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D2.4: Final layout of the integrated heat upgrade system ready to be built at the test sites.

Funded by the European Union

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Deliverable D2.4

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Produced by: **DLR- Cosquillo, Aldo**

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Thermochemical Heat Recovery and Upgrade for Industrial Processes

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DELIVERABLE FACTSHEET

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Produced by:	DLR- Aldo Cosquillo
Contributors:	TMEC-Artem Sybir
Work Package Leader	UT-Abhishek Singh
Reviewed by:	DTU-Hamid Reza Rahbari

Dissemination level	
X	PU = Public
	PP = Restricted to other programme participants (including the EC)
	RE = Restricted to a group of the consortium (including the EC)
	CO = Confidential, only members of the consortium (including the EC)

Contents

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1 Summary

This document contains the technical description of the demonstrator (or heat upgrade system) and the test rig where it is integrated for testing.

2 Heat exchanger element design developed by TMEC.

According to the project plan, TMEC has developed the design of a fluid-solid heat exchange element intended for integration into a modular heat exchanger system with an overall thermal duty of up to 5 kW.

The proposed heat exchanger system consists of two identical pressure modules operating in an opposite cyclic mode. When one module operates in hydration mode, the second module operates in dehydration mode, enabling alternating heat storage and heat release operation.

Each module is based on a standard, commercially available pressure vessel with an operating pressure of up to 6 bar. The general 3D assembly for a single module and the layout of the heat exchange element are shown in Figure 1.

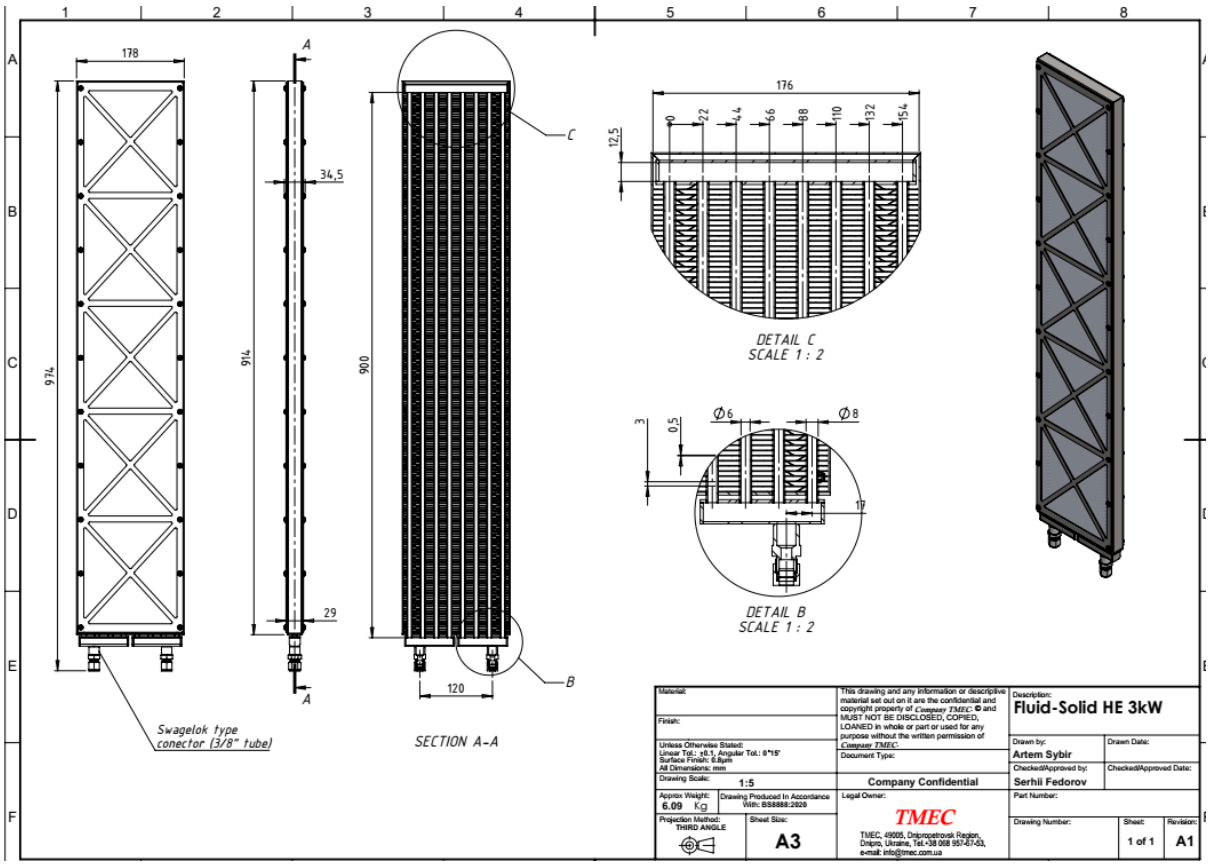

Figure 1. Layout of the heat exchange element and 3D assembly (Source: TMEC)

2.1 Heat Exchanger Element Configuration

Each heat exchange element is based on a tubular heat transfer system equipped with fins.

The main design features are as follows:

- Tubes: AISI 304 stainless steel
- Tube size: 8 × 1 mm, corresponding to 8 mm outer diameter and 6 mm inner diameter
- Fins: aluminum
- Fin thickness: 0.5 mm
- Distance between fins: 3 mm
- Overall thickness of one heat exchange element: 29 mm
- Distance between inlet and outlet ports: 120 mm
- Working temperature range: 150-300 °C
- Heat transfer fluid: thermal oil
- Thermal oil velocity at the inlet/outlet connection of the element: approximately 0.5-1.5 m/s
- Tube connectors: Swagelok-type connectors, 3/8" tube connection
- Approximate weight of one heat exchange element without storage material: 6 kg
- Maximum amount of heat storage material per element: up to 4 kg

The space between the fins is filled with the solid thermochemical heat storage material, for example, strontium bromide. During operation, steam is supplied to the external side of the heat exchange element inside the pressure vessel, enabling sorption and desorption by the solid material.

The system is intended for cyclic operation, with a typical cycle duration in the range of approximately 5-20 minutes

3 Test rig

The demonstrator (heat exchange element) is integrated in the test rig for experimental testing. It is placed inside a pressure vessel and the heat of reaction is supplied or collected by thermal oil connected to a process thermostat. The reaction gas (water vapor) is adjusted in the evaporator/condenser (E/C) unit by means of a second process thermostat. The pressure is adjusted according to the direction of the reaction: hydration or dehydration of the storage material.

In addition, the test rig has a series of valves to control the stream of reaction gas and to ensure the safe operation. In addition, multiple pressure and temperature sensors collect data to analyze the thermal performance of the heat upgrade system. Figure 2 displays the layout of the test rig and Figure 3 shows the actual test rig with the reactor unit integrated.

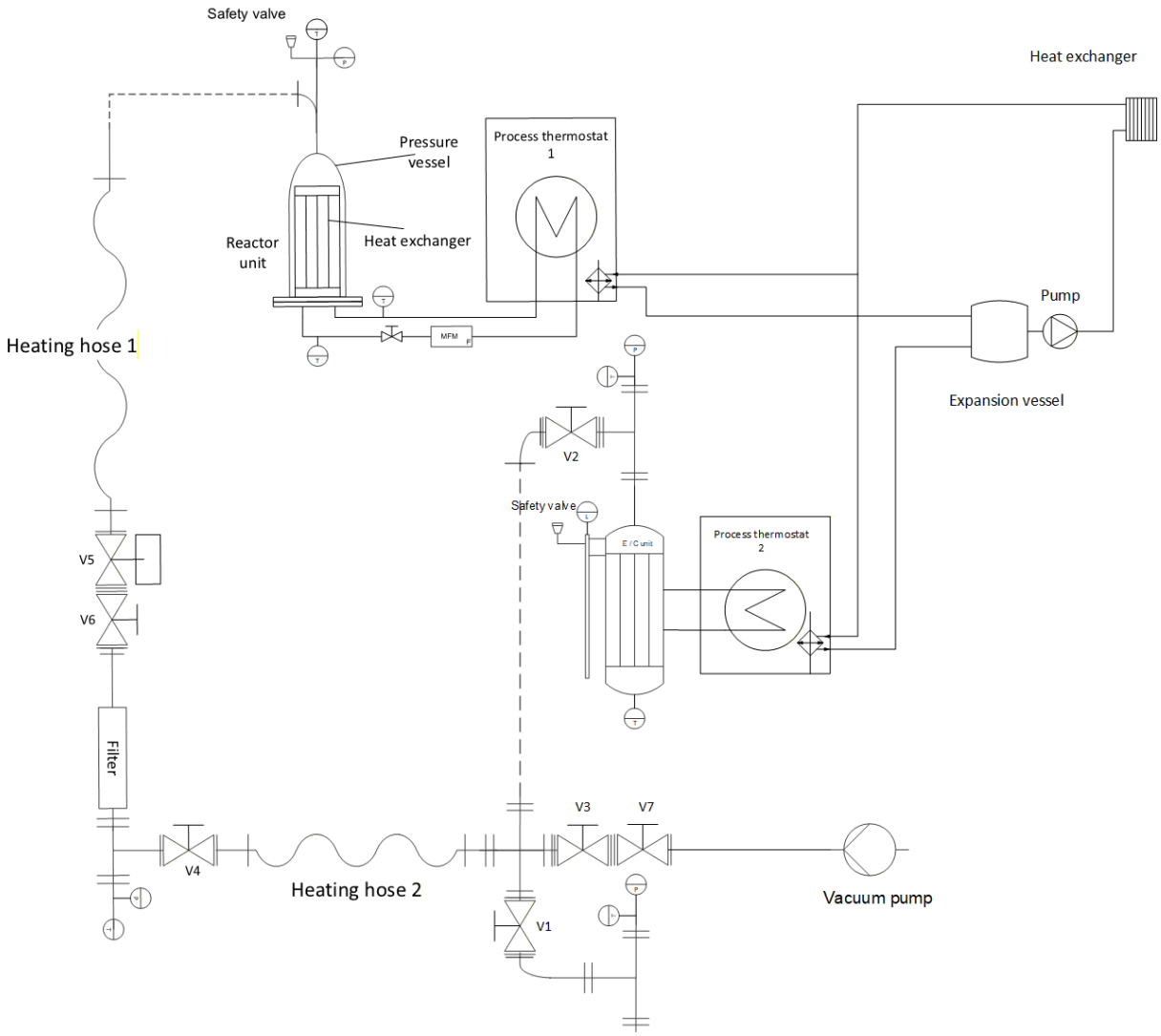

Figure 2. Test rig layout in DLR- Cologne (Source: DLR)

Figure 3. Current image of the test rig with the reactor unit integrated (Source: DLR)

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