HYDROGEN ACCUMULATORS AND COMPRESSORS FOR LABORATORY USE

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Introduction

At the present time the metal hydride (MH) technologies remain one of the basic lines of hydrogen materials science [1-5]. Their application allows the manufacture of compact, safe and technologically flexible hydrogen treatment units. Also, peculiarities of the reversible hydrogen interaction with hydride forming metals and alloys makes it possible to purify hydrogen from gas admixtures in the MH units. The possibility to control the output hydrogen pressure by controlling heat influence on the MH sorbent allows the realization of controlled hydrogen supply to a consumer under the preset pressures. Storage purification, compression / controlled supply can be combined in a single multi-functional unit. This feature makes such applications extremely effective.

Department № 67 at the Institute for Problems of Materials Science (IPMS) has developed a series of laboratory MH sources of high-pure hydrogen with hydrogen output under controlled increased pressure (up to 200 bar). The sources use MH placed in a high pressure container equipped with an internal heat exchanger. The accumulators have different operating characteristics that can be changed in dependence on requirements of user.

Results and discussion

This paper deals with the development of two models of laboratory accumulators of great capacity (2000-7000 l) on hydrogen. The model *"VEZAYF"* is designed to be operated for hydrogen delivery at low pressure (up to 0,5 MPa), but has the high hydrogen capacity. The model *"SVETZAG"* has three times smaller capacity on hydrogen, but owing to the presence of the temperature control system it permits to conduct the hydrogen under controlled pressure up to 20,0 MPa.

"VEZAYF"

The laboratory metal-hydride storage of high-pure hydrogen is designed for operation in the laboratory setups (Fig.1 - 2) in the cases when the high hydrogen demands of low pressure have been in existence.

The RE(Ni,Fe,Al)5 hydrogen storage alloy made on the basis of the commercial cerium ligature (Ce /83%/ La Pr Nd Fe Al), lanthanum and nickel (technical purity grade both) was used in the unit. The composi-tion of the alloy was selected to provide hydrogen equilibrium pressure over the MH of ~3-5 bar at room temperature.

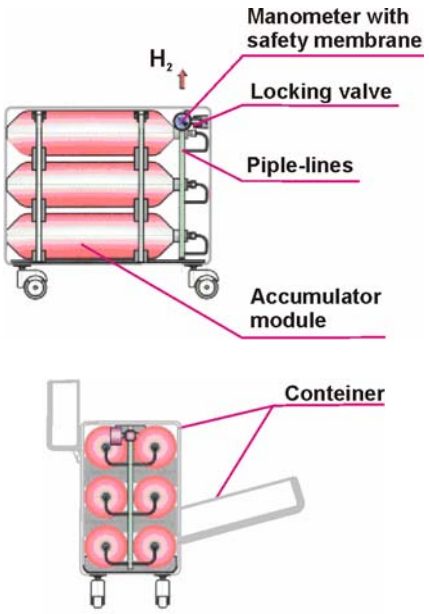

Fig. 1. Schematic view of the laboratory metal hydride storage of high-pure hydrogen *"VA – 7000"*.

Specifications "VEZAYF":
Overall dimensions of *"VA – 7000"*:
Length 480 mm
Height 440 mm
Width 300 mm

Number of modules 6 pieces
Mass of a module 9.8 kg
Mass of metal hydride in a module 8 kg
Hydrogen capacity of a module 1200 l
General hydrogen capacity of a storage element 7000 l
Lump of a storage element 63 kg
Lump of metal hydride 48 kg
Working pressure 0.3 – 0.5 MP (T = 30 ^{o}C)

Fig. 2. Metal hydride storage *"VA – 7000"*.

"SVETZAG"

The laboratory metal hydride storage/compressor of high-pure hydrogen is designed for operation in the laboratory setups.

The performed strength calculations (GOST 14249-89, margin of safety of 1.5 and correction for strength reduction by welding of 0.8) have shown that the allowed working pressure in the MH container can be as high as 400 bar at 300°C (Fig. 3-4).

The developed metal hydride unit for hydrogen storage and compression is characterized by high compactness and relatively low reheat temperature of MH with the delivery of sufficiently high hydrogen pressure and good dynamic performance.

Fig. 3. Schematic view of the laboratory metal hydride storage/compressor of high-pure hydrogen *"Svetzag – 2000"*.

Specifications "VEZAYF":

Overall dimensions of *"Svetzag - 2000"*:

Length….1410 mm

Flange diameter …….180 mm

Diameter of a working reactor 70 mm

Mass of a storage element 25.5 kg

Mass of metal hydride 7.5 kg

Hydrogen capacity 2000 l

Working pressure 30 MPa (300 °C)

Working pressure 0.3 ÷ 0.5 MPa (30 °C)

Chemical composition of metal hydride AB_5 + Mg alloys

Fig. 4. Compressor of high-pure hydrogen *"Svetzag – 2000"*.

Conclusions

At present method of hydrogen storage in the solid remains rather convenient, efficient and safe as before.

Acknowledgment

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