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:

\[
\begin{align*}
(\rho \cdot C_p) \frac{\partial T}{\partial t} + (\rho s \cdot C_p s) \cdot \nabla \cdot \mathbf{v} &= \nabla \cdot (k_e \cdot \nabla T) + m \cdot (\Delta H - T \cdot (C_p g - C_p s)) \\
(1 - \varepsilon) \frac{\partial (\rho s)}{\partial t} &= -m \\
\mathbf{v} &= \frac{K}{\mu_s} \nabla \ln(P)
\end{align*}
\]

Energy Conservation
Mass Conservation
Momentum Conservation

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: