Development, Construction and Testing of a Continuous Metal Hydrides H2 Compressor

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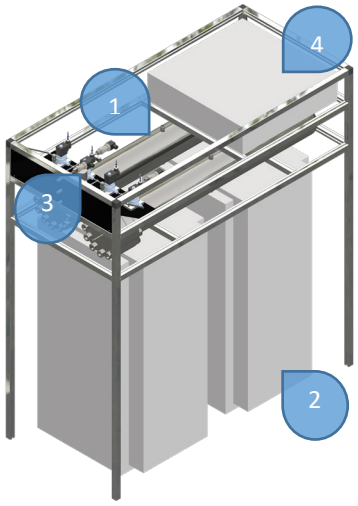

Metal Hydrides Compressor: Consisting of 2 compressor units (1), two thermal control systems (2), a hydrogen pipeline (3) and an electric box (4).

Bachelor's Thesis
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Degree programme
Systems Engineering

Field of application
Major Power & Control

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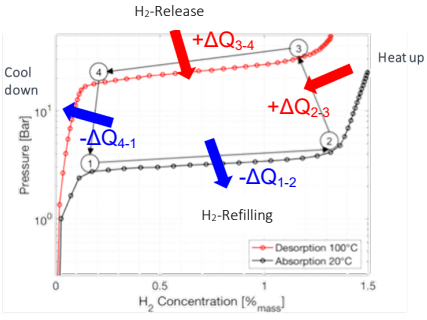
Objectives

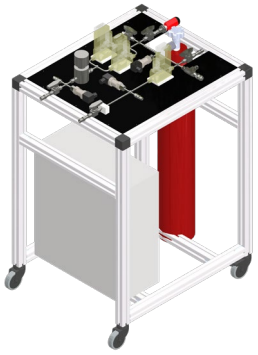
The objective of this thesis is to develop a metal hydrides hydrogen compressor for pressures up to 200 bar with continuous compression and a nominal flow of 1Nm³/h, based on a batch compressor developed by GRZ Technologies. The compressor works silently without mechanic components, using a thermal compression.

Methods | Experiences | Results

The compressor design has been developed based on a thermal model of the compressor unit. An energetic analysis, based on thermodynamic principles, allowed the estimation of the theoretical thermal energy required for the compression, which is around 7.7kWh/kg$_{H2}$. The mechanical design was realized according to high pressure norms. The pressure and temperature stress calculations were performed using a numerical computing software "SciLab". The 3D modeling of the compressor parts, as well as the finite elements stress simulation were done with CAD software "Autodesk Inventor 2020". The main challenge in the mechanical design of the project was the dimensioning of a leak free sealing for hydrogen under high pressure, as well as for the thermal fluid at high temperature. Every part of the compressor had to be precisely designed with strict tolerances to fulfil the design requirements. The 3D design has been finalized and the parts have been commissioned for production. Further steps of the project will be the assembling, commissioning and testing of the compressor performance.



Working Principle of a Metal Hydrides Compressor: absorption at low temperature (H_2-refilling), pressure increase (heat up), Desorption at high temperature (H_2-release) and pressure decrease (cool down).



Test Bench for the Metal Hydrides Compressor: The test bench has been developed to allow the activation and the continuous performance test of the metal hydrides compressor.