An application on the use of a seawater sourced heat pump in the process of cooling a hotel

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Abstract

In cities where seaside tourism is active, energy is being consumed in high quantities in order to ensure comfort conditions in the hotels. Energy consumption in our country is made by using fossil fuel or direct electricity. It accordingly leads to air pollution. Especially in the hot season, it is necessary to cool the hotels in order to ensure the comfort conditions of the hotel. But even in temperate regions cooling costs have a large share in total production costs. Heat pumps can be used ın order to reduce such effects of fossil fuels and to enable cooling from seawater at high temperatures. A heat pump is a system that simply conveys heat energy from one medium to another and is fed electrically. In this study, a system is examine that is integrated with sea water heat pump system and VRF as an alternative to conventional cooling systems in hotels where energy costs are high. Seawater has less annual temperature change period than air. Therefore, such a system is a great advantage for seaside facilities (hotels, shopping malls, hospitals, etc.). The application of cooling process obtained from seawater source heat pump at Asia Beach Resort SPA in Alanya province of Antalya has been examined. A general view of the hotel used in the study is shown in Figure 1. A general flow diagram of a hotel chilling process with a seawater source heat pump system is given in Figure 2.

Fig. 1 – A view of the Asia Beach Resort SPA Hotel

As shown in Figure 2, the system consists of seawater pumps (P1, P2, P3, P4), Bernoulli filter (BF), seawater plate heat exchanger (IE), secondary pumps (P5, P6), pumps of zones (P7 and P8 for zone 1, P9 and P10 for zone 2, P11 and P12 for zone 3, P13 and P14 for zone 4, P15 and P16 for zone 5) and the heat pump (IP) of zone 4. The seawater pumps of the system are located 150 meters from the sea shore and 6 meters deep from the sea level. There are 4 pumps separately in 2 wells. Seawater is pumped from each well by seawater pumps with 1.2 bar and 26.39 kg/s flow rate to Bernoulli filter. Seawater purified from foreign materials (grass, shaft, mussel, etc.) in the filter passes through the heat exchanger (IE) with a flow rate of 105.56 kg/s. The seawater in the heat exchanger is discharged to the sea by taking the heat of the water in the secondary circuit. In the secondary circuit where the temperature decreases, the water is pumped to the

cooling zone leading to 105.56 kg/s with the secondary pumps. The circulation pumps located in the 1st, 2nd, 3rd, 4th and 5th zones respectively are 20 kg/s, 23.33 kg/s, 23.33 kg/s, 20 kg/s and 22.23 kg/s the cooled water is pumped to the VRF outer units. The cooled water from the outdoor units reduces the room temperature with the refrigerant (R410A) in the VRF system. Thus, the room is cooled in comfort conditions.

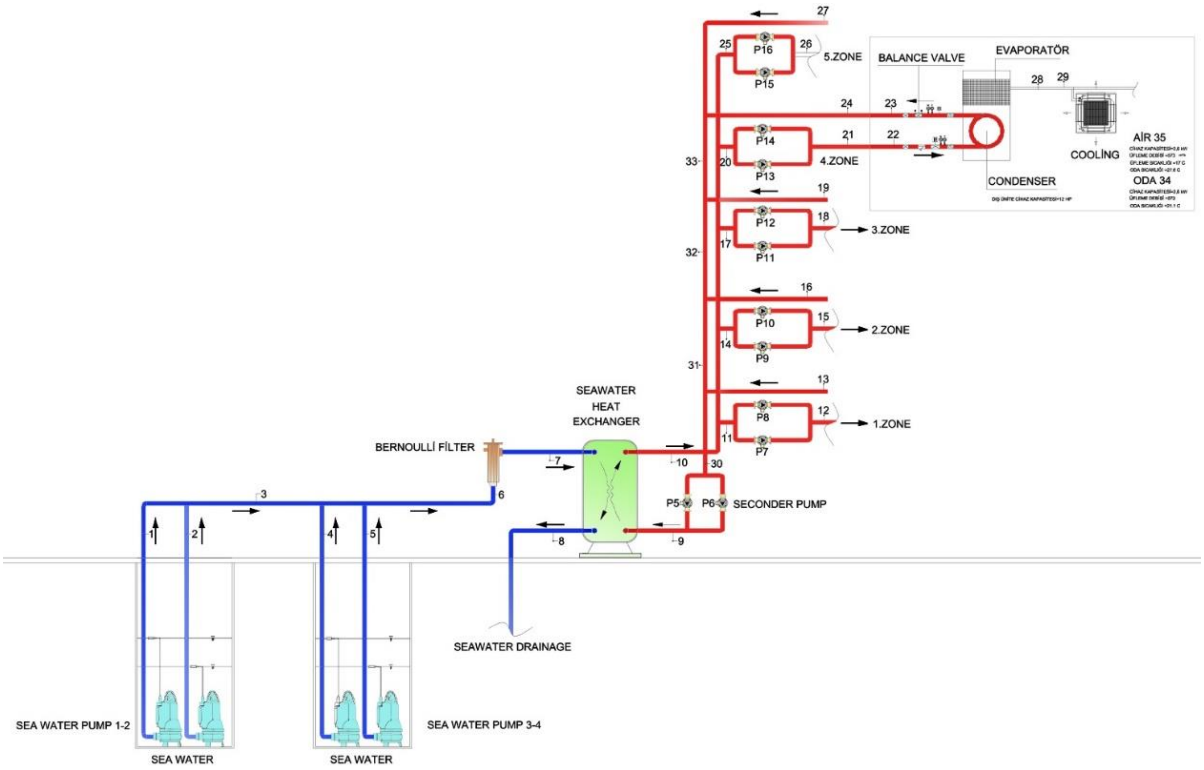

Fig. 2 – Flow chart of the system used for hotel cooling

The changes in the highest air temperature and seawater temperature values of the province of Antalya distribution by years are shown in Figure 3. As can be seen in Figure 3, the air temperature is generally between 35 °C and 40 °C. Seawater temperature generally ranges between 20 °C and 27 °C. Because the outside air temperature is higher than the seawater temperature, it will be suitable to use seawater instead of the air blown outdoors environment. In this way, the required cooling in the summer months will be done more efficiently. This will reduce the energy used in cooling the room significant.

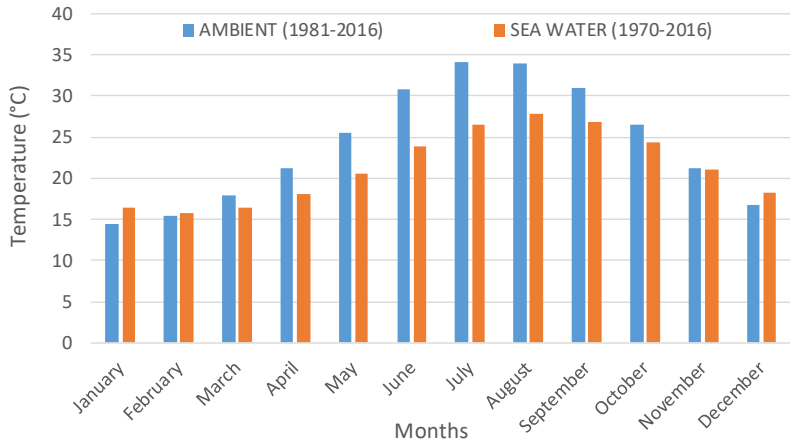

Fig. 3 – The highest average values of the ambient and the sea water temperatures for the province of Antalya