High Temperature Heat Pump for Steam Production at AstraZeneca

Figure 1: Two of the three heat pumps currently installed at AstraZeneca's R&D facility in Gothenburg, Sweden. Heat is transferred to the heat pump from the heat recovery circuit and steam is delivered from the heat pumps' steam generators to the steam distribution system. The third heat pump is installed on the opposite side of the room.

Summary of demonstration case

AstraZeneca (Gothenburg, Sweden) has historically used fossil fuel for steam production. An upgrade from oil to natural gas was made in 1997, and another upgrade was made to biogas in 2018, which have resulted in reduced CO_2 emissions over the years.

A technical part of the upgrade was to pursue steam production using high temperature heat pumps - a more efficient, more robust, less expensive and if possible (depends on source of electricity), even more sustainable solution.

To do this, the site has installed 3 HighLift heat pumps from Olvondo Technology. Each with a capacity of 500 kW heat at 10 bar steam system pressure, and with rejected heat from the chillers for the air condition as a heat source. A fourth heat pump which is an upgraded version with a capacity of 750 kW heat, is scheduled for installation in Q2 2021.

Main components of the installations in addition to the heat pumps are the cold circuits, the hot circuits and the steam generators.

The cold heat source is a heat recovery circuit that is transferred indirectly to the heat pumps. The heat pumps use this heat to heat a hot circuit that circulates over a steam generator. The steam generator uses this heat to generate steam that is fed to the steam distribution circuit of the plant.

The cold circuits are closed water circuits that transfer heat from the heat recovery system at the site to the heat pumps. The hot circuits are closed, pressurized water circuits that transfer heat from the heat pump to the steam generators. The steam generators are shell and plate heat exchangers that gets feed water from the site's feed water tanks and generate steam by cooling the hot circuit from the heat pump. The generated steam is thus supplied directly to the steam distribution system at the site.

Operating experiences

The heat pumps have been running between 5000 hours and 6800 hours. The running time for each pump has been:

- Heat pump #1: 6800 hours
- Heat pump #2: 5000 hours
- Heat pump #3: 6500 hours

The load has been varying, but the temperatures have remained quite constant during operation.

Special learnings

A proven concept for a Stirling engine operated as an industrial-scale heat pump is made in this demonstration case, where steam is delivered at 180 °C.

A brief assessment of losses and benefits is given, followed by technical performance data on the current installation at AstraZeneca's R&D center in Sweden.

Current activities involve improving system efficiency and reliability while increasing the heat output from 500 to 750 kW, and at the same time raising the TRL of the heat pump from level 7 to level 9.

Contact information

Olvondo Technology AS
info@olvondotech.no
+47 4650 8888

All information were provided by the supplier without third-party validation. The infomation was provided as an indicative basis and may be different in final installations depending on application specific parameters.

FACTS ABOUT THE CASE

Intallation year: 2017

Operating hours: 6100 hours acummulated on average for the three heat pumps since installation.

Working fluid used: R-704 (Helium)

Compressor technology: Piston

System manufacturer: Olvondo Technology AS

Performance in design point:

- Heat source: 36 °C → 34 °C (water)
- Heat sink: 178 °C → 183 °C (steam)
- Heat supply capacity: 1.5 MW
- $COP_{Heating}$: 1.7

Investment cost: 3xHighLift heat pumps approximately 1,800,000 € (excluding internal integration, but including monitering & control system and Helium solution.

Savings: Energy savings 9.4 GWh yearly

Estimated annual CO_2 savings: 600 t/a

Link to webpages;
highlift.olvondotech.no

https://klimat2030.se/astrazeneca-i-goteborg-leder-fossilfri-utveckling/