STEPSAHEAD

OPTIMIZED INDUSTRIAL ENERGY SYSTEMS

ABSORPTION HEAT PUMPS for BIOMASS BOILERS

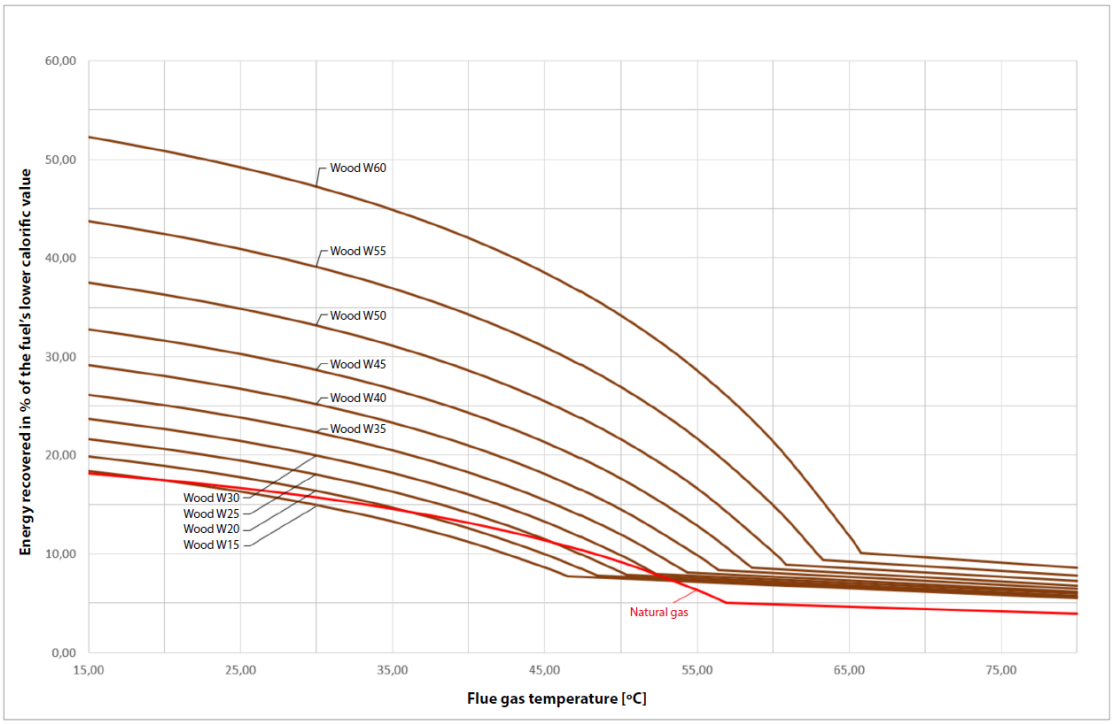
Absorption Heat Pump, © StepsAhead

Initial situation:

High return temperatures usually prevent the operation of a flue gas condensation plant in biomass furnaces. By using a heat pump, the flue gas can be reliably cooled to a temperature below 30°C.

In contrast to electric heat pumps, absorption heat pumps are driven by heat and can therefore significantly improve the fuel efficiency of a heating plant or cogeneration plant without additional electricity consumption. The electricity consumption required for circulation pumps is usually less than 1% of the energy supplied.

Depending on the water content of the fuel used, the output of the heating plant can be significantly increased or the necessary fuel input reduced. The fuel efficiency is typically increased by 20% to 30%, as shown in the graph below.



Values calculated at: Flue gas temp. 160°C / Lambda 1,5 (= flue gas O_2 content $_{(wet)}$ = 5,99% for W45) / calorific value dry wood = 18,78 MJ/kg / T_{amb} = 10°C / 13 % rel. humidity / 1000 mbar

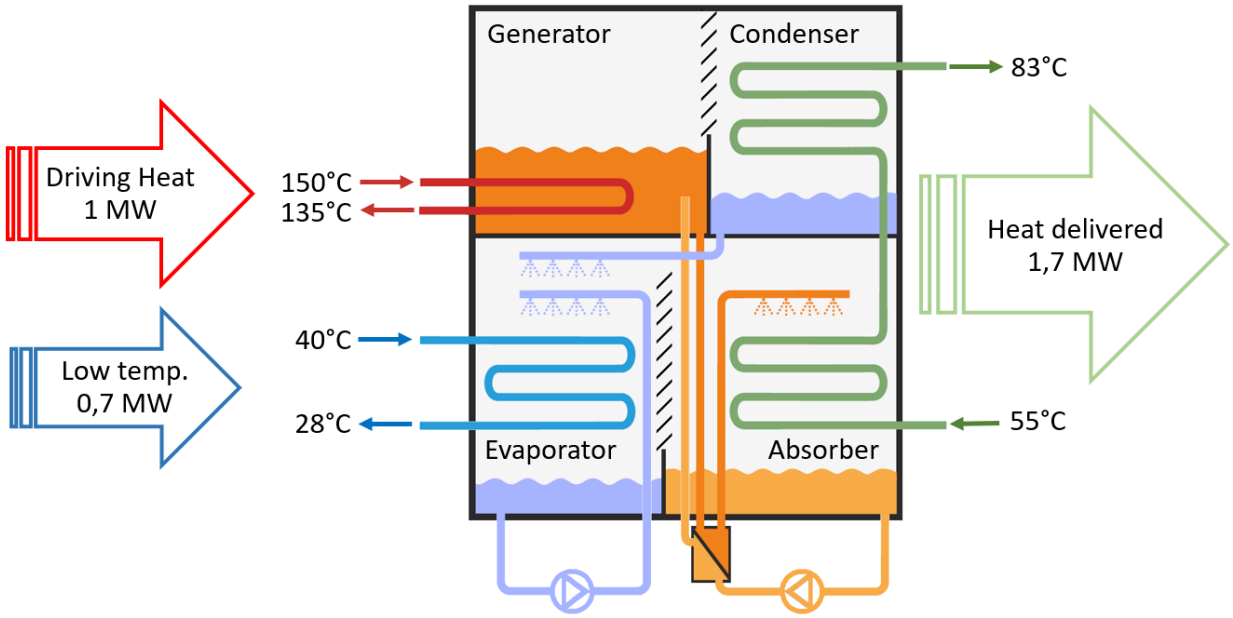
https://stepsahead.at/en/download/

The heat required to drive the machine is usually between 120°C - 170°C.
The low temperature source (flue gas condensation) is usually between 20°C - 40°C
The heat supply is usually between 60°C - 90°C.

The coefficient of performance (COP) of a LiBr absorption heat pump is approx. 170%.

1	MW	High temp. driving heat
+ 0,7	MW	Low temp. waste heat
1,7	MW	Heat delivered to consumer

Working principle of a Lithium Bromide absorption heat pump:



- Step 1, Evaporator & Absorber:
  - To be able to absorb heat at a low temperature level, water is evaporated at low pressure in the Evaporator.
  - The resulting water vapour is absorbed by a concentrated LiBr salt solution in the Absorber. In this process, the previously absorbed heat is released again at a higher temperature.
  - A pump brings the now diluted salt solution to the Generator.

- Step 2, Generator & Condenser:
  - In the Generator, water from the diluted salt solution is evaporated at higher pressure (below 1 bar absolute) by the driving heat. The salt solution therefore becomes more concentrated and can be reused in the Absorber.
  - In the Condenser, the generated steam is condensed on a heat exchanger, making it available again as water for the Evaporator.

The heat released in the Absorber and Condenser is transferred to the district heating system by heat exchangers.

Environmental assessment and substances used:

The operating materials used are water and lithium bromide salt. The absorption heat pump therefore uses neither ozone-depleting substances nor greenhouse gases.

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