



Heat Exchanger Development

FLEXIBLE POWER GENERATION - ETN WEBINAR SERIES

5TH EPISODE: 2/2/2021

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Fives Cryo



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WP4: Heat Exchanger Development

Heat Exchanger Design

4.1 HX Configuration and material definition

- Corrosion tests
- Mechanical tests



4.3 Design and manufacturing of HX prototypes

- Design of heat exchanger
- Manufacturing and testing



4.2 Heat exchanger design study

- Collection of heat transfer and pressure drop
- Limits of operation of HX



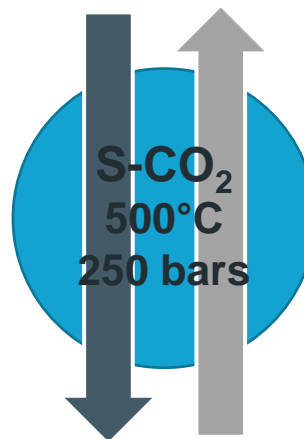
Universität Stuttgart

4.4 Experimental testing of the prototypes

- Performance validation
- Mechanical validation (fatigue...)
- Validation by simulation



Centrum výzkumu Řež s.r.o.
Research Centre Řež



Objectives

Compactness

Flexibility

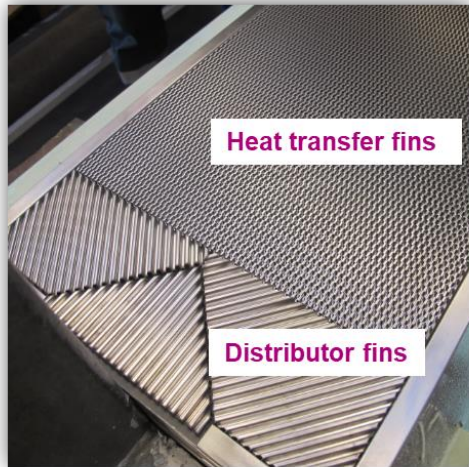
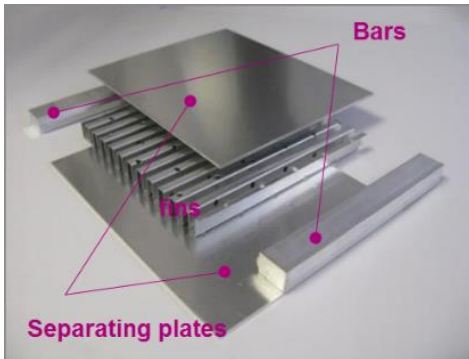
Efficiency

Robustness

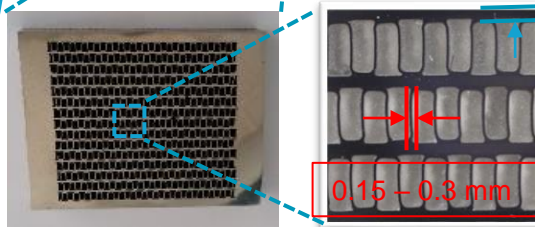
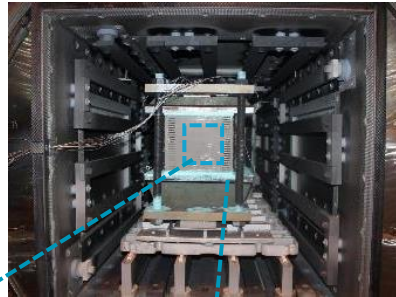
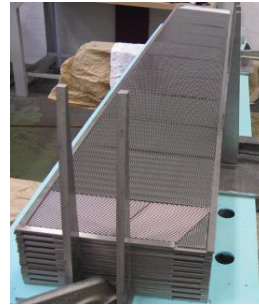
Stainless Steel PFHE

Overview of Stainless Steel Plate-Fin Heat Exchanger

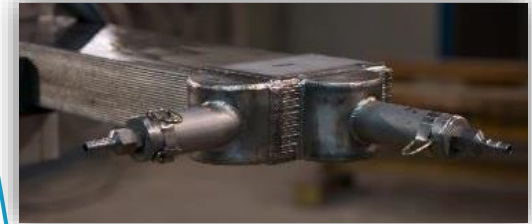
Plates, fins and bars assembly



Stacking, vacuum brazing

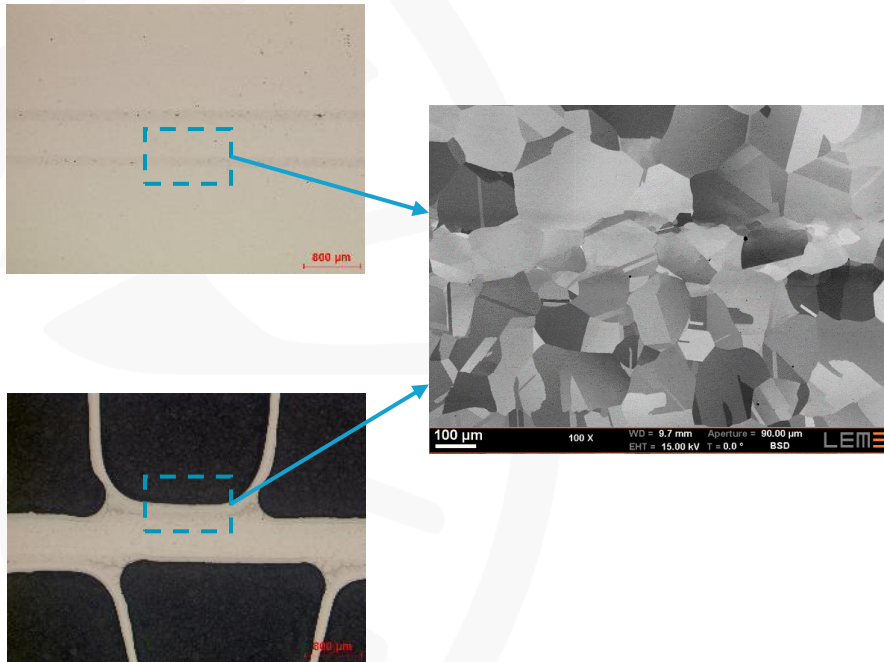


Header's welding, control



Stainless Steel PFHE

Metallurgical and mechanical properties of PFHE



Few intermetallic compounds in the brazed joint

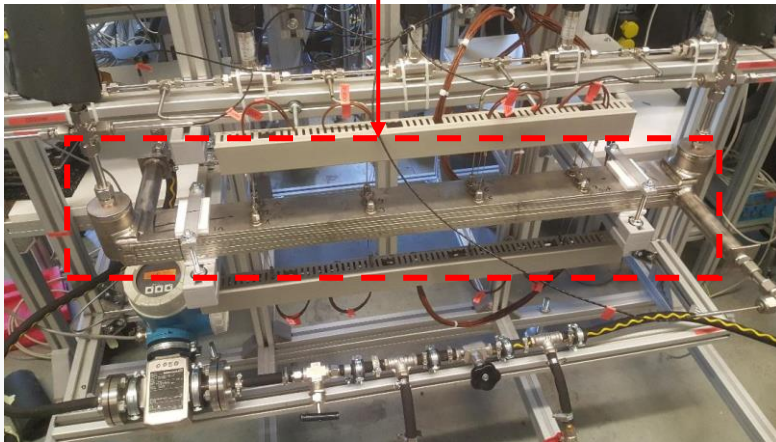
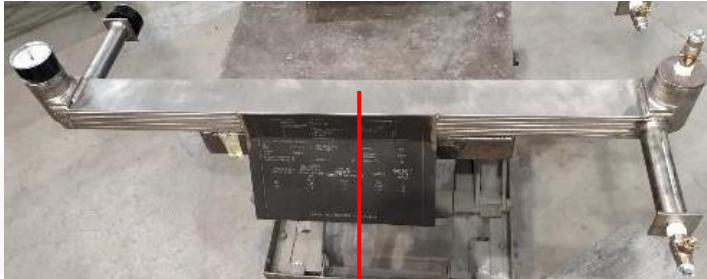
Less sensitive to corrosion compared to other brazing or welded assemblies

High pressure resistant heat exchanger

Substantial work on fin forming to preserve the brazed joint in progress

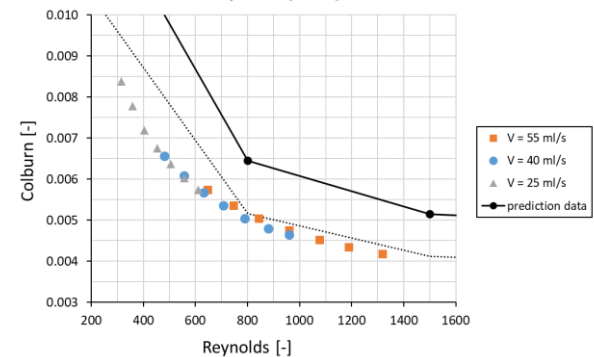
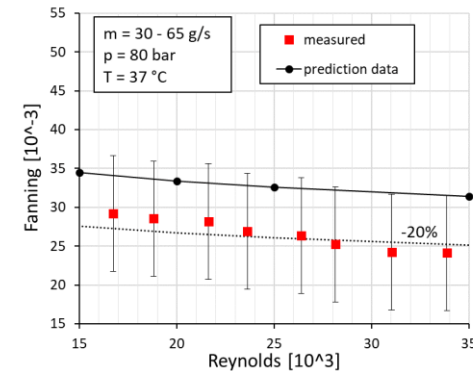
Stainless Steel PFHE

Manufacturing of 2 PFHE prototypes for testing at Ustutt



Integration of a prototype in Scarlett experimental loop

HX1 (serrated fins) mounted in frame, equipped with all measurements' devices



Comparison with modelization

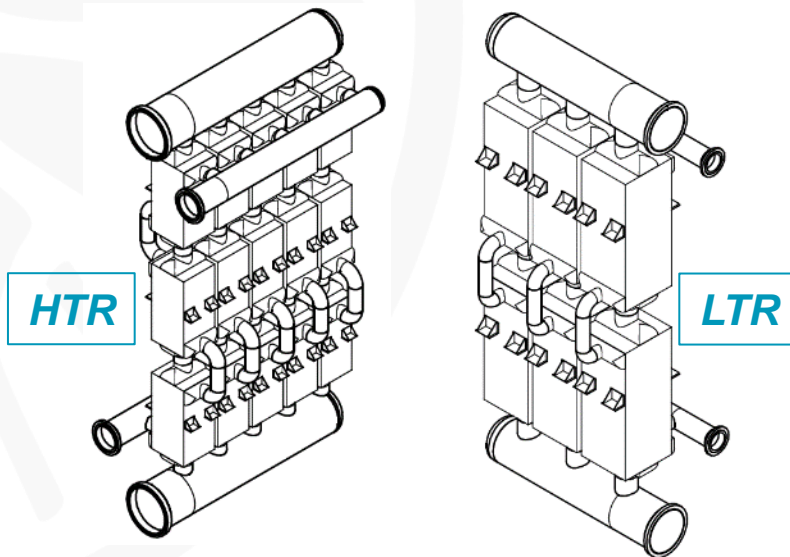
Pressure drop and heat transfer are within $\pm 20 \%$ of prediction

Stainless Steel PFHE

HX Design and cycle integration for a 25 MW_e s-CO₂ cycle

Designs of recuperators based on recompressed cycle with HTR bypass with 10°C temperature approach

10°C design case	Heat duty (MW)	HW weight (tons)
HTR	90	98
LTR	42	46

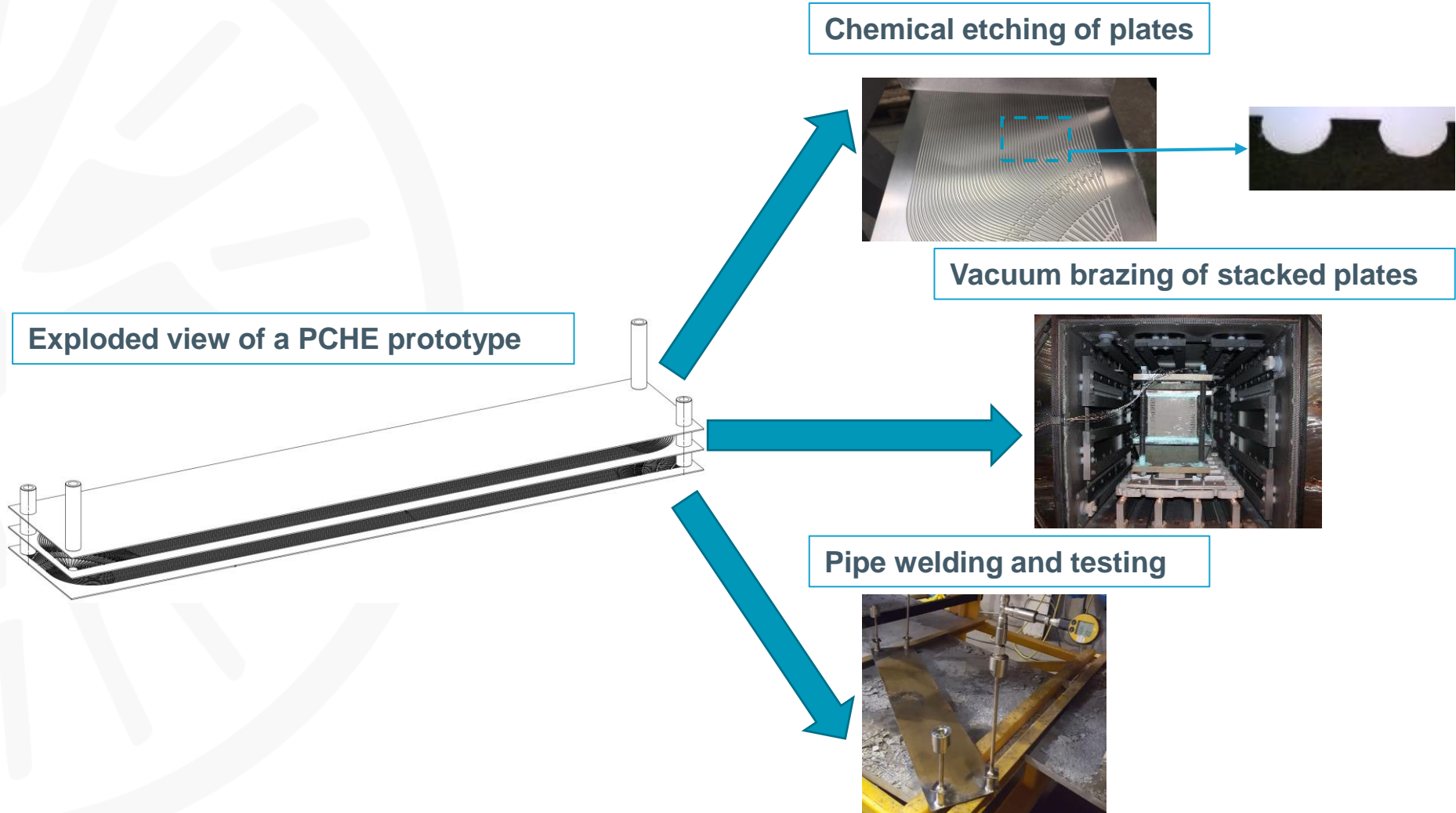


Integration of the recuperators in a cycle simulation model performed by Polimi

Permanent and transient conditions are studied to assess the best cycle efficiency with low thermal inertia for flexibility in electricity production

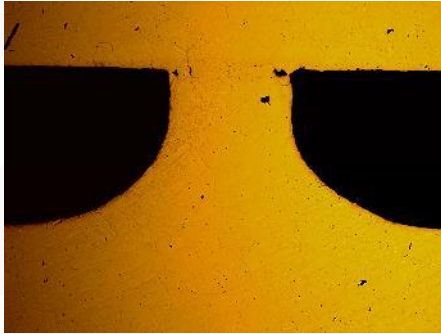
Stainless Steel PCHE

Overview of Stainless Steel Printed Circuit Heat Exchanger



Stainless Steel PCHE

Properties of brazed PCHE / other channel geometries



Brazing quality between plates

Good brazing quality obtained at the interface



Mechanical resistance of brazed PCHE

Tests upcoming to reach the mechanical strength limit of the prototype



Other proposed channel shape

Zig-zag 100° angle 6 mm pitch were successfully achieved to increase heat transfer