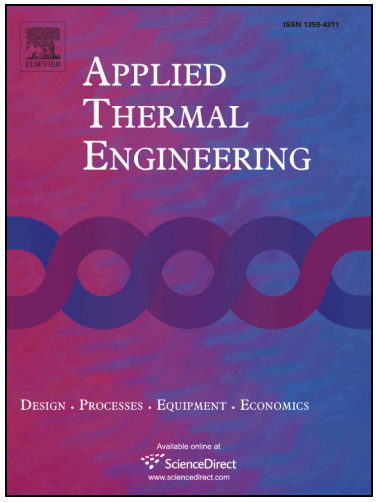

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Impact of Using a Heat Transfer Fluid Pipe in a Metal hydride-Phase Change Material Tank

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Abstract

This study evaluates numerically the feasibility of employing a Heat Transfer Fluid (HTF) pipe in a Metal Hydride (MH) tank that integrates a Phase Change Material (PCM) heat exchanger. A 3D mathematical model is developed for this system and is used for simulating various configurations (Case 1: MH tank with PCM heat exchanger, Case 2: MH tank with PCM heat exchanger and open HTF pipe and Case 3: MH tank with PCM heat exchanger and closed HTF pipe). For each case, advantages and limitations are evaluated with respect to their heat transfer performance and filling time of hydrogen vis-a-vis heat storage capacity. In addition, the effects of the HTF type and its mass flow rate on the performance of the MH tank are studied. Besides showing a thermal coupling between MH bed, HTF pipe and PCM medium, the computational results indicate that the use of HTF pipe in MH-PCM tank is a tradeoff between reducing the hydrogen filling time and compromising the heat storage capacity. The results indicate that compared to the Case 1 (without HTF pipe) the filling time can be reduced by 94% for the Case 2 where the HTF pipe extracts 70% of the heat of reaction and delivers it to environment as