

FLUE GAS CONDENSATION WITH ELECTRICALLY-POWERED HEAT PUMPS IN BJERRINGBRO - DENMARK

Røggaskondensering med eldrevne varmepumper i Bjerringbro

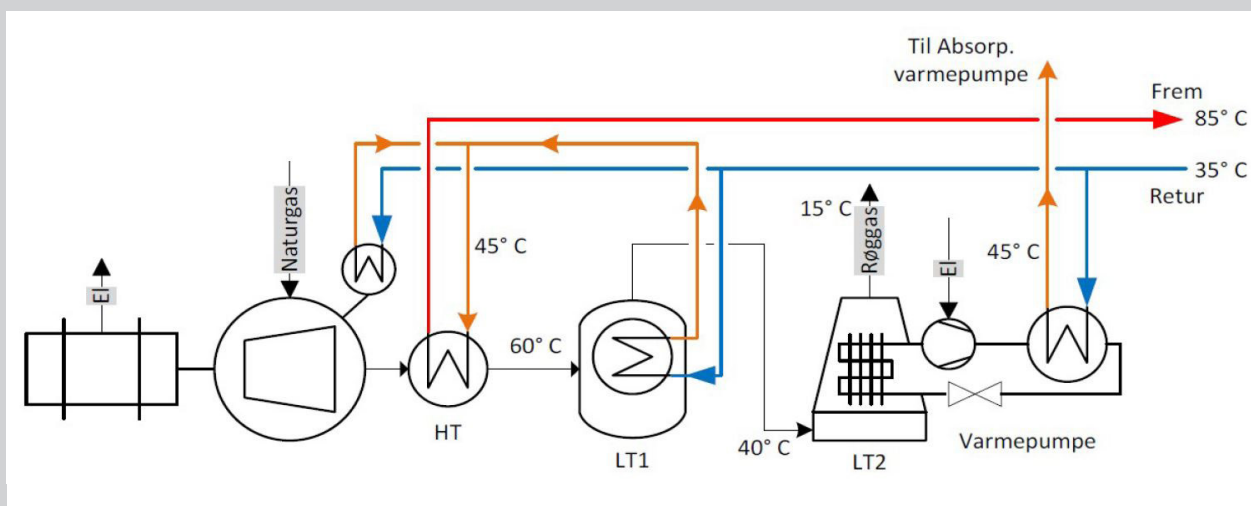


Fig 1: Principle sketch of flue gas condensation with electrically-powered heat pumps in Bjerringbro [Teknologisk Institut].

Summary of the project

In 2010 and 2011 Bjerringbro Varmeværk, a decentral natural gas-powered cogeneration plant located in central Jutland, installed two electrically-powered heat pumps that utilize heat from flue gas. The heat pumps increase the overall efficiency of the natural gas-powered units. As a result, less fuel can be used to produce the same amount of heat. This lowers the overall operation costs of Bjerringbro Varmeværk, which eventually benefits the consumers who experience lowered heat prices.

Flue gas condensation with electrically-powered heat pumps are an attractive and cost-effective method for energy recovery. The electrical heat pumps are utilized to condensate flue gas and pre-heat the returning district heating water, which is used in an absorption heat pump to further heat the water. Hereby, the extra energy content in the flue gas is utilized in the district heating network.

As stand-alone units, the heat pumps can produce low-priced and competitive heat. However, as the heat pumps contribute marginally to the overall heat capacity and as they are used in combination with the expensive

” FLUE GAS CONDENSATION WITH ELECTRICALLY-POWERED HEAT PUMPS ARE AN ATTRACTIVE AND COST-EFFECTIVE METHOD FOR ENERGY RECOVERY ”

natural gas units, the economic benefit is moderate. Nonetheless, flue gas proves to be a solid heat source for the electrically-powered heat pumps at cogeneration plants with a high number of operating hours. A high COP is obtained and the investment cost is relatively low, compared to stand-alone heat pump solutions.

With expectations of rising prices on natural gas and currently low electricity prices, flue gas condensation through electrically-powered heat pumps are an advantage for the district heating company. The heat pumps are accordingly an important part of the future district heating system in Bjerringbro.



Results

- The electrically-powered heat pumps lower the flue gas temperature from 40 °C to 15 °C.
- Total efficiency of the engine is increased from 95 % to 104 % and the efficiency of the boiler is increased from 103 % to 108 %.
- For both heat pumps, the COP is approximately 5.2.
- Total costs of the heat pumps are 2.0 million DKK and 3.0 million DKK.
- The overall heat cost is reduced moderately.
- Both heat pumps have functioned impeccably since their installment in 2010 and 2011.

FACTS ABOUT THIS PROJECT

Building type: -

Heated floor area [m²]: -

Installed heat capacity [kW]: 800 and 500 kW

District heating network: 2 271 consumers

Heat source: Flue gas from a gas engine and gas boiler

Investment cost: 2.0 and 3.0 million DKK

Participating countries: Denmark

Time frame: Finished in 2010 and 2011

Link to web page or report:

<http://www.danskfjernvarme.dk/groen-energi/projekter/drejebog-om-store-varmepumper> and <http://www.bjerringbro-varme.dk/> (in Danish)

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**IEA Technology Collaboration Programme on
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