Development of a lab-scale hydrogen liquefaction system

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The demand for small quantities of liquid hydrogen available at any time for testing of equipment and technologies for liquid hydrogen applications is growing. Therefore, several initiatives have started to develop a small-scale hydrogen liquefier with a liquefaction capacity in the range of 1 to 10 kg/day. The EHLAS (Economic Hydrogen Liquefaction And Storage) project is one of them and aims to develop an efficient and affordable lab-scale hydrogen liquefier.

Within the EHLAS project, two liquefier concepts are investigated. The first concept is based on using two single cryocoolers to achieve hydrogen liquefaction at a rate up to 10 kg/day. The main drawback of this concept is the low overall efficiency and high costs of the liquefaction process due to the COP and costs of the cryocoolers, respectively. Therefore, a second concept is developed that is based on a single-stage cryocooler, Joule-Thomson expansion and a recirculation loop of hydrogen gas with heat exchanger and a compressor to improve the efficiency and reduce the costs of the liquefaction system. With the current design, a liquefaction capacity of 5 to 6 kg/day can be reached.

This paper summarizes the status of the EHLAS project. It discusses the hydrogen liquefier concepts, the principle designs and performances. Further, the design of the compressor and heat exchangers will be described and the results of the validation experiments will be presented. The paper ends with giving an overview of the manufacturing status of the system.

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