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H2 and electrochemical storage

Although hydrogen is advocated as a promising candidate to replace fossil fuels, its low volumetric energy density still remains an important shortcoming (0.01079 MJ/L at standard temperature and pressure). Indeed, huge storage volumes would be required to store at least 1 kg of hydrogen at 25°C and 1 atm (tens of m^3). Nevertheless, technical solutions to overcome this issue exist, and will be discussed in this presentation.

Compression is the most widely used method to store hydrogen. Composite pressure tanks have been successfully developed, which allow reaching a gravimetric storage density of 6 wt.% at 700 atm. In addition, hydrogen liquefaction and the solid storage in either metal hydrides or microporous adsorbents are suitable alternatives to compression. Nevertheless, a large amount of energy is required to liquefy hydrogen in the first case, and to release hydrogen from the solid phase in the latter. Therefore, innovative hydrogen storage systems, such as the Liquid Organic Hydrogen Carriers, attracted a noteworthy attention during the last years.

At present, the cheapest hydrogen storage-delivery mode is still obtained by compression and truck delivery, especially for small stations and decentralized facilities, as well as for low hydrogen demands. In this framework, mechanical hydrogen compressors are worldwide used, since they are based on a mature and reliable technology. Nevertheless, the major shortcoming of mechanical hydrogen compressors has to be addressed: their cost, which is around half the cost of a hydrogen refuelling station. Conversely, hybrid non-mechanical hydrogen compressors have shown several advantages over the mechanical ones, such as the absence of moving parts and high compactness. Its use in decentralized hydrogen facilities might promote a new scenario for the future hydrogen supply chain.