LOHC dehydrogenation process intensification towards energy efficient, carbon-free hydrogen economy

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Liquid organic hydrogen carriers (LOHCs) present a potential solution for mitigation of challenges related with H2 compression and liquefaction while at the same time making use of existing fossil fuel transportation infrastructure. This work presents a process intensification strategy for a superior energy efficiency of a large scale LOHC dehydrogenation. Using a novel process concept called "temperature cascade" dehydrogenation it has been showed that a combination of LOHC chemicals utilizing a same heat source has better energy efficiency compared to a processes using a single LOHC chemical. Four LOHC candidates; Ammonia, Biphenyl / Diphenylmethane eutectic mixture, N-phenylcarbazole, and N-enthylcarbazole have been compared as a stand-alone systems and an integrated one in a rigorous process simulation using Aspen Plus. Taking into account different LOHC chemicals and varying quality of the heat source, temperature cascade dehydrogenation was shown to have the potential of doubling (on average) the energy generated per unit mass (kWh/kg) in an integrated system compared to stand-alone LOHC systems.