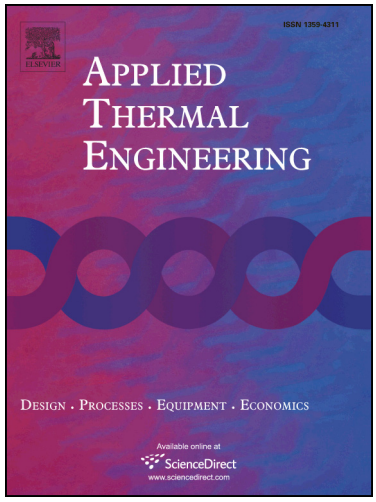

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SCREENING OF METAL HYDRIDE PAIRS FOR CLOSED THERMAL ENERGY STORAGE SYSTEMS

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ABSTRACT

Thermal energy storage systems based on metal/hydrides usually are closed systems composed of two beds of metal/alloy - one meant for energy storage and the other for hydrogen storage. It can be shown that a feasible operating cycle for such a system using a pair of metals/alloys operating between specified temperature values can be ensured if the equilibrium hydrogen intake characteristics satisfy certain criteria. In addition, application of first law of thermodynamics to an idealized operating cycle can provide the upper bounds of selected performance indices, namely volumetric energy storage density, energy storage efficiency and peak discharge temperature. This is demonstrated for a representative system composed of $LaNi_{4.7}Al_{0.3}$-$LaNi_5$ operating between 353K and 303K which gave values of about 56kWhm^{-3} for volumetric storage density, about 85% for energy storage efficiency and 343K for peak discharge temperature. A system level heat and mass transfer study considering the reaction kinetics, hydrogen flow between the beds and heat exchanger models is presented which gave second level estimates of about 40kWhm^{-3} for volumetric energy storage density, 73% for energy storage efficiency and 334K for peak temperature for the representative system. The results from such studies lead to identifying metal/alloy pairs which can be shortlisted for detailed studies.

Keywords: Thermal energy storage, Chemisorption, Metal hydride, Energy storage density

NOMENCLATURE

a	Area of flow (m^2)
A, B	Parameters in Eqn. (34)
c	Specific heat capacity (Jkg^{-1}K^{-1})
C	Heat capacity rate (WK^{-1})
h	Specific enthalpy (Jkg^{-1})
H	Enthalpy of reacting species per unit mass of H_2 (Jkg^{-1})
I	Additional heat capacity of bed (JK^{-1})
K	Overall heat conductance (WK^{-1})