INDUSTRY NEWSLETTER

An yearly update for industrial companies

Nr. 2
September 2001

IEA SHC - TASK 26

Solar Combisystems

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Edited by
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Irene Stadler

INTERNATIONAL ENERGY AGENCY
Solar Heating & Cooling Programme
http://www.iea-shc.org

Industry's participation is a good sign

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As already explained in the first Industry Newsletter, 32 experts from 9 European countries and the USA have been working on the documentation, optimisation and the development of system tests for solar combisystems as from December 1998 within the framework of Task 26 of the Solar Heating and Cooling Programme of the IEA.

Since the working programme has proved to be much more extensive than it was originally thought and additional requirements have arisen in terms of aspects pertaining to buildings and the architectural integration of solar combisystems, the time allocated to the Task was extended to the end of 2002 with the agreement of the Executive Committee.

Industry Workshops

An essential part of Task 26 is close co-operation between research institutes and solar engineering companies. On one hand, this is demonstrated by active collaboration from companies within the framework of the Task, as well as by the Industry Workshops which take place at half-yearly intervals. More than 50 companies from 10 European countries participated in the previous 6 Industry Workshops. To allow companies which did not participate in the workshops to have access to the results, all of the talks given were compiled in one conference edition each.

Up to now the Industry Workshops have focused on the following:

- Solar combisystems: systems and components
- European solar market
- New materials and components for solar heating systems
- Innovations in the field of pumps for solar heating systems
- Life cycle analyses of solar heating systems
- Stagnation behaviour of solar combisystems
- Biomass – auxiliary energy for solar combisystems
- Solar combisystems for multiple family houses
- Durability and reliability of solar combisystems
- Drainback systems
- Legionella
- Architectural integration of solar collectors

The conference editions can be downloaded from the Homepage of Task 26 http//:www.solenergi.dk/task26.

The next Industry Workshop

The next Industry Workshop will take place on October 10th, 2001 in Rapperswil, Switzerland. The workshop will concentrate on Solar Combisystems – market, systems and their dimensioning, architectural integration of solar collectors into roofs and facades as well as on stagnation and overheating behaviour of solar combisystems. Companies interested in new developments in thermal storage tanks can combine participation in the Industry Workshop with the IEA Workshop on 'Advanced Storage Concepts for Solar Thermal Domestic Applications' which takes place directly after the Task 26 Industry Workshop, on October 11th, 2001 in Rapperswil.

Next Industry Workshop		
Date	**Location**	**Detailed Information / Contact**
October 10th, 2001	Rapperswil, Switzerland	SPF-HSR P.O. Box 1475 CH-8640 Rapperswil Tel.: + 41 / 55 / 222 48 - 21 Fax: + 41 / 55 / 210 61 - 31 e-mail:spf@solarenergy.ch http://www.solarenergy.ch

As from September 2001, two detailed programmes, both for the Task 26 Industry Workshop and for the Storage Workshop, will be available on the homepage http//:www.solenergi.dk/task26, respectively this can be obtained from national contact persons (see below the list of SHC-TASK 26 Participants).

German project on solar combi-systems successfully finished

By Harald Drück, Stuttgart University, ITW, Pfaffenwaldring 6, 70550 Stuttgart, Germany, e-mail: drueck@itw.uni-stuttgart.de, http://www.itw.uni-stuttgart.de/

In Germany the market for solar combi-systems is strongly increasing. In order to support the further development of solar combisystems, a research project was launched. During the project, the thermal behaviour of combisystems was investigated in details by means of simulation studies, a guideline for the 'design and installation' of solar combi-systems was written and performance test methods were further developed. The project has been lasting for two years and was finished in spring 2001.

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In Germany as in many other European countries, the market share for solar combisystems is rapidly increasing and a continues trend can be expected for the future. For this reason, the 'German Professional Association of Solar Energy' (DFS, Deutscher Fachverband Solarenergie) and the ITW (Institut für Thermodynamik und Wärmetechnik, Universität Stuttgart) decided to launch a project in order to support the development of combisystems in this early state. The project called 'Kombianlagen' started in the beginning of 1999 and was finished in spring of this year (2001).

The project was financially supported by the 'Deutsche Bundesstiftung Umwelt' (DBU) and by 22 manufacturers. This large number of participating manufacturers is a strong indicator for the expected future relevance of solar combisystems as well as for the importance of know-how transfer between science and industry.

Work programme

The project was mainly focused on the following three topics:

- There are many different combisystem-designs in Germany, but there is still a lack of detailed information concerning the thermal behaviour of these systems. That is why there is a strong interest in getting further information about system technologies and possibilities to improve the overall efficiency of the solar heating system. The influence of a lot of parameters such as the store volume, the heat loss rate of the store, the set temperature of the auxiliary heated part etc. were investigated by means of numerical simulations. The influence of the design and the operating conditions of the conventional space heating system were analysed. Furthermore, the influence of the solar combisystem on the efficiency and the start - stop behaviour of the auxiliary heater was examined.

- The second topic was the preparation of a guideline containing relevant information about design and installation. The main target group for this guideline are planners and plumbers of solar combisystems. The intention of this guideline is to guarantee the market implementation and to secure the high standard in solar techniques reached so far.

- The third aim of the project was to develop a standardised performance test procedure for solar combisystems. Due to the widely different system designs, a component based approach, such as the CTSS method (component testing - system simulation) was found to be the most promising one. For solar domestic hot water systems, this method is already standardised in ENV 12977, Part 1-3. While testing of collectors is similar in both cases, the test procedures for the store and the controller had to be extended. Thus, additional store test sequences were developed to characterise the thermal behaviour of the store related to space heating. In order to assess the performance of the combistore with regard to the preparation of domestic hot water, a special test procedure of the determination of the 'useful hot water volume' was developed. For the determination of the thermal performance of the combisystems by means of numerical simulations, appropriate simulation models must be available. Thus, numerical models (TRNSYS Types) were further developed.
Since the controllers of solar combisystems are more complex as the ones of solar domestic hot water systems, it is not practical to use the controller test procedure as specified in ENV 12977-2, Annex A. Therefore, a computer driven controller test facility was developed.

The project report prepared by ITW as well as the guidelines for 'design and installation' of solar combisystems prepared by the DFS will be available (in German language) by the end of this year.

The Altener project: Solar Combi-systems

By Klaus Ellehauge, Danish Technological Institute, Solar Energy Centre Denmark, 8000 Aarhus C, Denmark, e-mail: klaus.ellehauge@teknologisk.dk, http://www.solarenergycentre.com

With the aim of increasing the use of optimised solar combisystems, 7 European countries are working together on a project funded by EC's Altener programme and by national funding. The project proposal has been prepared by the countries participating in the IEA Task 26. The project realisation started on April 1st, 2001 where the kick-off meeting was held in Delft in the Netherlands. The project will be running for 2 years.

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The participating countries are Austria, Denmark, France, Germany, Italy, Sweden and the Netherlands. Denmark is co-ordinator of the project. Except for Italy, all countries are participating in IEA Task 26 and it is of course the aim to work on the basis of the results from the work in IEA Task 26.

Although the interest in solar combisystems is increasing in most of the participating countries, the market has so far not been based on optimised systems as the evaluation of costs and performance has not been carried out systematically. Since this work is now being carried out in IEA Task 26, it is therefore the objective to realise a total of approximately 140 optimised combisystems in the participating countries.

However, it is also the objective that the above total shall establish and/or consolidate a further market development based on improved and optimised solar combisystems. In addition, the project shall also demonstrate good economy and performance of the systems and transfer knowledge of the systems to manufacturers and constructors.

The EU wanted the project to be clustered together with the following projects: Sun in Action II and Solar Keymark which were proposed by The European Solar Industry Federation (ESIF). To the three projects together are given the common title: Solar Thermal Technology Promotion. The Solar Keymark project is co-ordinated by the Danish Technological Institute and carried out by ESIF together with 10 European organisations with the aim of reaching a common European mark for solar water heaters based on EN standards. The Sun in Action II is co-ordinated and carried out by ESIF with the aim of updating the existing Sun in Action market study from 1996. It is the aim that all relevant information and results from each project will be distributed to the other projects. Especially information about test methods and certification will be exchanged between the Solar Combisystems project and the Keymark project; the Solar Keymark will make use of the Sun in Action II project in order to promote the Solar Keymark label. Furthermore, the Sun in Action II project will, in collaboration with the Solar Combisystem project, look on market potentials and strategies for dissemination of combisystems.

Work programme

It is the intention of the work programme to:

- increase the interest of national solar industries in solar combisystems and give them relevant documentation and user-friendly simulation programmes
- identify and group potential buyers of the approximately 23 systems (approximately 15 in countries with weak markets) in each country and assist the decision and pre-planning of the plants
- prepare call for tenders or technical specifications of the plants
- assist in contracting and planning the construction of the plants
- collect information concerning the plants and carry out costs and financial efficiency analyses of the plants
- install monitoring equipment in 3 systems in each country and collect monitoring data and evaluate the performance.

The work in the Altener Combisystems project is carried out in 6 work packages:

- Seminars and workshops
- Grouping of potential buyers
- Preparation of calls for tender (technical specifications)
- Construction of plants
- Costs and financial efficiency analyses
- Monitoring

The project is carried out in close contact with industry where several companies participate as subcontractors.

Expected results

It is expected that the project will demonstrate the ability of optimised combisystems to perform well and to have a sound economy with a higher solar fraction than solar domestic hot water systems. By demonstrating this, it is expected that the project will result in further realisation of a large number of solar combisystems as part of the EC Campaign for Take-off.

Website and contacts

The project has its own website on www.solenergi.dk/altener-combi. This is where you can find the contact persons in the participating countries. The Danish co-ordinator of the Altener Combisystems project is Klaus Ellehauge.

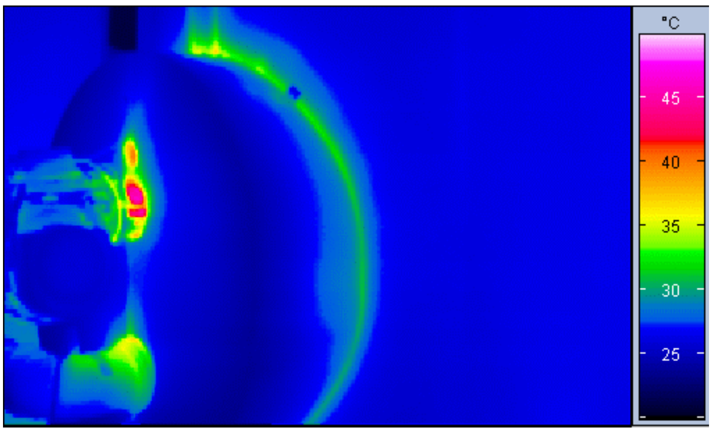
The following text is an abstract of an article which can be downloaded from the Homepage of Task 26 http://www.solenergi.dk/task26/downloads.html.

Heat Losses from Storage Tanks - Up to 5 times higher than calculated!

By Subtask A Leader Jean-Marc Suter, Suter Consulting, P.O. Box 130, CH-3000 Berne 16, Switzerland, e-mail: suter@email.ch

Abstract

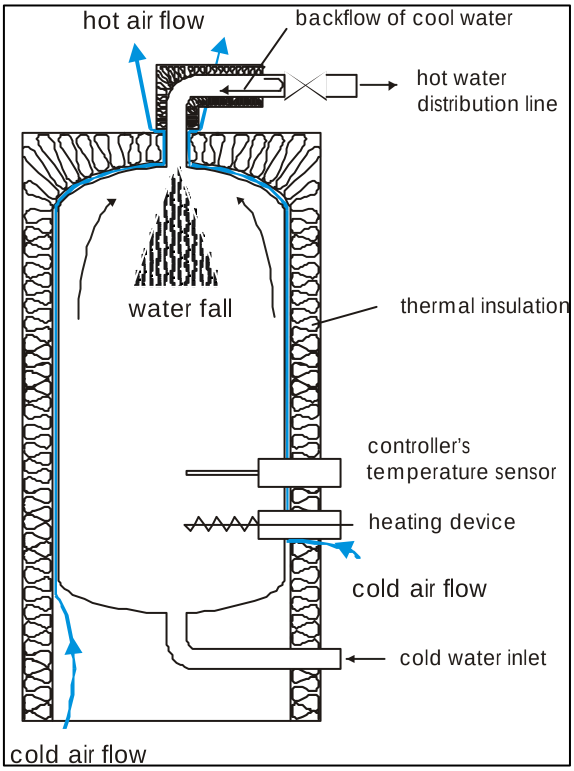
This is a summary of nearly 20-years-old research work at the former Swiss Federal Institute for Reactor Research, at Würenlingen, now the Paul Scherrer Institute. At the beginning of the eighties, solar-energy researchers performed systematic measurements of the long-term heat balance of solar heating systems. They became shocked by the results: heat storage tanks lost up to five times more heat than calculated from the simple heat transfer coefficient and geometry of the storage tank's thermal insulating mantle. They tracked all possible heat sinks as well as hidden measurement errors. In the end, they discovered totally unexpected phenomena in these storage tanks.



❹ Investigation on a hot water tank by means of infrared thermography. The heat losses are minimised thanks to optimal integration of an auxiliary heater with the help of a new insulating material, SOLVIS, Germany

Main origins for heat losses

There are two main origins for the huge heat losses:



(i) Air may circulate between the insulation layer and the metallic wall of the storage tank, dragged by buoyancy forces ('chimney effect'). Cold air enters the gap between insulation and wall through some slits located in the lower part of the tank; warm air leaves this gap through similar slits in the upper part; air velocities up to half-a-meter per second have been recorded. This effect makes up about one third of the high heat loss of the tank.

❺ Schematic representation of the mechanisms inducing the extra huge heat losses

(ii) The remaining part of the extra heat loss is due to a very efficient heat transport phenomenon along the pipework connected to the upper part of the tank. As long as the pipes considered are horizontal or upwards oriented, the water they content flows back to the tank in the lower part of the pipes' cross section. As this water is colder than the tank contents, it cools the tank continuously. To replace the cooled water leaving the pipes, warmer water is sucked from the tank into the upper cross section of the pipes, closing the flow circuit. This process has been filmed. It was found to happen in pipes with a length up to 20 m, but there is no reason for it to vanish in longer pipework. The only way to drastically reduce the overall heat loss is to create an air-tight insulation mantle around the side-walls and the top of the tank, and to install pipework provided with 'siphons', i.e. having some parts directed downwards, so that the cooled pipes' contents no longer can flow to the storage. If, and only if, these rules are strictly observed, the heat loss only amounts to 100% to 200% of the value calculated from the insulation mantle properties. This is acceptable in solar heating systems with a heat storage time lasting up to a few days.

The following text is an abstract of an article which can be downloaded from the Homepage of Task 26 http://www.solenergi.dk/task26/downloads.html.

Stagnation Behaviour of Thermal Solar Systems

By Robert Hausner and Christian Fink, AEE INTEC, Arbeitsgemeinschaft ERNEUERBARE ENERGIE, Institute for Sustainable Technologies, Feldgasse 19, 8200 Gleisdorf, Austria, e-mail: r.hausner@aee.at, http://www.aee.at

Abstract

Due to the large collector areas installed, combisystems in summertime are generally more frequently exposed to an excess in solar heat production than solar water heaters. Adequate protection against possible high temperatures in the system (up to 200 °C for flat-plate collectors) is therefore an important issue to make sure that these systems will operate properly in the long term, with minimum maintenance.

❻ To reach high fractional-energy-savings, huge collectors have to be installed, Two-family house, House Schiretz, Hitzendorf, AEE INTEC, Austria

The authors have studied the behaviour of combisystems at stagnation, when the collector loop pump is switched off. The most critical aspect is a possible heat transport by saturated steam produced in the collector and condensed at all 'cold' locations in the loop, with potential degradations of components even though they are located far away from the collectors, like e.g. the expansion vessel installed near the heat storage tank. Leakages may be the consequence.

The key issue in the prevention of the undesired effects is the design of collectors, collector array and collector loop in such a way that steam production at stagnation is able to expel in a short time the whole liquid content of the collector array, pushing it out by both the inlet and the outlet pipes. Some measures to improve critical systems are discussed. The research project is going on.

The following text is an abstract of an article which can be downloaded from the Homepage of Task 26 http://www.solenergi.dk/task26/downloads.html.

Controller Integration

By Stefan Larsson, Vattenfall Utveckling, Alvkarleby laboratory, 814 26 Alvkarleby, Sweden, e-mail: Stefan.larsson@utveckling.vattenfall.se

Abstract

The author shows the present integration's status of different solar-related as well as non-solar functions of a controller for solar heating systems, especially focusing on solar combisystems.

The review is based on the products currently available from the market place, including cost aspects. The integration may be performed at different levels, e.g. through hardware, software, networking, and/or by means of using common sensors. The connection to a PC as well as upcoming new features are also discussed.

Considering the hardware currently in use, it is concluded that industry does not yet utilise the full controllers' potential they sell to the market.

❼ An example of an integrated controller for solar combisystems, courtesy Lartec AB, Sweden

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Level 1: Participation in 1 workshop per year and answer technical and marketing questions

Level 2: Participation in all Task meetings and provide feedback from the market

Pictures

❶ Single-family house, Isère, Clipsol, France

❷ House Eickhorst, SOLVIS, Germany

❸ Terrace houses, Batec, Denmark

❹ Investigation on a hot water tank by means of infrared thermography. The heat losses are minimised thanks to optimal integration of an auxiliary heater with the help of a new insulating material, SOLVIS, Germany

❺ Schematic representation of the mechanisms inducing the extra huge heat losses

❻ To reach high fractional-energy-savings, huge collectors have to be installed, Two-family house, House Schiretz, Hitzendorf, AEE INTEC, Austria

❼ An example of an integrated controller for solar combisystems, courtesy Lartec AB, Sweden

Remark