12th IEA Heat Pump Conference 2017

Industrial heat pumps for cooling and heat recovery to district heating

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Abstract

The fight against climate change and the actions to be taken to reduce greenhouse gas emissions is covered by the EU's priorities. One significant way to reduce greenhouse gases is to recover the waste heat from cooling solutions. Cooling demand is growing in residential and public buildings as well as in data centers and industrial processes.
Oilon Oy has been involved in several projects in which waste heat is transferred to the district heating network. In Finland Oilon has implemented cooling/heating cases to public buildings (hospital, fire department…) and in Sweden to electron accelerator laboratory in Lund University. Mostly in this kind of cases water is supplied to district heating network approx. at temperature of 80 °C. More these kind of projects are coming yearly and new solutions have to be designed and implemented. Oilon Oy wants to be a part of this development and would like to bring new solutions and products to the market.
Oilon Oy specializes in environmental technology with a special emphasis on product research and development work. The main focus areas of research and development are improving energy efficiency, decreasing emission levels and developing new solutions utilizing renewable energy sources. Oilon manufactures burners and combustion systems for liquid and gaseous fuels in the capacity range of 10 kW – 80 MW, industrial heat pumps, cooling plants and ground source heat pumps. Oilon is also selling solar heat collectors.

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Selection and/or peer-review under responsibility of the organizers of the 12th IEA Heat Pump Conference 2017.

Keywords: heat pump; district heating; district cooling; heat recovery; waste heat

1. Foreword

It has been estimated that the cooling capacity will increase 35 % in Finland within the next 25 years. This also increases the amount of potential waste heat. Cities, having heating energy distributed via district heating networks, have opportunity to reduce greenhouse gas emissions significantly by recovering waste heat to district heating network. In the following two case-studies industrial heat pumps are used for cooling and heat recovery to district heating.

2. MAX IV Laboratory

MAX IV laboratory is located in Lund, Sweden. The synchrotron radiation facility of the MAX IV laboratory is an international top research facility which produces the world's brightest synchrotron radiation. Construction work was started in November 2010. The first phase of the facility's cooling and heating system has already been commissioned. The second phase is ready for production at the end of 2016.

The cooling and heating system, which provides cooling for the entire facility and supplies heat to the district heating network, must be highly reliable, and it may not cause any vibration in the structures of the synchrotron radiation facility. Functional safety requirements were resolved by connecting a number of effective cooling units in series.

Oilon Oy supplied a total of 11 ChillHeat industrial heat pumps, three S-series and eight P-series pumps. Total cooling capacity of the system is 3.9 MW producing simultaneously hot water up to 80 °C with capacity of 5.6 MW. The total system consists of three heat pump unities. The first and second unities consist of four heat pumps and they are producing +7.0 ºC cold water. The third unity consists of three heat pumps and it is producing +23.5 ºC cold water. Total COP is 5.7 and it remains high also in partial loads. It is easy to increase the capacity of the system if needed because of modularity. Other benefits are very wide capacity control range (3 - 100%), precise temperature control and that both the cooling and the heating energy output can be utilized 100%.

The energy solution is unique for this type of large-scale research facility, and will help laboratory to meet its goal of becoming a climate neutral facility and MAX IV to deliver more environmentally friendly heating energy.



Fig. 1. Picture of MAX IV laboratory [1]

3. HUS Jorvi hospital

HUS Jorvi hospital is located in Espoo, Finland. It's a part of Helsinki University Hospital, and provides several specialist outpatient clinics and service functions that support examinations and care. The hospital was started to build in 1972 and it has undergone several extensions and renovations, latest extension being ready in 2016.

During the latest extension two pcs. Oilon industrial heat pumps were installed to produce cooling and heating for the hospital buildings. Cooling capacity is 900 kW and cooling water temperature is 10 ºC. Heat is transferred to district heating network at temperature of 70 ºC with capacity of 1380 kW. Total COP is 4.60. Heat pumps are equipped with variable frequency drives which provide good partial load possibility for the system.

This is an open energy network solution. Hospital can utilize its own production and energy purchased from the market in an optimal way. Solution also reduces environmental emissions of district heating in the region. [3]



Fig. 2. Picture of HUS Jorvi Hospital [2]

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