BWE 28001 + BWE 28002

Abstract

New and high efficient heat storage technologies play a key role for changing our energy supply from fossil and nuclear towards renewable energy sources. One key component are thermal energy stores on the one hand for using solar heat to a much greater extend, but also for other technologies such as co-generation plants or as a cost-effective alternative to power (electricity) storage (for example space heating stores that can be charged with an electrical driven heat pumps during times of power excess in the grid).
Heat stores for renewable energy sources need to be able to offer large storage capacities while using little space and having heat losses as low as possible. Furthermore they should be designed for an easy and cost-effective installation in existing buildings. Only if these aspects are fulfilled a broad application and hence a quick transformation of our energy supply towards renewable sources can be expected.
For the installation of solar thermal hot water and space heating systems, the possible storage tank volume is often limited by the existing building structure. The usage of the developed modular storage concept enables the realization of large heat store capacities in the existing building stock. The subject of the development performed within this project ModSto was a pressurized heat store consisting of several heat store modules with a volume of approx. 1300 litres which can be easily transported to the installation site. The pressure resistance to approx. 2.5 bar of the store enables the easy and efficient coupling with the space heating circuit and auxiliary heat sources such as a boiler or a heat pump. Due to the patented modular heat store concept based on a parallel interconnection of the heat store modules they can be stacked without thermal insulation between each other /1*/. This offers the realization of large and very compact storage units and implies a very good utilization of the available space.
The heat store modules consist of a pressure stable sandwich module with an in-lined polymeric tank for the water used as storage medium. The heat store modules are interlocked by the connecting pipes and two plane sandwich endplates in order to establish a pressure neutrality between the modules. The connecting pipes are used for charging and discharging of the heat store as well.
The sandwich elements were designed using extensive FEM simulations (FEM: Finite element method) in order to elaborate a pressure resistant design of the storage module and a maximum space utilization. The heat store modules were first built up in a 1:3 model for gathering technical expertise concerning the pressure stability. Within a next step the store concept was built in real dimensions for the integration in two test systems in order to analyse the heat losses as well as the thermal stratification behavior and gather more information on the pressure stability.
A first test of the heat store concept showed good handling characteristics as well as promising pressure stability. The ecological assessment of the concept reveals a considerable saving potential concerning the cumulative energy demand for the realization of large hot water store volumes compared to the usage of several small conventional hot water stores. Two functional models of the heat store systems consisting of 2 modules each were built up and tested. The thermal properties of the heat store system could not have been tested within the duration of the project due to problems based on manufacturing tolerances. Those problems do not raise general questions concerning the concept. Hence it is intended to perform the tests after the end of the project and to publish the results later on.
The achieved results and the knowledge gained during this project, which are of a common interest, were made accessible to the solar industry by publication of scientific papers and informative industry workshops. By doing so, a significant contribution to the further development and a broader market introduction of advanced solar combisystems was performed.