

## WKK op biogas

Apeldoorn, 31 januari 2012

14:00 - 14:30

Fluegas condensation with absorption heat pump  
Combined Heat and Power plant Bjerringbro, DK.

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## Fluegas condensation with absorption heat pump Combined Heat and Power plant Bjerringbro



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## Fluegas condensation for optimizing:

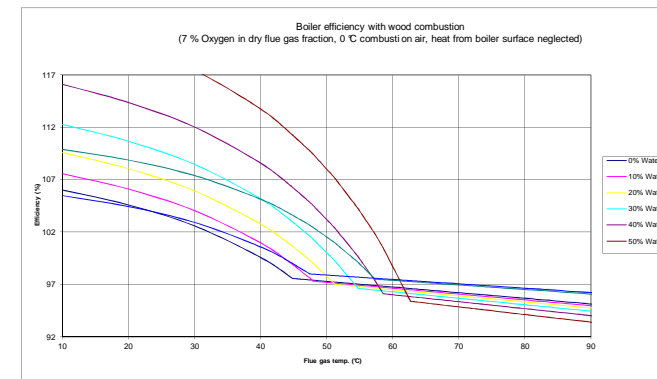
- Always check whether it is feasible and economical to achieve high efficiency with condensation, examples:
  - Wood chip fired boilers typically +10 - 12% by direct heat condensation (lower heat value)
    - and additional +10% with absorption heat pump
  - **Gas engine heat output further +24% by condensation with absorption heat pump**
  - Waste incineration (CHP) thermal load additional +20 - 25% direct heat condensation
    - and additional +> 10% with heat pump.

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## Flue gas cooling by wood, oil and gas firing

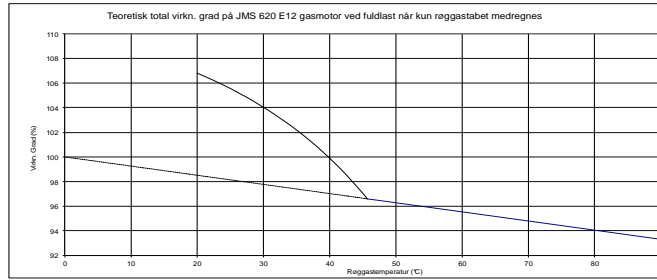


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Flue gas cooling on the gas engine, theoretical efficiency



Bjerringbro CHP plant:  
4 Ulstein Bergen (RR),  
output 16,5 MWt and 13,4 MWe



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One engine equipped with fluegas condenser for direct heat exchange



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One engine equipped with fluegas condenser with absorption heat pump

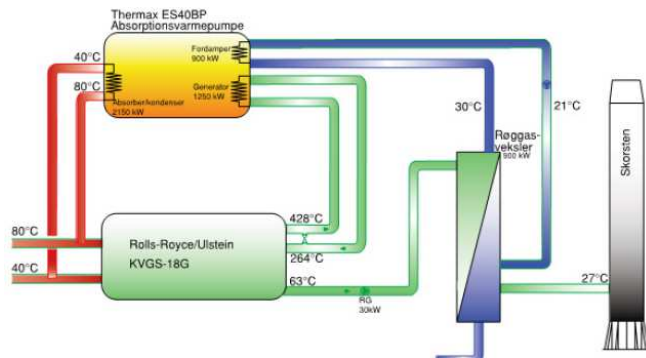


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Principle diagram of engine / heatexchangers / absorption heat pump

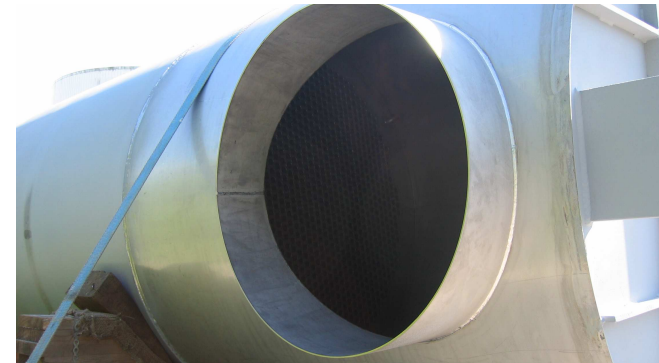


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Tube / shell type condenser

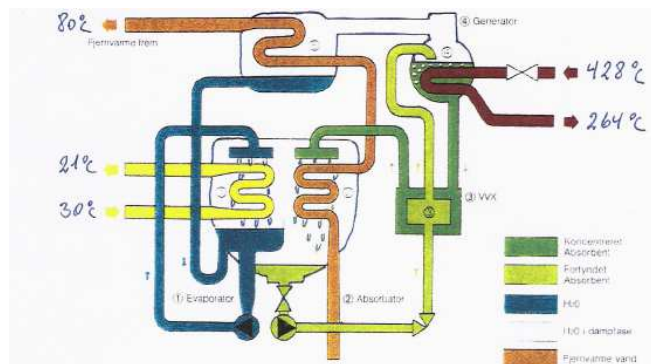


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Exhaustgas fired absorption heat pump



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Bjerringbro operating data on gas engine

Before absorption heat pump

- Flue gas temp. = 63 dgr. Celsius
- Electrical efficiency = 42.1%
- Thermal efficiency = 48.4%
- Heat Capacity = 3.7 MW

After installation of absorption heat pump

- Flue gas temp. = 27 dgr. Celsius
- Electrical efficiency = 42.1%
- Thermal efficiency = 60.1%
- Heat Capacity = 4.6 MW



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### Bjerringbro advantages I:

- Optimum utilization of natural gas (expensive in DK)
- Not taxed propellant, as for Electric driven heat pumps
- Reduction of CO2 emissions
- Reduction of NOx emissions
- Lower marginal price for the spot market
- Many hours of operation
- Easy operation and maintenance
- Can be combined with production of district cooling (in summer)

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### Bjerringbro advantages II:

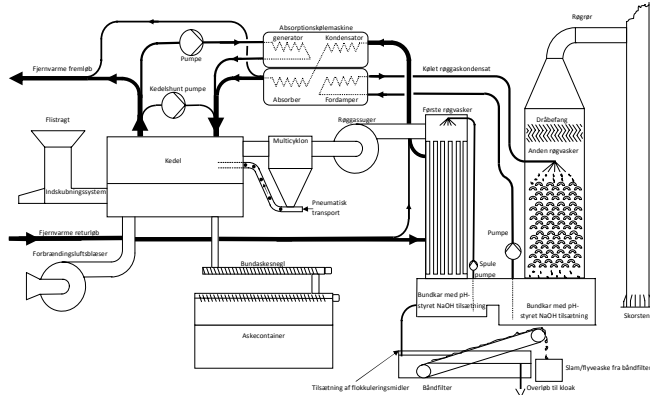
- Good investment, which will reduce the consumer price with 3%, when 25% of DH production is supplied from the engine with absorption heat pump
- Reduce the need of CO2 quotas with 18% in relation to the same amount of heat produced on a gas-motor without an absorption heat pump
- The marginal price is reduced with 13 EUR pr. MWh
- Make cogeneration of electricity and heat at lower market prices for electricity, and thus produce more environmentally friendly heat

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Procesdiagram for flisfyrringsanlæg til Hillerød fjernvarme (rev. 14. oktober 2010)



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### Questions?



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Thank you for your attention

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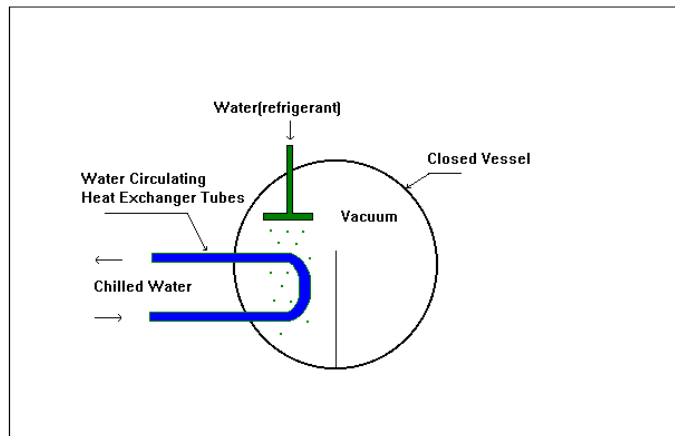
## Appendix

- But how does a LithiumBromide Water heat pump work?
- Please see following slides...

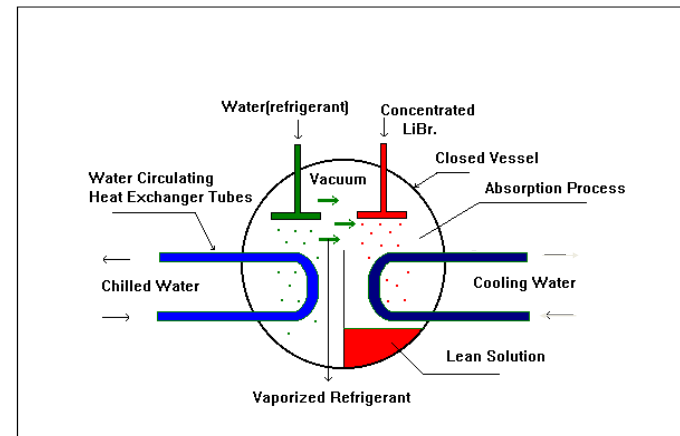
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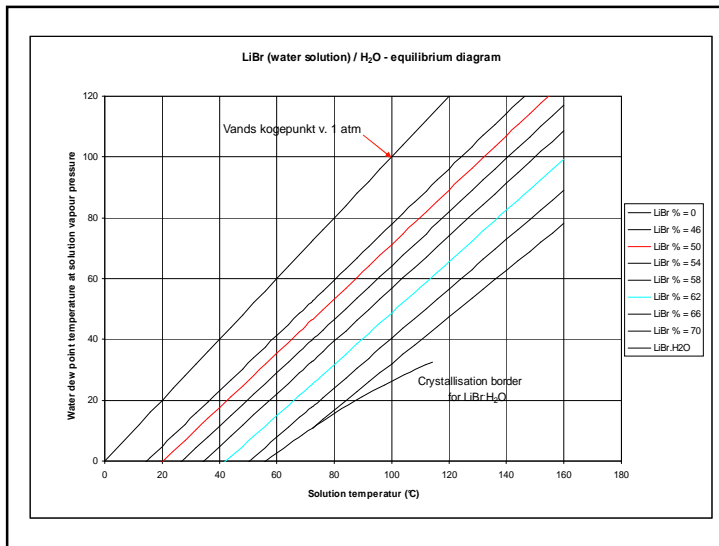
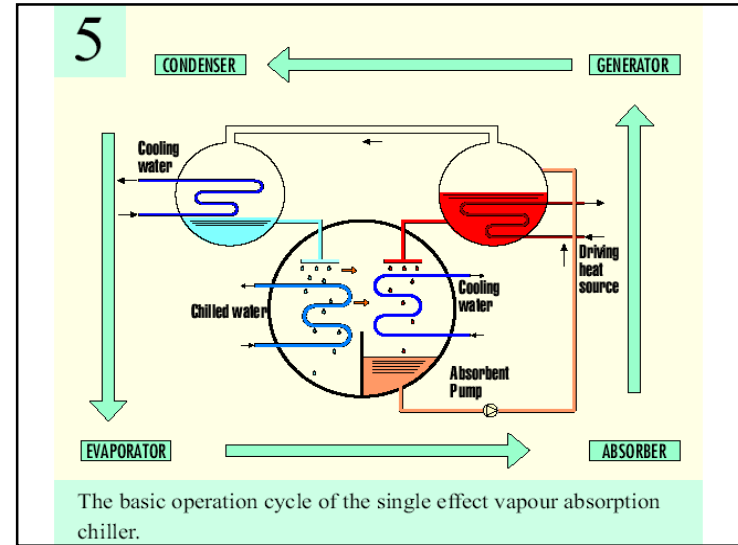
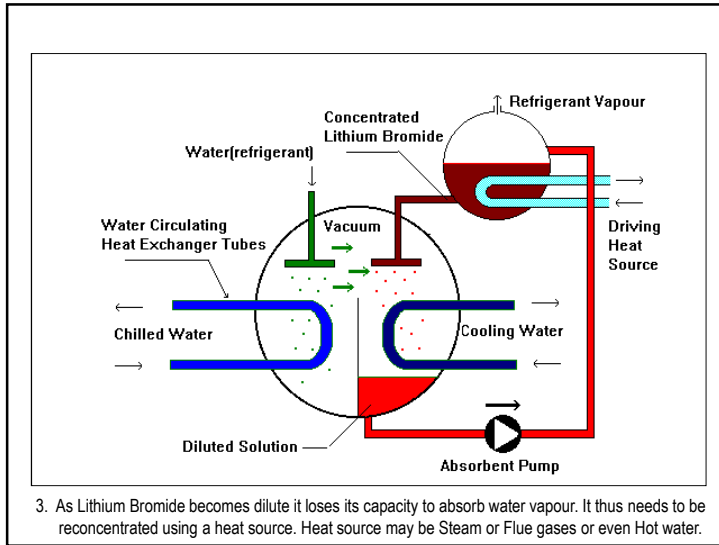
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1. Boiling point of the water is a function of pressure. At atmospheric pressure water boils at 100 deg. C. When maintained at high vacuum, water will boil and subcool itself. The boiling point of the water at 6 mmHg (abs) is 3.7 deg. C.



2. Lithium Bromide (LiBr) has the property to absorb water due to its chemical affinity. At higher concentration and lower temperature LiBr absorbs water vapour (refrigerant vapour) very effectively.



### Exhaust Gas Fired Absorption Chiller & Absorption Heat Pump

The absorption units are available from 100 kW to 12 MW cooling capacity. The Direct Exhaust Fired units offer

- COP of 1.4 (double stage)
- Superior part load performance. 10 – 100% stepless modulation.
- The units are provided with a PLC based control panel, with display, user friendly interface and data-logging.
- Auto De-crystallization. The chillers are installed with a unique auto de-crystallization circuit to eliminate any chances of crystallization.
- The exhaust driven absorption heat pumps are customer designed to be optimized at the specific purpose.

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