Integrated design for demonstration of efficient liquefaction of hydrogen (IDEALHY)

Fuel Cells and Hydrogen Joint Undertaking (FCH JU)

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Publishable summary

As reported in Deliverable 1.1 in the past a number of different cycles for large scale hydrogen liquefaction has been published in the literature. A significant drawback is that these cycles cannot be compared directly in terms of efficiency or characterisation, because in most cases the boundary conditions are different. Key boundary conditions include feed inlet pressure, product pressure and supposed component efficiencies.

Task 1.2 of the IDEALHY project sets out to define a set of boundary conditions. These will allow a direct comparison of different cycles and processes, especially in terms of overall liquefaction efficiency. At the same time, the conditions are specifically chosen to be be appropriate for the foreseeable technical demands and standards of the future. They will be used as a standard for all subsequent cycle analysis and calculation within the IDEALHY project.

The key parameters considered for boundary conditions are listed below:

Feed	Pressure Temperature *Para* content Impurities	20 bar 293K 25% up to 100 ppm
Product	Pressure Temperature *Para* content Purity	2 bar 22.8K (saturated) 98% pure hydrogen
Cooling water	Temperature Temperature rise	293K 10K
Isentropic efficiency	cycle compressors wet expander turbine brake compressor cold compressor expansion turbines	85% per stage 90% 80% 70% 90%
Ortho-*para* conversion	Temperature delay	2K

Furthermore, pressure drops and dedicated heat exchanger parameters were also defined.

The effect of varying some of these parameters is also studied. The impact of increasing the feed pressure from 20bar to 80bar is studied in detail.

The influence of both compressor and expander efficiency is analysed. Formulae for the calculation of exergy losses due to the heat exchangers are derived.

Key words:

Large scale hydrogen liquefaction plants
Boundary conditions

Table of Contents