FLUE GAS CONDENSATION AT THE BIOMASS COGENERATION PLANT KLAGENFURT-EAST

Fig. 1: New biomass cogeneration plant in Klagenfurt-East (www.bioenergie-kaernten.at, 12.01.2018)

Summary of the project

The district heating network of Klagenfurt with a pipe length of about 165 km is operated by the Energie Klagenfurt GmbH and supplies about 27 000 connected customers. The flow temperature depends on the ambient temperature and varies between 85 °C and 120 °C. The volume flow rate of the district heating network is varied between 800 m3/h and 1 600 m³/h to hold the return temperature at about 60 °C. However, at low heating demand the return temperature may increase up to 80 °C.

90 % of the district heating network's heating demand is supplied by 3 biomass cogeneration plants which are operated by the Bio-Energie Kärnten (Bioenergiezentrum GmbH). These are the biomass cogeneration plant Klagenfurt-East (50 MWth and 10 MWel), Klagenfurt-South (16 MWth and 5 MWel) and Klagenfurt-North (20 MWth and 5 MWel). Since the biomass cogeneration plant Klagenfurt-East is in operation the existing natural gas cogeneration plant in the city center (34 MWel and 120 MWth) is only required to cover the peak load.

The absorption heat pump was manufactured by the company EBARA (China) and was delivered in 2 parts with 70 tons each. The absorption heat pump uses H2O/LiBr as working pair and reaches a heating capacity of about 20 MW and an efficiency of about COPH=1.77 at heat source temperatures of about 45/35 °C (inlet/outlet of the evaporator), heat sink temperatures of about 60/70 °C (inlet of the absorber/outlet of the condenser) and driving temperatures of about 130/120 °C (inlet/outlet of the generator

"THE INTEGRATION OF AN ABSORPTION HEAT PUMP IN A BIOMASS COGENERATION PLANT INCREASES THE EFFICIENCY AND THUS THE AMOUNT OF HEAT PRODUCED FROM BIOMASS"

After the parallel heating of the return flow by the heat exchanger for direct flue gas condensation and by the absorber and condenser of the heat pump the return flow is further heated by the condenser of the steam cycle to reach the desired flow temperature of the district heating network (see fig. 2).

The optimum driving temperature for the absorption heat pump is about 130 °C at the inlet of the generator and the minimum possible driving temperature of the absorption heat pump is about 110 °C. The volume flow rate of the driving circuit is adjusted to reach a temperature difference

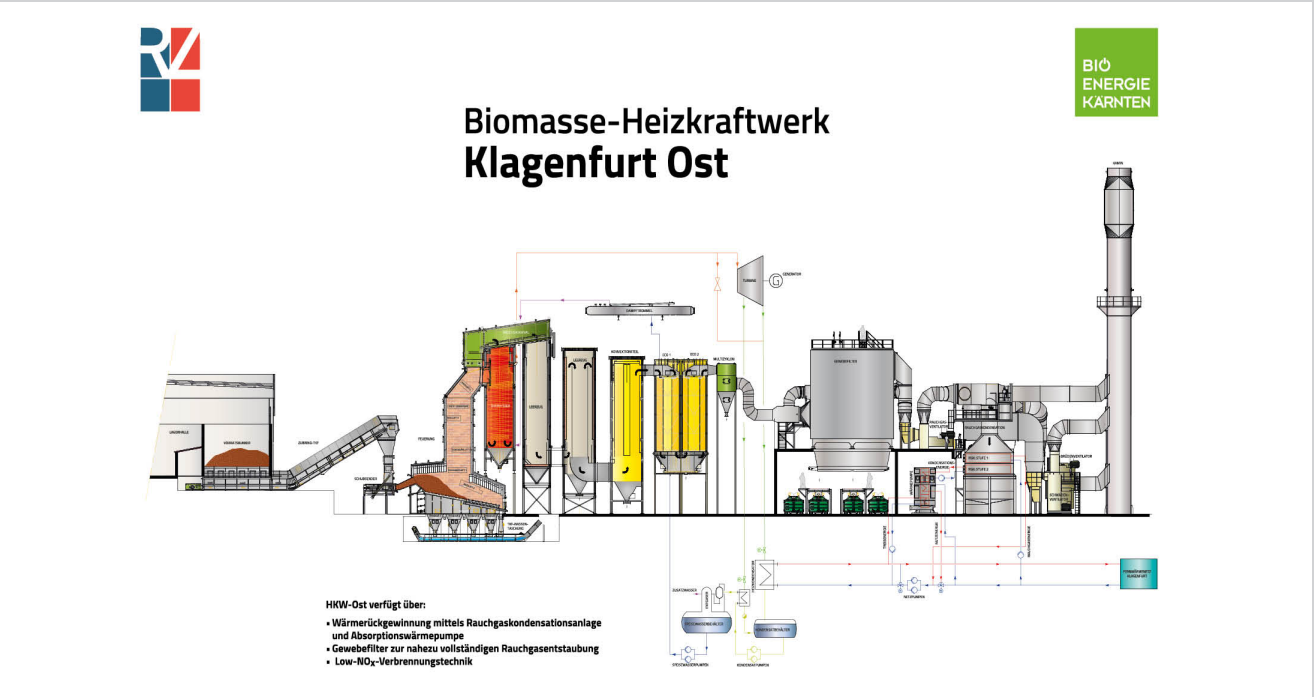

Fig. 2: Hydraulic scheme of the biomass power plant including a part of the steam cycle and the connection to the district heating network (www.bioenergie-kaernten.at, 12.01.2018)

at the generator of about 10 K. With the supply water of the district heating network as driving source and the minimum possible driving temperature an operation of the absorption heat pump is only possible if the flow temperature of the district heating network is higher or equal than 110 °C. This is in the winter months and in the transition periods.

Expected results

- Due to legal requirements related to the vapor clouds at the chimney of the biomass cogeneration plant an absorption heat pump was installed to increase the amount of flue gas condensation und thus to decrease the effort for devaporization.
- The integration of an absorption heat pump in a biomass cogeneration plant increases the efficiency and thus the utilization of biomass fuel.
- After the first two months the operation of the system is reliable and better than expected. Small changes as an adaption of the charge (H2O/LiBr) and a thermal insulation of the absorption heat pump will improve the efficiency.
- A challenge is the fast capacity adjustment to cover the peak load in the morning and in the evening due to the systems inertia (biomass cogeneration plant and absorption heat pump). For example the peak load in the morning increases the heating demand from 15 MWth to 54 MWth within a half hour.

File compiled by Arnitz, A., Rieberer, R., Institute of Thermal Engineering, Graz University of Technology, www.tugraz.at, 18.01.2018

FACTS ABOUT THIS PROJECT

Building type: Residential buildings and commercial buildings

Heated floor area: 27 000 connected customers

Installed heat capacity [kW]: 50 000 (includes 20 000 of the absorption heat pump) in Klagenfurt-East

Heat source: Flue gas condensation

Time frame: In operation since 2017

Project organisation: Energie Klagenfurt GmbH (operator of the district heating network), Bioenergie Kärnten (Bioenergiezentrum GmbH) (operator of the biomass cogeneration plant Klagenfurt-East), Riegler & Zechmeister GmbH (engineering of the biomass cogeneration plant), S.O.L.I.D. Gesellschaft für Solarinstallation und Design mbH (supplier of the absorption heat pump)

Link to web page or report: www.bioenergie-kaernten.at

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