MODELLING OF THE HYDROGEN STORAGE AND SUPPLY SYSTEMS WITH OUTPUT HYDROGEN PRESSURE IN WIDE RANGE OF PRESSURES USING LOW-POTENTIAL HEAT-TRANSFER AGENT

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Present work aims on the development an advanced hydrogen storage and supply system with a wide range of output pressures (up to 80 MPa) using low-grade heat sources (<100 ° C) to heat and release hydrogen from metal hydrides (MH) and convert it into high-pressure hydrogen. Preliminary studies showed that to reach the specified conditions the whole system has to be a four-stage one. The alloy compositions were determined using statistical model developed in MSU. At present, three-stage hydrogen compression system has been developed, including rare earth based and Ti-Cr-Mn hydrogen storage materials. The output pressure at 90 °C reaches 42.97 MPa, which has the advantages of good hydrogen storage performance, low plateau pressure hysteresis and wide flat platform for hydrogen absorption and desorption. The transition toward carbon-free transportation is only possible by adopting renewable energy alternatives. Part of the project has the aim to present a study on a renewable energy-based hydrogen refuelling station from an energy point of view. The proposed system comprises a photovoltaic plant, water electrolysis sub-system, hydrogen compression, storage and distribution section based on MHHC for compressing hydrogen. The analytical study focuses on the energy assessment of the small-scale hydrogen refuelling station being able to provide hydrogen to the fuel cell-driven electrical bicycles. The thermal modelling of the plant is carried out and the energy and mass balances are used to evaluate the overall system performance.

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