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Numerical Simulation of the Dynamic Behavior of a LaNi5 Water Pumping System

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Abstract : Metal hydride water pumping system uses hydrogen as working fluid to pump water for low head and high discharge. The principal operation of this pump is based on the desorption of hydrogen at high pressure and its absorption at low pressure by a metal hydride. This work is devoted to study a concept of the dynamic behavior of a metal hydride pump using unsteady model and LaNi5 as hydriding alloy. This study shows that with MHP, it is possible to pump 340l/kg-cycle of water in 15 000s using 1 Kg of LaNi5 at a desorption temperature of 360 K, a pumping head equal to 5 m and a desorption gear ratio equal to 33. This study reveals also that the error given by the steady model, using LaNi5 is about 2%.A dimensional mathematical model and the governing equations of the pump were presented to predict the coupled heat and mass transfer within the MHP. Then, a numerical simulation is carried out to present the time evolution of the specific water discharge and to test the effect of different parameters (desorption temperature, absorption temperature, desorption gear ratio) on the performance of the water pumping system (specific water discharge, pumping efficiency and pumping time). In addition, a comparison between results obtained with steady and unsteady model is performed with different hydride mass. Finally, a geometric configuration of the reactor is simulated to optimize the pumping time.

Keywords : dynamic behavior, LaNi5, performance of water pumping system, unsteady model
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