COMPACT COLLECTOR FOR BRINE TO WATER HEAT PUMP A FIELD TEST

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Abstract: Due to the possibility of optimisation of the horizontal brine collector, a special compact collector for the brine to water heat pumps was developed. Field tests and simulation regarding the efficiency and the energy gain have been made over 2 years. The results of the field measurement and the simulation show a high efficiency of this system.

The compact collector is an area saving way of reducing the digging work for the brine collector and reduces the needed area for the collector in comparison to a standard horizontal collector. Both simulation and measurements prove that there is enough capacity to recover the brine source in summer. The minimum temperatures that occur at the end of the heating period do not pass the -2.5 °C.

Key Words: ***compact collector, efficiency, field test***

1 FIELDTEST

The use of thermal energy from the upper layer is used in that project as the energy source for the operation of the heat pump. The used horizontal compact collectors gain the heat out of the surface, mainly by solar radiation. The location of the single family house is in the north of Germany, in Bremerhaven.

The horizontal compact collectors are installed in the garden in a depth of 1,20 m, covered with a 5 cm layer of sand to protect the pipes. Due to the use of the compact absorber the needed area for the heat source of the heat pump was reduced to an area of 80 m².

Figure 1: Collectors during installation

The installed brine / water heat pump NIBE FIGHTER 1210 - 5 is a compact unit (60x60 cm) including a double jacket hot water tank (160l and 45l in the jacket) and all needed pumps for the brine and the heating system. The cooling module uses 1,4 kg of the refrigerant R 407 C and provides at B0/W35 a heating capacity of 6,0 kW, by an electrical energy consumption of 1,03 kW. In addition to that, in the brine an exhaust air module – NIBE FLM -has been added. So the energy from the domestic home ventilation system is transferred over a heat exchanger from the air to the brine. The heating distribution is based on floor heating on a temperature of 35 °C in the house.

2 MEASUREMENT

The temperatures and flow are measured at the inlet and outlet to the heating system and on the brine system, according the drawing, and also the energy consumption of the system. The measurements are carried out with devices in combination with data loggers with measure the space heating and domestic hot water.

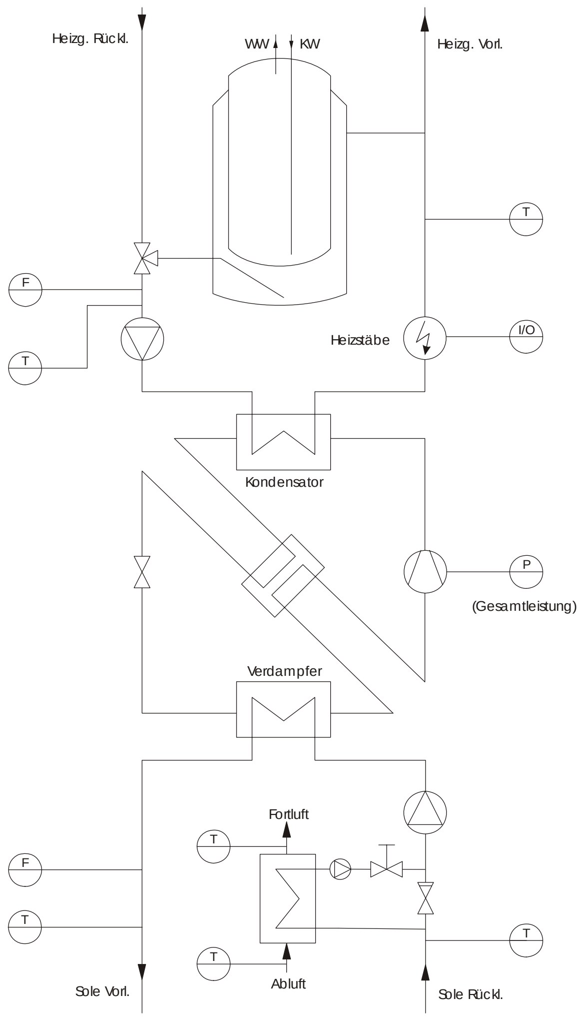

Figure 2: heat pump system

In the installation on the brine side the temperature sensors (PT 100) are located on the pipes and also in the ground near by the collector and also in different vertical distances. In addition to that the temperatures and flow are measured before entering the heat pump. The values from the measurement equipment were taken every minute and had been summed up to daily average values.

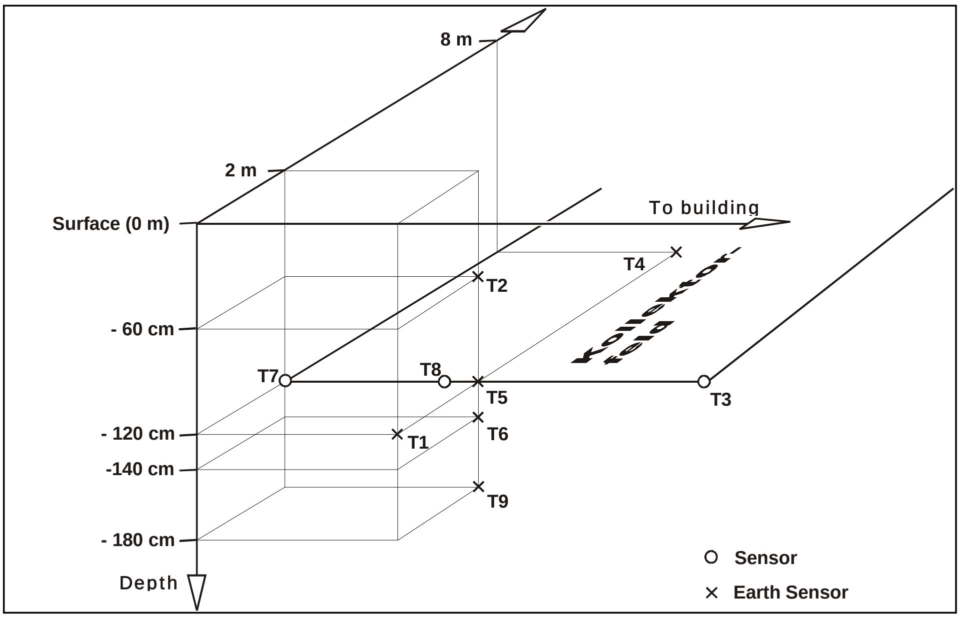

Figure 3: Temperatures measured in the ground

3 RESULTS

The measurement had been carried out from Feb 2004 to May 2006. In the figure 4 the daily average values are displayed. The minimum temperature did occur in February, maximum values are measured in August. The general behavior of the temperatures over the measured period is similar. No shift due to the use of the ground to lower temperature was measured. The temperature near by the compact collector is during the heating period significant higher that the temperature in the collector field (sensor T7, T8 and T3). During the recovery over the year in November the temperature in the ground is almost equal.

There are two main aspects to achieve an energy efficient system with a heatpump and a brine collector:

- The energy again at the maximum load for the heat pump, especially during the winter (Jan. - Feb.) has to be secured.
- The regeneration of the ground during the year has to be taken into consideration. It has to match with the design of the collectors and the heatpump system. The exhaust air module is supporting the recovery of the brine collector.

During the measurement in February 2005 there had been the maximum load from the heat pump occurred several times and the heat pump gained enough heat out of the system.

In addition to the measurement simulations will be carried out to investigate the influence of the exhaust air module on the recovery of the brine during the year.

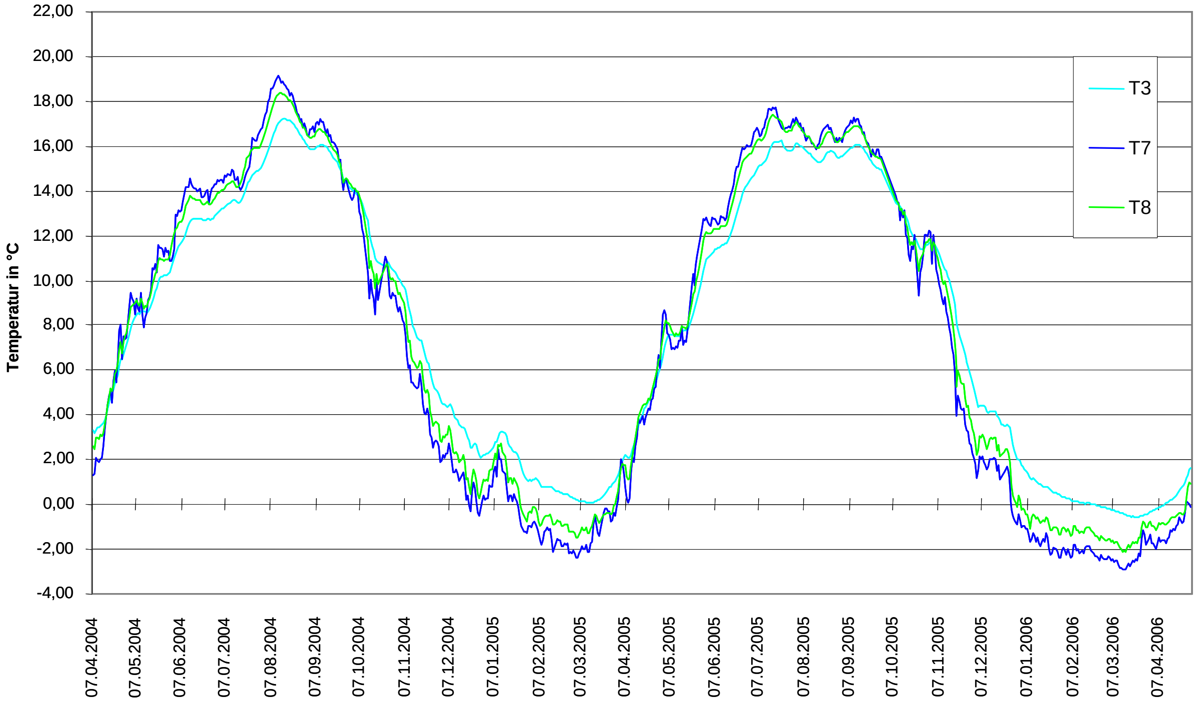

Figure 4: Temperature in the compact collector field

4 CONCLUSION

The field test proved that the amount of energy taken out of the horizontal compact collector is able to cover the energy demand for heating and hot water production.
The temperature in the ground did recover in the period between each 3 heating seasons. During the measurement also the maximal heating power was needed from the heat pump and during the maximal load the compact collector was able to supply the heat pump. The annual performance factor in that field test was 3.8 (produced heat energy of the heat pump/ electrical energy use of the heat pump and ventilation). That is a proof the designed compact collector in combination with the heat pump system build up an efficient solution.

5 REFERENCES

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