

# Compressie-resorptie warmtepompen

Carlos Infante Ferreira

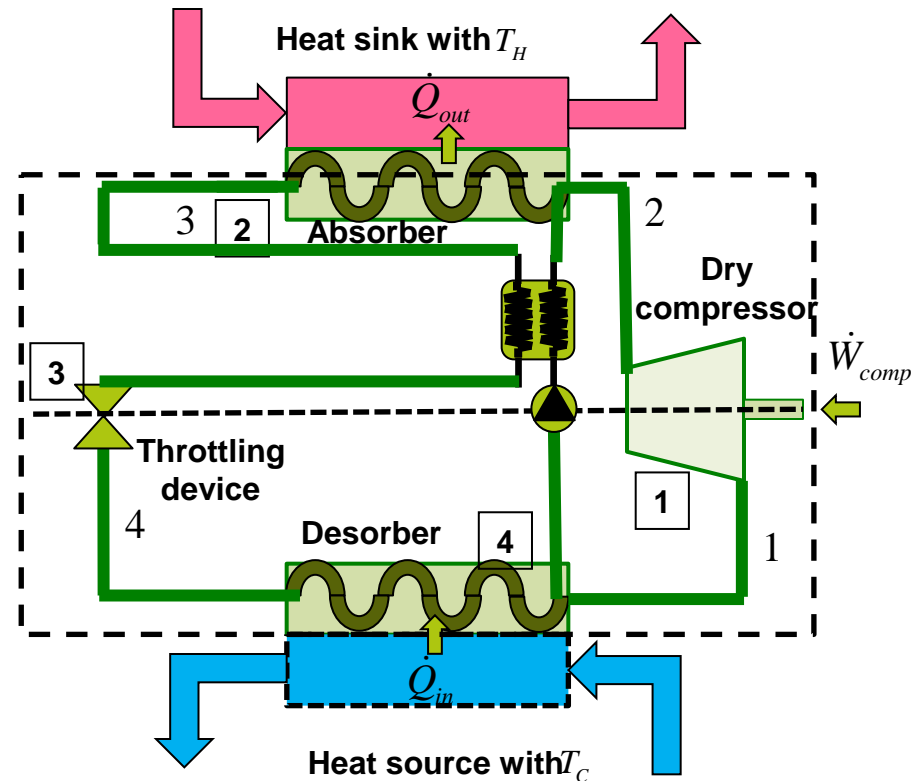
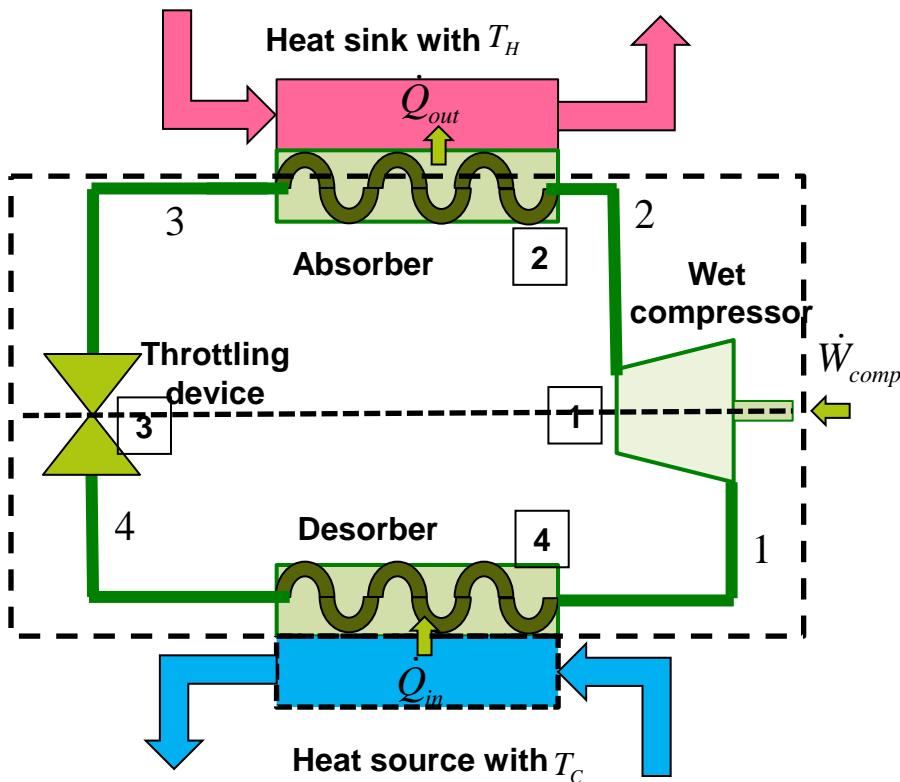
# Inhoud

- Compressie-resorptie warmtepompen
- Werkmedium en temperatuur glide
- Inzet voor warmteterugwinning
- Prestaties van warmtepomp
- Vergelijking met dampcompressie warmtepomp

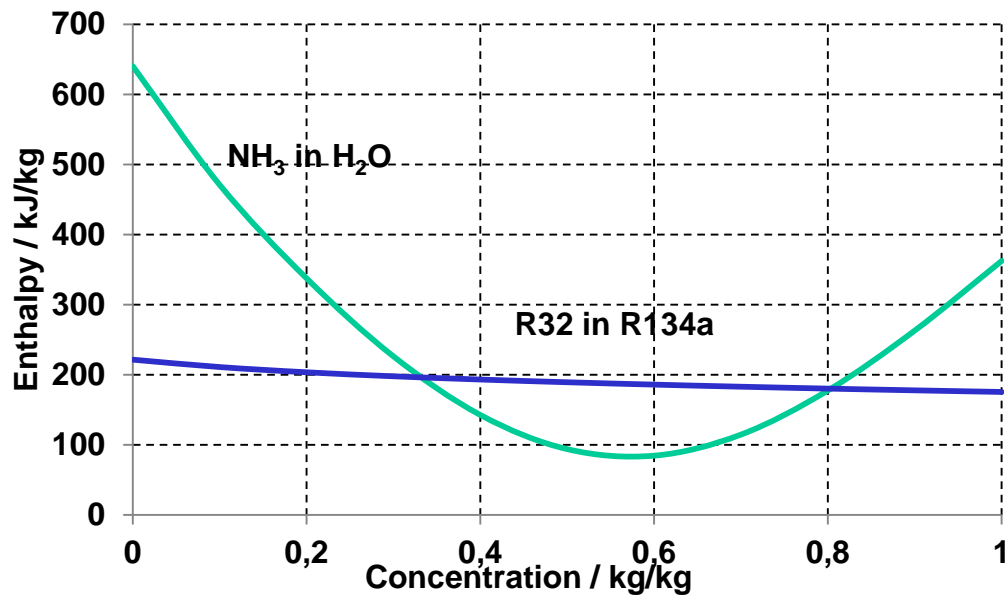
# Compressie-resorptie warmtepompen

Natte compressie

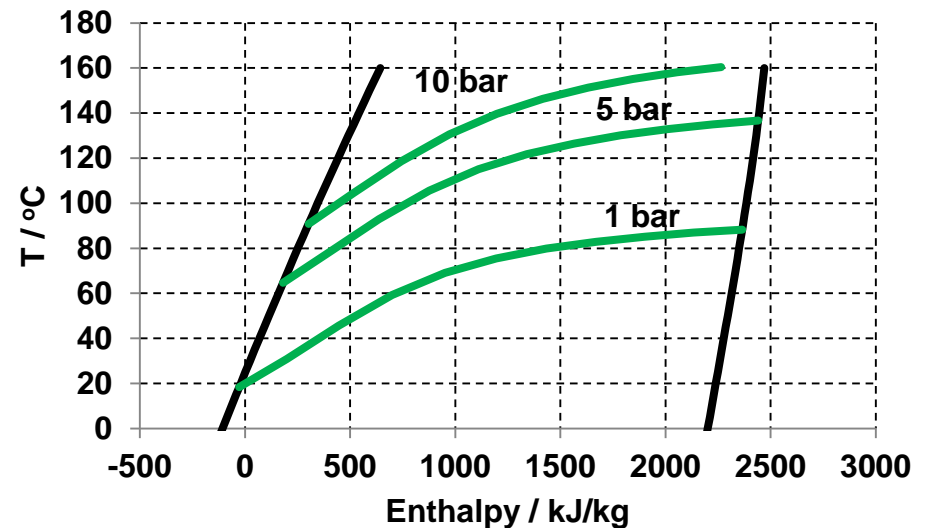
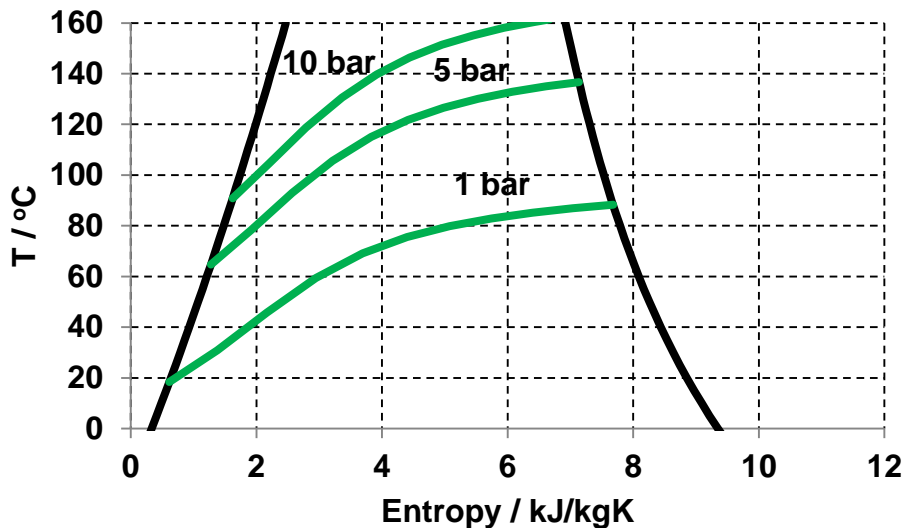
Osenbrück (recirculatie van oplossing)



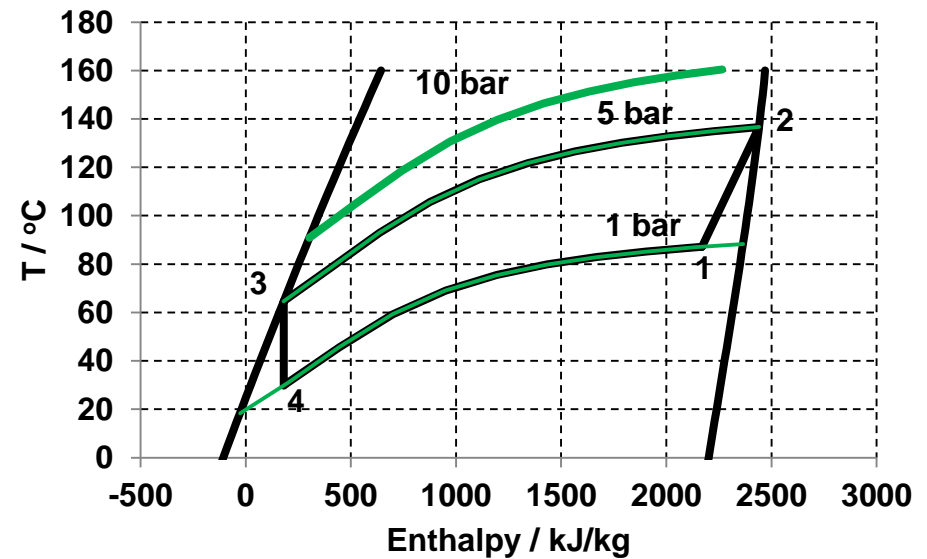
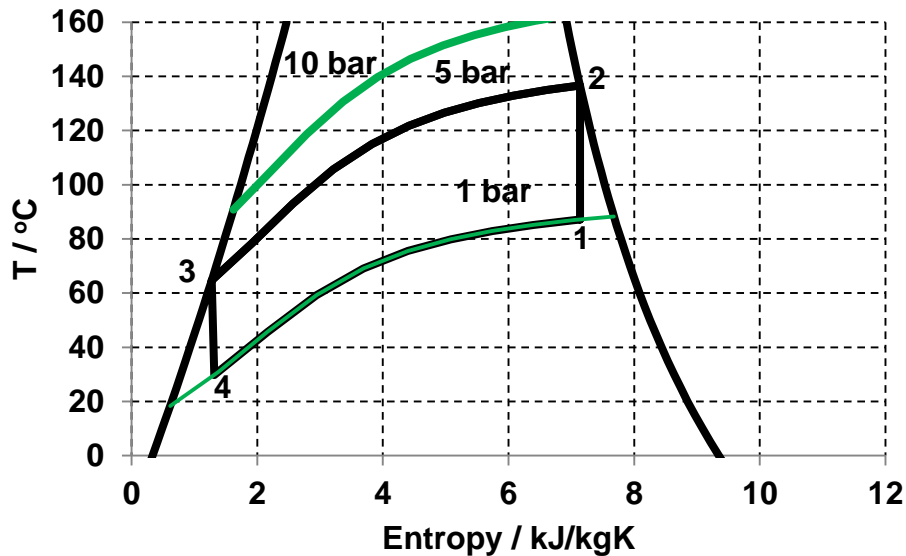
# Werkmedium: ammoniak-water mengsel



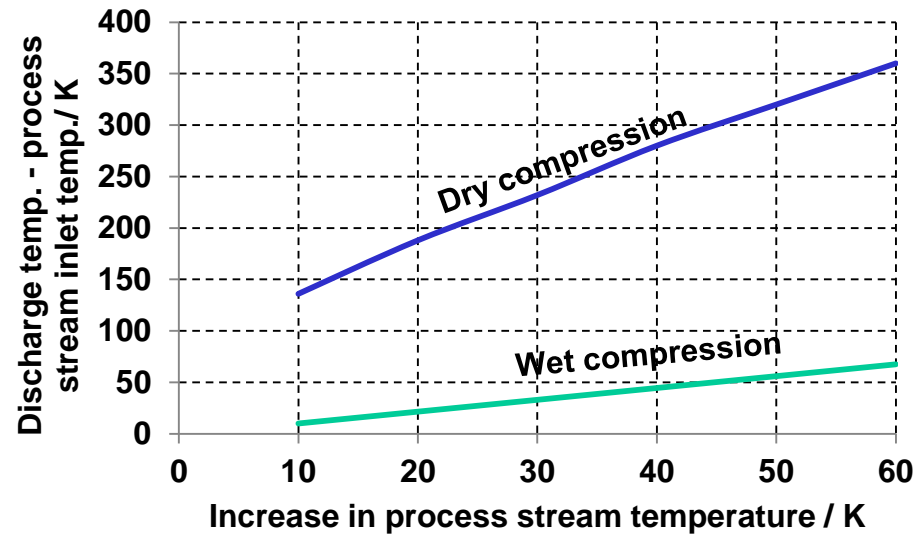
# Processen bij constant druk voor ammoniak-water



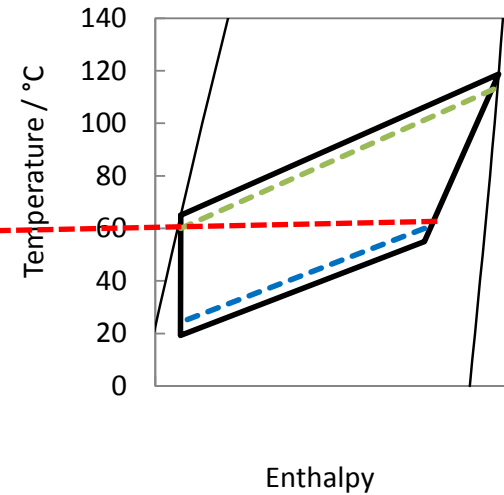
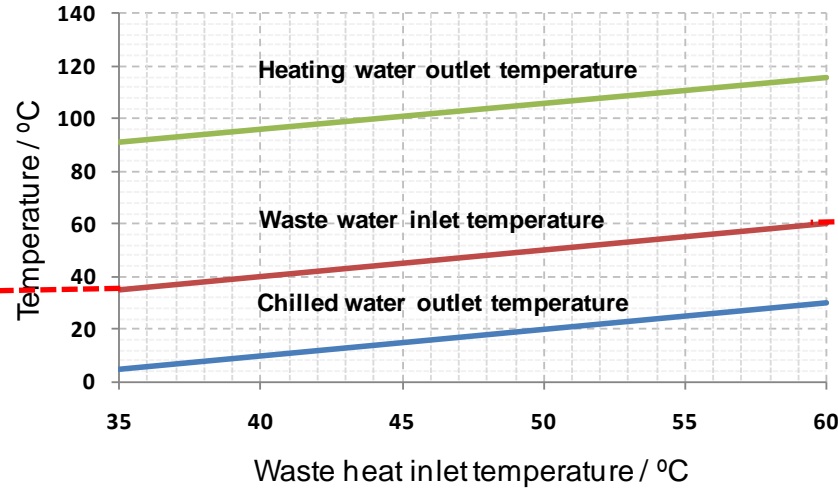
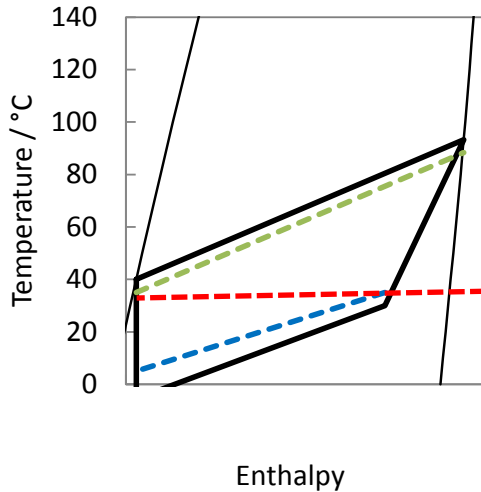
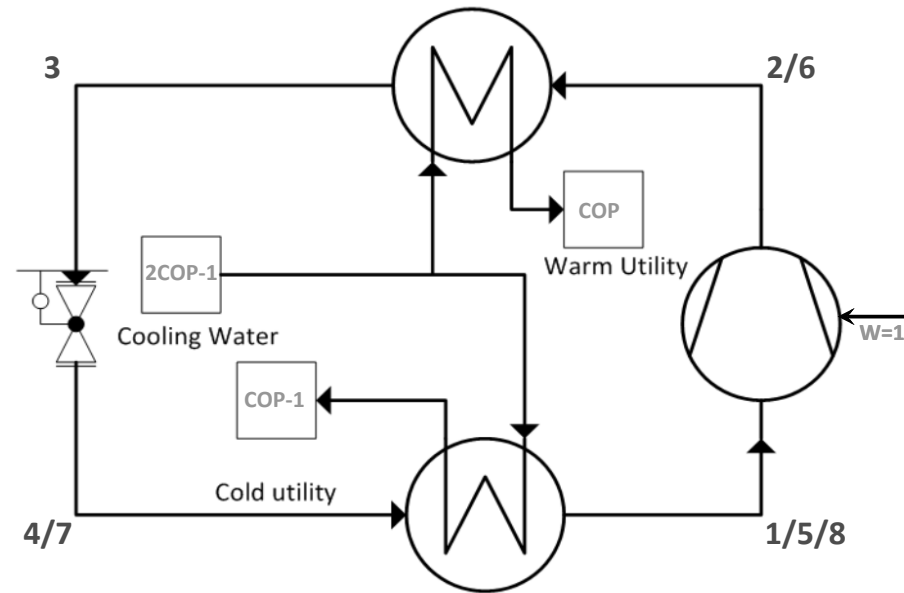
# Voorbeeld compressie-resorptie warmtepomp proces



# Persgas temperatuur

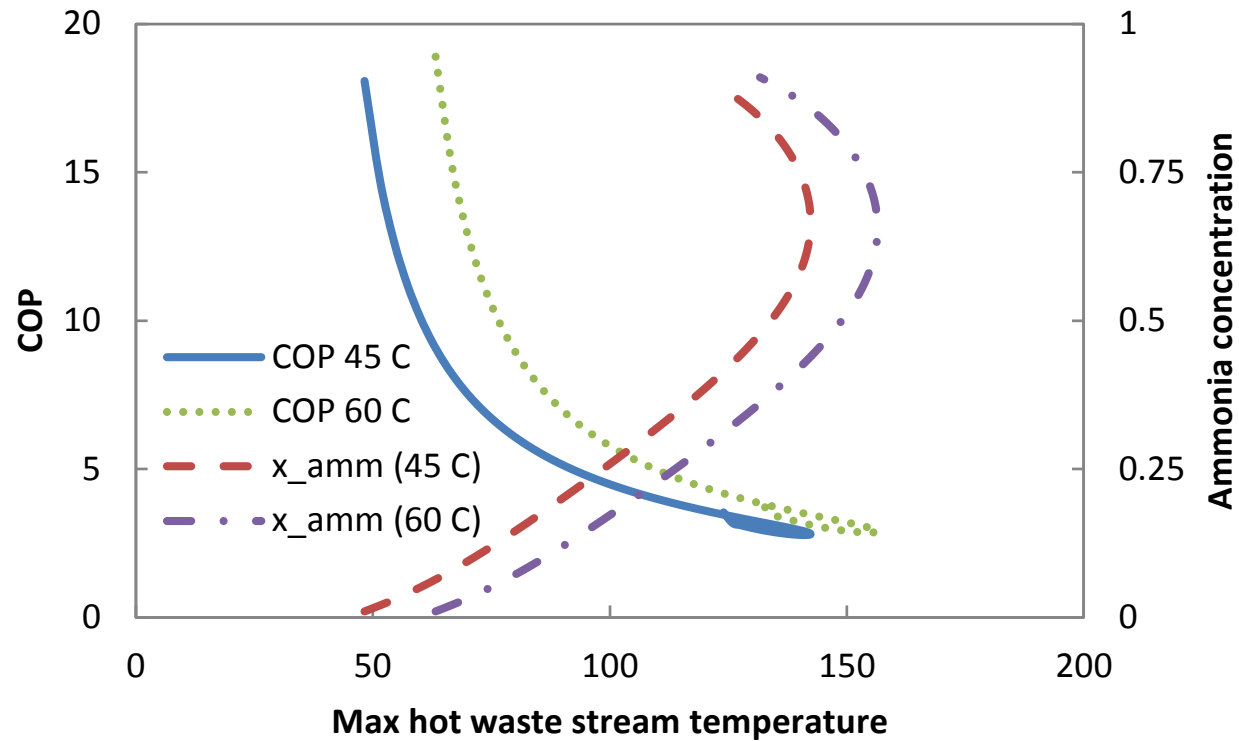


# Warmte terugwinning

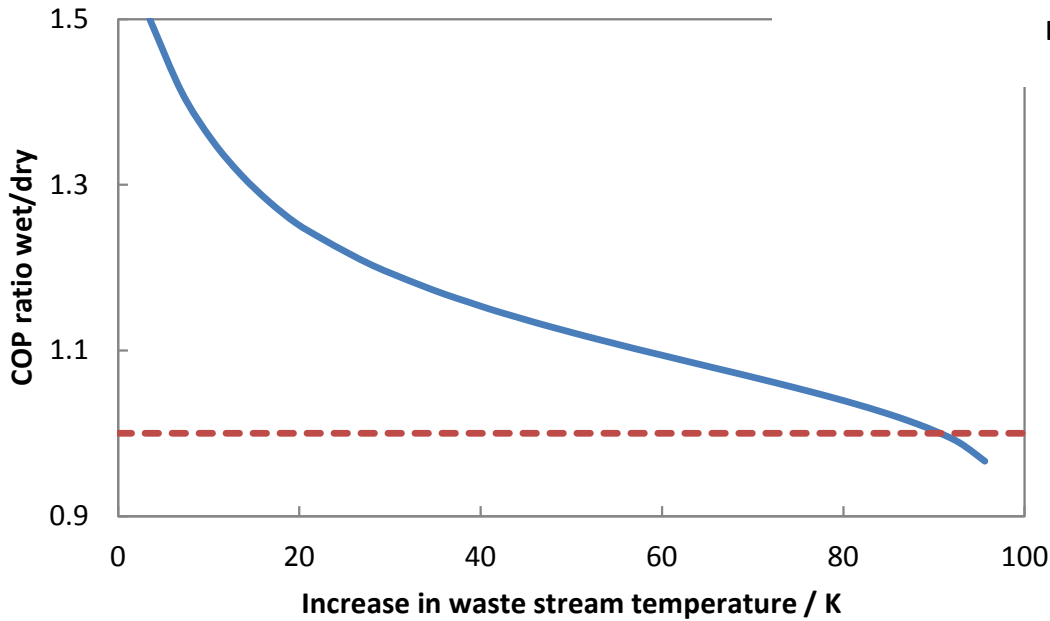
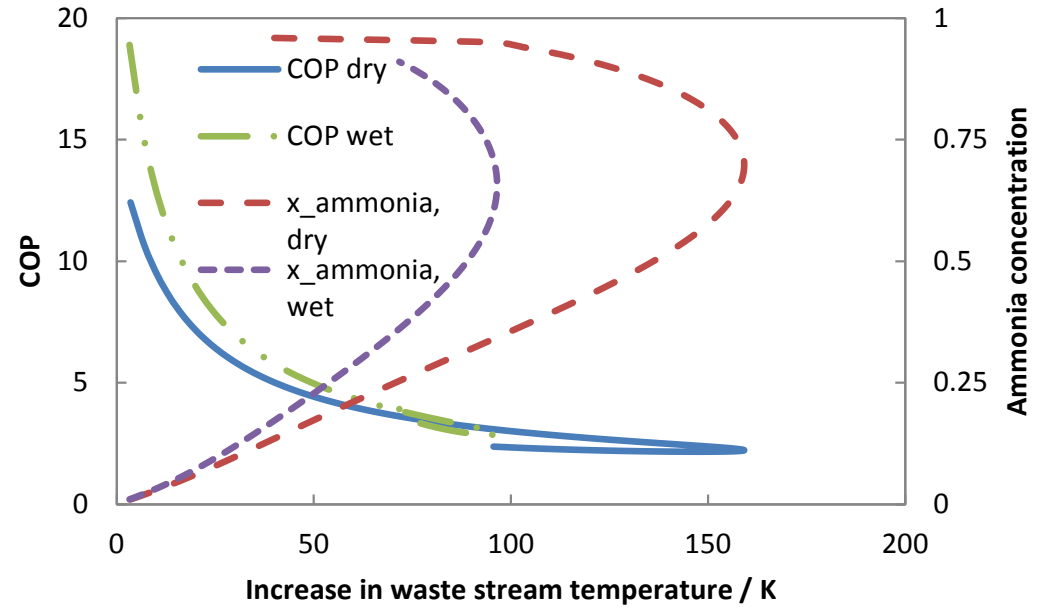




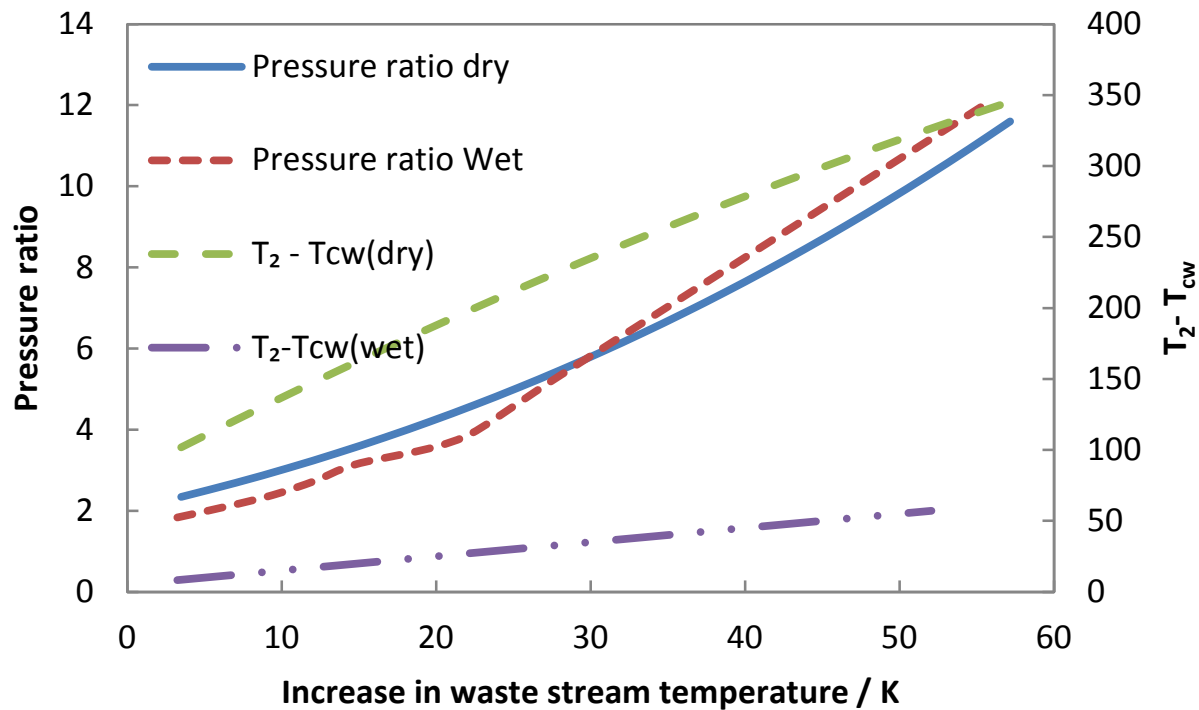
# COP en ammoniak concentratie



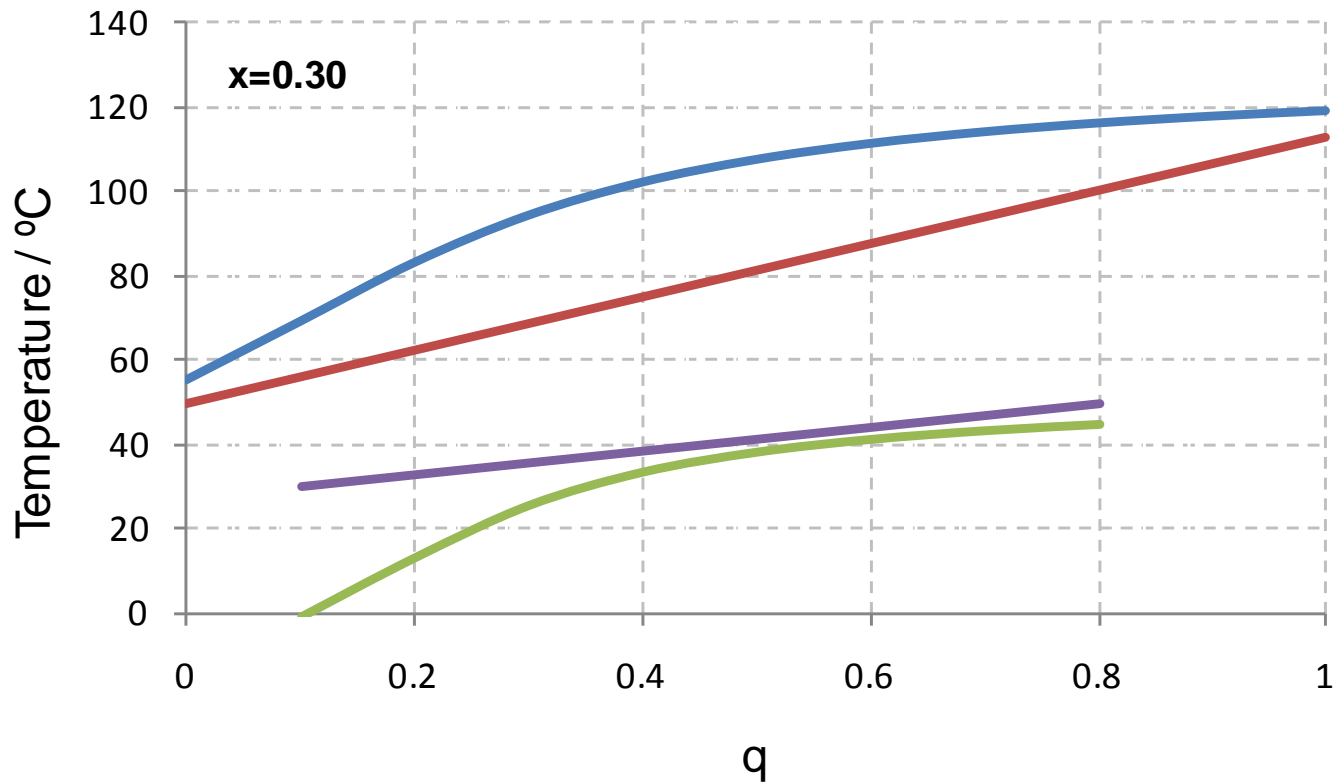
# Nat vs droog compressie



# Drukverhouding en persgastemperatuur



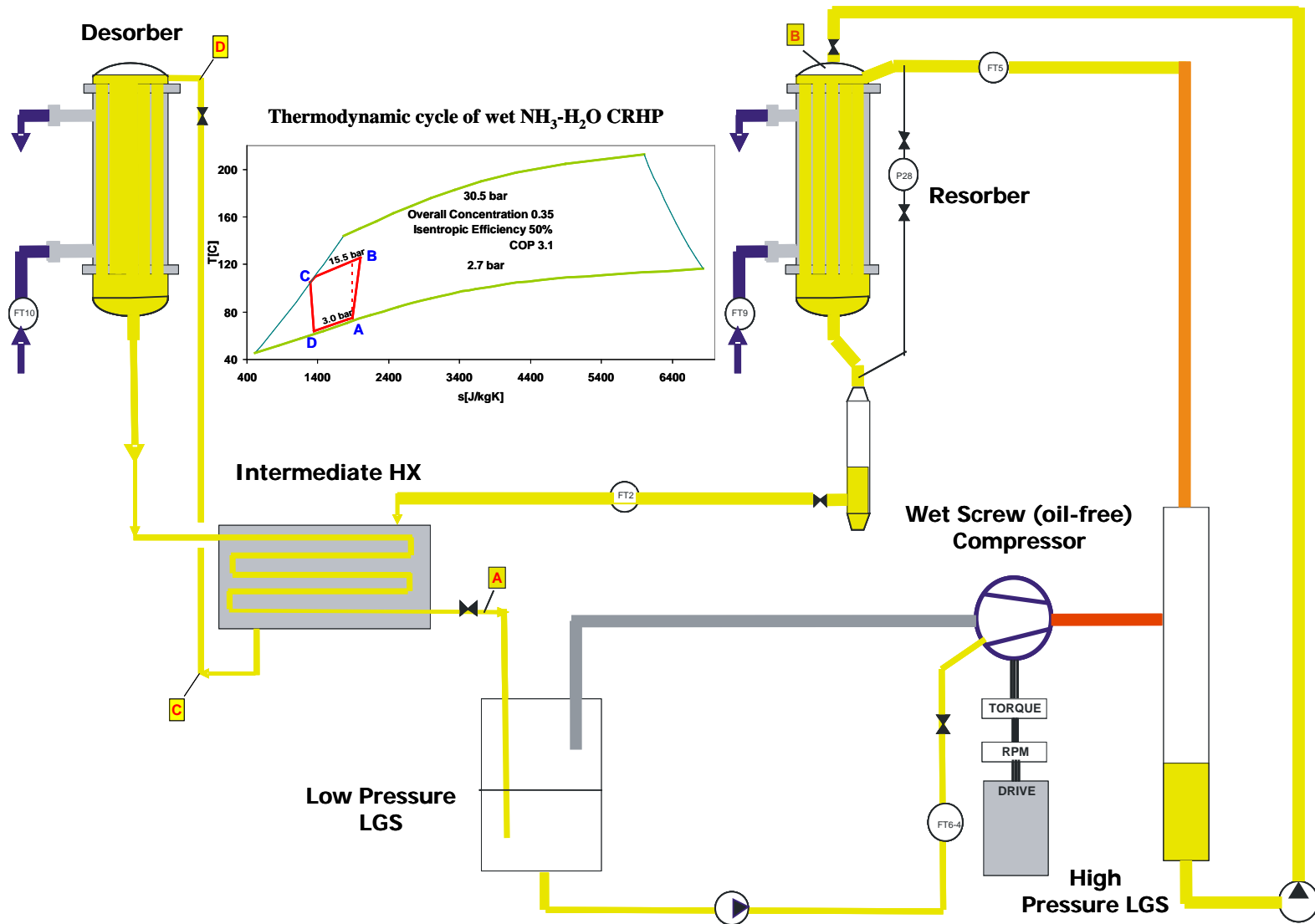
# Voorbeeld werkcondities



# Stroom van 60°C

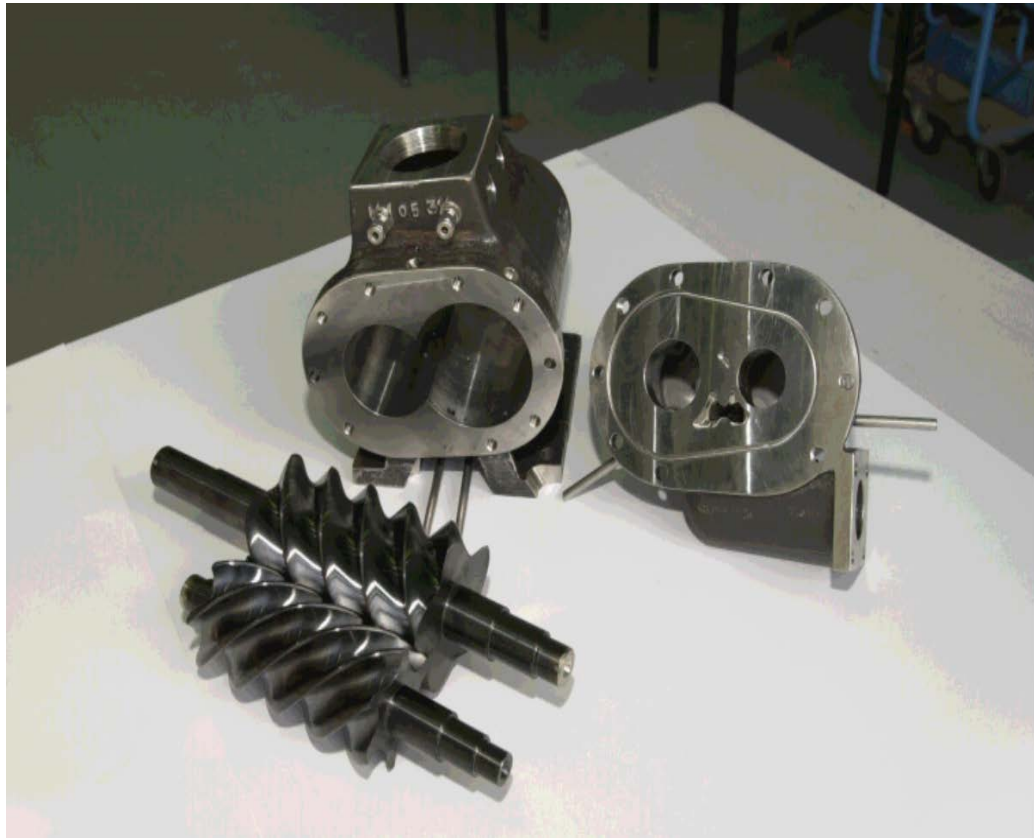
	CRHP <sub>dry</sub>	CRHP <sub>wet</sub>	VCHP
$T_{avg} = 85^{\circ}\text{C}$			
60 °C → Hot	110°C	110°C	85°C
60 °C → Cold	29°C	26°C	45°C
COP	4.46	4.94	3.88
Input (MW)	1	1	1
Output (MW)	4.46	4.94	3.88
Cost (€/h)	65	65	65
Revenues (€/h)	138.3	153.2	120.0
Net benefit (€/h)	73.3	88.2	55.0
Max. savings (k€/yr)	586	706	440

# Compression resorption cycle





Experimental CRHP  
Right: absorber; Left: desorber

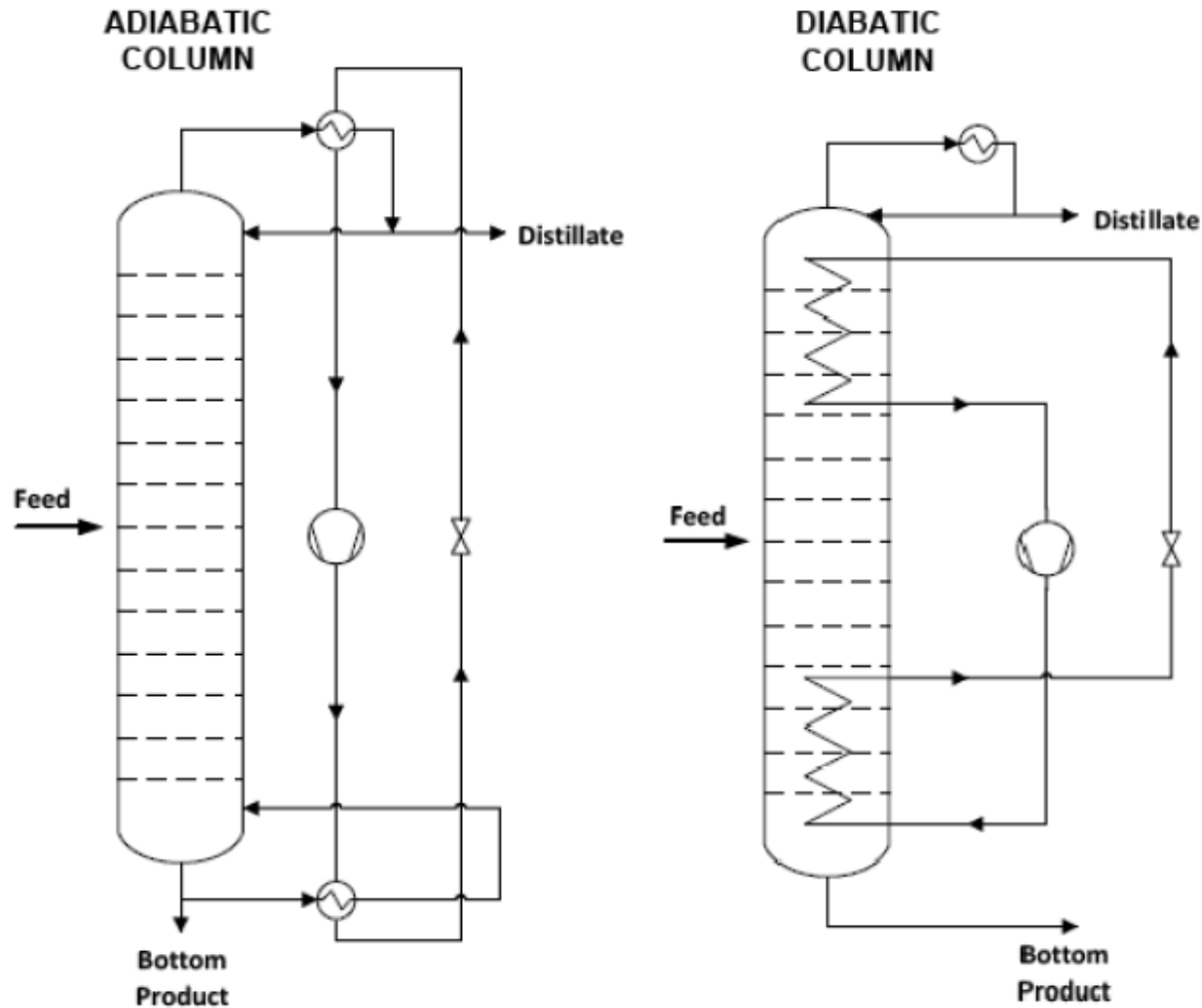


# Experimental CRHP

## Olievrij schroefcompressor

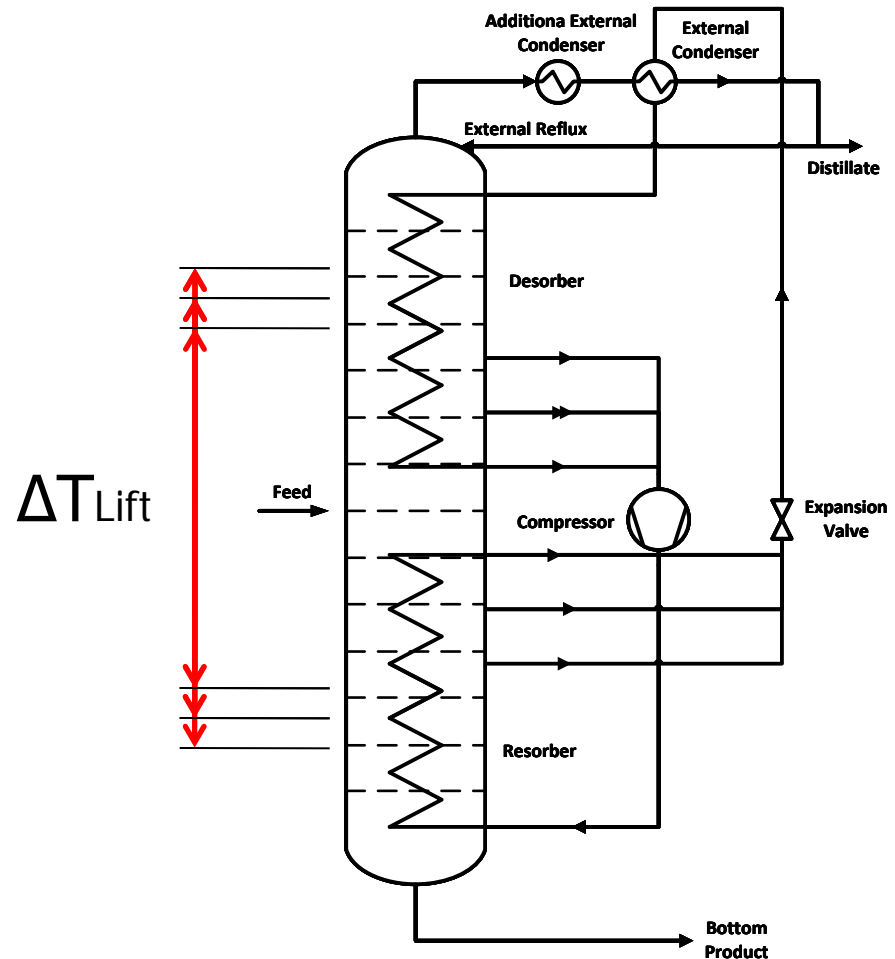


# Compression resorption cycle

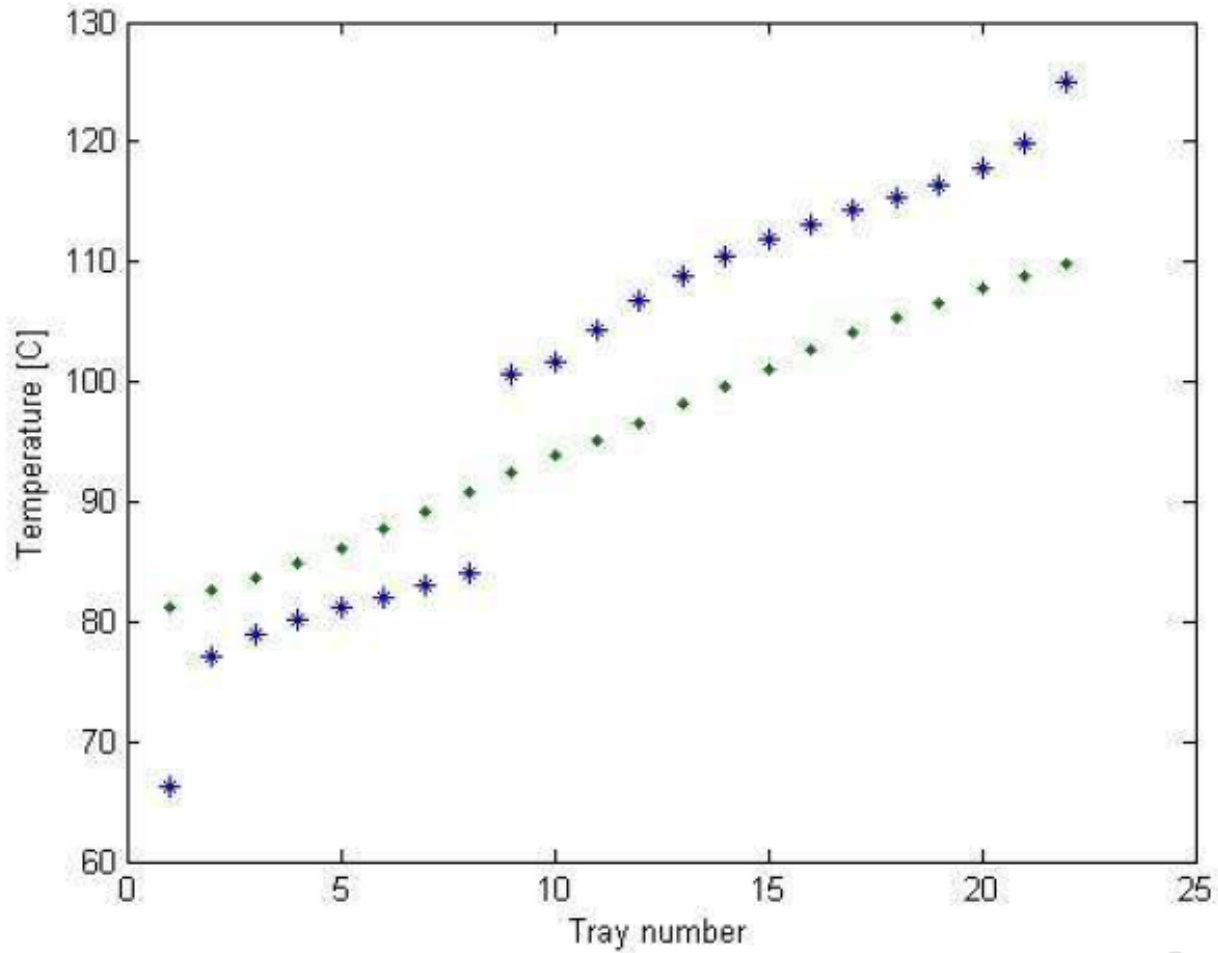


# Configurations of the CRHP

$\Delta T_{\text{Lift}}$  indicates the difference between the hot and cold reservoirs, which are the mixture to distillate in the column, that acts as external medium of the CRHP

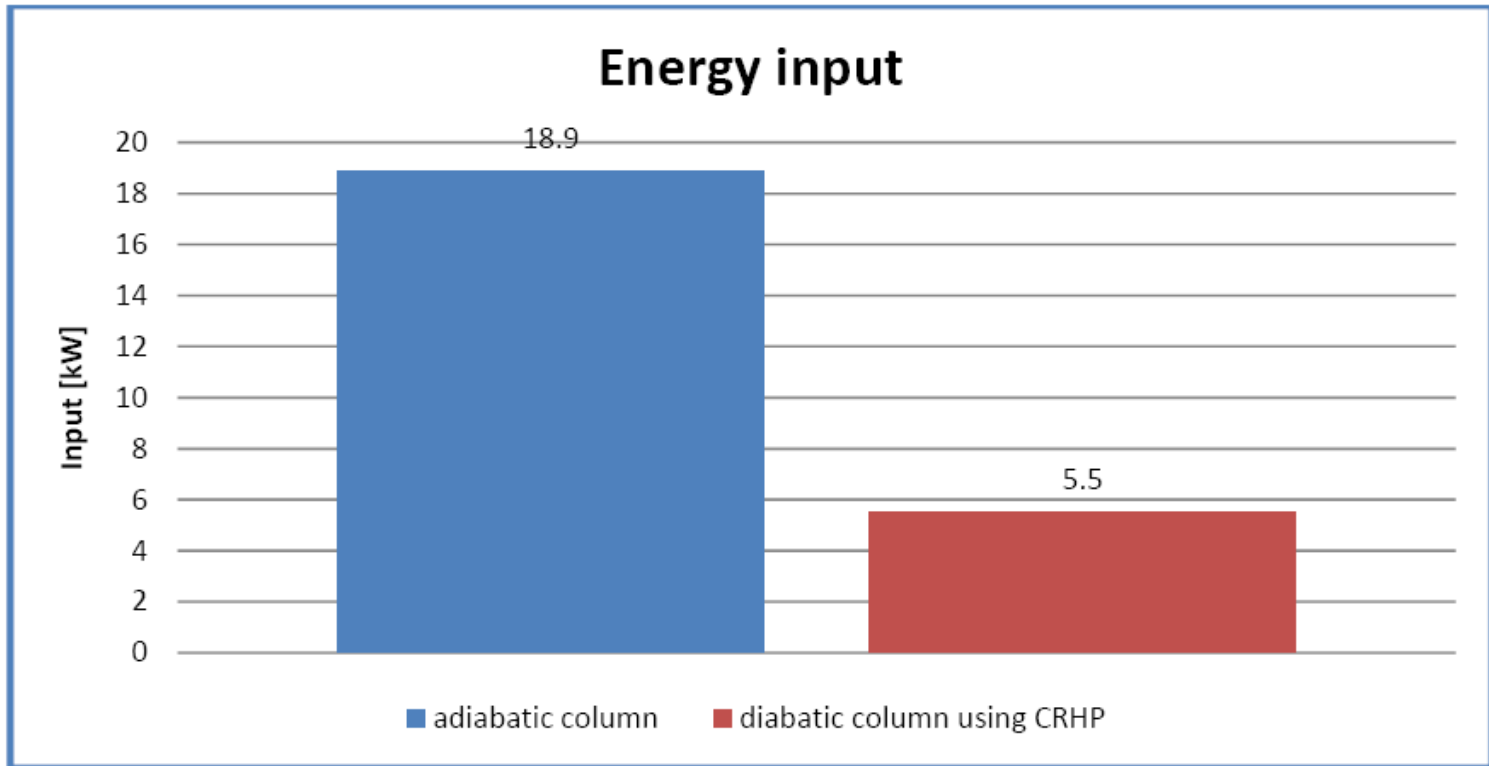


# Compression resorption cycle



Benzene / Toluene

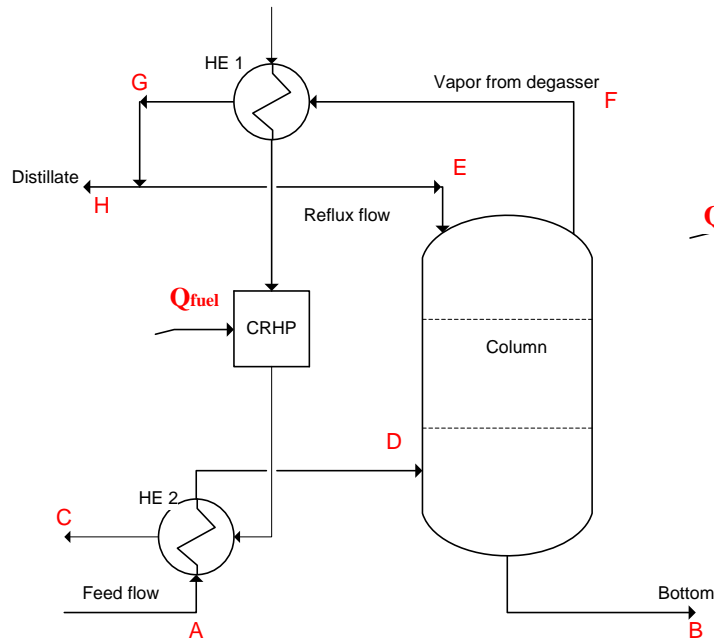
# Compression resorption cycle



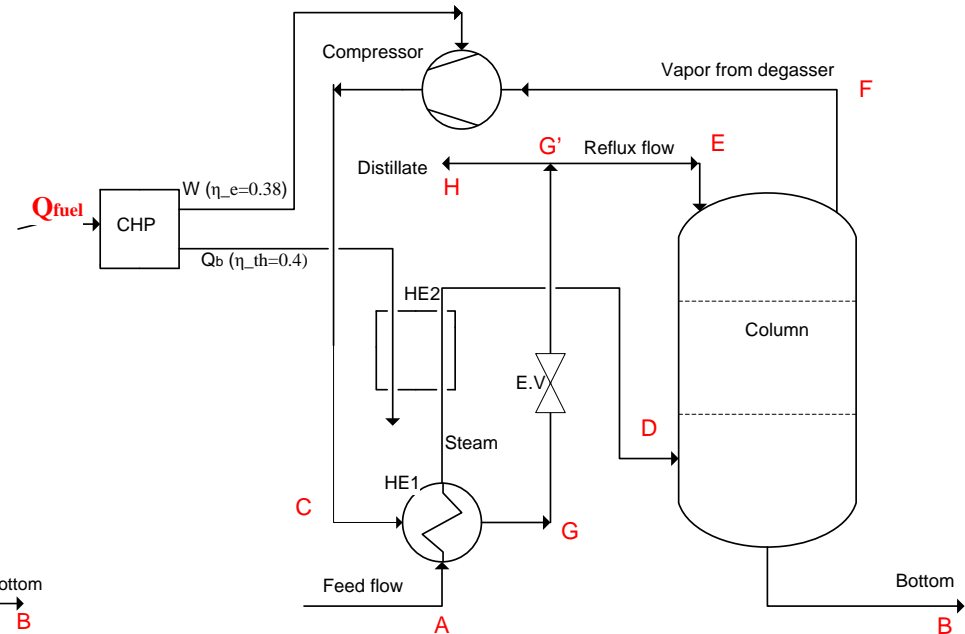
# Case study:

- Case description and heat pump applications

## 1. CRHP application



## 2. VRHP application



Starting condition: Fixed State A, B, D, F

# Case study:

- Energy and economic evaluation

Solutions	$Q_{\text{fuel}}$ (kW)	$Q_{\text{saving}}$ (%)	Cost (€/h)	Cost saving (M€/y)
CRHP	2408.9	74.90%	67.21	1.61
VRHP	3096.4	67.80%	86.39	1.46
Reference	9607	100%	268.04	0

COP: CRHP:7.87, VRHP:5.9

Total operating time :8030 h/y

# Conclusie