Thermally-driven Hydrogen Compression Utilising Metal Hydrides

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Hydrogen compression is a major contributor to capital costs and maintenance hours in the infrastructure related to storage, distribution and end-use of hydrogen. Conventionally used mechanical hydrogen compressors have a number of disadvantages including a complicated design, insufficient reliability, high operating costs, a probability of hydrogen leakage and hydrogen contamination [1-3].

A promising alternative is a thermally driven metal hydride hydrogen compressor (MHHC) whose operation is based on the reversible interaction of hydride-forming alloys with hydrogen gas. MHHC's have a number of advantages including practically unlimited (up to 5000 bar) discharge pressure, good scalability (from several litres to tens normal cubic metres of hydrogen per an hour), modular design, simplicity in service and operation, as well as the possibility to utilise low-grade heat and high purity of the delivered hydrogen. In addition, the MHHC does not contain moving parts that simplifies its design, increases reliability, and eliminates noise and vibration [4-6].

This presentation overviews R&D activities related to the thermally-driven hydrogen compression utilising metal hydrides. The focus is put on the interrelation between properties of metal hydride materials and their hydrogen compression performances, first of all, operating pressure – temperature range, process productivity and efficiency. Typical design features of the hydrogen compression systems and ways of their optimization are considered as well. Finally, a brief techno-economic analysis of the MHHC's benchmarked against alternative hydrogen compression technologies (mechanical and electrochemical) is presented, and their promising application niches are outlined.

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Table 1. Recently developed industrial-scale MHHC's

#	Manufacturer	Pressure range [bar]	Productivity [Nm^3/h]
1	HYSTORSYS AS (Norway)	5–200	5
2	SAIAMC / UWC (South Africa)	3–200	5
3	IPCP RAS, SKTBE (Russia)	3–160	15
4	HYSTORE Technologies (Cyprus)	7–220	2.5

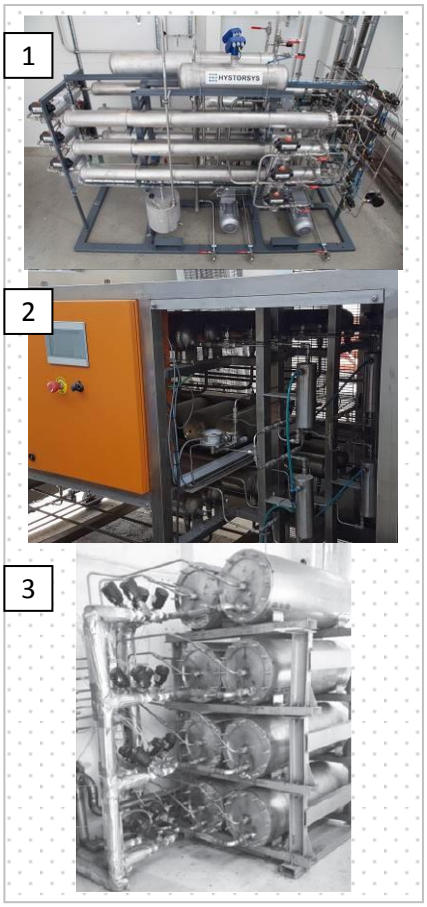

Figure 1. Industrial-scale MHHC's (see Table 1).

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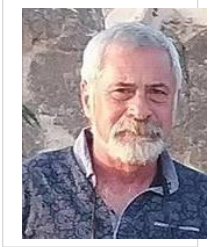

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