New Generation of Solar Thermal Systems

WP1.E3a / THEORETICAL EVALUATION OF PROMISING SYSTEM: Drainback Solar Water Heating System

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SUMMARY

The evaluation of the new *Drainback Solar Water Heating System* **is based on a comparison of the system concept with a state-of-technology drain-back solar water heater**. During operation, the fluid in the collector loop is driven by a circulating pump, during stand-still periods the collector is emptied through gravity and the entire collector fluid is stored in the upper part of the solar loop heat exchanger inside the store. The pump, situated at the lowest position of the collector loop, is able to refill the collector with fluid after the stand-still period. The primary market for this system is Southern European countries.

The main advantages compared to state-of-technology drain-back systems are that

- the system is less expensive,
- it has a high durability, with little maintenance needs,
- installation expenditure is low,
- the system is safe against stagnation and it is frost-resistant,
- therefore it can be used not only in Southern Countries,
- fewer components are needed (for example, the system contains no return or expansion vessel)

The difference compared to state-of-technology drain-back systems is that water-glycol fluid is used as collector fluid, although it is principally not needed. Antifreeze fluid is used due to security reasons. Additionally, thanks to the use of antifreeze fluid, the system can be used not only in Southern Countries.

As a conclusion, the evaluated system can technically and economically be located between the market dominating thermosiphon system and a conventional state-of-the-art drainback system. Therefore, the evaluated system is compared in this report to a drain-back system. A comparison to a thermosiphon system is described in a separate evaluation report.

Reference system

In this report the system evaluated is compared to a typical drainback system as reference system. The reference system matches the state of the art of drain-back system technology used for solar water heating in some Southern European countries. Table 1 shows estimated market shares of drain-back systems in some South European Countries.

All statements in the *evaluation* section below are relative to (or in comparison with) the properties of the reference system.

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Table 1: Market shares of drain-back systems in Southern Europe /Neg05/

Country	Typical collector area in m²	Market Share in %
Italy	3	10
Greece	2,4	<1
Spain	4	15
Portugal	4	10

Description of the reference system

Application: Solar domestic hot water system
Collector loop: Drainback system
Description: A conventional drain-back system is characterized by the ability to empty the collector loop completely in critical operating conditions. Neither antifreeze fluid are needed nor arrangements have to be made to prevent stagnation. These features are realized with a return and expansion vessel that is located in the return loop (see Fig. 1). A sufficient insulation of the vessel is necessary to reduce heat losses. The pump that is used in the reference is a displacement pump.
Costs: About 2000 Euro (retail sales price without installation + VAT, depending on the collector and storage size). Installation costs: unknown
Collector area: 2 to 3 m²
Store volume: about 200 l
Solar fraction: about 50…60% (domestic hot water only).
Country: The system represents the state of the technology in Greece, like in the other evaluation report with a thermosiphon system as reference, but not the state of the market (less than 1% market share, see Table 1).

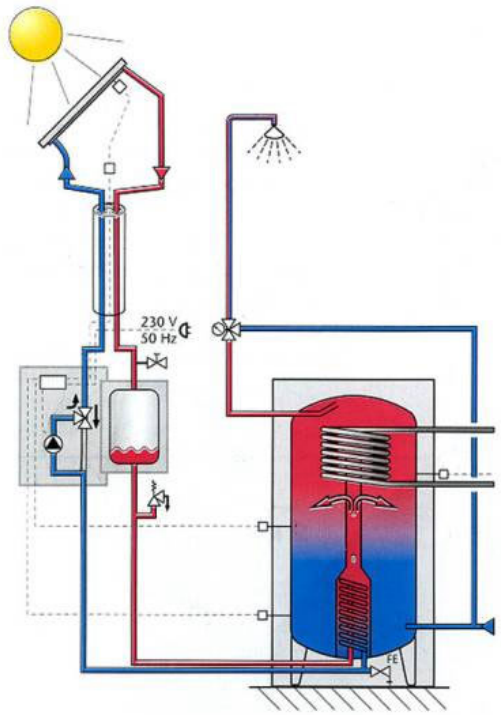

Figure 1: Reference system

Evaluation

Description of the evaluated system

Application: Solar domestic hot water system
Collector loop: Pumped, combined with drain-back
Description: The functionality of the solar thermal system evaluated complies the functionality of the reference drainback system. In opposite, the evaluated system is not equipped with a return and expansion vessel. The upper part of the internal pipe coil heat exchanger (see Fig. 2) is designed large enough to fully incorporate the liquid of the collector and part of the collector loop /Sch03/.
A conventional circulation pump that is providing the pressure head is used.
The control unit, circulation pump, security devices and the solar storage are integrated in one module. Additional devices like a collector loop control unit are not needed. This leads to a compact construction and only two components plus tubings: the storage unit and the collector /Wag05/.
Costs: The system cost is about 1900 € gross end-user price (retail sales price without installation) with a store volume of 160 l and a collector area of 2.4 m^2;
about 2100 € end-user price (retail sales price without installation+ vat) with a store volume of 260 l and a collector area of 2.4 m^2.
Installation costs: 300 € (according to oral information from manufacturer)
Collector area:2.4 m²
Store volume: 160l or 260l
Solar fraction: about 65% in Southern European countries (domestic hot water only).

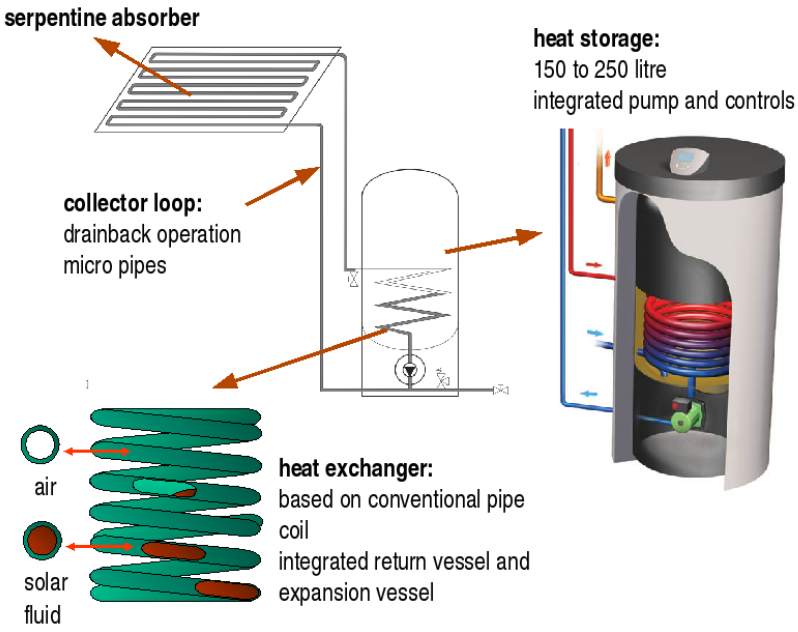

Figure 2: Solar thermal system evaluated

Cost and savings

Material and manufacturing:

- less components (return vessel, collector loop unit, bypass circuit are not needed)
- advanced use of conventional pipe coil heat exchanger
- efficient use of material

Installation:

- easy installation due to the reduced number of components and devices, the system consists of only two units, i.e. the collector and the storage unit) /Wag05/
- standardized transport dimensions (norm pallet), efficient transport and storage of the components

Maintenance:

Disadvantages of the evaluated drain-back system:

The access to the components is more difficult for the evaluated system compared to the reference system due to the integrated system design. Moreover the use of water-glycol fluid instead of plain water makes it necessary to check the fluid periodically.

Advantages of the evaluated drain-back system:

The filling process is improved (less noise, less wearout) by the application of a self-priming pump instead of an injection pump /Sch03/.

Performance and energy savings:

The performance of the evaluated drain-back system is expected to be similar to that of the reference system.

Due to the larger pressure head of the pump in the evaluated advanced drain-back system, the power consumption of the pump is slightly larger than that of the reference system. The maximum system height is 10 m.

For an average operating time of 2000 hours per year (according to EN 12976) the electrical energy consumption is about 100 kWh.

Cost performance ratio :
The cost/performance ratio is expected to be slightly better than the reference system.

Additional benefits

- Simplified assembly, less failure risks.
- No soldering of the collector loop pipes through the use of micropipes with flanges.
- Small amounts of antifreeze fluid needed (about 7 l).
- The use of a conventional pump enables a quiet operation of the evaluated system.

Environmental friendliness:
- Good energy payback time due to reduced material consumption of the whole system.

Aesthetics, building integration and space requirement:
- Low space requirements due to the small number of components. Also the hot water stores are relatively small (160 / 260l) and fit well in most buildings.
- The dimensions of the all-in-one storage allow the store to get into the building (e.g. through doors) easily.

Markets and marketing considerations

Opening-up of new and niche markets:
Primarily designed for countries in Southern Europe, the evaluated drain-back system can also be used in most climates of the world. The protection from stagnation through emptying the collector loop and the use of water-glycol as an antifreeze fluid enables the installation of the system not only in Southern European countries.

Expansion of existing market:
The easy installation and the low price of the evaluated system can lead to more installations of solar thermal systems in Southern Europe.

Special considerations and limitations

This type of system is marketed by Wagner & Co Solartechnik under the product name SECUSOL. Its specialized heat exchanger is patented since 2003.

Acknowledgements

Special thanks goes to Dr. Thomas Schabbach of Wagner & Co. Solartechnik, Cölbe, Germany, for his most valuable contribution and co-authorship.

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