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Hydrogenation behaviour in rectangular metal hydride tanks under effective heat management processes for green building applications

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Abstract

A fully validated with solid experimental results numerical study regarding the hydrogenation process of rectangular metal hydride beds under effective internal heat management is presented and analysed. Three different geometries equipped with plain embedded heat management tubes are introduced and examined. For each geometry, five different values of metal hydride thickness are studied and additionally, the effect of the coolant flow is examined in terms of different values of heat transfer coefficient [W/m\(^2\)K]. To evaluate the effect of the heat management process, a variable named as Non-Dimensional Conductance (NDC) is analysed and studied. Furthermore, three different materials are introduced, two “conventional” AB\(_5\) intermetallics and a novel AB\(_2\)-based Laves phase intermetallic. According to the results, the optimum value for the metal hydride thickness was found to be 10.39 mm, while the optimum value for the heat transfer coefficient was 2000 [W/m\(^2\)K]. For the above optimum conditions, the performance of the novel AB\(_2\)-based Laves phase intermetallic showed the fastest hydrogenation kinetics compared to the other two AB\(_5\) intermetallics indicating that is a powerful storage material for stationary applications.

**Keywords:** Hydrogen Storage; Heat Management; Stationary Applications; Heat and Mass Transfer; Green Buildings;
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