

# Upgrading Waste Streams of Separation Processes with Compression Resorption Heat Pumps



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**Project #:** UH – 20 – 10

## Objective

To develop a compressor prototype suitable for operation in compression-resorption cycles for heat recovery from process waste streams.

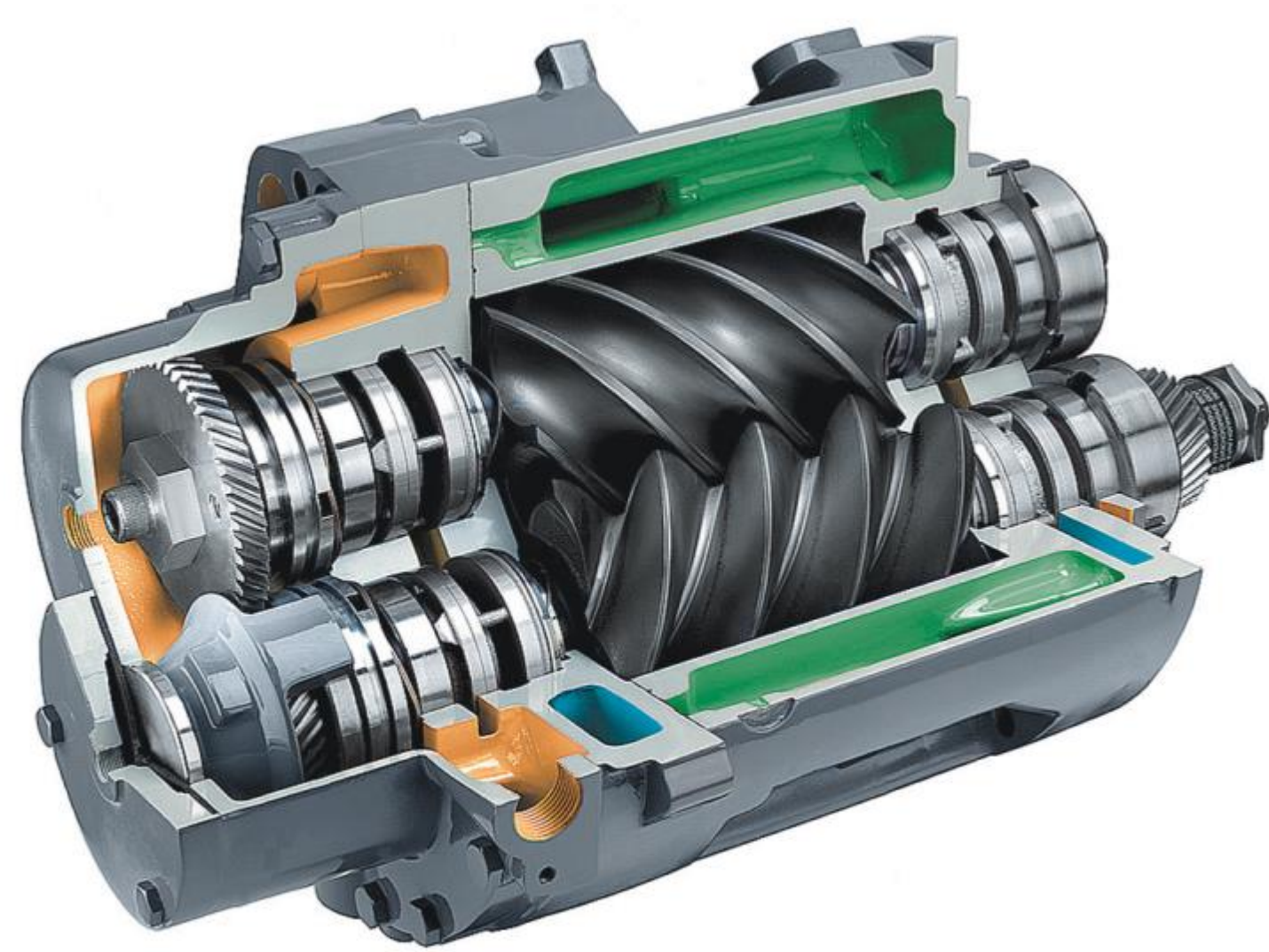
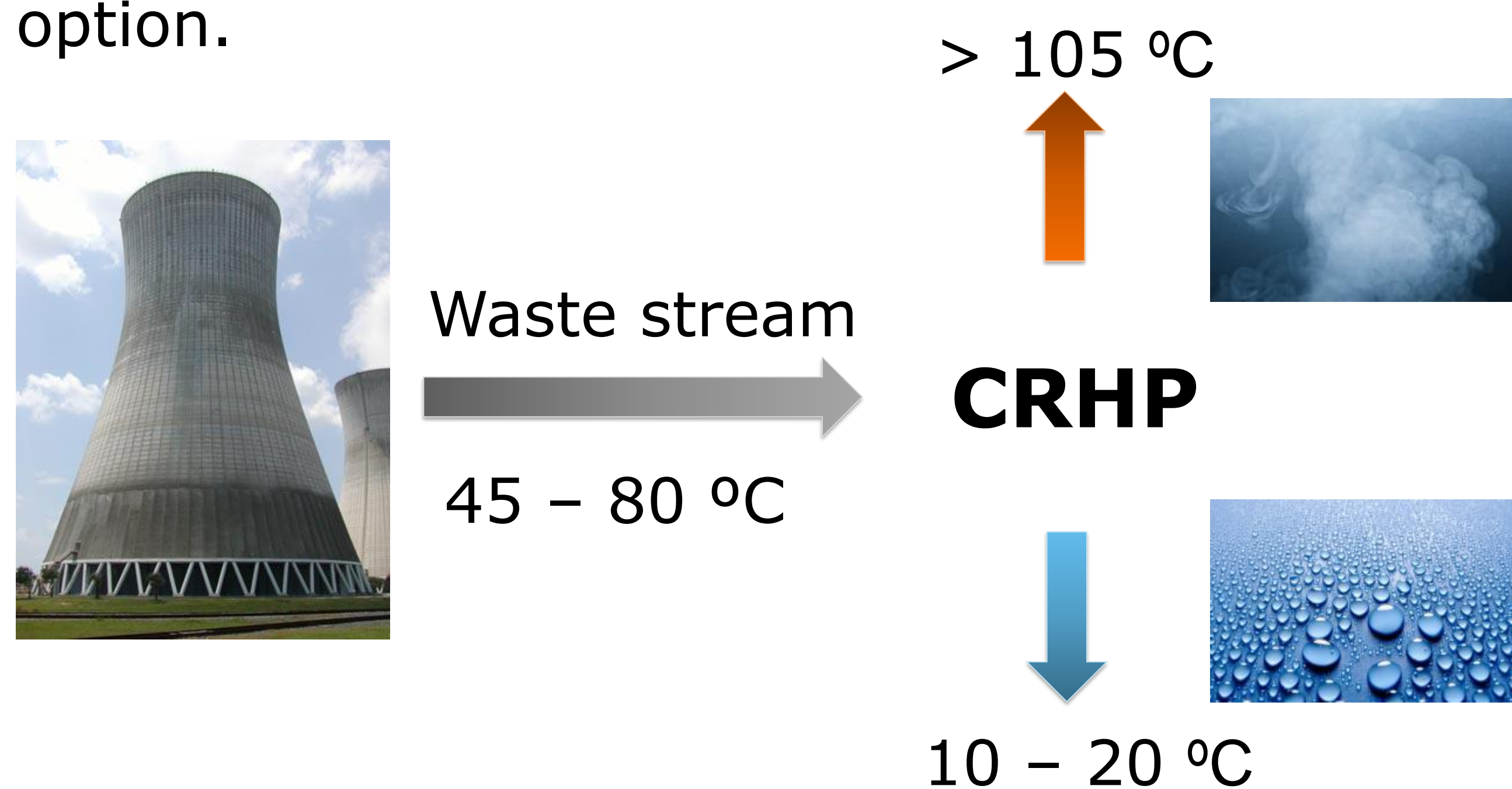


Fig 1. Twin screw compressor.

## Motivation

Waste heat recovery in the industry is still negligible. For many application compression-resorption heat pumps (CRHP) are an attractive option.



## Status

Homogeneous thermodynamic model including entropy production for each leakage path has been developed.<sup>1</sup>

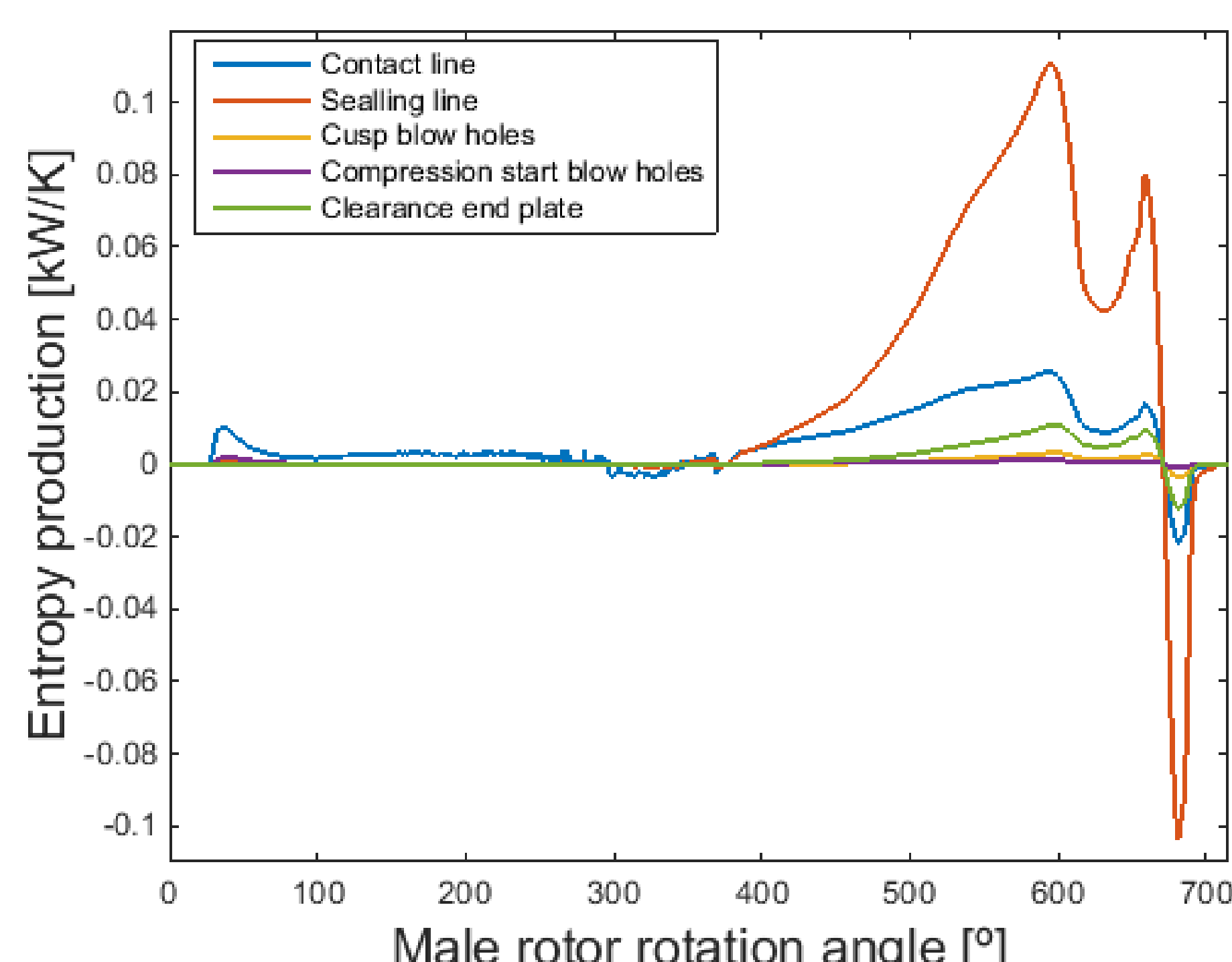


Fig 2. Example of entropy production of each leakage path in a twin screw compressor.

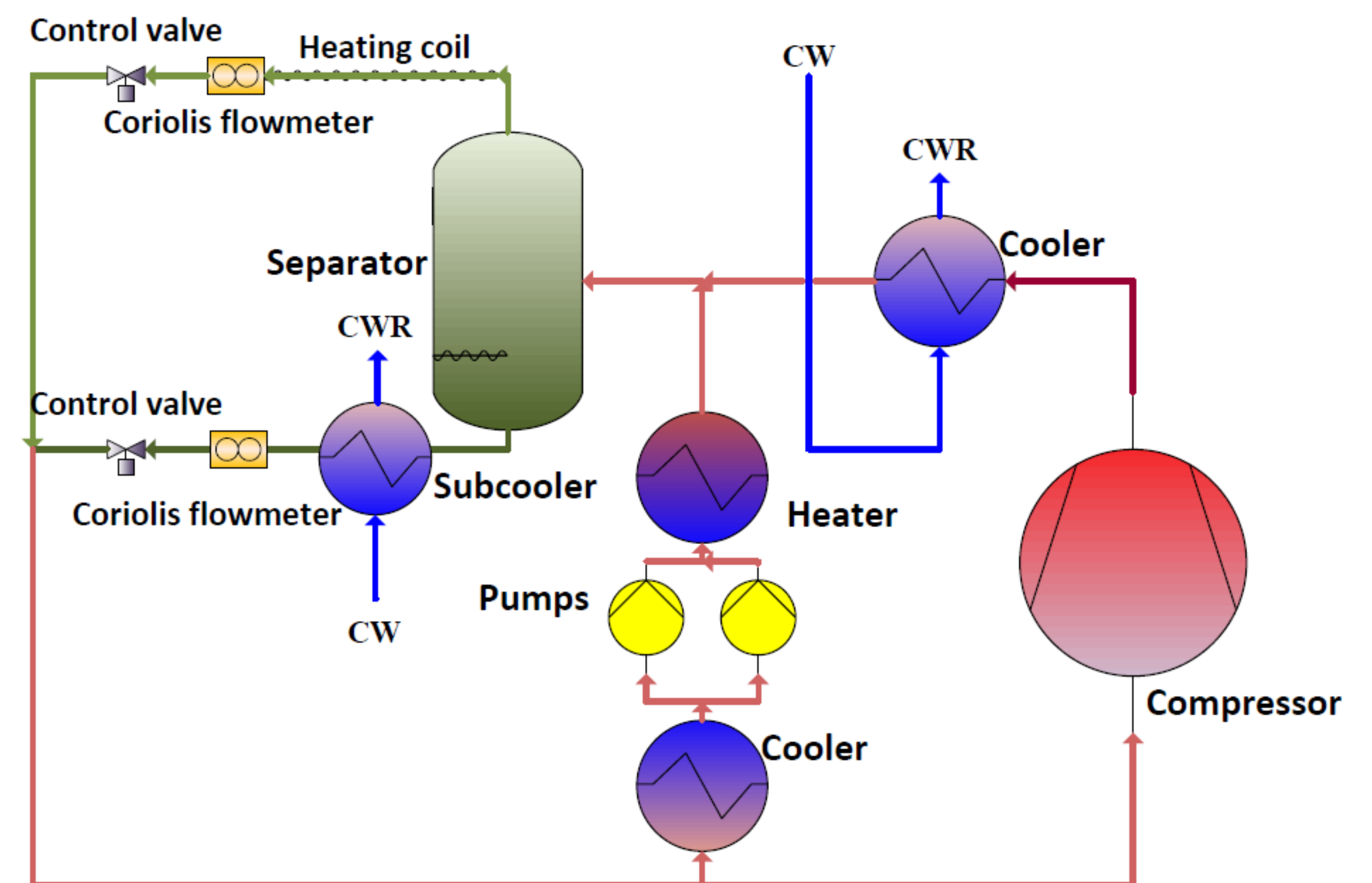


Fig 3. Simplified P&ID of the experimental set-up.

For certain applications adding small amounts of CO<sub>2</sub> to NH<sub>3</sub>-H<sub>2</sub>O can increase the coefficient of performance (COP), decrease the pressure ratio and increase the lower pressure level.

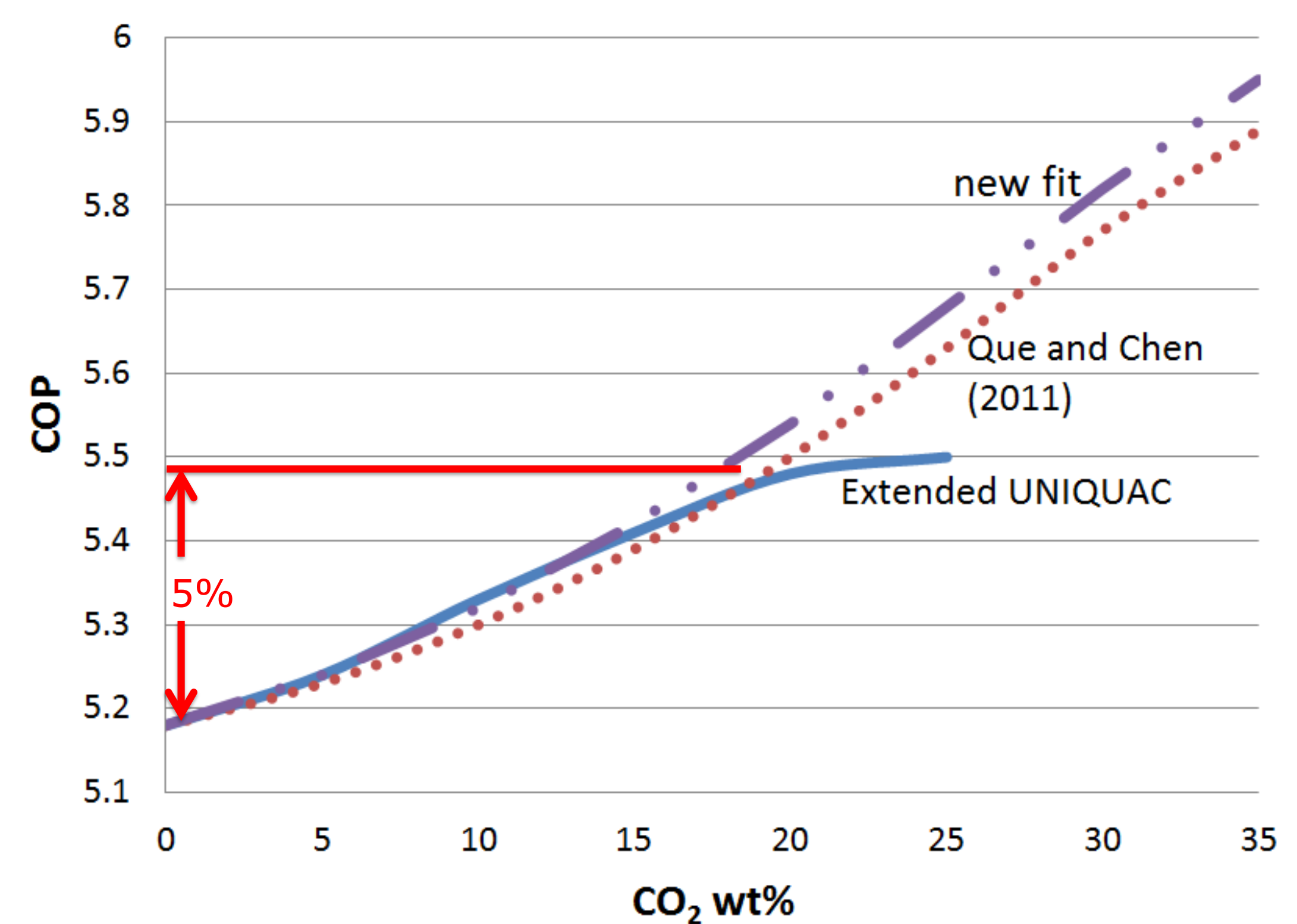


Fig 4. COP vs. added CO<sub>2</sub> to NH<sub>3</sub>-H<sub>2</sub>O mixture when a waste stream is heated from 60 °C to 105 °C with a CRHP.

## Future work

- Integrate all compression resorption heat pump components into an optimization model based on entropy production minimization.
- Perform experiments for evaluation of the compressor prototype performance. Additionally confirm the benefits of NH<sub>3</sub>-CO<sub>2</sub>-H<sub>2</sub>O versus NH<sub>3</sub>-H<sub>2</sub>O.
- Compare the optimized design with reference system (boiler + chiller).

## References:

[1] Zaytsev, 2003, PhD thesis.