TASK39

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

Performace requirements (general)

INFO Sheet B1

Description:	*Performance requirements at reference sites and applications*
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Introduction

A crucial aspect of using polymeric materials in solar thermal systems is the exact knowledge about the occurring loads especially for temperature and pressure changes. The limited thermal property in various polymers in comparison to the present primarily used materials (copper, aluminum or glass) in reference systems makes it inevitable to determine load profiles. In the framework of the national project SolPol investigations were made to create temperature and pressure load matrices for the main components of solar thermal systems. To achieve a broad knowledge-base, different applications (domestic hot water in single and multifamily houses, combi-systems) and systems concepts for the main climate zones of the world have been investigated. Furthermore, modified polymeric solar thermal systems with overheat protection (backcooling, ventilation, thermotropic layer) and without overheat protection (drain-back, thermosiphon) have been examined. Extended simulations form the basis to deliver load profiles for solar thermal systems based on polymeric materials. Building on the results (system efficiency) derived from reference systems, the accompanying INFO Sheets B2: “Thermal stress” and B3: “Pressure stress” give an overview about the performance requirements for the materials which will be investigated.

Reference sites and applications

Five reference sites with existing potential and intensified solar thermal market activities have been identified to generate a wide range of system loads as a result of different climate conditions: continental, mediterranean, hot and dry, tropical and moderate. The dimensioning of the reference systems was determined by the collector area which is in line with the market and the climate conditions (see Table 1).

Table 1: Summary of the climatic conditions at the selected locations; applications as well as the dimensions of the reference solar thermal systems (gross collector area) correspond to the chosen site; DHW…domestic hot water, SFH…single-family house, MFH…multi-family house; datasource: Meteonorm(test) 6.1

	climatic conditions			gross collector area [m²]			
site / climatic zone	accumulated global radiation (horizontal) [kWh/m²a]	ambient temperature min [°C]	ambient temperature max [°C]	DHW-SFH, pumped	DHW-SFH, thermo siphon	Combi-System-SFH, pumped	DHW-MFH, pumped
Central Europe (Graz) / continental	1160	-12	33	6,6	-	18	44
South Europe (Athen) / mediterranean	1610	2	38	-	3,8	17	42
Africa (Pretoria) / hot, dry	2050	1	34	-	2,5	-	38
Brazil (Fortaleza) / tropical	2030	22	33	-	2,4	-	22
China (Peking) / moderate	1480	-14	38	-	4	18	50

Thermal loads in one reference system

Determination of load profiles prerequisites an overall consideration of the whole solar thermal system. Figure 1 shows the temperature load profiles from different system components derived from a typical reference system in Graz (Austria) as a representative location in Central Europe. The solar thermal system provides domestic hot water and supports space heating. The temperature in the hot water storage tank is limited to a maximum value of about 90 C by the controller. Especially during summer month, temperatures above 200°C can be reached at the surface of a selective coated absorber in the state of system stagnation. This implies that several technological challenges have to be met prior to the use of polymeric materials in solar thermal systems. This includes active overheat protection (backcooling, ventilation, thermotropic switching) and passive overheat protection (thermosiphon systems) for commodity plastics as well as “drain-back” solutions for engineering and high performance polymers.

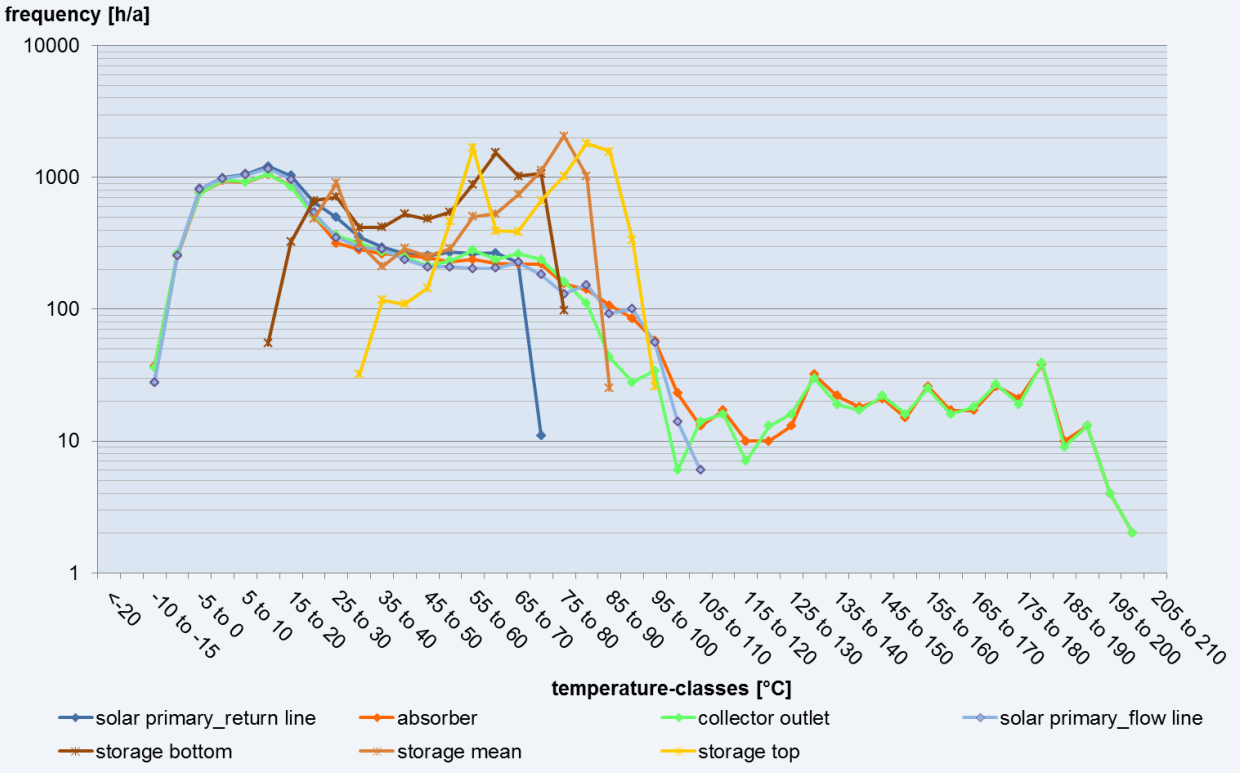

Figure 1: Frequency (log scale) of the occurring thermal loads on different system components of the reference combi-system in a single family house in Central Europe (Graz) with selective metal absorber.

References

Kaiser A., Hausner R., Ramschak T., Streicher W. (2013) Leistungsanforderungen an Polymermaterialien in solarthermischen Systemen, EE-Zeitschrift für eine nachhaltige Energiezukunft 2013-1:12-16, Gleisdorf, Austria