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C2Or3B-02: Development of an economic lab-scale hydrogen liquefier system

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With the energy transition ongoing, the demand for small quantities of liquid hydrogen available at any time for testing liquid hydrogen equipment and technologies is growing. Industrial liquefier technologies are focused on large quantities and downscaling is not efficient due to the turbines used which will decrease in performance when scaling down. Therefore, several initiatives have started to develop small-scale hydrogen liquefiers in which the liquefaction is achieved by using a two-stage cryocooler. 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 two-stage cryocooler, respectively. Further, the liquefaction capacity is limited to about 1 - 2 kg/hr.

The EHLAS (Economic Hydrogen Liquefaction And Storage) project aims to develop an efficient and affordable lab-scale hydrogen liquefier. To obtain this, a liquefier 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 - 6 kg/day can be reached.

This paper summarizes the status of the EHLAS project. It discusses the hydrogen liquefier concept, the design of the main components - compressor, heat exchangers, Joule-Thomson valve and storage vessel and liquefier performance.

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