therefore, the storage tank has to be mounted higher than the collector and the flow resistance within the system has to be kept low. The solar thermal circuit can be operated as open or closed system, using a heat exchanger, pressurized or pressureless, with the resulting different system specifications. This specification may vary, depending on regional requirements. Developing regions tend to have strong variation in water pressure, which need to be considered in the system design, for example resulting in an open system with pressure reduction at the fresh water inlet. Furthermore, depending on the system, a heat exchanger or backup heating may be necessary. In the following three different systems, for three applications and in different price ranges, will be characterized in more detail to illustrate the system implementation using polymeric materials.

Collector

At the moment there are only few polymeric collectors on the market counting as standard product and even fewer fully polymeric collectors. The model eco-SPARK®, produced by Magen EcoEnergy (Israel), is a glazed collector of extruded polypropylene (PP) tubes and polycarbonate (PC) twin wall sheets. It is produced in variable length defining the collectors' surface. The chosen model has a surface of 2.77 m² and is selected for all three system concepts.

Additional Parts

The large variety of additional parts for the systems is either available in polymeric materials (connections, fittings, valves, etc.) or cannot be replaced (Backup heating, valves, electronics, etc.).

Storage tank

The requirements for the storage tank depend strongly on whether the system is pressurized or pressureless. Also the proportions between the collector surface and tank volume define the maximum temperature in the tank and therefore the operation temperature for the used materials. Further, the total dimensions of the tank define the total mechanical load on the construction material. Inexpensive polymers are not suitable for the occurring loads at elevated temperatures and make an uneconomic wall thicknesses or reinforcement necessary. For this reason, the choice of the storage tank is one of the significant differences between the three systems. Small tanks are cheaper than one large tank and therefore system 1, which is based on two tanks instead of one large one, is more promising. For an operation of a pressurized solar circuit, only steel tanks or more expensive tanks of composite materials are suitable options.

Frame and Mounting

In order to complete the fully polymeric solar thermal system, aluminum or steel mounting systems should be replaced by more eco-friendly materials. Possibilities would be recycled plastic or wood-plastic-composites (WPC).

Piping

Replacing metal pipes with polymeric materials is possible, using standard materials like PP or cross-linked polyethylene (PEX), however restrictions regarding the maximums service life time at temperatures above 100 °C need to be considered.

Overview

Table 1: Specifications, target costs and estimated costs of the components for the 3 proposed systems. Prices are based on market experience and may vary for individual components.

Name:	**System 1**		**System 2**		**System 3**	
Description:	**Pressureless, no back up heating**		**With heat exchanger, back up heating**		**Pressurised system (6 bar), back up heating**	
	Specification	Price [€]	Specification	Price [€]	Specification	Price [€]
Collector	Magen Spark	80	Magen Spark	80	Magen Spark	80
Storage	2 x 80 l, PP	100	100 l, PP*	90	150 l; steel	250
Frame	Rec. PP/WPC	30	Rec. PP/WPC	30	Rec. PP/WPC	30
Piping	PP/PEX	10	PP/PEX	10	PP/PEX	10
Connection/ Others	Valves, Connections	30	Heating, Heat exchan.	>60	Electr., Connections	>75
Target Price	**Total system**	**250**	**Total system**	**260**	**Total system**	**445**

* not necessarily potable water approved