Feasibility Study

Odörfer

HVAC distributor

Beneficiary of the consultation:
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Subject of Feasibility Study:
Feasibility of the implementation of solar driven sorption chiller(s) within an existing and expanding show- and seminarroom

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Current situation

Odörfer is a distributor for bathroom equipment and HVAC products which operates Austrian wide. The store in Graz is the biggest bath-showroom in Styria and will be enlarged and completed by a show room for heating technologies. Therefore an existing storage hall will be converted. For the additional area a certain cooling demand occurs. The existing cooling system should be analysed concerning to an implementation of solar cooling in the framework of the enlargement.
Fig. 1 shows the aerial view of the building complex with the location of the cooling areas, the compression chiller and the mechanical ventilation device. The chiller is situated outside of the building and the ventilation device is situated in the basement. Possible areas to situate the solar thermal collectors are at the flat roof around the seminar room and the new showroom. The existing showroom is already supplied with conditioned air. Additional to those enlargements there will be activated a further showroom with 500 m² area in the basement. An existing ventilation system is already installed in the basement. Table 1 shows the building data of the 4 halls/rooms of the Odörfer facility.

Fig. 1: Airial view of the building complex

Table 1: Building data

areas	area	Cooling load / energy demand
Existing showroom	1519 m²	73 kW / 75850 kWh/a
New showroom	300 m²	15 kW / 14980 kWh/a
Seminar room	190 m²	9 kW / 9487 kWh/a
Basement showroom	500 m²	20 kW / 24967 kWh/a
Office area west	unknown	30 kW / 9690 kWh/a
Office area east	unknown	20 kW / 4570 kWh/a

The installation schemes of the actual installed cold water production and ventilation system are shown in Fig. 2 and Fig. 3. There is a district heating access with a nominal power of 460 kW present which supplies the facility with heat energy.
The outdoor situated compression chiller has a nominal electricity connection power of 49.65 kW with around 150 kW cooling capacity. The generated cold water with a temperature of 7 °C supplies two office areas, equipped with fan coils, with 30 kW and 20 kW cooling load and also a 73 kW cooling register within the mechanical ventilation device. A 1 m³ cold water storage is installed between the chiller and the distribution system.
The ventilation device is situated in the basement and generates 16,400 m³/h conditioned air flow for cooling and heating of the existing showroom. Additionally it is further designed to be able to condition aflow rate of 7,400 m³/h for the basement air distribution system but actually this part is not in operation.

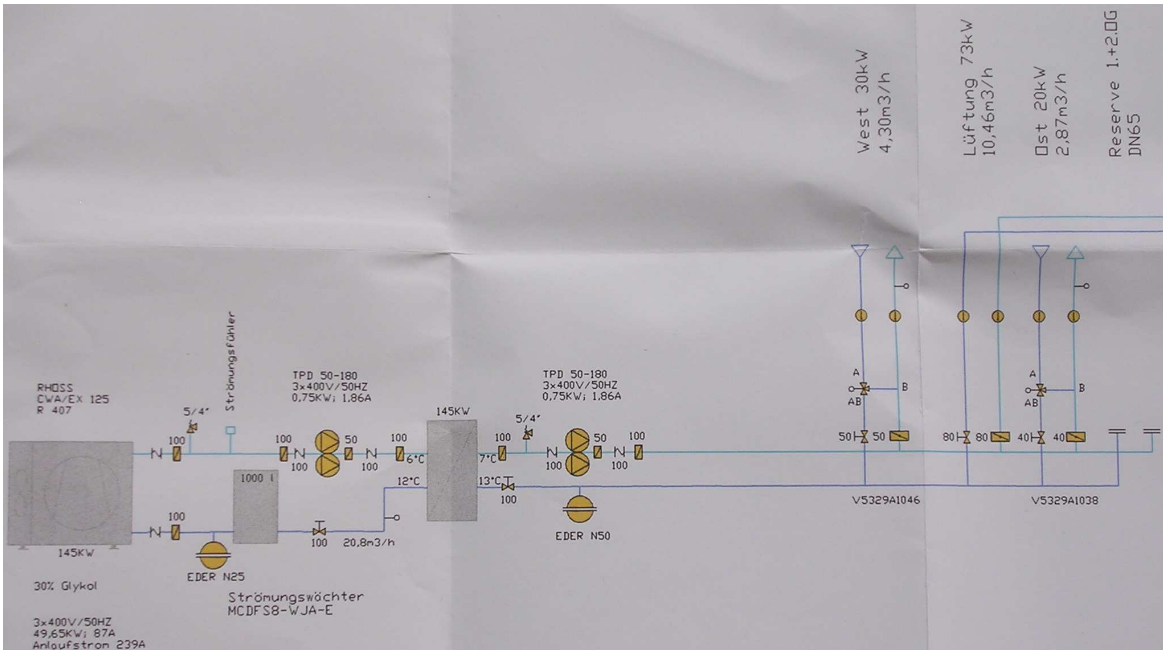

Fig. 2: Installation scheme – existing cold water production

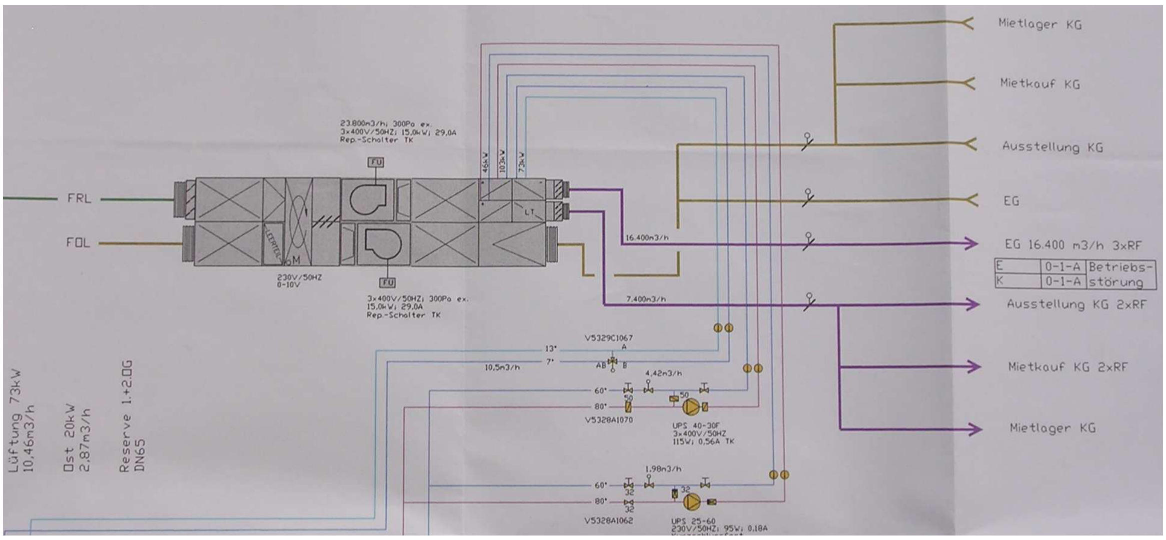

Fig. 3: Installation scheme – existing mechanical ventilation system

Pictures of the compression chiller, the cold water storage, the cooling register and the existing showroom are shown in Fig. 4. The chiller is equipped with three ventilators for a dry heat rejection. The cold water storage is installed in series to the distribution system (see Fig. 2). The hydraulic cycle of the cooling register within the ventilation device is equipped with an energy meter, as well as the two office distribution cycles. Heating and cooling energy distribution occurs via a ventilation system within the existing showroom.

Fig. 4: top left: Compression chiller; top right: cold water storage; bottom left: ventilation device cooling register with energy meter; bottom right: existing showroom with air ducts

Proposed system concept

The cooling demand of the two existing office areas is 50 kW and the existing show room requires 73 kW cooling capacity. Therefore, from the 150 kW cooling capacity of the electrical driven compression chiller 123 kW are needed. So there is a further cooling capacity of 27 kW available. This free cooling power should be used for conditioning the basement showroom with a cooling load of about 20 kW. The distribution ducts of the mechanical ventilation system has to be enlarged to supply the new

seminar room, the new showroom and the new show room in the ground floor with a hygienic air flow.

The additional demand on cooling load for the new showroom (15 kW, 300 m²) and the new seminar room (9 kW, 190 m²) sums up to about 24 kW. This cooling demand will be produced by a solar driven sorption chiller. With the assumption that a sorption chiller shows a thermal coefficient of performance of 0.6, a thermal generator power of 40 kW is necessary. With 400 W/m² collector power for a flat plate collector, a collector area of about 100 m² is required. This 4 m² collector area per one kW cooling capacity are according to the simulation results, which were calculated within the SC+ project. A wet cooling tower with a capacity of 65 kW is used for recooling the process. A storage volume of 50 to 75 l/m² collector surface should be installed, that will be 5 to 7 m³.

Since it is the wish of the management to have this solar cooling installation as a show case integrated in the new show room, a possible chiller for this purpose would be the adsorption chiller ACS15 because it is absolutely quiet since inside the machine no running pumps exist. In combination with high temperature chilled ceiling elements this chiller has a cooling capacity of about 23 kW. In a show room chilled ceilings have the advantage of silent cooling and in the actual case the existing ceiling anyway somehow needs to be prettified.

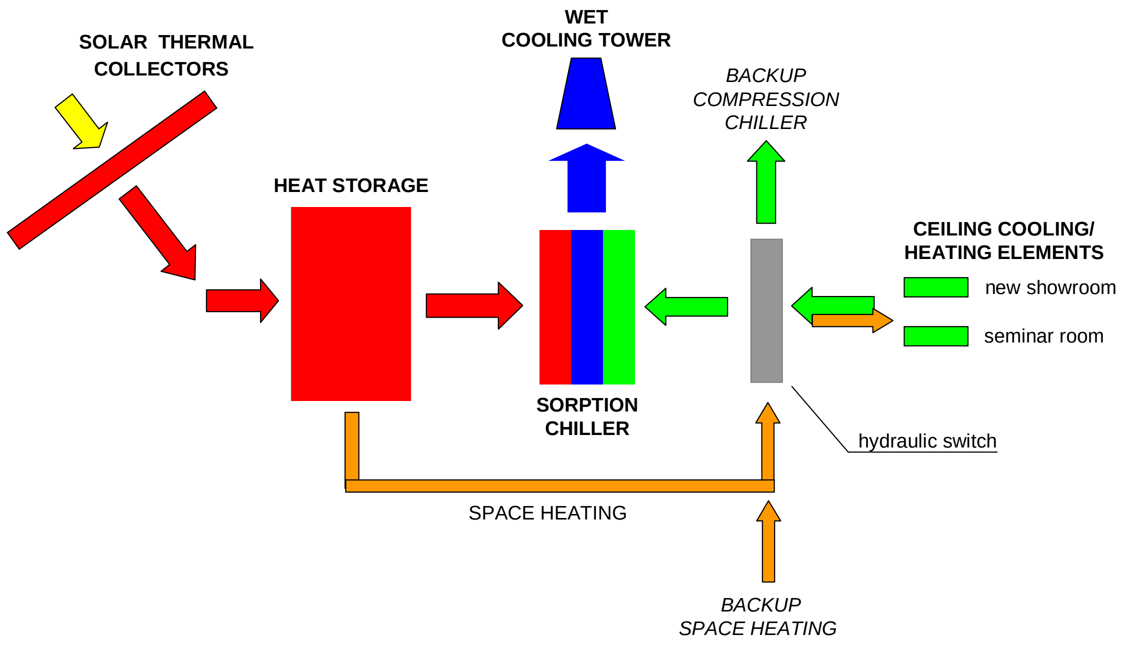

Fig. 5: Odörfer system concept

Fig. 5 shows the proposed concept of the solar thermal cooling system. The technical devices like the sorption chiller and the heat storage will be situated within the new seminar room for presentation and training activities. The flat plate collectors and a wet cooling tower will be situated at the seminar room's flat roof. The heat generated by flat plate collectors is stored in the heat storage. The sorption chiller is supplied with heat from the heat storage. The produced cold water by the sorption chiller is distributed over a hydraulic switch to two ceiling cooling cycles. One cycle is for cooling the seminar room and the other cycle is for cooling the new showroom. A hydraulic cold water cycle from the compression chiller serves as cold backup and is connected with the hydraulic switch. The cold water cycle of the sorption chiller and the cold water cycle of the compression chiller have to be designed for variable flow rates.
Within the heating period produced solar thermal energy is distributed to the hydraulic switch and further to the ceiling cooling/heating elements. Additional heat from the district heating access serves as backup. Even in this case, the backup and the heat storage cycle have to be designed for a variable flow rate.