



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

Fuel Cells and Hydrogen Joint Undertaking (FCH JU)

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Boundary Condition and Duty Specification
Worked Out in Task 1.2
(*Publishable Summary*)

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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 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 <i>Para</i> content Impurities	20 bar 293K 25% up to 100 ppm
Product	Pressure Temperature <i>Para</i> 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- <i>para</i> 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

Disclaimer	iii
Publishable summary	iv
Key words:	iv
1. Introduction	1
1.1 IDEALHY Project Objectives	1
1.2 Work Package Scope and Objectives	1
2. Boundary conditions and component parameters for calculation and recalculation	1
2.1 Feed	1
2.1.1 Feed mass flow	2
2.2 Product	2
2.3 Pre-Cooling.....	4
2.4 Ambient Cooling	4
2.5 Heat Leak into the cryogenic system.....	4
2.6 Pressure Drop	6
2.7 Component Efficiencies.....	6
2.7.1 Compressors	6
2.7.2 Expanders	6
2.8 Heat exchanger	7
2.9 Ortho-para conversion.....	7
3. Influence of boundary conditions	8
3.1 Influence of changing ambient temperature	8
3.2 Influence of the para content of the product.....	8
3.3 Influence of pressure	9
3.3.1 Influence of the feed pressure (20bar standard)	9
3.3.2 Influence of product pressure (2bar standard)	10
3.3.3 Influence of liquefaction pressure.....	10
3.4 Influence of efficiency	13
3.4.1 Compressor efficiency.....	13
3.4.2 Expander efficiency - entropy generated by non-ideal expansion.....	15
3.5 Influence of heat exchanger boundaries - exergy losses due to heat transfer during cooling of the feed	17

3.1	Comparison of cycles	21
4.	External boundaries of storage and transport.....	23
4.1	Storage vessels	23
4.2	Underground caverns	23
5.	Impact of results on WP objectives and overall project	23
6.	Conclusion and recommendations	23