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WCRHP - Upgrading waste streams with compression resorption heat pumps

Investigate potential of wet CRHPs for high temperature heat recovery. Develop a compressor prototype suitable for wet compression operation.

Project number UH–20–10

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Partners Atlas Copco, DOW, Frames, IBK, ISPT, Nouryon, TU Delft

Budget Euro 590.000,00

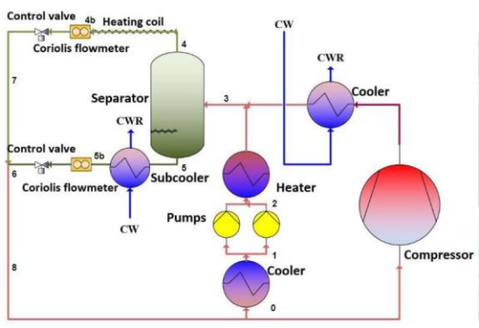
Duration 2015–2019

Incentive

Electrification in industry requires the use of high temperature heat pumps. When a temperature glide of sink and source flows is required, wet compression heat pumps show superior performance.

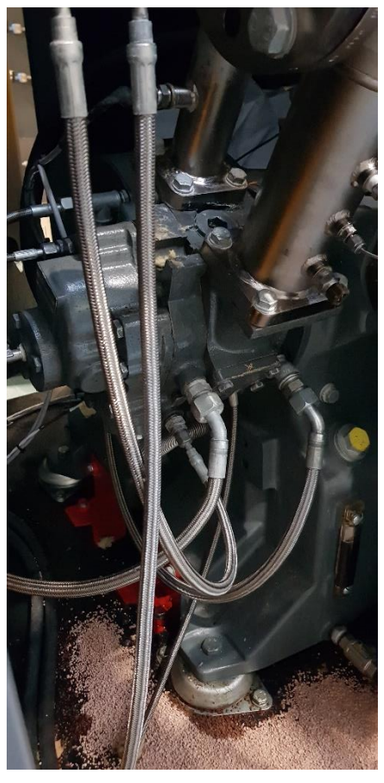
Objective

Identify the potential of wet compression resorption heat pumps for heat recovery of waste streams in industry. Develop a compressor prototype suitable for operation in wet compression resorption heat pumps and verify the expected advantages of operation under such conditions.



Approach

Possible applications at partners sites. Advantages of adding CO_2 as an extra component to the NH_3-H_2O solutions. Modeling of the wet compression process. Wet compressor prototype manufacturing & testing. Technical and economical evaluation of CRHPs.



Results

The impact of adding small amounts of CO_2 to the working fluid has been investigated. Indicating a ca. 5% improvement in COP.

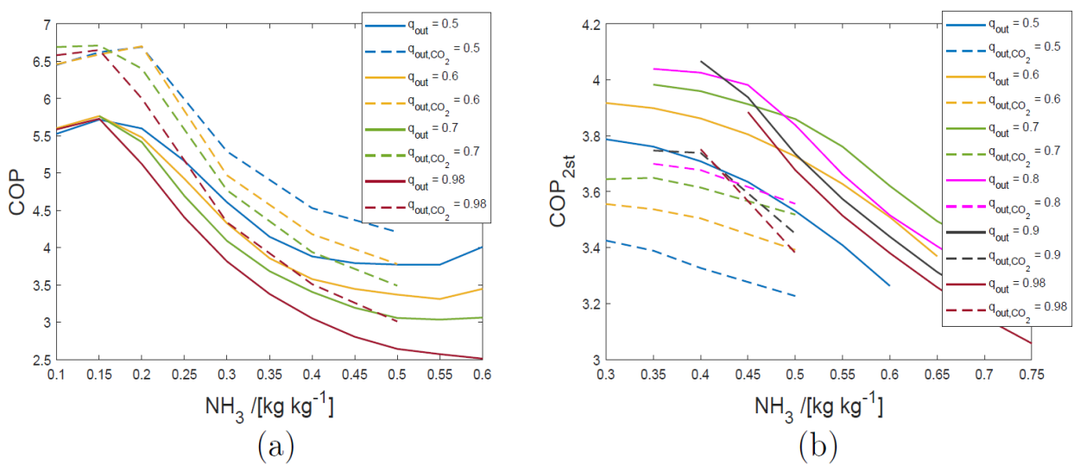


Figure: COP of CRHPs heating pressurized water from 90 to 130 °C (left) and from 60 to 140 °C (right). Solid lines apply for NH_3-H_2O systems and dotted lines apply for NH_3-H_2O-CO_2 systems.

A thermodynamic model has been developed for twin-screw wet compressors which allows localization of major irreversibility losses during the compression process in CRHPs.

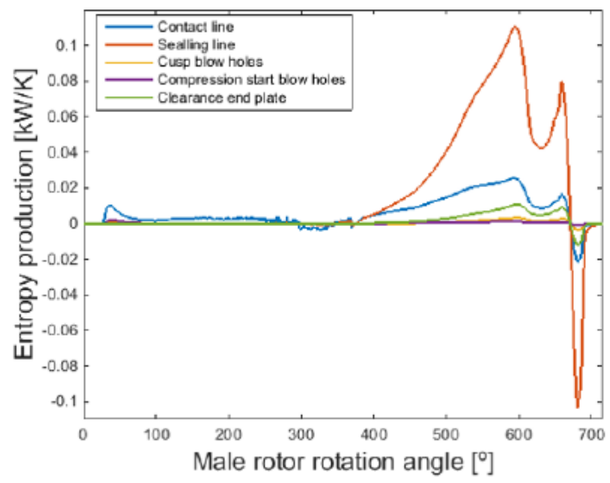
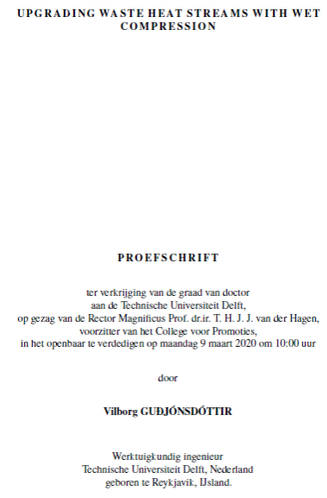


Figure: Main irreversibility losses during compression.

An experimental set-up has been constructed at the TU Delft to test the performance of the wet compressor prototype.

A summary of the results can be found in Gudjonsdottir PhD thesis which can be downloaded from https://repository.tudelft.nl/islandora/object/uuid:53822efe-863f-4708-b0d4-37f76fcd8a8e?collection=research



UPGRADING WASTE HEAT STREAMS WITH WET COMPRESSION

PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Technische Universiteit Delft,
op gezag van de Rector Magnificus Prof. dr.ir. T. H. J. J. van der Hagen,
voorzitter van het College voor Promoties,
in het openbaar te verdedigen op maandag 9 maart 2020 om 10:00 uur

door

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