

Modeling and Optimization of a Mg – Metal Hydride Rectangular Tank at the Hydriding Process

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Introduction: Hydrogen storage can be considered as a key factor in the development of hydrogen economy. Hydrogen storage in a magnesium hydride MgH₂ is a very promising technique for numerous of reasons. Magnesium is abundant, relatively cheap, life – friendly , weight storage capacity of 7.6% and low price of Mg metal. A simulation work is presented in order to study the absorption kinetics of a Mg – metal hydride tank.

Computational Methods: Energy, mass and momentum differential equation solved simultaneously using COMSOL Multiphysics software. The main equations used are :

$$(\rho \cdot Cp)_e \cdot \frac{\partial T}{\partial t} + (\rho_g \cdot Cp_g) \cdot \vec{v}_g \cdot \nabla T \quad \text{Energy Conservation}$$

$$= \nabla \cdot (k_e \cdot \nabla T) + m \cdot (\Delta H - T \cdot (Cp_g - Cp_s))$$

$$(1 - \varepsilon) \cdot \frac{\partial(\rho_s)}{\partial t} = -m \quad \text{Mass Conservation}$$

$$\vec{v}_g = -\frac{K}{\mu_g} \cdot \text{grad}(\bar{P}_g) \quad \text{Momentum Conservation}$$

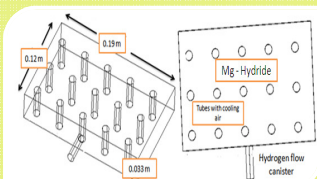


Figure 1. Geometry of the Metal hydride tank

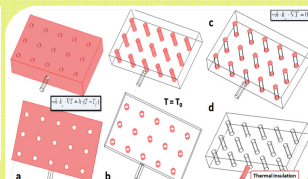


Figure 2. Initial and Boundary Conditions

Results:

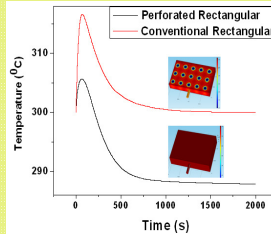


Figure 3. Temperature evolution for two different rectangular tanks.

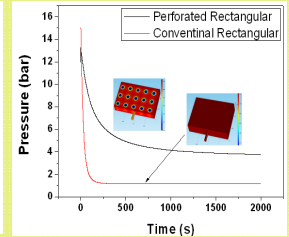


Figure 4. Pressure evolution for two different rectangular tanks

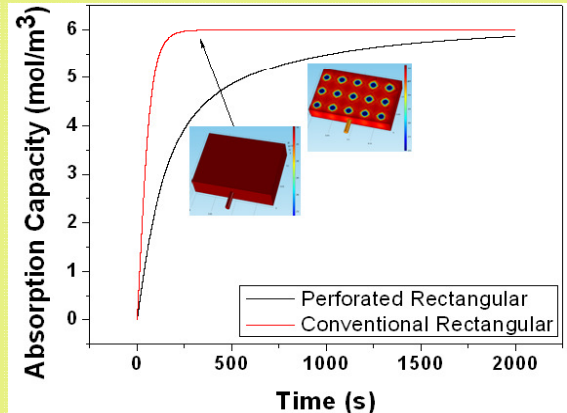


Figure 5. Absorption Capacity for the different rectangular tanks

Conclusions:

- 1) Very good absorption capacity (6mol/m³) – Use in Hydrogen Storage Technology
- 2) The presence of a cooling medium affects hardly the absorption procedure

References:

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2. B. Sakintura, F. Dakrim et al. “Metal Hydride Materials for Solid Hydrogen Storage”, Int.Jour.Hydr.En., 32, 1121-1140, (2007)
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