

HEAT PUMPS IN COMBINATION WITH DISTRICT HEATING INCREASES ENERGY EFFICIENCY AT HAMMARBYVERKET



Summary of the project

Hammarbyverket is an important part of Stockholm's district heating network. Located in the southern part of Stockholm the district heating plant has been providing households with heat since 1986. Hammarbyverket consists of seven heat pumps (225 MW), a district cooling system (23 MW), two electric boilers (80 MW) and two biooil-fired boilers (200 MW). The heat pumps are used as base production of heat to the district heating network. The other units are used when the heat demand is high, for example when it's cold outside.

The installed heat pumps are producing around 1.235 GWh which is enough to supply 95 000 two-bedroom apartments with heat. Four of the heat pumps was installed 1986, a fifth 1991 and two more 1997. During 1998 it was decided to install a district cooling system. Today are two of the heat pumps rebuilt to be able to operate in cooling mode during summer.

The heat source to the heat pumps are wastewater from Henriksdals water treatment plant. Clean was-

**”HAMMARBYVERKET, WORLD'S
LARGEST HEAT PUMP SYSTEM
REGENERATING LOW TEMPERA-
TURE HEAT FROM WASTEWATER”**

tewater is led through tunnels to a reservoir placed under the heat pump station. The wastewater is pumped to the evaporators of the heat pumps, at this stage the water temperature is between 7-22°C depending on season. In the evaporators, the wastewater is cooled while heat is being released to the refrigerant and evaporates. The pressure and temperature of the refrigerant then increases in an electric driven compressor. The refrigerant vapor is cooled down by district heating water and condensed in a condenser. The temperature of the district heating water is about 70-80°C. District heating water is then being adjusted to the right temperature before its distributed to customers.



If the heat capacity of the heat pumps is insufficient then electric boilers or biooil-fired boilers are used as complement to increase the temperature of the district heating water. Wastewater which has been cooled of is led to the district cooling system and by pressure exchanger provides cooling to customers on the network. The wastewater is led back to the treatment plant after passing through the district cooling system.

All seven heat pumps are filled with approximately 23 ton each of the refrigerant R134a.

To smooth out the daily variations and thus provide a more even operation of the system there are two hot water accumulators connected to Hammarbyverket's district heating network. The accumulators each holds 2 400 m3 water.

A flue-gas return system was installed to ensure that the air released from Hammarbyverket is reduced from as much NOx as possible. This system returns flue-gas to a secondary air system where the emissions of NOx can decrease with 20-30% compared to use of cold combustion air. Electric filters have also been installed for dust reduction.

To ensure and promote continued production of district heating in Hammarbyverket based on biofuel and heat pumps, Stockholm Exergi who owns the district heating plant is planning on building two new boilers (180 MW). These will be running on biofuel instead of today's biooil. Existing boilers are supposed to work as complement when the heat demand is high.



Results

- Radically reduced emissions in Stockholm.
- 60% reduced CO₂, 95% SO_x and 80% NO_x in Stockholm since 1980.
- Reduced emissions of SO_x and dust in the Swedish district Södermalm by two-thirds since the start of Hammarbyverket in 1986.
- High energy efficiency using energy in wastewater and through heat pumps producing low temperature heat to the district heating plant.
- High energy efficiency using cooled of water from the evaporator production district cooling.

FACTS ABOUT THIS PROJECT

Building type: Residential and commercial buildings

Heated floor area [m²]: Up to 95 000 apartments

Installed heat capacity [kW]: Heat Pumps: 225 MW, Total: 505 MW

Heat source: wastewater, heat pumps, district heating, electric boilers, biooil-fired boilers

Location: Stockholm, Sweden

Company: Stockholm Exergi

Link to web page or report:

https://www.stockholmexergi.se/content/uploads/2018/05/Milj%C3%B6rapport_Hammarbyverket_2017.pdf

(in Swedish)

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IEA Technology Collaboration Programme on Heat Pumping Technologies (HPT TCP)