CombiSol project

Solar Combisystems Promotion and Standardisation

D2.1 : Criteria for Best Practice

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Introduction

Within the IEE project CombiSol in total 70 solar combisystems in Austria, France, Germany and Sweden were qualitatively evaluated on site by experts of the project team based on an extensive evaluation form. Results of this evaluation are reported in D5.4 “Summary of the Qualitative Evaluation of Solar Combisystems” [1].

Further within CombiSol in total 41 solar combisystems were equipped with a monitoring system giving the possibility to measure energy flows going in and out of the solar combisystem. Based on these measurements performance figures were calculated and some specific evaluations were done. Results of the monitoring campaign are reported in D4.4 “Comparison of results of all monitored plants” [2].

Based on experiences of these intensive evaluations of solar combisystem in four European countries the following “Criteria for Best Practice” were elaborated with the goal to support all professionals of the solar thermal industry, manufacturers, solar companies, installers, planers and consultants to improve solar combisystems in all phases: development and design of solar combisystems by the solar industry, project specific planning by solar companies, planers and installers and finally installation and commissioning by the installer. Following up based on this document a “Guideline for Design and Dimensioning” as D2.3 also is available [3]. Further elaborated within CombiSol the document D6.3 “Guidelines for manufacturers on the best practice” [4] is available as well on the project webpage: www.combisol.eu.

Generally speaking, the main focus of thinking about product and system improvements should not be on increasing solar gains but much more on reducing heat losses within a solar combisystem, which has more components causing heat losses (mainly tanks and pipes) and therefore – unfortunately – more potential of overall heat losses than conventional heating systems typically have. Further a solar combisystem consists of two main parts: the solar thermal and the auxiliary heating system. The integration of both in terms of hydraulic AND control integration is a complex problem and needs to be handled with sufficient design and planning effort in order to achieve high performance of all subparts during heat generation (solar thermal and auxiliary) but also during heat storage and heat distribution.

The following 3 parts provide a check list of what is important to think about for the different target groups a) manufacturer and system supplier when developing and designing solar combisystems, b) system supplier, planner, energy consultants and installer when planning a specific solar combisystem for a costumer and c) installers when installing and setting in operation a solar combisystem. More detailed discussion of each point is done in the document D2.3 “Guideline for Design and Dimensioning” [3] and D6.3 “Guidelines for manufacturers on the best practice” [4].
1 System Development and Design by Manufacturer
(mainly for manufacturer and system supplier)

- Compactness and high degree of prefabrication of the solar combisystem, for:
  - Reduced cost due to less installed material
  - Reduced heat losses due to less meter of piping causing heat losses
  - Reduced risk of wrong installation of components on site
  - Reduced risk of bad insulation quality of piping
  - Reduced risk of bad integration of the auxiliary heater

- Heat loss optimized tank in terms of:
  - Pre-built or at least pre-defined thermosiphon traps at pipe connections which can not be ignored at construction site by installers.
  - No or minimized number of cold bridges in the insulation for pipe connections or sensors in general.
  - No cold bridges in the insulation for pipe connections or sensors in the hottest top part of the tank which is also kept hot by the auxiliary heater (e.g.: use internal pipes with connections lower down).
  - Tank insulation which fits to the tank - pre-fitted or separate but to be mounted EASILY and WITHOUT problems by the installer.
  - For systems with pellet boilers, an electrical heater in the store is beneficial so that the boiler can be turned off when the solar fraction is very high.

- Concept of temperature controlled, stratified charge and/or discharge of the heat storage (by external 3/4-way valves or internal devices like stratifier pipes)

- The design must ensure that the sensors (all types of temperature sensors accepted by the manufacturer) have a proper fixation that guarantees good thermal contact without risk for movement and consequent loss of thermal contact with the temperature that it should measure.

- Clearly defined hydraulic/control concept AND control hardware in terms of integration of the auxiliary heater into the entire solar combisystem shall be guaranteed by one of the following solutions:
  - Development and delivery of the entire solar combisystem including the auxiliary heater
  - Development and delivery of an own system controller with a sufficient flexible interface for clearly defined accepted external auxiliary heater types.
  - Delivery of clear and absolutely detailed control concepts for market typical auxiliary heater and their integrated controller including a detailed description of needed parameter settings and the expected behavior. It must be avoided that the installers need to find a solution in each specific installation themselves. (it is clear that this is not an easy task!).

- Good stagnation behavior of collector, collector field and the complete primary collector loop with all components which shall be predictable and safe, and make sure to use suitable materials (especially for parts of the system which could have high temperatures).

- For external collector pipes pre-fabricated piping with proper insulation and protection against UV-radiation and animal bites should be developed and offered.

- High efficiency pumps for reduced parasitic electricity consumption

- Existence of supporting documents for documentation of the specific installed solar combisystem (e.g.: hydraulic scheme, commissioning protocol, control parameter settings, operation and maintenance guideline) AND guarantee measures that those documents are filled in, handed out to customers and are archived by the installer AND the system supplier.
2 Planning of a Specific Solar Combisystem
(mainly for system supplier, planner, energy consultants and installers)

- Hydraulic concept in terms of Domestic Hot Water (DHW) preparation depending on:
  - With/without DHW circulation
  - Type of auxiliary heater, nominal power, speed, modulation range, etc.
- DHW circulation circuit, if absolutely necessary, is properly controlled in order to minimize heat losses. Customers need to be informed of the high losses that DHW circulation normally causes.
- Space heating system fits or is adapted properly for a solar combisystem guaranteeing low operating temperatures and especially lowest possible return temperatures.
- Hydraulic concept in terms of auxiliary heater integration depending on:
  - Type of auxiliary heater, nominal power, speed, modulation range, etc.
  - Type of space heating distribution
- Control concept in terms of auxiliary heater integration in order to keep the heat storage and auxiliary volume on average as cold as possible for minimizing heat losses depending on:
  - Type of auxiliary heater, nominal power, speed, modulation range, etc.
  - Type of space heating distribution
  - Type of DHW preparation
- Collector area in a proper size depending on expected solar fraction
- Storage volume / heat storage capacity in a proper size depending on:
  - Collector area
  - Expected solar fraction
  - Space heating system and occasionally other heat storage effects in the building
  - Hydraulic integration of auxiliary heater
  - Auxiliary heater type
  - Auxiliary volume in relation to auxiliary heater type and nominal power of auxiliary heater – lower set temperature and auxiliary heated volume lead to greater energy savings. A minimum is required to satisfy the customers desires for DHW comfort (required flow rate and volume available at all times).
- Proper and very careful check whether it is really an advantage to plan a two/multi store system instead of a maybe under-dimensioned single store system or an on-site welded larger single store. Extra tanks lead to significantly larger heat losses from both the tank and interconnections.
- Concept of temperature controlled charge and discharge of the heat storage
- Collector field design with good emptying behavior for minimized thermal and mechanical stress of all components in the solar primary collector loop
- Measures planned that guarantee that temperature critical components in collector primary circuit are not reached by steam during stagnation.
- Protection of well insulated external collector pipes against UV-radiation and animal bites
- Proper choice of high temperature resistant components for the primary collector loop and placement of all components in the circuit correctly
- Proper placement of the main components in the technical room in order to keep the system compact and enabling minimized pipe length (especially high temperature pipes) including thermosiphon traps at pipe connections at the heat storage.
- Reduced number of pumps (external/internal solar heat exchanger, number of space heating loops) and high efficient pumps for reduced parasitic electricity consumption.
3 Installation and Commissioning of a Solar Combisystem
(mainly for installers)

- Overall system, hydraulic scheme:
  - Installation or adaption of the space heating system for a solar combisystem guaranteeing low operating temperatures and especially lowest possible return temperatures (pre-adjustment of hydraulic loop, thermostat valves in the rooms).
  - Correct DHW circulation circuit connection (maximum temperature limited) and time control in order to minimize heat losses.
  - All pipes, connections and components are insulated properly.
  - DHW set temperature as low as possible in order to minimize distribution heat losses

- Collector primary circuit:
  - Collector field installed with good emptying behavior during stagnation.
  - No high temperature critical components wrong positioned in the primary collector circuit.
  - Expansion vessel connected from top.
  - High temperature resistance drain pipe (metal) and collection tank at pressure release valve.
  - Automatic de-aeration valve can not be reached by steam or is manually closed

- Heat storage
  - Pipes for DHW and space heating are connected at the correct height in relation to auxiliary DHW volume, auxiliary space heating volume and solar volume.
  - Heat storage insulation is mounted perfectly, especially the top part.
  - Thermosiphon traps at all pipe connections at the heat storage.
  - Unused pipe connections at the heat storage are insulated.
  - Temperature sensor connections at the heat storage are insulated and fixed so that the sensor cannot move.

- Controller:
  - Controller parameter and set temperatures are chosen in order to keep the auxiliary heated part at lowest possible temperature.
  - Temperature sensors are properly fixed and have perfect thermal contact and are well insulated in order to measure exactly.
  - Temperature sensors mounted in the correct position. Check for shadowing effects on collector to choose most suitable position for placement of sensor.
  - Pumps are set correctly for minimized parasitic electricity consumption.

- Supporting documents for documentation of the specific installed solar combisystem (e.g.: hydraulic scheme, commissioning protocol, control parameter settings, operation and maintenance guideline) exist AND are filled in, handed out to the customer and are archived by the installer AND the system supplier.
4 Bibliography

[1]: THUER A. et.al., 2010, D5.4: Summary of the Qualitative Evaluation of Solar Combisystems, Technical report of the Combisol project

[2]: LETZ T. et.al., 2010, D4.4: Comparison of results of all monitored plants, technical report of the Combisol project

[3]: THUER A. et.al., 2010, D2.3: Guideline for Design and Dimensioning, Technical report of the Combisol project

[4]: Nielsen J.E. et.al., 2010, D6.3 Guidelines for manufacturers on the best practice, Technical report of the Combisol project

[5]: Project Webpage: www.combisol.eu